AN EVALUATION OF THE BROADBAND ECOSYSTEM IN WESTERN DOWNS REGION (WDR)

A Thesis submitted by

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Abstract

There is a large body of research on broadband adoption and use at the macro and national level, however, there is limited research on rural and remote areas. This research provides an in-depth understanding of the broadband ecosystem in terms of supply (broadband infrastructure), and household demand (adoption and use) of broadband Internet and its impact (building and maintaining social capital) in the Western Downs Region (WDR) of Queensland, Australia.

Using the broadband ecosystem as an overarching framework, three phases and a mixed methods approach was used to conduct an in-depth explanatory case study of the WDR. The first research phase collected publicly available archival (primarily quantitative) data and field data from testing of mobile networks to determine and evaluate the status (supply) of broadband infrastructure in the WDR (RQ1). The second research phase collected primarily qualitative information using semi-structured interviews to address research questions (RQ2 and RQ3). The third phase, using a survey, collected quantitative data to validate and test broadband adoption, use and impact components of the broadband ecosystem (RQ2 and RQ3, 13 hypotheses). Thereby, the second and third research phase determined the extent of adoption and use of broadband Internet services by households and its impact in helping to build and maintain social capital in rural communities in the WDR.

The research findings show that there are limitations in broadband infrastructure in remote and outer regional locations. In these locations, most households rely on mobile broadband services which were clearly demonstrated to be patchy at best in most areas of the WDR. To a lesser extent in remote and outer regional locations affordability of mobile broadband is also an issue for households given the lower socio-economic status of much of rural Australia including the WDR. Furthermore, data quotas are much more expensive for mobile broadband and satellite broadband in comparison to wired broadband. Hence, there would also appear to be a digital divide, particularly between remote and outer regional locations of the WDR and inner regional and urban locations in Australia. The researcher also demonstrated that this reflects a similar situation in many other remote and outer regional locations in Australia. The findings indicate that most households have moved beyond the adoption phase to the use phase

and indicate that hedonic outcomes, self-efficacy and number of years of Internet use are significant determinants of actual use of broadband. Conversely, perceived cost, prior knowledge and experience factors were found to be significant determinants of intention to adopt and use broadband services. However, utilitarian outcomes and purchase complexity had no significant impact on intention to adopt and use. The study also found that broadband Internet use has significant impact for rural communities in the WDR by helping to build and maintain social capital (bonding and bridging).

This research has made several important contributions to knowledge, theory and practice. Firstly, this research adapted the Broadband Ecosystem framework to incorporate system quality and impact components of information systems success theory, Technology Acceptance Model (TAM) and Model of Adoption of Technology in Household (MATH) technology adoption theories and two dimensions of social capital theory (bridging and bonding theory) which complement the overarching economic theory of supply and demand in this theoretical and conceptual model. Secondly, this research addressed an important gap in information systems research - the lack of empirical research on digital infrastructure. In this study, broadband infrastructure was included in a comprehensive evaluation of the broadband ecosystem in a rural setting, the WDR. Thirdly, by focusing on two units of analysis—broadband infrastructure in a rural region and household adoption, and use and impact of broadband—this study addresses important research problems from a societal and government policy perspectives. Fourthly, this research examined and validated the broadband ecosystem framework using mixed methods approach in a rural context.

Finally, this research has made significant practical contributions which can inform government policy by identifying that availability, reliability and affordability shortcomings of broadband infrastructure in outer regional and remote regions is impacting household adoption, use and benefits of broadband services in rural Australia. Hence, future government policy needs to ensure that access to reliable and high speed broadband services is part of its Universal Service Obligation so that the current shortcomings in broadband infrastructure in rural Australia are prioritised and addressed. This study confirms that improved access and more effective use of broadband could help to address the digital divide that currently exists between rural and urban Australia and also help to build and maintain social capital in rural communities.

Certification of Thesis

This thesis is entirely the work of Sanjib Tiwari except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

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List of Publications

Some of the materials contained in this thesis have been presented in publications. These include various aspects of the theoretical and practical findings that are described in this thesis.

Refereed journal papers published:

Lane, MS, Tiwari, S & Alam, K 2016, 'The supply and use of broadband in rural Australia: an explanatory case study of the Western Downs Region', *Australasian Journal of Information Systems*, vol. 20. pp 1-24.

McDonald, L, Starasts, A, Tiwari, S & Lane, M 2016, 'Perceptions of older age and digital participation in rural Queensland', *Australasian Journal of Regional Studies*, vol. 22, no. 2, pp. 263- 84.

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Tiwari, S, Lane, M & Alam, K 2015, 'Does broadband connectivity and social networking sites build and maintain social capital in rural communities?', *in Proceedings of the Australasian Conference on Information Systems* arXiv.org, Adelaide, Nov 30th-Dec 4th, 2015.

Tiwari, S, Lane, M & Alam, K 2015, 'The challenges and opportunities of delivering wireless high speed broadband services in Rural and Remote Australia: A case study of Western Downs Region (WDR)', in *Proceedings of the Australasian Conference on Information Systems* arXiv.org, Adelaide, Nov 30th-Dec 4th, 2015.

Tiwari, S, Lane, M & Hume, M 2014, 'Does Facebook build social capital in rural and regional households? A case study of Western Downs Region (WDR)', in *Proceedings of the Digital Rural Futures Conference* Toowoomba, 25-27 June, 2014.

Lane, M, Tiwari, S & Hume, M 2014, 'The challenges of delivering high speed broadband infrastructure in regional Australia: A case study of Western Downs Region (WDR)', in *Proceedings of the Digital Rural Futures Conference* Toowoomba, 25-27 June, 2014.

Research report commissioned by WDRC:

Lane, M., & Tiwari, S. 2013. An audit and gap analysis of digital infrastructure and digital services: A case study of Western Downs Regional Council (WDRC). Western Downs Regional Council, Queensland, Australia.

List of Research Presentations

Paper presented in Symposium on Broadband-enabled Communities and Regional Economic Development:

Tiwari, S, Lane, M & Hume, M 2014, ‘Does broadband Internet access to social networking sites build social capital for households in rural and regional communities? a case study of Western Downs Region (WDR)’ papers presented at *Symposium on Broadband-enabled Communities and Regional Economic Development,* Toowoomba, USQ, 10–11 November, 2014

Lane, M, Tiwari, S & Hume, M 2014, ‘The adoption and use of broadband Internet: A case study of Western Downs Region (WDR)’ papers presented at *Symposium on Broadband-enabled Communities and Regional Economic Development,* Toowoomba, USQ, 10–11 November, 2014

Poster presentation in PACIS 2015:

Tiwari, S, Lane, M & Alam, K 2015, 'Key factors determining adoption of broadband Internet services by households in rural and regional Australia', in *Proceedings of the Pacific Asia Conference on Information Systems* National University of Singapore, Singapore, 5-9 July, 2015.

Doctoral Consortium- Research proposal present in PACIS 2015

Doctoral Consortium, 2015 *Pacific Asia Conference on Information Systems,* National University of Singapore, Singapore, 5–6 July 2015

List of Abbreviations

ABS	Australian Bureau of Statistics
ABU	Actual Broadband Use
ADSL	Asymmetric Digital Subscriber Line
ASGC	Australian Standard Geographical Classification
BA	Broadband Adoption
BI	Behavioural Intentions
BOSC	Bonding Social Capital
BRSC	Bridging Social Capital
DOI	Diffusion of Innovations
FTTN	Fibre to the Node
GIS	Geographic Information System
GPT	General Purpose Technology
HFC	Hybrid Fibre Co-Axial
HILU	Length of Internet Use
HO	Hedonic Outcomes
ICT	Information and Communications Technology
IS	Information Systems
IT	Information Technology
ITUB	Intention to Adopt and Use Broadband
LTE	Long-Term Evolution
MATH	Model of Adoption of Technology in Household
NBN	National Broadband Network
OECD	Organisation for Economic Co-operation and Development
PCI	Perceived Characteristics of Innovating

PerC	Perceived Cost
PEU	Perceived-Ease-of Use
PKE	Prior Knowledge and Experience
PU	Perceived Usefulness
PurC	Purchase Complexity
RFNSA	Radio Frequency National Site Archive
ROI	Return on Investment
RTR	Regional Telecommunications Review
SC	Social Capital
SCT	Social Cognitive Theory
SE	Self-Efficacy
SEM	Structure Equation Modelling
SI	Social Influence
TAM	Technology Acceptance Model
TAM2	Extension of Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UO	Utilitarian Outcomes
USO	Universal Service Obligation
UTAUT	Unified Theory of Acceptance and Use of Technology
VDSL	Very-High-Bit-Rate Digital Subscriber Line
WDR	Western Downs Region
WDRC	Western Downs Regional Council

Chapter 1: Introduction

This chapter provides the background, context for the research problem, and the general research question being investigated in this PhD thesis. First, Section 1.1 provides a background and context for this study. Then Section 1.2 provides a discussion on the justification and motivation of the study. Next, Section 1.3 defines and outlines the conceptual framework and research questions that guided this study. A discussion of the research approach and method used to achieve the proposed objectives (research questions) of this study is provided in section 1.4. Then, some important key terms and definitions used in this thesis are listed and described in section 1.5. Delimitations of this study are acknowledged in section 1.6 and, finally, an outline of the structure of this thesis is provided in section 1.7.

1.1 BACKGROUND

With the evolution of Internet download and upload speeds, advances in access technology and increased user efficacy, the capability of broadband services is evolving in terms of usability and accessibility (Tucker 2010). Generally speaking, broadband describes high-speed, high-capacity data communications making use of a wide range of technologies that often have diverse characteristics appropriate for certain network scenarios and situations (Bouras, Giannaka & Tsiatsos 2009). The exponential use and adoption of broadband services directly influences economic growth (Koutroumpis 2009; Vu 2011) and facilitates strong social connections (Harris, Rae & Misner 2012). The use of broadband has been demonstrated to have a positive impact on regional, state and national gross domestic product (GDP) in countries which have embraced broadband and have a population with the digital literacy to utilise broadband to drive technology-led innovation (Gruber, Hätönen & Koutroumpis 2014; Whitacre, Gallardo & Strover 2014). The use of broadband is based on its availability and capability to meet the requirements of users—in other words, highly dependent upon both the supply of, and the demand for, that technology (Middleton & Chang 2008). When supply, demand and use are meet, the benefits of broadband in rural communities will be significant in terms of economic and social development. These benefits have resulted in many governments around the world investing in broadband infrastructure (Garcia-Murillo, Vargas Leon & Velez-Ospina 2012; Hill, Burgan & Troshani 2011). The purpose of this study is to advance knowledge in this area and examine the relationship between the supply, adoption and use of broadband Internet services and its impact on social capital in communities in rural Australia.

Research into information technology adoption and acceptance has introduced the dimensions of useability, ease of use, perceived resources and has applied these in many contexts to ascertain the antecedents and consequences of technology innovation, adoption and acceptance. Recent research (Oni & Papazafeiropoulou 2012; Rohman & Bohlin 2012) suggests that a number of productivity, social and economic benefits are evidenced with adoption and use of broadband Internet. However, to date, these have only been tested empirically to a limited degree in a rural setting (Hill, Burgan & Troshani 2011). In this study, the key results of an in-depth case study of broadband infrastructure (supply), household adoption (demand) and use and related impact of building and maintaining social capital with broadband services in rural Australia—specifically in the Western Downs Region (WDR)—are presented. Broadly, this study focuses on rural communities and the two units of analysis of this study are broadband infrastructure (supply) in rural communities and households (adoption, use and impact of broadband) living in rural communities. This study is an explanatory case study of the WDR and examines the relationship between quality of broadband infrastructure (supply) and the adoption and use of broadband services by households and its impact in building and maintaining social capital in rural communities.

1.1.1 Rural Australia

Australia is one of the most urbanised countries in the world (Flew 2012), with over two-thirds (71%) of the population living in major cities (ABS 2015b). In comparison, less than 3% of the population live in remote or very remote Australia. Major cities in Australia had the fastest population growth, up 1.8% in the year to June 2014 from June 2013, followed by inner regional (1.2%), outer regional (0.7%) and remote areas (0.3%). In contrast, very remote areas declined in population by 0.4% (ABS 2015b), which is much higher than previous population decline trends for remote Australia. The average annual regional population growth over the last five years (2010-15) was highest in capital cities and inner regional and coastal cities (satellite cities within 150 km of a capital city), however, statistics show slower rates of growth in outer regional areas and remote and very remote areas (ABS 2015b)

However, despite its much lower population density, rural Australia plays a critical role in the Australian economy and GDP growth through tourism and agriculture industries (Burgess, Parish & Alcock 2011; McFarlane et al. 2016). Moreover, rural regions are one of the major sources of Australia's export earnings, with the agricultural and resources sectors representing over 13% of the value of Australia's exports (Batt 2015). In 2012–13, tourism industries' direct contribution to Australia's GDP was worth $49 billion, or around 3.2% of GDP (Kookana, Pham & Quinn 2014). According to National Rural Health Alliance (2015), around 45% of tourism expenditure occurs in areas outside Australian capital cities. Even though rural and regional Australia is a major contributor to national GDP, these communities remain isolated and struggle to gain reliable access to daily-required services such as telecommunications, healthcare, education and transportation services.

Communities, especially in remote areas, have low population densities, where farms and communities are scattered over considerable distances. Bandias and Ram Vemuri (2005) suggest that it is difficult to supply telecommunications, hospital, education, transportation and other services in low-density populated areas. However, this delivery of essential services can be optimised by advancing the latest Information and Communications Technology (ICT), especially broadband Internet. Bandias and Ram Vemuri (2005) suggest that broadband Internet in rural areas can deliver services such as e-learning (distance education), telemedicine and e-government services (Dickes, Lamie & Whitacre 2010). Using a long time series data (1965-2011) and multivariate modelling framework, Shahiduzzaman and Alam (2014) found a positive impact of ICT capital on economic output growth in both the long- and short-run in Australia. Due to inadequate information and communication infrastructure and facilities in rural and regional Australia, the digital divide between rural and urban communities is widening (Park et al. 2015; Willis & Tranter 2006).

This study focuses on Australian rural communities, therefore, it is important to understand and define rural communities for this research. Several different classification systems have been developed to define rural communities in Australia. These tend to define a community in terms of size of a community, distance from population centres, and access to services. The three principal approaches used for measuring remoteness in Australia are listed below (AIHW 2014):

- **Rural Remote and Metropolitan Areas (RRMA)** classification: The RRMA uses population size and direct distance from the nearest service centre to determine seven categories: capital cities; other metropolitan centres; large rural centres; small rural centres; other rural areas; remote centres; and other remote areas (SARRAH 2015).
- **Accessibility/Remoteness Index of Australia (ARIA)**: ARIA uses a geographical information system (GIS) to define road distance to service centres to produce a sliding scale of remoteness. ARIA includes five categories: highly accessible; accessible; moderately accessible; remote; and very remote (SARRAH 2015)
- **Australian Standard Geographical classification (ASGC):** The ASGC defines remoteness by Census Collection Districts on the basis of the average ARIA score within the district. The remoteness of local areas is then assessed and classified by the ARIA categories: major cities; inner regional; outer regional; remote; and very remote (SARRAH 2015). ASGC Remoteness Areas are based on ARIA+ methodology (for details please see Appendix A).

This study was conducted in a rural region of Australia, the Western Downs Region (WDR) and, based on the ASGC classification, rural towns in the WDR were classified as being one of the following: inner regional; outer regional; or remote (here after referred to as rural Australia).

1.2 JUSTIFICATION AND MOTIVATION FOR THIS RESEARCH

Broadband access has become increasingly critical for day-to-day life and business activities. Broadband is now widely considered to be one of the key enablers and drivers for social and economic growth (Budde 2016; Hudson 2013; Touré 2014). A strong correlation between higher broadband Internet adoption and increased GDP exists (Amiri & Reif 2013; Rohman & Bohlin 2012). Time-series analyses of Australian Bureau of Statistics (ABS) data shows that Internet subscriptions in Australia overall have increased substantially from 60% of households in 2005-6 to 86% of households in 2014-15 (ABS 2016c). However, according to ABS (2014), the proportion of households with an Internet in 2012–13 access remains higher (85%) for those located in capital cities compared to those outside capital cities (79%). According to Akamai (2016) and a report from the OECD (2015), Australia is one of the leaders in developed countries on wireless mobile broadband subscription such as 4G, although this is not the case in rural communities where most of the towns are reliant on patchy and unreliable 3G mobile broadband services or satellite broadband services. However, research also suggests that Australia is behind on wired broadband Internet speed compared to other developed countries (Akamai 2016). Australia currently ranked 12th out of 35 OECD countries (OECD 2015). Also, it should be noted that adoption of fast speed broadband in Australia is lower compared to other developed nations such as the UK, South Korea, Japan, and Denmark (OECD 2015). Moreover, rural Australia is lagging behind in broadband adoption and use because of poor digital infrastructure and the subsequent reduced availability of digital services in rural areas (Erdiaw-Kwasie & Alam 2016; Freeman & Park 2015; Park et al. 2015). Rural Australia could be directly affected if many rural communities are excluded from the potential benefits of accessing and utilising broadband infrastructure as a universal service. Inadequate broadband infrastructure and lower levels of broadband services in rural areas remain an ongoing problem (Alam & Imran 2015; Bandias & Ram Vemuri 2005; Park et al. 2015). This ultimately impacts on effective use of digital services in rural Australia. This has effectively created a digital divide between urban and rural Australia.

Communities generate social capital (bonding and bridging) as a result of their daily communication and interaction among communities member such as family, friends, colleagues and outsiders, people also potentially make a mindful investment in social interaction (Valenzuela, Park & Kee 2009). Moreover, broadband Internet use can positively influence and maintain bonding social capital and build bridging social capital in rural communities by fostering new avenues for communication and voluntary engagement (Stern & Adams 2010; Valenzuela, Park & Kee 2009) that might otherwise difficult to achieve due to the tyranny of distance in rural areas. It has been noted that communities with strong social capital have more access to novel information than communities with weak social capital (Bryant, Jackson & Smallwood 2006; Burt 1995; Granovetter 1973; Stubblefield et al. 2010). Bonding and bridging social capital are recognised in the literature as important factors of social connectivity. However, there is lack of empirical research which has investigated the extent to which bonding and bridging social capital can be attributed as an outcome of the use of a general purpose technology such as broadband by households in rural communities.

Examination of previous literature in the Information Systems (IS) discipline illustrates that little empirical research has been undertaken on broadband diffusion in rural households, including the supply, demand, usage and its impact in building and maintaining social capital for households (Hill, Burgan & Troshani 2011; Hill, Troshani & Burgan 2014; Oh, Ahn & Kim 2003). Instead, most of the research associated with broadband has mainly focused on examining the macro level factors leading to adoption of broadband at the national level (Hill, Burgan & Troshani 2011; Majumdar, Carare & Chang 2010). Recently-conducted studies highlight the need to understand adoption and use of broadband from the household perspective (Hill, Burgan & Troshani 2011; Majumdar, Carare & Chang 2010). There has been a lack of in-depth empirical studies aimed specifically at rural Australia that have examined the broadband ecosystem (Kelly & Rossotto 2012) in a holistic manner by investigating supply, demand/use and impact at the micro level (Hill, Burgan & Troshani 2011; Hollifield & Donnermeyer 2003). Furthermore, the objective of this research is to address another gap in the information systems literature, given it is argued there has been a lack of empirical studies on digital infrastructure, including broadband infrastructure in Information Systems. Tilson, Lyytinen and Sørensen (2010) refer to digital infrastructure research as the orphan of information systems research and an important but under-researched area.

Therefore, the objective of this study is to investigate the problems associated with broadband access (supply), its use and impact by examining the broadband ecosystem in a rural region. For the purpose, this study uses the WDR as a case study. By focusing on supply of broadband infrastructure and its relationship with household adoption and use of broadband Internet and its impact in building and maintaining social capital in rural Australia, this study hopes to provide a more complete picture and understanding of the problem. The use and potential impact of broadband is based on its availability and quality in order to meet the requirements of the users—in other words, highly dependent upon both the supply of, and the demand for, that technology (Middleton & Chang 2008).

1.3 CONCEPTUAL FRAMEWORK OF THIS RESEARCH

To understand the relationship between the quality of broadband infrastructure (supply) and broadband adoption, its use and impact in rural communities, this study takes a holistic approach to examining how broadband supply and demand/use is occurring in rural communities. The World Bank Broadband Ecosystem Framework provides a conceptual framework for understanding the supply (penetration), demand (adoption and use) and potential impact of broadband services (World Bank 2012). building and maintaining social capital in rural communities of WDR (See Figure 1-1).

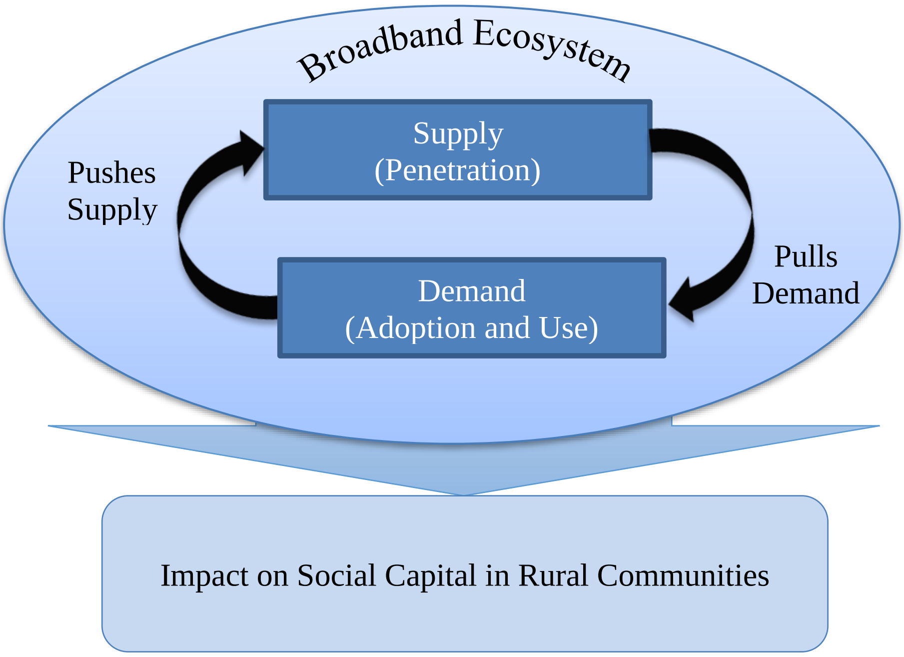

Figure 1-1 Broadband ecosystem
Adapted fromWorld Bank (2012)

Broadband Internet can be represented as an ecosystem consisting of supply and demand components which are equally important to the successful expansion and delivery of broadband infrastructure and services (Kelly & Rossotto 2012). The supply side is concerned with the push—the building and delivering broadband network infrastructure which encourages increased demand for broadband services. The demand side is concerned with using the available infrastructure to access digital services which ultimately encourages the push of latest broadband access technologies. Based on the broadband ecosystem framework, this research addressed the three important components – supply, demand and impact of the broadband ecosystem in WDR. Details of the related theory to each component of broadband ecosystem are

discussed in chapter 2, however overview of these component and related theories are highlighted here: Firstly, this research conducted an audit of the broadband infrastructure that is available in the WDR to determine the quality of broadband infrastructure and address the supply component of the broadband ecosystem drawing on the information success dimension-system quality-to assess the quality of broadband infrastructure. Secondly, based on the underpinning technology adoption and using theories such as Technology Acceptance Model (TAM) (Davis 1989) and Model of Adoption of Technology in Households (MATH) (Venkatesh & Brown 2001), this study addresses the demand (adoption and use) component of the broadband ecosystem. Hence, this study investigates the key factors that influence rural household intention to adopt and use broadband Internet services. Thirdly, in order to understand the impact component of broadband ecosystems this study uses Social Capital (SC) theory (Fukuyama 2001; Granovetter 1973). Hence, this research seeks to determine to what extent were households in the WDR using broadband in their daily lives and what impact was it having on their social capital.
Hence this study will address three important questions:

RQ1: What is the status (supply) of broadband infrastructure in the WDR?

RQ2: What is the extent of adoption and use of broadband Internet services by households in the WDR?

RQ3: To what extent does broadband Internet use by households help to build and maintain social capital in the WDR?

The supply (broadband infrastructure) and demand (adoption and use) of broadband services is fundamental to ensuring rural regions such as the WDR are sufficiently covered with fast and reliable broadband services to enable industries and communities to flourish and realise the benefits of the digitalisation of the economy, both at national and international level. The three research questions focus on (1) the coverage and quality of broadband infrastructure in rural Australia; (2) key factors that influence rural households' intention to adopt and use broadband Internet services; and (3) to what extent the use of broadband Internet could benefit rural households by building and maintaining social capital. Based on a conceptual framework (See Figure 1-1), a broadband ecosystem is developed by drawing on the existing body of literature and from gaps in the existing literature. This research argues that while many of the adoption factors identified in the existing literature are the antecedents of behavioural intention, they have been developed in the organisational context considering individual technology adoption and may have limited applicability at the household level, particularly for rural households. More importantly, much empirical research on the adoption and use of broadband ignores the importance of broadband infrastructure and its relationship with the use and potential impact of broadband infrastructure—which is particularly problematic due to the lack of coverage and poor quality of broadband infrastructure in rural Australia. Moreover, the results of previous studies in terms of the key factors determining adoption and use of broadband in the context of rural and remote households are inconclusive. This study focuses on gaining an in-depth understanding of broadband infrastructure and its relationship with factors that encourage rural and remote households to adopt and use broadband Internet and thus boost local socio-economic activity. This study also investigates to what extent using broadband Internet would appear to benefit households in rural communities through maintaining bonding and building bridging social capital.

1.4 METHODOLOGY

This research used a mixed methods approach and three research phases in an in-depth explanatory case study to examine the relationship between the supply (coverage and quality of broadband infrastructure) and adoption and use of broadband services and the impacts on social capital in rural Australia. In Research Phase 1—to determine and assess broadband infrastructure available in the WDR (to answer Research Question 1)—archival data from the Radio Frequency National Site Archive (RFNSA) (www.rfnsa.com.au) and publicly-contributed data from the social media website www.adsl2exchanges.com.au were used. This study also conducted mobile broadband speed tests to check the speed, reliability and availability of mobile broadband services using the OpenSignal mobile app (www.opensignal.com) for the three mobile network services (Telstra, Optus and Vodafone) in the WDR.

In Research Phase 2 this study conducted 25 semi-structured interviews with the major decision-maker(s) of each household regarding their adoption and use of broadband Internet (to answer Research Question 2) and its impact in building and maintaining social capital (to answer Research Question 3).

In Research Phase 3 this research conducted a large-scale survey of households in the WDR during 2014 to collect quantitative data relating to household adoption and use of broadband Internet and its impact in building and maintaining social capital (bonding and bridging). The survey questionnaire was delivered in person to randomly-selected households using a stratified sampling method to ensure that 1500 surveys were distributed to a sample representative of the population distribution of the towns and localities in the WDR.

1.4.1 Case study area–Western Downs Region (WDR)

The WDR is located in south-east Queensland (SE Qld) 200 kilometres west of Brisbane, the capital city of Queensland, Australia. The economy of the WDR has continued to grow at a rapid pace in the last five years to 2014/15, where the annual growth rate of 6.3% is significantly higher than the annual overall growth rate for the State of Queensland (2.5%) over the same period of time (WDRC 2015). The Western Downs Regional Council (WDRC) is the 20th largest council in terms of area in Queensland. The WDR covers a land area of 38,039 square kilometres and a population of 32,872 (as at 2012). The Western Downs has six main towns, namely, Dalby, Chinchilla, Jandowae, Miles, Tara and Wandoan—with another 14 smaller towns and villages scattered throughout the region. The remoteness of localities across the WDR are classified as inner regional, outer regional and remote using the ASGC classification (see section 1.1.1) (AIHW 2014). This natural distribution of the population in the WDR encompasses three larger towns, a number of small towns and rural districts and, therefore, makes it a representative sample of rural Australia and an ideal setting for studying issues concerning the supply, adoption and use of a technology such as broadband Internet; and to determine to what extent broadband Internet adoption and use benefits rural communities by building and maintaining social capital in communities.

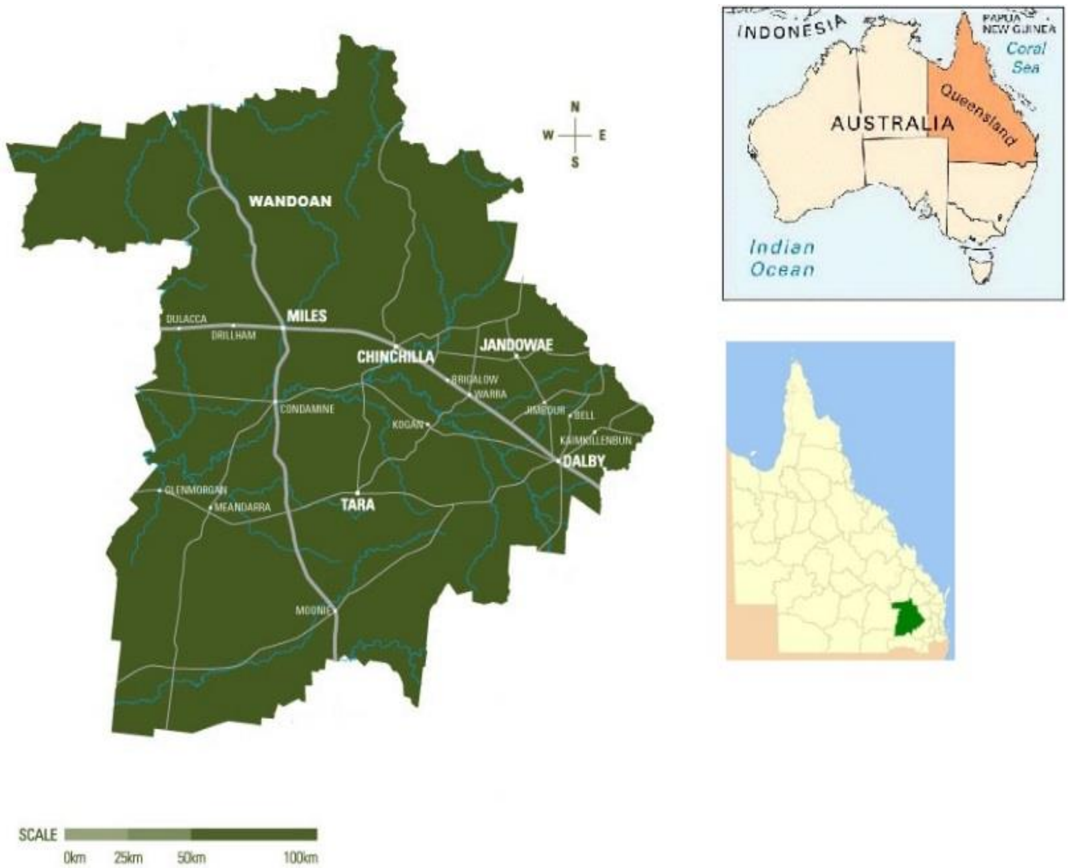

Figure 1-2 Showing study area - Western Downs Region, Queensland, Australia (AWD 2015; Wikipedia 2015)

1.5 DEFINITION OF KEY TERMS

Before proceeding further, a term frequently used within this thesis is ‘broadband Internet’ and it needs to be defined. Definitions adopted by researchers are often not uniform, so key and potentially ambiguous terms are defined in this section to establish positions taken in this research.

Broadband Internet has different meanings for different people, depending on whether their focus is in terms of capability, capacity and speed. There is no exact definition of broadband. There are differing (international) definitions and standards for broadband among countries (Prieger 2013). Sawyer, Allen and Lee (2003, p. 122) said that ‘broadband has continually evolved over time—as the underlying transmission and routing technologies continuously advance, yesterday’s broadband is todays’ narrowband’. For the purpose of this research, broadband Internet is defined as high-speed, always on, Internet connectivity, with a minimum download speed of 256 kbps and minimum upload speed of 64 kbps. Broadband Internet allows multiple tasks to be performed at the same time (for example, a user can download and upload data at the same time without any delay).

This study frequently uses the term *broadband adoption* throughout the thesis. Broadband adoption is defined as households (or person) that have access to a broadband connection and subscribe to a broadband Internet service but do not necessarily use it, whereas broadband use means households (or persons) that actually subscribe to a broadband Internet service and use the Internet (Lanzolla & Suarez 2012).

It would be hard to come up with a single definition of *social capital* that satisfies and matches everyone's definition. Social capital is defined as 'networks together with shared norms, values and understandings that facilitate co-operation within or among groups' (OECD 2007, p. 103). In this definition, networks are regarded as real-world links between groups or individuals such as networks of friends, family networks, networks of former colleagues, and so on.

In this study, social capital is measured by two dimensions: bonding and bridging social capital. Bonding capital usually relates to homogeneous and close-knit groups such as family, close friends, relatives and people who share the same culture or ethnicity (Williams 2006). Bridging capital can be conceptualized as links that stretch beyond a shared sense of identity, for example, to distant friends, friends of friends, outside community, colleagues and associates (Williams 2006).

1.6 DELIMITATIONS OF SCOPE

The scope of this study is limited to assessing the broadband infrastructure available in the WDR, the adoption and use of broadband Internet by households and its impact in building and maintaining social capital in the WDR. First, broadband infrastructure is considered from the perspective of what is available within the WDR only. The purpose is to identify the supply, coverage and type of broadband Internet service across the WDR. For this study, an assessment of effectiveness of broadband network infrastructure was referenced against a dimension of IS success model: system quality of the broadband Internet.

Secondly, this study investigates the key factors that influence rural household intention to adopt, use and impact of broadband Internet services in the WDR. This study interviewed and surveyed participants who have already some kind of Internet connection in their home and were the major decision-making member of a household in the WDR. For this study, broadband adoption and use by households was measured by the following technology adoption and use factors: utilitarian outcomes; hedonic outcomes; self-efficacy; perceived cost; pervious knowledge and experiment; and purchase complexity.

Thirdly, the issue of understanding how social capital is built and maintained in rural communities using broadband Internet is challenging because there are not any predefined items for measuring, building and maintaining social capital using broadband Internet. So how households might be building and maintaining social capital through the use of broadband Internet is measured by adapting existing instruments for measuring how two dimensions of social capital (bonding and bridging) are built and maintained through online activities.

Finally, this research collected empirical data from one rural region of Australia, the WDR which is administered by a local government council (Australia has 547 councils). Moreover, the data collected from the WDR in south-east Queensland has population socio-economic characters and a geographic nature similar to a number of other rural regions across Australia.

1.7 OUTLINE OF PhD THESIS

This PhD thesis consists of eight chapters. A brief description of each subsequent chapter is provided below.

Chapter Two reviews and summarises the current literature regarding broadband supply, use and its impact on social connectivity in rural households. This chapter identifies and defines gaps in the literature in relation to the research problem being investigated in this PhD study. Subsequently, in order to develop a theoretical and conceptual basis for this study, this chapter reviewed the current literature relating to the broadband ecosystem and the key underlying theories of information systems success, technology adoption and use and social capital in relation to broadband supply, adoption and use; and its impact in building and maintaining social capital in rural communities. The extensive review of the relevant literature and theories provided the foundation for the development of an appropriate theoretical and conceptual model, and for the development of specific research questions and testable hypotheses to provide answers to the key components of the general research question of this study.

Chapter Three describes and justifies the research paradigm that underpinned the methodological approach used for this study. This research uses a mixed methods approach to examine the relationship between broadband infrastructure and the adoption and use of broadband services and the impacts in building and maintaining social capital in rural communities.

Chapter Four presents key findings from the data analysis of the broadband infrastructure in the WDR. The fixed wired and wireless broadband infrastructure currently available in the WDR were assessed in terms of current coverage and quality.

Chapter Five presents the key findings from the data analysis of 25 semi-structured face-to-face interviews of households regarding their perceptions of the broadband infrastructure, broadband adoption, use and its impact in building and maintaining social capital in rural communities.

Chapter Six presents the key findings from the data analysis of the survey responses from households on their perceptions of broadband infrastructure, adoption, use and its impact in building and maintaining social capital in rural communities.

Chapter Seven discusses the findings from chapters 4, 5 and 6 in terms of each of the three research questions investigated and hypotheses tested in this study in relation to the existing knowledge and relevant literature.

Chapter Eight summarises this study in terms of the three research questions investigated and 13 hypotheses tested in this study, the methodological approach employed. and the key findings. Then Chapter Eight discusses the key contributions of this research study to theory and practice. Next, this chapter outlines the limitations of the study and future directions for broadband research in rural areas are suggested. Finally, this chapter summarises how the main aims and objectives of this study were achieved within this research.

1.8 CHAPTER SUMMARY

This chapter provides a background and rural context for the research problem and general research question being investigated. Then the justification and motivation for this study is provided. Then this chapter described the theoretical and conceptual framework, the broadband ecosystem that provided an overarching conceptual framework and a focus for the three research questions investigated in this study. The research paradigm and methodological approach that was used to achieve the proposed objectives (research questions, hypotheses) of this study is described. Some important key terms and definitions used in this study are provided. Then this chapter outlines delimitations of scope of this study and, finally, the structure of this PhD Thesis is provided. In Chapter Two, the relevant literature and theories are reviewed to provide a sound foundation for the development of a theoretical and conceptual model and the specific research questions investigated and hypotheses tested in this current research.

Chapter 2: Literature review

2.1 INTRODUCTION

Chapter 1 introduced the research problem and the context of this study, the lack of in-depth understanding of the broadband ecosystem in a rural context and, in particular, the relationship between the supply, demand and use and impact of broadband in building and maintaining social capital in rural communities. These elements are addressed by the following general research question:

What is the relationship between broadband infrastructure supply and household adoption and use of broadband services in rural Australia and to what extend does broadband use help to build and maintain social capital in rural communities?

Figure 2-1 presents an overview of the structure of this chapter.

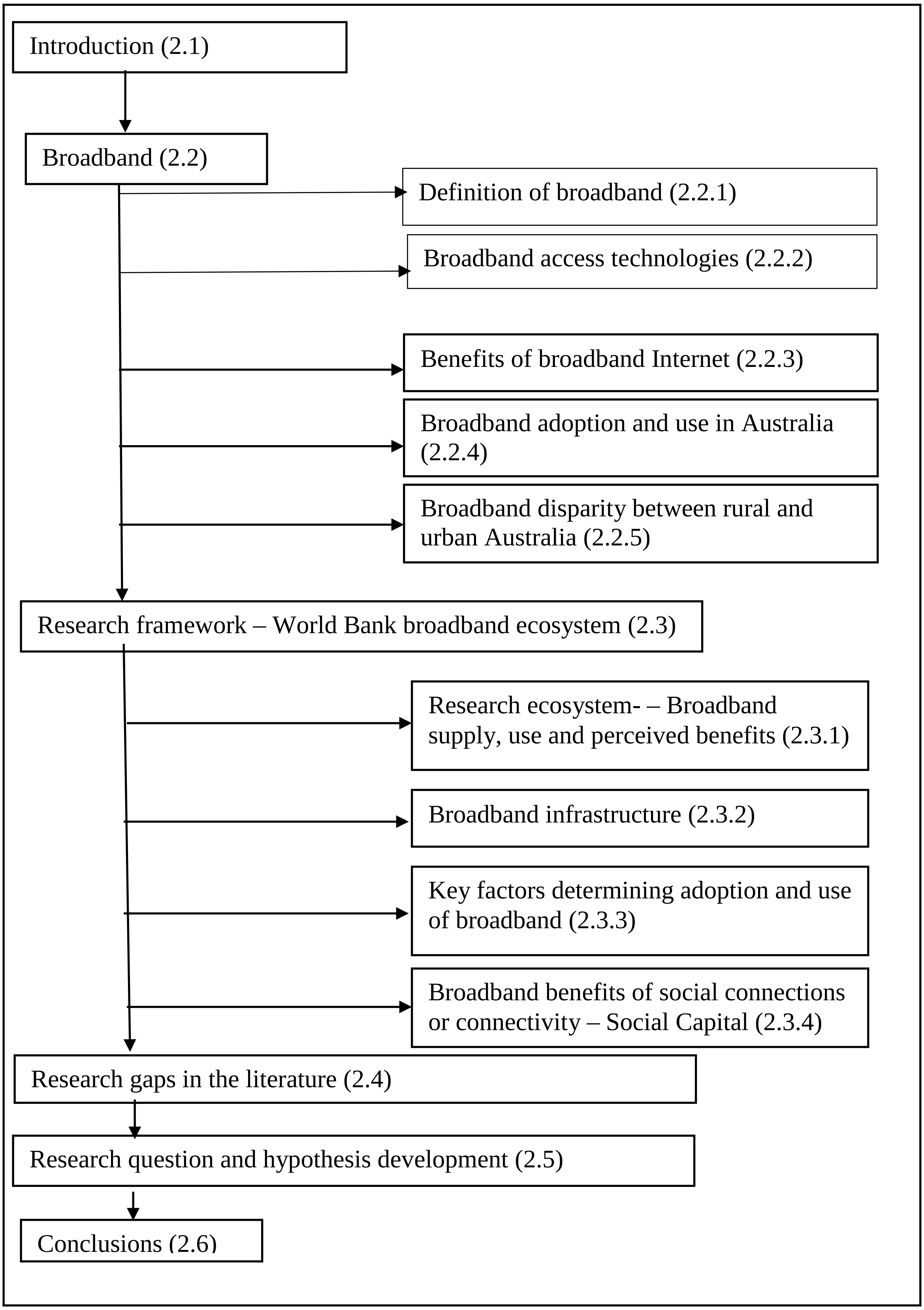

Figure 2-1 Outline of Chapter 2 with section numbers in brackets

2.2 BROADBAND

2.2.1 Definition of broadband

According to the Organisation for Economic Co-operation and Development (OECD 2014) the term ‘broadband’ is typically used to denote an Internet connection with download speeds (at 256 kbps or more) faster than traditional dial-up connections (56kps). The reality is that the current speed of broadband Internet in developed countries such as the United States and Australia is much faster now and is measured in mbps rather than kbps. For example, Akamai (2016) reports that the average broadband Internet speed in 2015 was 8.5 Mbps in Australia compared to South Korea 26.9 Mbps, United States 15.2 Mbps and the United Kingdom 14.9 Mbps (see Figure 2-2). More recently, the United States Federal Communications Commission (FCC) has revised its definition of broadband with the minimum download speed upgraded from 4 Mbps to 25 Mbps, and the minimum upload speed upgraded from 1Mbps to 3Mbps (Singleton 2015). In the near future, a download and upload speed of 100 Mbps may become the threshold for the definition of broadband as suggested by FCC Commissioner Jessica Rosenworcel (Singleton 2015).

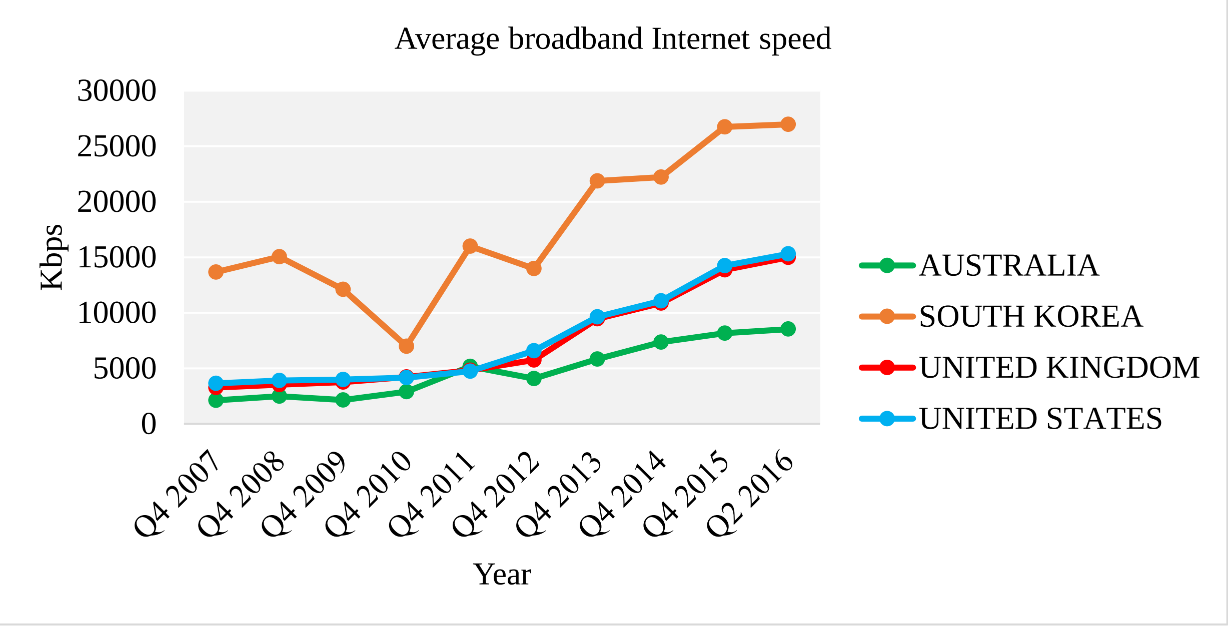

Figure 2-2 Average broadband Internet connection speeds for Australia, South Korea, United Kingdom and United States 2007 to 2015
Source from Akamai (2016)

2.2.2 Broadband access technologies

This section discusses the broadband access technologies that are available in Australia, namely:

- Asynchronous Digital Subscriber Line (ADSL);
- Very high data rate DSL (VDSL) underpinning NBN Fibre to the Node/Basement (FTTN / FTTB);
- NBN Fibre Network;
- Hybrid Fibre Coaxial (HFC);
- NBN Fixed Wireless;
- Wireless Broadband Networks (3G/ 4G); and
- NBN Satellite Broadband.

Table 2-1 provides a summary of the download speeds and upload speeds of these broadband access technologies.

Table 2-1 Broadband access technologies in Australia by download and upload speeds

Type of network	Download speed	Upload speed
ADSL1	8 Mbps	384 Kbps
ADSL2+	20 Mbps	820 Kbps
VDSL2*	100 Mbps	40 Mbps
2G (GPRS)	0.1 Mbps	<0.1Mbps
3G (HSPA)	7.2 Mbps	1.5 Mbps
4G (LTE)	150 Mbps	50 Mbps
Cable (HFC)	100 Mbps	2 Mbps
NBN Optical Fibre	100 Mbps	40 Mbps
NBN Satellite	25 Mbps	1Mbps

*Currently NBN Australia using this technology as FTTN/FTTB

Source: this research

Public switched telephone network (PSTN)

Before discussing each of the broadband access technologies available it is important to note that ADSL and ADSL2 and Fibre to the Node are broadband access technologies which are reliant on the PSTN to provide coverage to households and businesses. Public switched telephone network service is the voice-grade telephone service that is based on analogue signal transmission that was common before the advent of advanced forms of telephony such as Integrated Services Digital Network (ISDN), cellular telephone systems, and voice over Internet Protocol (VoIP) (Frieden 2013). The majority of Australian cities and towns are covered by the Telstra PSTN services (see Figure 2-3).

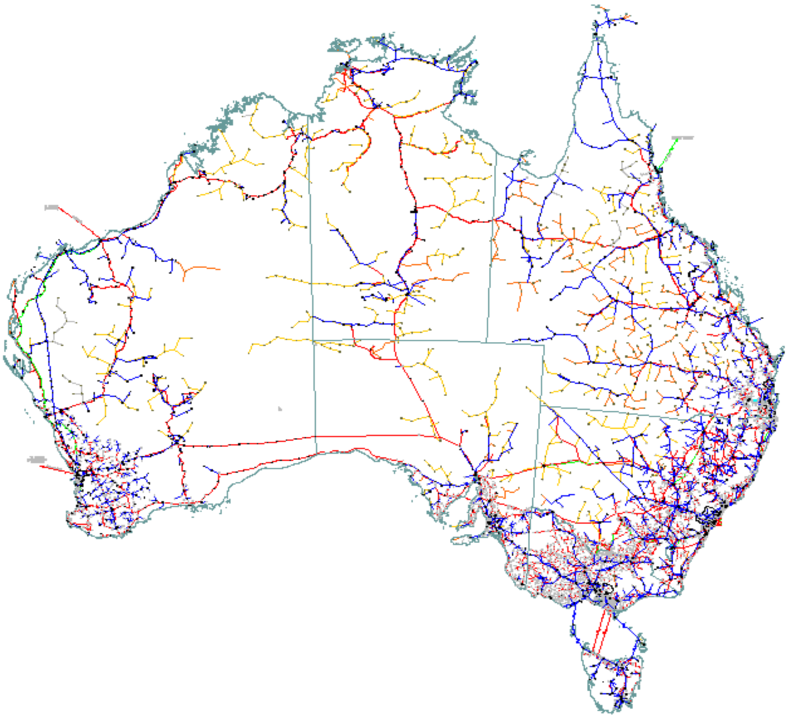

Figure 2-3 Telstra PSTN network coverage across Australia
Adapted from BIS Shrapnel (2001)

Asymmetric Digital Subscriber Line (ADSL)

Asymmetric digital subscriber line (ADSL) is a type of digital subscriber line (DSL) technology, a data communications technology that enables faster data transmission over copper telephone lines than a conventional voice band modem can provide. A larger frequency spectrum is available for download of data in comparison to the upload of data, hence, with this broadband technology higher speeds are achievable for download of data (Fornefeld, Delaunay & Elixmann 2008). The maximum transmission speed of ADSL is currently from 2 to 8 Mbps and ADSL2+ can deliver speeds up to a maximum of 20 Mbps. The speed of ADSL/ADSL2+ services is dependent upon the distance from the telephone exchange (Islam, Selvadurai & Town 2008).

Very high data rate DSL (VDSL)

VDSL is a developing technology that promises much higher data rates over relatively short distances (between 51 and 100 Mbps over lines up to 200 meters in length). VDSL and VDSL2 have been widely deployed in many countries such as South Korea, Belgium, France, Germany, Norway, United Kingdom and United States. Currently the NBN is rolling out VDSL2 with its Fibre to the Node (FTTN) broadband access technology in Australia (Brown 2015). With VDSL2 currently 100 Mbps download and 40 Mbps upload speeds are possible with the NBN FTTN service (Brown 2015; iiNet 2016).

Hybrid Fibre Co-axial (HFC)

HFC are broadband networks that use a combination of optical fibre and coaxial cables to provide two-way, high-speed broadband content (video, voice and data) that can be delivered to the home (NBN 2016b). The first HFC networks were originally used to deliver cable TV services. Foxtel in Australia used HFC cable to provide a number of different pay TV channels (NBN 2016b). HFC has been deployed across a number of areas in the capital cities and surrounding suburbs (Sydney, Melbourne, Brisbane, Adelaide and Perth) of Australia. There are more than one million Australian homes and businesses currently covered by the HFC technology network which was rolled out by Optus and Telstra (Coyne 2015). NBN has planned a further rollout of HFC to other suburbs in the Australian state capital cities, so that a total of 219 regions covering 3 million premises across Australia can receive an HFC NBN connection before the end of 2018 (see Appendix B Table B2-1 for a full list of communities where HFC will be available) (Coyne 2015; NBN 2016c).

Wireless broadband Internet networks

Wireless broadband is a high-speed Internet and data service delivered through a wireless local area network or wireless-wide area network technologies which includes cellular data networks like 4G, 3G, as well as public Wi-Fi or satellite networks (Rouse 2009, 2016). Wireless broadband may be either fixed or mobile. A fixed wireless service such as WiMAX provides wireless Internet connectivity to user specific or permanent locations, such as homes, mobile broadband networks and offices (Middleton & Bryne 2011). NBN provides fixed LTE 4G wireless services to rural areas of Australia not covered by a fixed broadband service. Mobile broadband services are delivered via wireless networks and enhance connectivity of users of advanced technologies (such as smart phones and other wireless devices) at any place at any time (Gulati et al. 2015; Srinuan, Srinuan & Bohlin 2012).

In Australia, there are three major mobile broadband network providers: Telstra, Optus and Vodafone. Telstra is one of the most available mobile broadband networks in terms of coverage of area, provides Next G (3G/4G) services. Optus is the second largest mobile network, followed by Vodafone. There are a number of virtual mobile network operators such as TPG, Dodo, Virgin Mobile, Aldi Mobile, iinet, iPrimus, and Woolworths Connect (see Appendix B Table B2-2 for a full list of mobile virtual network operators in Australia) that use the mobile network infrastructure of main carriers including Telstra, Optus or Vodafone (IDD 2016; Mobile Network Guide 2016a) (Kidman 2012). The existing mobile network operators have spectrum holdings from 850MHz to 2 GHz, as listed in Table 2-2 below. These are, in most cases, fully utilised providing 2G, 3G and 4G mobile services.

Table 2-2 Australian mobile networks with frequency range in MHz

Mobile Carrier	GSM Frequency	3G Frequency	4G/LTE Frequency
Telstra	900 (shutdown end of 2016)	850 (NextG), 2100	700, 1800, 900, 2600
Optus	900, 1800	900, 2100	700, 1800, 2100, 2300, 2600
Vodafone	900, 1800	850, 900, 2100	1800, 850

Source from Kidman (2015); and Mobile Network Guide (2016b)

3G networks

3G is the third generation of mobile phone standards and technology based on wide band wireless networks which provided peak data rates of at least 200 kbps. 3G supersedes 2G[1] technology and precedes 4G technology. 3G technologies enabled faster data-transmission speeds, greater network capacity and more advanced network services (Fendelman 2016). Recent 3G releases provide mobile broadband access of several Mbps to smart phones and mobile modems in laptop computers. 3G functions in the range of 850, 900 and 2100 MHz bandwidth (Shukla et al. 2013).

[1] Telstra decommissioned its 2G (GSM) mobile network on 1 December 2016 and has redeployed the 2G spectrum for 3G and 4G mobile network services (Coyne 2014).

4G network

4G wireless is the term used to describe the fourth-generation of wireless service. 4G is a step up from 3G, which is currently the most widespread, high-speed wireless service. 4G is only available in limited areas (Cassavoy 2016). The 4G network is based on LTE-Advanced - 3GPP Long Term Evolution (LTE). This network boosts peak downloads speeds up to 100Mbps and upload speeds to 50Mbps. The mobile network latency reduced from around 300ms to less than 100ms, resulting in significantly lower mobile network congestion (Teleco Antennas 2016).

Satellite Broadband

Satellite broadband services are the most expensive broadband Internet access technology (Anderson & Mavrakis 2009; Skinner 2016) available in Australia as far as pricing and accessibility is concerned, yet it can reach locations where most other forms of broadband cannot reach, including remote and very remote communities. To provide fast broadband to rural and remote areas of Australia, NBN Co launched the Interim Satellite Service (ISS) on 1 July 2011 to provide an improved broadband internet service to rural and remote Australia not covered by wired broadband and wireless mobile broadband access technologies ahead of the rollout of the Long Term Satellite Service. The Interim Satellite Service (ISS) will be shut down in February 2017 (NBN 2016d). Recently NBN Co launched two new dedicated Long Term Satellites-Sky Muster One in October 2015 and Sky Muster Two in October 2016- to reach 3% of rural and remote communities that currently do not have access to broadband internet services and offer wholesale services configured for a planned 25 Mbps download and 5Mbps upload (NBN 2016a).

2.2.3 Benefits of broadband Internet

Broadband Internet connectivity, and its availability and mobility, are fundamental to modern societies effectively using e-government services, e-commerce, e-health, online communication and e-learning (Paulraj 2011; Saygili 2015; Van der Wee et al. 2015). The implementation and adoption of broadband networks has a revolutionary impact on sustainable economic development (Majumdar 2010; Prieger 2013; Tella & Olorunfemi 2010). The United States Federal Communications Commissioner, suggested that broadband networks will be as critical to the 21st century as roads, canals and railroads were to the 19th century; and how the Interstate Highway System and basic telephone networks were to the 20th century (Bouras, Giannaka & Tsiatsos 2009; Bouras, Gkamas & Tsiatsos 2010).

People are increasingly reliant on the Internet and other ICTs in their business and academic domain, as well as in their personal spheres such as areas of health, information and education (Stern, Adams & Boase 2011). The Internet is a pervasive medium through which individuals can engage in everything from personal communication through to civic participation. Broadband Internet provides higher speeds of data transmission and is facilitating the digitalization of the economy and society in general. People can use broadband Internet to engage socially and civically (Stern, Adams & Boase 2011). Hence, the Internet can serve as a vehicle for communication on formal (e.g., professional communication) and informal (e.g., emailing friends and family members) levels, as well as a source for entertainment and social activities and connection (Prieger 2013; Quan-Haase & Wellman 2004). Broadband Internet connectivity has enabled the emergence of new work practices, home-based entrepreneurship and job searches (Autor 2001; Bauernschuster, Falck & Woessmann 2014; Fairlie 2006; Krueger 2000; Stevenson 2008).

More importantly, broadband Internet connectivity can provide potential benefits in communication, finance, health, education, entertainment, social activities and politics that can improve one’s life chances (LaRose et al. 2007; Stern, Adams & Boase 2011; Townsend et al. 2013). Broadband Internet as a general purpose technology is recognized as an important tool for many different aspects of social life (Stern, Adams & Boase 2011), such as building and maintaining social relations. Broadband Internet can enhance distinct interactions that provide valuable links and opportunities. For example, the relationships leveraged through social connections can be very helpful in finding jobs or for obtaining information and knowledge using the Internet. So broadband Internet plays an important role in facilitating interaction with communities and helps to build and maintain social connectivity (Hodge et al. 2016). Moreover, due to its low cost and ubiquity of usages, broadband Internet creates the opportunity for constant social communication, i.e. connectivity, and supports personal ties and connections with larger communities with similar interest and enables information sharing (Wellman et al. 2003).

Pénard and Poussing (2010) suggest that the communication functions of broadband Internet make social interaction more convenient and efficient; and help interpersonal exchange by desynchronizing in time and space. Furthermore, the information function of broadband Internet facilitates the acquisition of information about places, times of social events, politics and civic initiatives. It reduces transaction costs of travel and even helps individuals' to find out about opportunities for preferred social volunteer engagement and jobs (Bauernschuster, Falck & Woessmann 2014). Social media and other communication applications enable regional and rural residents to keep in touch with family and friends who live far away from home, whilst at the same time connecting with local residents (Western Australia 2011).

Overall, it appears that access (supply) and demand (adoption and use) of high quality, broadband Internet networks is a critical connectivity, economic and community development tool for all communities in the twenty-first century.

2.2.4 Broadband adoption and use in Australia

According to the Australian Bureau of Statistics (ABS) (2016b), the demand for and use of Internet across Australia has increased steadily from the late 90s (see Figure 2-4). According to the ABS *Household Use of Information Technology Survey*, 56% of households in Australia in 2004 -2005 had Internet access; and by 2015–2016 this figured had climbed to 90% (ABS 2005, 2016b, 2016a). ABS data also suggests that 99% of Internet connections were broadband in Australia as at the end of June 2016 (ABS 2016a). Australia has already moved into what Rogers describes as the late majority adoption phase of his well-known diffusion curve (Rogers 2003) for broadband. However, the proportion of households with Internet access remains higher for those located in capital cities (85%). However, households located outside capital cities experienced stronger growth in their proportion of Internet access, rising from 79% in 2012–13 to 82% in 2014–15 (see Figure 2-4), they are still lagging behind urban Australia (ABS 2016b).

Broadband services only started to become widely available in Australia from 2005 when Telstra embarked on a large scale program to enable telephone exchanges to support ADSL services (Fletcher 2009; Islam, Selvadurai & Town 2008). Prior to that, access to the Internet for households and many businesses was by narrowband and a dial-up modem which did not allow sharing of a fixed telephone line. A significant increase in the use of broadband services occurred from that time in 2005 when ADSL broadband services became widely available in Australia. This trend can be seen in

Figure 2-4 where a substantial increase in the proportion of households with Internet access from 2005 is evident in the ABS data comparing the relative proportion of metropolitan and ex-metropolitan households with Internet access. It should also be noted that in later years since 2006 the widespread availability of mobile broadband services with the advent of the Telstra NextG 3G Mobile network and subsequent 3.5G and 4G mobile network improvements have also contributed to increased Internet access (Teleco Antennas 2016).

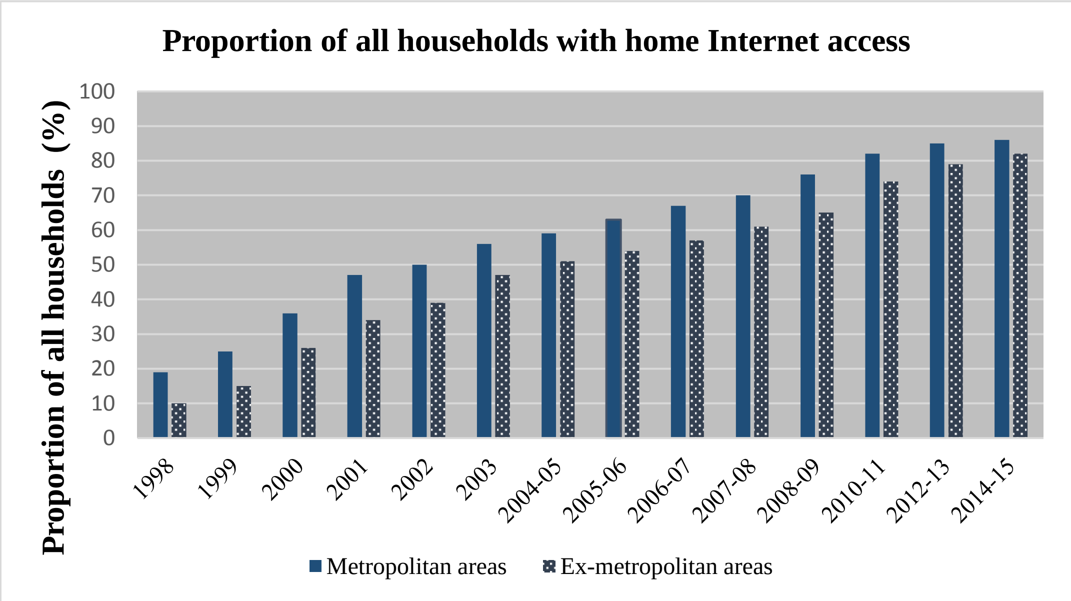

Figure 2-4 Household Internet access - metropolitan and ex-metropolitan areas

Source from ABS (2016b)

As noted previously, starting from 2006 there has been an exponential increase in the adoption of mobile broadband services, which has contributed significantly to the overall adoption of broadband services across Australia. Figure 2-5 shows how mobile broadband services have overtaken fixed line ADSL services since 2010. However, it should be noted that fixed line broadband tends to be via household subscription, whereas mobile broadband tends to be a personal subscription. Conversely dial-up narrowband access has become almost negligible after accounting for almost 40% of Internet access back in 2006 (ABS 2013, 2015c).

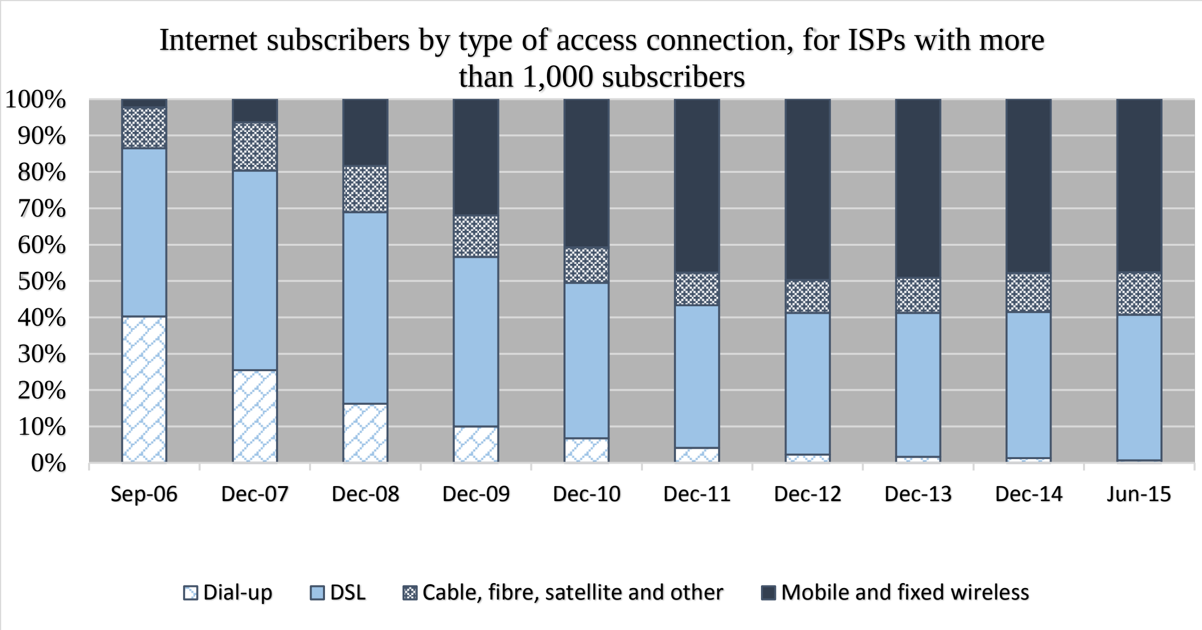

Figure 2-5 Number of Internet subscribers by Internet access connection technology
Source from ABS (2015c)

According to the OECD (2015) and Akamai (2016), Australia lags behind on wired broadband Internet speeds when compared to other developed countries. Akamai's 2015 report shows that the average download speed of Australian wired broadband was 8.2 Mbps and peak download speed was 39.3 in 2015 compared to South Korea where average wired broadband download speed was 26.7 Mbps and peak speed was 95.3 Mbps; Sweden where average wired broadband download speed was 19.1 Mbps and peak speed was 71.8 Mbps; Norway where average wired broadband download speed was 18.8 Mbps and peak speed was 59.8 Mbps; the United States where average wired broadband download speed was 14.2 Mbps and peak speed was 61.5 Mbps; and Canada where average wired broadband download speed was 13.1 Mbps and peak speed was 54.9 Mbps (see Table 2-3). Conversely, Australia is a leader in the roll out of high speed mobile broadband networks such as 4G (see Table 2-3) (Akamai 2016). For Australia, the average mobile broadband speed in 2015 was 8.0 Mbps and peak speed was 153.3 Mbps (Akamai 2016), compared to South Korea where the average mobile broadband was 11.8 Mbps and peak speed was 71.2 Mbps; Sweden where the average mobile broadband was 11.1 Mbps and peak speed was 48.3 Mbps; Norway where the average mobile broadband was 9.8 Mbps and peak speed was 48.2 Mbps; the United States where the average mobile broadband was 4.8 Mbps and peak speed was 18.3 Mbps; and Canada where the average mobile broadband was 7.6 Mbps and peak speed was 62 Mbps (see Table 2-3). However, this is not the case in rural areas where mobile broadband services are best described as patchy and unreliable. Moreover, mobile phone operators are reluctant to roll out 4G networks in rural areas with low population densities as it difficult to justify the return on investment in mobile network infrastructure in such locations (Park et al. 2015).

Table 2-3 Average and peak connection speed of wired and wireless broadband across the global region

Global Rank by average connection speed	Country	% Wired broadband Average Mbps in 2015	Peak wired broadband speed Mbps	% Mobile broadband Average Mbps	Peak Mobile broadband speed Mbps
1	South Korea	26.7	95.3	11.8	71.2
2	Sweden	19.1	71.8	11.0	48.3
3	Norway	18.8	59.8	9.8	48.2
4	Japan	17.4	82.9	9.9	112.2
5	Netherland	17.0	65.3	8.8	33.0
9	Finland	16.6	55.4	12.8	79.9
14	United States	14.2	61.5	4.8	18.3
20	Canada	13.1	54.9	7.6	62
48	Australia	8.2	39.3	8.0	153.3

Source from Akamai (2016)

2.2.5 Broadband disparity between rural and urban Australia

In developed countries, the quality of broadband infrastructure (supply) in rural areas is much lower compared to urban (ABS 2013; Dobson, Jackson & Gengatharen 2013; Dwivedi, Alsudairi & Irani 2010; Grubesic 2012; Kawade & Nekovee 2012; Prieger 2013; Rajabiun & Middleton 2013). A combination of poor telecommunications infrastructure coverage, low population density, inadequate regulation, and a focus by telecommunications companies on high-cost technologies designed for urban markets makes broadband internet connectivity in many rural areas a complex and costly proposition (Arai, Naganuma & Satake 2012; Grubesic 2012; Hill, Troshani & Burgan 2014; Kawade & Nekovee 2012; Park et al. 2015).

Typically, rural Australia lags behind urban Australia in terms of broadband infrastructure, which is often highly variable - coverage and quality (reliability and speed). Broadband infrastructure is often under-serviced or not serviced in terms of large parts of rural Australia in comparison to urban Australia—which creates a digital divide among rural and urban Australia (see Table 2-4) (Dobson, Jackson & Gengatharen 2013; Hill, Burgan & Troshani 2011; Hill, Troshani & Burgan 2014; Middleton & Park 2014; RTIRC 2015).

Table 2-4 Possible download, upload speeds and availability of broadband access technologies in rural Australia

Broadband Access Technology	**Download Speed**	**Upload Speed**	**Availability**		
			Inner regional	**Outer Regional**	**Remote**
ADSL1	8 Mbps	384 Kbps	Available	Available	Limited availability
ADSL2+	20 Mbps	820 Kbps	Available	Limited availability	Not available
Cable (HFC)	100 Mbps	2 Mbps	Not available	Not available	Not available
NBN Fibre	100 Mbps	40 Mbps	Limited availability	Not available	Not Available
3G	7.2 Mbps	2 Mbps	Available	Available	Available
3G HSPA+	42 Mbps	22 Mbps	Available	Limited availability	Limited available
4G- LTE	150 Mbps	50 Mbps	Limited availability	Limited availability	Not available
4G- LTE Advanced	300 Mbps	150 Mbps	Limited availability	Limited availability	Not available
NBN Fixed Wireless	50 Mbps	20 Mbps	Limited availability	Limited availability	Not available
NBN Satellite Wireless	25 Mbps	5 Mbps	Limited availability	Limited availability	Available

Source: this research (Date: September 2016)

Digital divide in rural communities in terms of supply and use

The term 'digital divide' describes the fact that the world can be divided into people who do and people who do not have access to—and the capability to use—modern information technology, such as the telephone, television, or the Internet (Kvasny & Payton 2009). In other words, the digital divide is the gap between those who have access to digital technologies and those who do not. Secondly, the digital divide is the gap between those who use digital technologies and those who do not understand how to use digital technologies in binary terms distinguishing the ‘haves’ from the ‘have-nots’ (Rice & Katz 2003). In addition, socio-economic inequalities create divisions of access to, and use of, networked communication technologies (Freeman 2012). In the broadest sense, there are ICT access inequalities caused by varying levels of infrastructure and resources between different communities, particularly in relation to developed and developing economies (Cullen 2006; Freeman 2012). The digital divide for the context of this study will be in relation to supply (access, availability and quality) and ability of households to effectively adopt and use broadband Internet services in rural communities.

Broadband supply is considered as the technical access and availability or coverage and the quality (reliable) of broadband infrastructure in communities (Lee 2011). The majority of rural Australia has inadequate and poor quality broadband infrastructure and the subsequent reduced availability of digital services in rural areas (Vidot 2016). The Australian Government has made a significant investment in the NBN to reduce the supply gap. A key element of the NBN is the guarantee that all Australians will be able to access broadband Internet at a minimum of 12 Megabits per second (Mbps) peak speed. The increased virtual access will also contribute significantly to reducing the digital divide (NBN 2010). However, it should be noted that roll out of the NBN in rural Australia will take time and widespread coverage will not occur for years. This could widen the digital divide between rural and urban Australia where its urban counterparts in the meantime have access to advanced broadband access technologies. Clearly, the digital divide between rural and urban Australia will not solved by the NBN within the next few years.

Digital divide is also caused by an ability and affordability to use broadband Internet which include factors such as education and income (Alam & Imran 2015; Atkinson, Black & Curtis 2008; Gibson 2003; Lee 2011; Park 2015). 'Ability' is explained as the provision of training and support, including culturally appropriate training, and 'affordability' is referred to as the cost of access to appropriate technologies (Lee 2011). The rural population of Australia has a lower level of education and socioeconomic status compared to urban Australia, both of which are essential components for driving technology use such as the use of broadband Internet (Park 2015). Moreover, rural communities are paying more for the same broadband Internet service used by their urban counterparts (Adhikari 2016; Park 2015; RTIRC 2015). Other factors that may contribute to the digital divide include age, location, disability, opinion, gender and culture (Atkinson, Black & Curtis 2008; Gibson 2003; Lee 2011; Park 2015)

2.3 RESEARCH FRAMEWORK—WORLD BANK BROADBAND ECO-SYSTEM

The Broadband Ecosystem is adapted to provide an overarching conceptual framework for this study (World Bank 2012). This adaptation of the broadband ecosystem is underpinned and supported by the economic theory of supply and demand, information systems success theory, technology adoption and use theory, and social capital theory (see Figure 2-6) (Ajzen 1991; Brown & Venkatesh 2005; Davis 1989; DeLone & McLean 2003; Dwivedi, Alsudairi & Irani 2010; Dwivedi & Lal 2007; Fukuyama 2001; Granovetter 1973; Rogers 1962, 2003; Taylor & Todd 1995; Venkatesh & Brown 2001). The economic theory of supply and demand provides a high-level view of the relationship between broadband infrastructure (supply) and the adoption and use of broadband (demand) and its impact on rural communities. System quality dimension of Information System Success (DeLone & McLean 1992, 2003) is used to evaluate the quality of broadband infrastructure. Technology adoption and use by households is measured by the MATH and technology adoption and use of model (TAM). The impact of broadband adoption and use in rural communities is measured by the two dimensions of social capital—bonding and bridging social capital. This section discusses the Broadband Ecosystem framework in terms of a supply and demand ecosystem with impact and its theoretical dimensions of system quality, technology adoption and use and social capital.

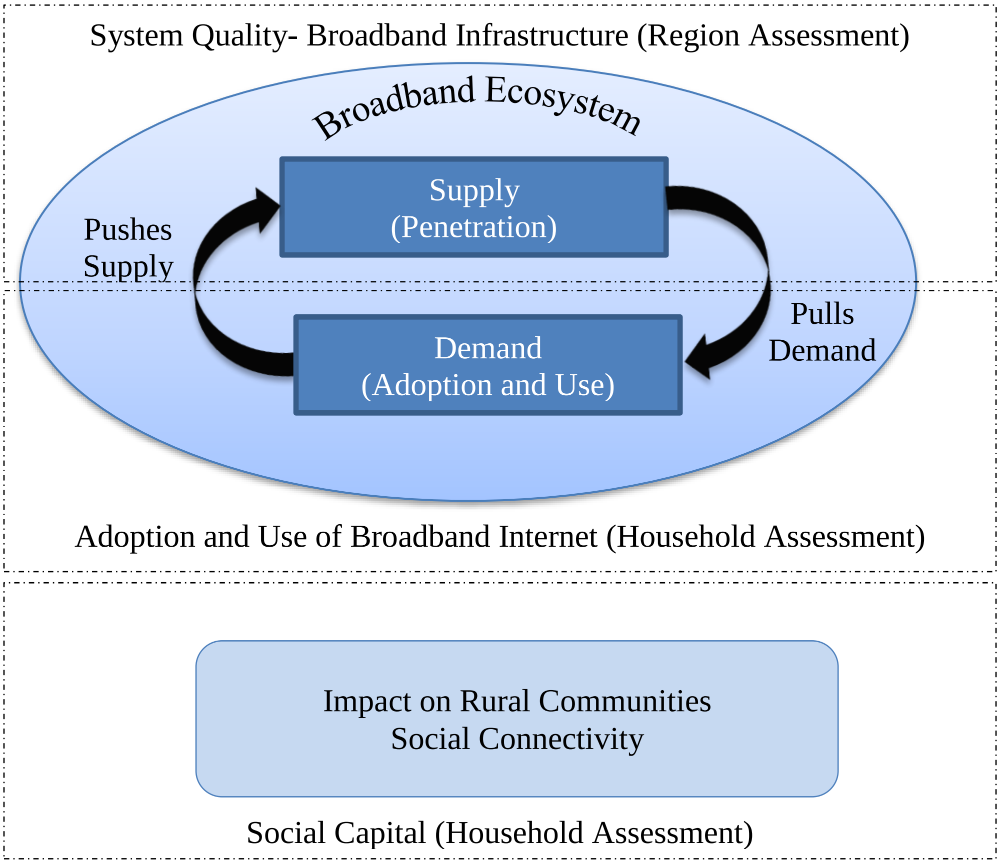

Figure 2-6 Broadband ecosystem –conceptual framework
Adapted fromWorld Bank (2012)

2.3.1 Broadband ecosystem: Broadband supply, use and perceived benefits

The adoption or use of any technology is based on its availability and meet the requirements of the users or, in other terms, dependent upon both supply and demand for that technology (Middleton & Chang 2008). On the supply side, building a broadband network that has national coverage involves a huge capital investment as has been seen with the roll out of broadband networks in countries such as Australia, Britain, Canada, Germany, Singapore, South Korea and the United States (Hill, Troshani & Burgan 2014; Qiang 2010). The problem of providing adequate broadband supply is not as simple as just building networks. As operators roll out their broadband business plans, service quality (reliability and data speeds), and technology choice are all ultimately dependent on cost (Kelly & Rossotto 2012). Capital expense is significantly higher and commercially less viable for constructing wired broadband networks in rural areas. High speed broadband deployment in the low population density and highly-scattered settlements in rural areas is difficult to justify in terms of the return on investment (ROI), which is significant (European Commission 2013;

Kelly & Rossotto 2012). Broadband deployments and adoption and use can be broadly explained by economic theory, which suggests that supply and demand are not independent variables interacting; they represent a symbiotic relationship where each is absolutely dependent on the other (Adam 2009; Lin & Wu 2013; Potts 2014). Disruption of one automatically disrupts the other.

For network providers, cost is perhaps the most important contributing factor to deployment of telecommunication services such as broadband to rural areas. Even then, just building more networks or providing access to all residents will not guarantee successful use of the Internet by communities (Jain, Mandviwalla & Banker 2007). In this scenario, governments need to support broadband infrastructure deployment through a variety of promotional policies to encourage demand for Broadband Internet use among the communities so that they use the broadband service. In sum, holistically, this study views broadband as an ecosystem, with supply and demand components and perceived benefits, in order to understand how to maximize the effective deployment of adoption and use of broadband in rural communities.

2.3.2 Broadband infrastructure

Broadband Infrastructure is one of the greatest barriers of access to the Internet in many countries, especially those that are poor or with large rural or remote populations (World Economic Forum 2016). The availability, reliability and affordability of Internet access are all affected by infrastructure (Black & Atkinson 2007; Cradduck 2016). These challenges are especially prevalent in remote areas because of long distances, difficult terrain, large capital expenditures, high operating costs and low average revenues per user (World Economic Forum 2016). Broadband Internet which fulfils many characteristics of a general purpose technology is a little different from other technologies such as the personal computer, which could be purchased individually, whereas it is very difficult and expensive to build broadband infrastructure individually. Hence, governments need to play a key role in extending broadband connectivity and coverage in rural and remote areas through policy setting and infrastructure initiatives such as national broadband plans to enable appropriate broadband infrastructure coverage nationally (Kelly & Rossotto 2012). Broadband infrastructure in the context of the broadband ecosystem can be evaluated by system and service quality (Bauer & Tsai 2014; Bauer, Clark & Lehr 2010; Gharakheili, Vishwanath & Sivaraman 2016; Kim, Kelly & Raja 2010; Lehr et al. 2011).

In this study, broadband infrastructure in the context of the broadband ecosystem is explained by the system quality dimension of information system success theory (DeLone & McLean 1992, 2003). System and service quality of the broadband infrastructure environment, measures the desired characteristics of a broadband internet connection such as availability, quality, reliability and affordability (Bauer & Tsai 2014; Bauer, Clark & Lehr 2010; DeLone & McLean 2003; Lehr et al. 2011). Broadband infrastructure (supply) connects households so they can adopt and use broadband Internet. Currently, there is no universal service obligation for broadband Internet—in contrast to PSTN (Nucciarelli, Sadowski & Ruhle 2014; Picot & Wernick 2007; Williams 2016; Xavier 2003). Therefore, for this research model, broadband infrastructure has been included at the regional level as a contributing construct when evaluating household broadband adoption and use model in the overall context of the broadband ecosystem framework in rural Australia.

2.3.3 Key factors determining adoption and use of broadband by households

The main objective of this section is to determine the key factors that drive household behavioural intention to adopt and use broadband Internet technologies. It is therefore important to review the key technology adoption and use theories, since theoretical concepts from these theories will help to draw the adoption and use component of the broadband ecosystem for this study.

Technology adoption and use models

There are number of different technology adoption and use models that are widely applied to study technology adoption from the individual or user's perspectives (Brown, Venkatesh & Hoehle 2015; Williams et al. 2009), which are relevant to understanding broadband Internet adoption and use (Tsai & LaRose 2015). These major theories and models that have been used as the theoretical basis for technology adoption research are listed below:

- Diffusion of innovations (DOI) (Rogers 1962, 2003)
- Theory of reasoned action (TRA) (Fishbein & Ajzen 1975)
- Theory of planned behaviour (TPB) (Ajzen 1991)

- Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al. 2003)
- Technology acceptance model (TAM) (Davis 1989)
- Model of adoption of technology in household (MATH) (Venkatesh & Brown 2001)

These technology adoption models have been used and applied in many different technology studies such as cloud computing (Oliveira, Thomas & Espadanal 2014; Park & Kim 2014), mobile and web- based technology (Goh & Karimi 2014; Lee, Trimi & Kim 2013; Sanakulov & Karjaluoto 2015; YeeSum 2016), social media (Maertens & Barrett 2013; Park et al. 2014), broadband Internet (Dwivedi, Alsudairi & Irani 2010; Dwivedi, Selamat & Lal 2013; Fletcher, Sarkani & Mazzuchi 2014; Hill, Troshani & Burgan 2014; Niehaves & Plattfaut 2014), ICT (Buabeng-Andoh 2012; Nguyen, Newby & Macaulay 2015), mobile health (Dwivedi et al. 2016), Internet banking (Alalwan et al. 2015), game consoles (Kartas & Goode 2012; Park et al. 2014; Proctor & Marks 2013), smart watches (Cho & Park 2016), and smart TV (Bae & Chang 2012; Im et al. 2014).

Different research traditions or disciplines such as sociology, psychology and marketing have been influential and frequently used as a foundation and modified and developed for IS research into the adoption of technology-related innovations (Brown, Venkatesh & Hoehle 2015; Venkatesh et al. 2003).

Further, with the needs of different IS technology research, the abovementioned theories were further modified, extended and integrated. For instance, in order to understand intention to use and subsequent usage of information technology in detail, Taylor and Todd (1995) proposed the decomposed TPB (DTPB) by modifying TPB and integrating the construct from TAM (Brown, Venkatesh & Hoehle 2015). Venkatesh and Morris (2000) modified and extended TAM by including sex and subjective norm constructs with the TAM model to establish whether gender plays a significant role in technology adoption at the organization level. Furthermore, Venkatesh et al. (2003) argued that the researcher should ‘pick and choose’ the best and most suitable constructs as required from different IS technology adoption models to fit their study. These major theories and models now discusses below:

Diffusion of innovations (DOI)

From a sociological perspective Rogers (1962, 2003; 2010) aggregated the work in the area of rural sociology (Ryan & Gross 1943) with other innovation studies (Bowers 1937; Deutschmann & Danielson 1960) and proposed diffusion of innovation (DOI) theory which looks at how the perception of the characteristics of innovations can help to explain their diffusion in a social system. According to Rogers, the term 'diffusion' is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers 1995, p. 5) and 'innovation' refers to "an idea, practice or object that is perceived as new by an individual or other unit of adoption" (Rogers 1995, p. 11). Rogers's DOI mainly focuses on five attributes that would describe innovation and determines the prediction of adoption of innovation. Relative advantage, compatibility, complexity, trialability and observability attributes of an innovation are described in Table 2-5:

Table 2-5 Five attributes of an innovation

Attribute	Definition
Relative advantage	Is the degree to which an innovation is perceived as better than the idea it supersedes
Compatibility	Is the degree to which an innovation is perceived as being consistent with the existing values, past experiences and needs of potential adopters
Complexity	Is the degree to which an innovation is perceived as difficult to understand and use
Trialability	Is the degree to which an innovation may be experimented with on a limited basis
Observability	Is the degree to which the results of an innovation are visible to others

(adapted from Rogers 2003, pp. 15-6)

Theory of reasoned action (TRA)

Fishbein and Ajzen (1975) developed a theory of reasoned action (TRA) in their attitude-behaviour research to explain human behavioural intention in psychology. TRA, which defines a person's behavioural intention, is influenced by attitude toward behaviours and subjective norms (Fishbein & Ajzen 1975). These two constructs are defined below in Table 2-6.

Table 2-6 Theory of reasoned action

Construct	Definition
Attitude toward behaviour	The degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question
Subjective norm	The perceived social pressure to perform or not to perform behaviour

Adapted from Fishbein and Ajzen (1975, pp. 301-2)

According to Fishbein and Ajzen (1975), these two constructs could impact differently among individuals-either directly impacting or determinants of behavioural intentions (BI). BI directly impacts or determines an individual's actual behaviour. According to Fishbein and Ajzen (1975) TRA is a basic model which considers how individual people consider their action before they decide to perform a certain behaviour, so they argue that any research following TRA needs to understand their most important beliefs for that particular research context. Furthermore, Fishbein and Ajzen (1975) added that TRA has no limitations on any other external constraints that would affect a person performing the intended behaviour.

Theory of planned behaviour (TPB)

Theory of planned behaviour is another strong social psychology theory developed by Ajzen (1991). Although TPB is based on social psychology it has been widely used in IS research to study technology adoption, implementation and use (Benbasat & Zmud 1999). TPB has been derived and extended from Fishbein and Ajzen's (1975) TRA, and was developed to overcome TRA's limitations in dealing with incomplete volitional control. According to Ajzen (1991), TPB defines an individual's adoption, in this study the use of broadband technology, and is determined by three beliefs factors, behavioural beliefs, normative beliefs and control beliefs. Behavioural beliefs are generated by favourable or unfavourable attitudes toward the behaviour, whereas normative beliefs are created by social norms; and control beliefs are generated by perceived behavioural controls (Ajzen 1991). These constructs are defined in Table 2-7:

Table 2-7 Theory of planned behaviour

Construct	Definition
Attitude toward behaviour	The degree to which a person has a favourable or unfavourable evaluation or appraisal of the behaviour in question
Subjective norm	The perceived social pressure to perform or not to perform behaviour
Perceived behavioural control	Perceived ease or difficulty of performing the behaviour

Adapted from Ajzen (1991, p. 188)

According to Ajzen (1991), the more favourable the attitude and subjective norm and the greater the perceived control, the stronger should be the person's intention to perform the behaviour. Moreover, if persons have strong actual control over the behaviour, they are more likely to execute their intentions in favourable circumstances. This suggests that intention is an immediate antecedent of behaviour. In addition, TPB added the concept of perceived behavioural control which considers the perceived ease or otherwise of performing the desired behaviour and, therefore, gives a stronger indication of whether intention will translate into actual behaviour (Ajzen 1991).

Unified theory of acceptance and use of technology (UTAUT)

Venkatesh et al. (2003) developed UTAUT by reviewing eight IS models (TRA; TAM; the Motivational Model; TPB, a model combining Technology Acceptance Model and Theory of Planned Behaviour; MATH; DOI; and Social Cognitive Theory) to study user acceptance of information technology in organizations. UTAUT consists of four key constructs: performance expectancy; effort expectancy; social influence; and facilitating conditions that influence behavioural intention to use a technology and technology use. These constructs are defined in Table 2-8. Four variables namely age; sex; experience; and voluntariness-have been added in UTAUT as moderating variables in the process of ICT acceptance and use.

Table 2-8 Unified theory of acceptance and use of technology

Construct	Definition
Performance expectancy	The degree to which an individual believes that using the system will help him or her to attain gains in job performance.
Effort expectancy	The degree of ease associated with the use of the system.
Social influence	The degree to which an individual perceives that influential others believe he or she should use the new system.
Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system.

Adapted from Venkatesh et al. (2003)

Technology acceptance model (TAM)

Davis (1989) developed the Technology Acceptance Model (TAM) based on TRA to explain technology usage and acceptance of information technology. According to TAM, one's actual use of a technology system is influenced directly or indirectly by the user's behavioural intentions, attitude, perceived usefulness of the system, and perceived ease of the system (Davis 1989). Davis (1989)'s (1989) definitions of perceived usefulness and perceived ease of use are outlined in Table 2-9.

Table 2-9 Technology acceptance model

Construct	Definition
Perceived usefulness	The extent to which a person believes that using the system will enhance his or her job performance
Perceived ease of use	The extent to which a person believes that using the system will be free of effort

Adapted from Davis (1989, p. 320)

TAM also proposes that external factors affect intention and actual use through mediated effects on perceived usefulness and perceived ease of use. Parsimony is one of the advantages and strengths of the TAM model and its simplicity makes it more advantageous over other technology adoption models (Hill, Burgan & Troshani 2011). TAM has mainly been defined by two constructs-perceived usefulness and perceived ease of use-which are extensively used in many different technology adoption models. Moreover, Venkatesh and Morris (2000) and Venkatesh et al. (2003) argued that TAM is one of the most robust and influential theories used by many researchers after its introduction in the IS field. Furthermore, TAM has been extensively replicated in different studies which provide the validity for its predication on technology adoption (Venkatesh et al. 2003). The modified and extended TAM model has been used in many different technology adoption and use studies such as Internet; intranet; wireless networking technologies; online business and purchase using internet; e-learning; and cloud application (Behrend et al. 2011; Chang 2004; Eid 2010; Giovanis, Binioris & Polychronopoulos 2012; Lee & Kim 2009; Lu et al. 2003; Shih 2004; Tarhini, Hone & Liu 2013). However, it has been argued that to utilize TAM in different domains and settings it has been modified and extended using subjective norms, behavioural controls, facilitating conditions, perceived entertainment, and perceived flexibility constructs (Anderson et al. 2002; Hung, Ku & Chang 2003).

Model of adoption of technology in the household (MATH)

To date, application of these previously discussed technology adoption models is limited in the study of technology adoption from the household perspective (Brown, Venkatesh & Hoehle 2015; Irani, Dwivedi & Williams 2009; Venkatesh & Brown 2001). MATH is based on the principle of TPB and is composed of constructs particularly suited to evaluate the usefulness of technology for household purposes (Brown, Venkatesh & Bala 2006). According to the MATH model, technology adoption in households is determined by a number of factors classified as attitudinal beliefs, normative beliefs, and control beliefs (Venkatesh & Brown 2001). Attitudinal beliefs are those relating to utilitarian outcomes (i.e., applications for personal use, utility for children and utility for work-related use) or hedonic outcomes (applications for fun). Normative beliefs cover the influences of friends and family, workplace referents; and secondary sources such as television or newspapers. Control beliefs classically refer to the perceived ease of use, requisite knowledge or self-efficacy, fear of technological advances, and costs. All of these factors are assumed to have an impact on behavioural intention (BI) to use a technology. The majority of the constructs included in this model are also useful to study broadband adoption and use in the context of rural communities.

The following section provides the selected theory for broadband ecosystem component-demand (adoption and use)-for this study in the context of rural communities.

2.3.4 **Potential guiding theory for broadband adoption and use study**

According to Taylor and Todd (1995), there are two main criteria when selecting an appropriate model. First, a model that provides good predictions while using the fewest predictors is preferable; in other words, it is more parsimonious (Bagozzi, Davis & Warshaw 1992; Taylor & Todd 1995). Second, the model should provide reasonable predictive ability and should also contribute enough in providing an understanding of the phenomenon under investigation (Taylor & Todd 1995). Accordingly, this study has selected the second criteria suggested by Taylor and Todd (1995) because this study aims to provide adoption- predicative ability and use to contribute to the understanding of the phenomenon under investigation.

Section 2.3.3 described a number of technology adoption theories such as TRA, TPB and TAM that are widely applied in different technologies and contexts (individual or organization). However, Venkatesh and Brown (2001) argued that these studies are limited in terms of household context. Venkatesh and Brown's (2001) MATH model was successfully applied in the household context in order to examine PC adoption in the United States. Choudrie and Dwivedi (2006) considered the MATH model in their study of broadband adoption in UK households; and further suggested that the MATH model (2001) is specially designed for technology adoption in households and is an appropriate model for the study of household technology adoption and use.

Based on an extensive review of technology adoption models and diffusion theories, and as the household is the context for this study, MATH and TAM models are suitable theoretical models to guide the assessment of adoption and use of the broadband component of the broadband ecosystem for this study.

2.3.5 Broadband benefits of social connectivity – social capital

Broadband Internet is a critical infrastructure for connecting individuals and communities to create opportunities. Broadband Internet can facilitate communication and connection with family members, friends, relatives and broader communities both in online and offline environments, as well as a being a source for entertainment and social engagement (Bauernschuster, Falck & Woessmann 2014; Sherman & Waterman 2016). Moreover, broadband Internet helps individuals to reach beyond their close ties and harness its power to reach weak ties for resources that enhance both their economic and social connections and development (Townsend et al. 2013). Collectively, broadband Internet has the power to enhance an individual's information and knowledge sharing, which could improve collaboration and empower their participation in economic and social life by sharing and using resources to support each other in communities (Neves 2013). The use of Broadband Internet to connect with family, friends and communities online and offline to build and maintain social capital can be measured empirically.

Despite the lack of consensus on a precise definition, the term 'social capital' is extensively accepted and used as a multidimensional concept (Warburton, Cowan & Bathgate 2013). An extensive review of literature shows that researchers have defined the construct of social capital in terms of social networks, trust, civic engagement, life satisfaction and other concepts (Bourdieu 1985; Coleman 1988; Lin 2002; Putnam 2001). Putnam (2001, p. 19) compares social capital to "connecting among individuals – and social networks and the norms of reciprocity and trustworthiness that arise from them". Drawing on theory developed by Coleman (1988) and Bourdieu (1985), social capital is considered as a resource that may be used when it is shared to achieve a variety of ends. Moreover, the basic idea of social capital is, in simple terms, a resource available to access and use by individuals or groups of people through social interactions and communication among communities. The theory of social capital is based on two primary driving forces that account for most individuals' actions, and can be classified as expressive actions (bonding) and instrumental actions (bridging) (Lin 1999).

Social capital, in its two key dimensions-bonding social capital and bridging social capital-is found across a diversity of settings from informal to the most formal social arrangements. However, in defining social capital as a multidimensional concept, it is obvious that social capital is intangible and cannot be seen or touched. As such, social capital cannot be formed in isolation and, instead, is the product of people's association and communication with others. Individuals with a large and diverse network of contacts are thought to have more social capital than individuals with small or less diverse networks. Although people often generate social capital as a result of their daily communication and interaction with friends, colleagues and outsiders, people also potentially make a mindful investment in social interaction (Valenzuela, Park & Kee 2009). Moreover, communities with strong social capital have more access to novel information than communities with weak social capital (Bryant, Jackson & Smallwood 2006; Burt 1995; Granovetter 1973; Stubblefield et al. 2010). However, it must be noted that bonding and bridging social capital are distinct, but related, dimensions of social capital. Therefore, social capital bonding and bridging are important factors of social connectivity, which can be an outcome of the use of a general purpose technology such as broadband by households in rural communities.

Bonding social capital

Expressive actions which are representative of bonding social capital endeavour to maintain valued resources, and to preserve and defend resources already at an individual's disposal (Lin 2005; Stefanone, Kwon & Lackaff 2012; Williams & Durrance 2008). Bonding social capital is generated and shared by members of a relatively homogenous group which exhibit strong or close ties founded by shared values, accepted thoughts and social norms, such as families, relatives, friends or neighbourhood groups (Warburton, Cowan & Bathgate 2013; Woodhouse 2006). The resources that are available through one's strong ties correspond to bonding social capital. A typical expressive action that illustrates how bonding social capital can be maintained online would be to confide one feelings with a family member or friend via a social networking site. Bonding social capital provides personal, social and emotional support (e.g. look after someone when they are feeling unwell or sick), which plays a key role in maintaining close relations (Lin 2002). So bonding social capital helps to maintain the social capital that exists in communities. Hence, bonding social capital is about maintaining social capital that already exists in a community with close ties.

Bridging social capital

On the other hand, instrumental actions which are representative of bridging social capital seek to gain valued resources by promoting actions to gain resources not already at an individual's disposal (Lin 2005; Stefanone, Kwon & Lackaff 2012; Williams & Durrance 2008). Bridging social capital is generated and shared through interconnections between heterogeneous groups and more diverse groups. Consequently, bridging social capital allows individuals to access resources not available in their close social networks. Bridging social capital is useful to gain resources, for example, for instrumental actions such as finding a job (Lin 2002). Bridging social capital draws on outside or peripheral knowledge, resources and ideas that can help communities interconnect and build capital with other communities. Weak ties are more crosscutting than strong ties and present a lower level of homophile when compared with strong ties (Hampton 2011). There are different ways people could build bridging social capital. For example, with social media such as a Social Networking Site (SNS) (such as Facebook.), a user could share the non–redundant information (resources) on the SNS which could then be accessed by other SNS users and, similarly, one could access the information (resources) from other users (Utz & Muscanell 2015; Vitak 2014).

To conclude, bridging social capital helps build social capital beyond what already exists in communities by extending relationships beyond immediate family, friends and community to a broader set of connections and ties.

Broadband building and maintaining social capital

Boase et al. (2006) and Stern (2008) suggest that the Internet can be used to connect members of communities to each other and to other communities and support the positive relationships in community engagement. Others including Steinfield et al. (2009), Stern and Dillman (2006) and Valenzuela, Park and Kee (2009) support this notion within and outside an organization and society and show how organizations can also engage with communities using the Internet. Warburton, Cowan and Bathgate (2013) argued that Internet usage could help to build social capital in communities. Broadband Internet is critical for the web 2.0 technologies which underpin interactivity, connectivity and richness of content which make social media and social networking sites so attractive and persuasive (Donnelly 2010; Sivarajah, Irani & Weerakkody 2015).

The growth and usage of Broadband Internet access in rural Australia has risen in recent years (ABS 2016) and it could provide a significant opportunity for building and maintaining social capital in rural communities. However, most studies of determinants of social capital focus on use of different kind of social media particularly social networking sites and attention has been overwhelmingly centered on what the ICT can do to social capital (Chen 2013; Hodge et al. 2016; Salahuddin et al. 2015, 2016; Warburton, Cowan & Bathgate 2013). But less attention has been paid to the important role of broadband connectivity in rural communities to build and maintain bridging and bonding social capital (Hodge et al. 2016; Salahuddin et al. 2015, 2016). As a result of increased availability of broadband internet, rural communities would be able to access increased inclusive social opportunities and have improved connectedness; thus creating opportunities to build new social capital and to facilitate the maintenance of existing social capital in rural communities. This study addresses this issue by examining the effect of the use of the broadband Internet on social capital in rural communities. Applying this argument to the field of online communication, connection and engagement suggests that bonding and bridging social capital would be stronger and enhanced in rural communities through the use of broadband Internet.

2.4 RESEARCH GAPS IN THE LITERATURE

Li (2012) argues that limited studies have been conducted in the field of broadband Internet adoption and use particularly in Australia. Moreover, findings relating to adoption and use of broadband Internet are still limited and inconclusive, particularly in relation rural and regional Australia. Since the government realized the importance of internet, the general public and researchers have focused on the uses and benefits of broadband Internet in comparison to currently available broadband and other Internet services such as dial up, ADSL and HFC. However, majority of the literature on the study of broadband in Australia has largely only focused on technology side for rural communities (Given 2010; Islam, Selvadurai & Town 2008; Middleton & Park 2014) or adoption factors (Hill, Burgan & Troshani 2011). Most of the previous study conducted based on broadband technology and adoption but lacking on study of what is available or not. According to World Bank broadband ecosystem framework (2012) policy maker and analyst suggest that to adopt and promote the broadband, it was necessary to consider broadband as an ecosystem i.e supply, demand, use and its impact. On the supply side, the building of networks to carry broadband services is the top priority. But simply having a network available does not guarantee that broadband services will automatically be used. It will also be necessary for government policy and private sector investment to focus on driving demand for broadband services adoption. Therefore, supplier need to provide required infrastructure to use particular technology and if technology is there then demand would push to supplier to provide more services. So to more fully understand the broadband ecosystem and adoption this study conducted a broadband infrastructure audit (See Chapter Four for detail report) to determine the supply and availability of broadband before endeavouring to determine the factors driving broadband adoption in the study region.

Through this literature review number of different factors were identified in the three main aspects of the broadband ecosystem. These included the supply or availability of broadband, demand and use (utilitarian outcomes, hedonic outcomes, self-efficacy, experience and knowledge, purchase complexity, and perceived cost) and the social impact (bonding, bridging capital) have been identified as key factors influencing adoption of broadband Internet by households in rural and regional communities. The results of the empirical studies conducted on the adoption of broadband by households (Adams 2011; Brown & Venkatesh 2005; Dwivedi, Y. K., Choudrie, J. & Brinkman, W. P. 2006) are inconclusive in terms of the supply, demand, use and its impact. Moreover, there is lack of empirical studies which have considered the adoption of broadband Internet in rural and regional communities despite there being substantial empirical evidence over a long period of time that there is a digital divide between urban and rural and regional communities. Moreover, previous studies have done simple data analysis almost decade ago when just broadband has introduced with nation level data. Therefore, the findings of previous studies of broadband adoption should be carried forward with more comprehensive approaches that consider both the supply, demand, use and impact of broadband and utilise advanced and reliable statistical approaches such as structural equation modelling to provide a better understanding of the supply demand, use and impact of broadband in building and maintaining social capita rural and regional communities.

Moreover, one of the neglected area of previous studies is the purchase complexity of broadband services. Where due to lack of proper information and confusion of different services available households could not make a decision to adopt high – speed broadband (Adams 2011). On the other hand, there are few previous studies conducted on how Internet helps to develop social capital among communities but there is lack of empirical study on examined to what extent broadband Internet influence to build social capital in rural and remote communities (Mignone & Henley 2009). These are the justifications for conducting an empirical study for understanding of the broadband ecosystem in a rural context and, in particular, the relationship between the supply, demand, use and impact of broadband in building and maintaining social capital in rural communities.

2.5 RESEARCH QUESTION AND HYPOTHESIS DEVELOPMENT

The three research questions which provide the focus for this study are now developed and justified from the relevant literature.

Broadband access has become increasingly critical for day-to-day life and business activities. Broadband is now widely considered to be one of the key enablers and drivers for social and economic growth (Budde 2016; Hudson 2013; Touré 2014). Rural Australia could be directly affected if many rural communities are excluded from the potential benefits of accessing and utilising broadband infrastructure as a universal service. According to the 2014–15 Regional Telecommunications Review (RTR), individuals and businesses in rural communities have limited options in choosing a broadband provider; they typically have access to lower internet connection speeds, smaller data quotas, limited mobile broadband availability and generally higher prices for broadband services compared to their urban counterparts (RTIRC 2015). This ultimately impacts on effective use of digital services in rural Australia. Numerous previous studies have tended to focus on strategies for improving the impacts of broadband adoption and use at the macro level or national level including socio-economic development, developing broadband diffusion strategies and policy, and providing some technical solutions for rural broadband (Islam, Selvadurai & Town 2008; Middleton & Chang 2008; Stern et al. 2004). However, there has been a lack of in-depth empirical studies aimed specifically at rural Australia that have examined and investigating broadband infrastructure (supply) at the micro level (Lane, Tiwari & Alam 2016). The RTR 2014-15 study shows that there is a lack of broadband infrastructure in Australian rural communities (RTIRC 2015). Furthermore, a significant gap in the literature exists in terms of an in-depth study of the relationship between supply of broadband infrastructure and household adoption and use and the impact and perceived benefits of broadband services in rural Australia (Whitacre, Strover & Gallardo 2015). In general, it is argued that there is a lack of empirical studies on digital infrastructure, including broadband infrastructure (Bauer & Tsai 2014). Tilson, Lyytinen and Sørensen (2010) also highlighted that digital infrastructure research is an important but under-researched area. Therefore, the first aim of this research is to investigate the problems associated with broadband access in rural Australia by focusing on supply of broadband infrastructure in a rural area–Western Downs Region. Hence the following research question is investigated:

RQ1: What is the status (supply) of broadband infrastructure in WDR?

Middleton and Chang (2008) suggest that adoption and use of broadband Internet is based on its availability and user requirement. However, adoption and use of available broadband Internet is sometimes varied by individual attitudes and behaviour, determined by access, and ability to use through knowledge and experience of broadband access technologies (Park 2014; Thomas et al. 2016; Tsai & LaRose 2015). The literature suggest that a gap exists between those who adopt and use broadband Internet effectively and those who do not (Whitacre, Strover & Gallardo 2015). Scholars have conducted considerable research on adoption and use of broadband in different regions, but most of these studies were focused on macro or national level in Australia (Hill, Burgan & Troshani 2011; Majumdar, Carare & Chang 2010). Therefore, the second aim of this research is to investigate the key factors that determine the adoption and use of broadband Internet by rural Australian households—specifically attitudinal, and control belief constructs.

Hence, the following research question is investigated:

RQ2: What is the extent of adoption and use of broadband Internet services by households in WDR?

To fully address research question two, it is broken down into eight testable hypotheses. The proposed broadband Internet adoption and use model (see Figure 2-7) tested for this study within the overarching broadband ecosystem postulates that the intention to adopt and use broadband is determined by two types of constructs (Ahmed & Ward 2016; Ajzen 1991; Brown, Venkatesh & Hoehle 2015; Martins, Oliveira & Popovič 2014; Rogers 1995; Taylor & Todd 1995; Venkatesh & Brown 2001;

Venkatesh, Thong & Xu 2012). These are: (1) attitudinal constructs (utilitarian outcomes and hedonic outcomes) which represent the consumers' favourable or unfavourable evaluation of the behaviour in question (i.e. intention to adopt and use broadband Internet); and (2) control constructs (prior knowledge and experience, self-efficacy, and perceived cost) which represent the perceived control over the personal or external factors that may facilitate or constrain the behavioural performance (Ahmed & Ward 2016; Ajzen 1991; Brown, Venkatesh & Hoehle 2015; Hill, Burgan & Troshani 2011; Rogers 1995; Taylor & Todd 1995; Venkatesh & Brown 2001). These two categories of predictor variables are expected to determine and explain the decision to adopt and actually use broadband by households (Ahmed & Ward 2016; Ajzen 1991; Brown & Venkatesh 2005; Brown, Venkatesh & Bala 2006; Brown, Venkatesh & Hoehle 2015; Hill, Burgan & Troshani 2011; Rogers 1995; Taylor & Todd 1995; Venkatesh & Brown 2001). Apart from these variables, Ettlie and Penner-Hahn (1994) introduced the purchase complexity construct for technology adoption.

Furthermore, Brown, Venkatesh and Hoehle (2015) argued that if purchased technologies were used exclusively by individuals then the purchase decision could be made solely by individuals without consulting other household members. Purchasing technology in a household context is significantly different from an individual-level adoption context and the complex interactions and negotiations among household members, such as the decision-maker’s spouse or children, are expected to add significantly to the purchase decision complexity and can be influential in the decision outcome. Adams (2011) found that purchase complexity has a significant impact on adoption of broadband services. Brown, Venkatesh and Hoehle (2015) suggested that research on technology adoption should be extended to study the impact of purchase complexity on a household’s decision to adopt and use a technology. Therefore, this study also considered purchase complexity as a control construct for adoption and use of broadband Internet in the household context.

This study excluded the normative beliefs (such as social influence) from the adoption and use part of the broadband ecosystem framework because the researcher believes that most households have moved beyond the adoption phase into the use phase. Furthermore, Brown, Venkatesh and Bala (2006) in their study of household use of technology (PCs) found normative beliefs were non-significant. They argue that technology such as PCs, once considered a luxury item, have now moved from being a luxury to a necessity for most households. Similarly, broadband internet in the early days of its adoption was considered a luxury service by households but is now regarded as a necessity for the daily needs of a household (Anderson & Whalley 2015; Hoffman, Novak & Venkatesh 2004; Stenberg 2010).

The proposed adoption and use conceptual model postulates that the behavioural intention to adopt and use broadband Internet is determined by attitudinal beliefs and control beliefs, which are measured by six constructs in this research:

- Utilitarian outcomes
- Hedonic outcomes
- Self-efficacy
- Perceived cost
- Prior knowledge and experience
- Purchase complexity

Figure 2-7 shows the hypothesised relationships in the proposed broadband Internet adoption and use model for this study

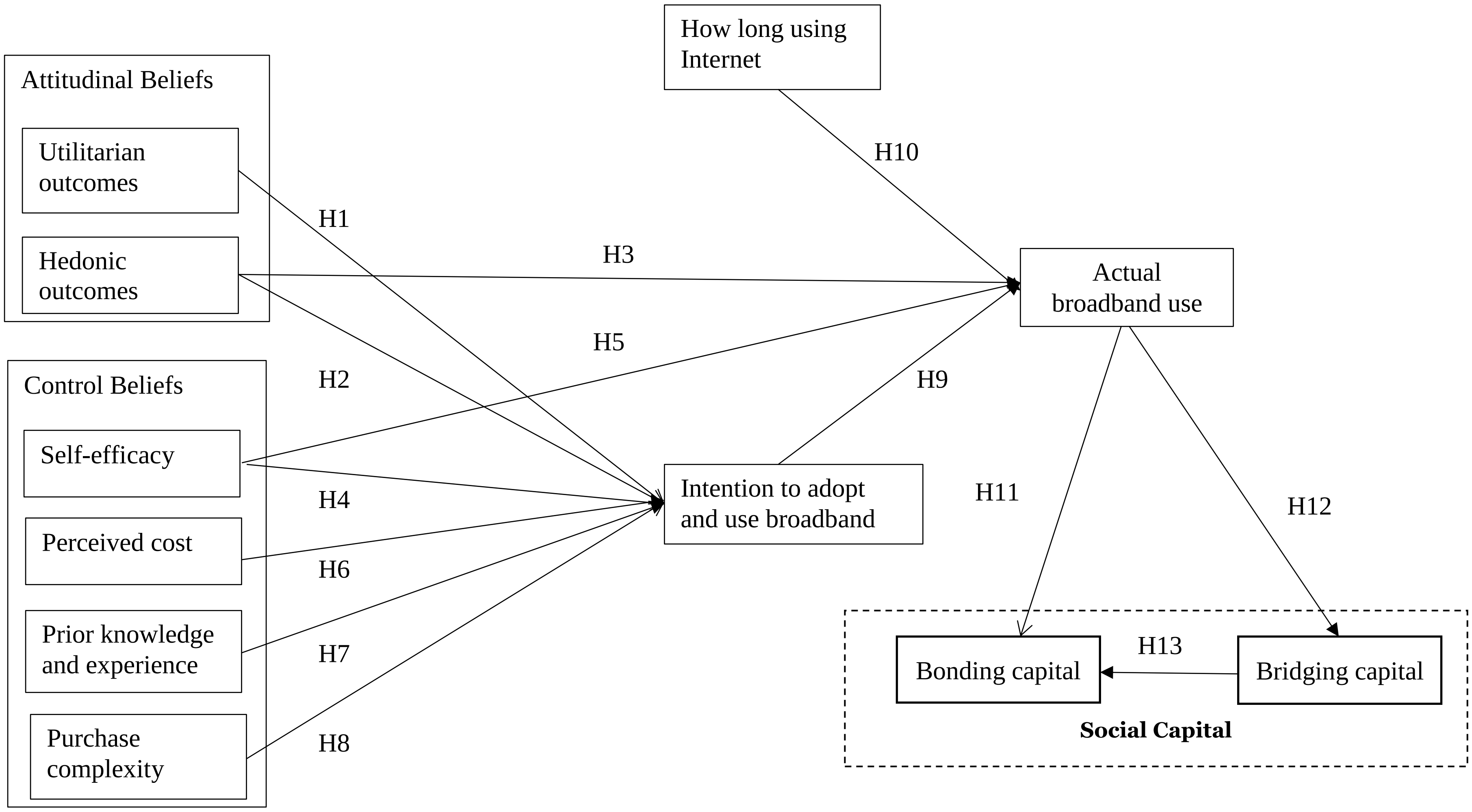

Figure 2-7**.** Broadband Internet adoption, use and impact model

Each of the proposed hypothesised relationships depicted in Figure 2-7 are now discussed and justified in relation to the relevant literature.

Utilitarian outcomes

Utilitarian outcomes is defined as the extent to which using a technology enhances the effectiveness of household activities, such as shopping, information seeking, budgeting, homework and work (Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009; Venkatesh & Brown 2001). Venkatesh and Brown (2001) and (Bruner & Kumar 2005) renamed perceived usefulness with the term *utilitarian outcomes* when examining the usefulness of technology in the context of household utility. Since this study examines usefulness of broadband in household contexts, the researcher adapted the term 'utilitarian outcomes'. The MATH and almost all follow-up studies have found utilitarian outcomes to be an important predictor of behavioural intention to adopt technology in a household and workplace environment (Brown, Venkatesh & Bala 2006; Brown, Venkatesh & Hoehle 2015; Hill, Troshani & Burgan 2014; Irani, Dwivedi & Williams 2009). It is expected that the greater the perception of broadband utility for work or household-related activities, the more likely that the broadband technology will be adopted and used in the home (Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009; Lurudusamy & Ramayah 2016). Hence, the literature supports the following hypothesis:

H1: Utilitarian outcomes will have a positive influence on intention to adopt and use broadband Internet.

Hedonic outcomes

Hedonic outcomes are defined as the pleasure, entertainment, fantasy or fun derived from the use or consumption of a technology in this study—broadband Internet (Brown & Venkatesh 2005; Gareeb & Naicker 2015; Hill, Troshani & Burgan 2014; Venkatesh & Brown 2001). Hedonic outcomes are related to satisfying user needs by means of perceived enjoyment such as entertainment from the use of broadband Internet, for example, streaming online radio, audio and video or online games (Arbore, Soscia & Bagozzi 2014; Chang, Liu & Chen 2014; Dwivedi, Selamat & Lal 2013; Hitt & Tambe 2007; Premkumar, Ramamurthy & Liu 2008). This means adopters use an innovation for their preference or enjoyment which helps them to adopt a technology (Hill, Burgan & Troshani 2011; Hill, Troshani & Burgan 2014). Considering broadband offers the opportunity to access a wide range of entertainment online, it is expected that households are likely to adopt the technology. Hence, the literature supports the following hypothesis:

H2: Hedonic outcomes will have a positive influence on intention to adopt and use broadband Internet.

Venkatesh and Brown (2001) and Brown and Venkatesh (2005) found that hedonic outcomes is one of the factors that influence actual PC adoption and use in households. The empirical findings of Venkatesh and Brown (2001), Choudrie and Vyas (2014) and Venkatesh, Thong and Xu (2012) established that, when adopting a technology, the role of entertainment (example online games, movies) was an important factor for consideration in the consumer decision-making process. Hence, broadband offers the opportunity for adults and children to play online games, download and watch movies, music and video, chat, and send online messages (Chang, Liu & Chen 2014; Moon & Kim 2001; Shin 2007, 2009). Considering broadband offers the opportunity to access a wide range of entertainment online, it is expected that households are likely to actually be using technology for hedonic outcomes rather merely an intention to adopt and use broadband Internet. Hence, the literature supports the following hypothesis:

H3: Hedonic outcomes will have a positive influence on actual broadband use.

Self-efficacy

Self-efficacy is an individual's belief and capability to be able to conduct a task (Hill, Burgan & Troshani 2011; Hill, Troshani & Burgan 2014; Lu et al. 2015). Many previous studies (Igbaria & Iivari 1995; Luarn & Lin 2005; Maillet, Mathieu & Sicotte 2015; McFarland & Hamilton 2006; Shiau & Chau 2016; Wang 2003; Wang et al. 2003) have identified that self-efficacy is an important factor in influencing technology adoption decisions (Irani, Dwivedi & Williams 2009). According to Hill, Burgan & Troshani (2011) and Tsai and LaRose (2015) self-efficacy is a major predictor of broadband adoption. Given that the use of broadband is likely to involve the use of a PC and the Internet, the perceived ease or difficulty of use and requisite knowledge of PCs and the Internet are also expected to have an impact upon broadband adoption (Irani, Dwivedi & Williams 2009). Indeed, Choudrie and Lee (2004) found that the South Korean Government's broadband promotion policies, such as training to use a computer and to improve Internet skills, increased the number of online users. In addition, users with self-capabilities for utilising a technology could be more likely to have an intention to adopt and use that technology (Alalwan et al. 2016; Tsai et al. 2015). Hence, the literature supports the following hypothesis:

H4: Self-efficacy will have a positive influence on intention to adopt and use broadband Internet.

Brown, Venkatesh and Hoehle (2015) indicated that self-efficacy is an important factor and predictor of household actual use of technology and the purchase decision-making process. Many studies suggest that to use the broadband requires the skills of using a computer or other digital devices (Dwivedi 2005). Solid knowledge and skills of using digital devices and the Internet were expected to have an impact upon actual broadband use. Choudrie and Lee (2004) and Shim (2013) findings suggest that government policy to support (training) households to use a computer and Internet was found to have boosted actual use of broadband Internet. Oh, Ahn and Kim (2003) suggest that a person with a higher level of self-efficacy for using the Internet is expected to higher actual broadband Internet use. Brown, Venkatesh and Hoehle (2015) findings also indicated that self-efficacy is an important factor that determines household actual technology adoption and use. Hence, the literature supports the following hypothesis:

H5: Self-efficacy will have a positive influence on actual broadband use.

Perceived cost

Perceived cost is defined as the extent to which an individual believes that using a particular technology will cost money (Phonthanukitithaworn, Sellitto & Fong 2015). In the context of household broadband adoption, perceived cost is described as the extent to which a household believes that using or subscribing to broadband Internet will cost money. Similar to the facilitating conditions described by Hill, Burgan and Troshani (2011), it also involves the beliefs about having the necessary resources and opportunities to adopt broadband at home (Hill, Burgan & Troshani 2011). Perceived cost can help adoption behaviour by removing obstacles to adoption and sustained usage (Larose et al. 2012; Venkatesh et al. 2003). Perceived cost is the behavioural control factor which refers to external controls and acts as a catalyst for adoption of new technologies (Hill, Burgan & Troshani 2011). It is, therefore, expected that if broadband services are affordable in terms of cost, or if financial assistance is available from government or telecommunication providers to make broadband more affordable, it is likely to influence households' adoption and use in rural and regional area. For example, Choudrie and Lee (2004) found that an affordable monthly cost for broadband was one of the most important factors that led to high rates of adoption in South Korea. Correspondingly, it can be argued that if the perceived cost of obtaining access to broadband services is high, then adoption rates will be low. A number of previous studies (Escobar-Rodríguez & Carvajal-Trujillo 2014; Hanafizadeh et al. 2014; Luarn & Lin 2005; Mathieson, Peacock & Chin 2001; Oh, Ahn & Kim 2003; Wu & Wang 2005) have evaluated the usefulness of this construct for explaining the behavioural intentions of users to adopt different forms of technology. Choudrie and Lee (2004) suggest that it is very important to understand the impact of cost on adoption of new technology. Further, Tsai and LaRose (2015) found cost was a significant predictor of the intention to adopt broadband. Hence, the literature supports the following hypothesis:

H6 Perceived cost negatively influences the intention to adopt and use broadband Internet.

Prior knowledge and experience

Prior knowledge is essential in comprehending a new technology such as broadband (Hill, Burgan & Troshani 2011). According to Rogers (2003), knowledge occurs when potential adopters learn about the existence of an innovation and gain some understanding concerning its functionality. Existing knowledge, in general, and analogical learning, in particular, has been shown to be a powerful factor in acquiring in-depth understanding of innovation benefits and functionality (Al-Qeisi et al. 2014; Moreau, Lehmann & Markman 2001; Roehm & Sternthal 2001; Yamauchi & Markman 2000). Hill, Burgan and Troshani (2011) found that prior knowledge is a predictor of adoption of broadband. Dwivedi, Alsudairi and Irani (2010) in their study of adoption broadband in UK households found that prior experience and education have an impact on adoption and suggest that prior knowledge and experience are factors that need further study. Hence, the literature supports the following hypothesis:

H7 Prior knowledge and experience will have a positive influence on intention to adopt and use broadband Internet.

Purchase complexity

Purchase complexity is often defined as the complexity of the buying decision or task under consideration (Brown, Venkatesh & Hoehle 2015; Lewin & Donthu 2005). While Rogers' (2003) DOI has complexity as one of its five key belief structures, it is specific to the use and understanding of the technology under study, rather than the complexity of the purchase decision which has emerged as a theme in the technology adoption literature (see Brown, Venkatesh & Hoehle 2015). Ajzen (1991), in relation to TPB, argued that purchase complexity is a subset of the broader concept of perceived behavioural control. A PhD study by Adams (2011) and a study by ACCC (2016) suggest that purchase complexity of broadband plans has a significant impact on households' decision to adopt broadband. Adams (2011) suggested that, in some cases, the complexity of the purchase decision was enough of a barrier to result in a decision not to purchase, despite having committed to the 'idea' of buying a particular technology. Hence, the literature supports the following hypothesis:

H8: A high level of purchase complexity will have a negative influence on intention to adopt and use broadband Internet.

Intention to adopt and use broadband

The majority of technology adoption and usage research has utilised behavioural intention (BI) and actual behaviour variables to predict the intention to adopt and use a technology (Ajzen 1991; Brown, Venkatesh & Hoehle 2015; Davis 1989; Hill, Troshani & Burgan 2014; Venkatesh & Brown 2001). TPB and findings from previous empirical studies suggest BI is a mediating variable between the predictors and actual behaviour. Therefore, BI is considered to have a direct influence on actual use (Ajzen 1991; Brown, Venkatesh & Hoehle 2015; Irani, Dwivedi & Williams 2009). Previous studies have reported a strong correlation between these control factors and behavioural attitude (Ajzen 1991). Findings from a number of technology adoption and usage studies within the IS field suggest intention to adopt and use behaviour is a good predictor of actual use or usage behaviour (Ajzen 1991; Drouard 2010; Hill, Troshani & Burgan 2014; Irani, Dwivedi & Williams 2009; Venkatesh & Brown 2001; Venkatesh & Davis 2000; Venkatesh & Morris 2000; Venkatesh et al. 2003). Consistent with and based on previous studies and the guiding theory, this study considered intention to adopt and use broadband could influence the actual use of broadband Internet. Hence, the literature supports the following hypothesis:

H9: Intention to use broadband Internet will have a positive influence on actual broadband use

Length of Internet use

Pew Internet reports on the broadband difference- how online Americans' behavior changes with high-speed Internet connections at home. The findings of this study suggest that users who have beenusing the Internet long term had higher frequency of Internet usage and online activities, which helps users to actually adopt and use high speed broadband Internet (Horrigan 2002). Similarly, Lurudusamy and Ramayah (2016) in their study of broadband Internet adoption and continuance usage in Malaysian household context found that there is a significant relation between the duration and frequency of Internet access and broadband use. Dwivedi (2007) suggests that using the Internet for a longer timeframe helps users to build trust in the technology and using the Internet will become habitual, therefore, the length of the time for which a user have using the Internet is likely to influence actual use of broadband Internet. Hence, the literature supports the following hypothesis:

H10: Length of Internet use will have a positive influence on actual broadband use

Building and maintaining Social Capital using broadband Internet

The Internet become a mainstream medium through which individuals can engage in everything from personal communication through to civic participation (Gil de Zúñiga, Jung & Valenzuela 2012). The Internet can serve as a vehicle for communication on formal (e.g., professional communication) and informal (e.g., emailing friends and family members) levels, as well as a source for entertainment and social activities (Quan-Haase & Wellman 2004). According to Warburton, Cowan and Bathgate (2013) broadband Internet access and usage provides a significant opportunity for building social capital in communities. Boase et al. (2006) and Stern (2008) suggest that the Internet can be used to connect communities to each other and support the positive relationships in community engagement using different Internet communication applications such as social media. Broadband Internet provides higher speeds of data transmission, and is facilitating the digitalization of the economy and digitally connecting society in general. Previous research has shown that the Internet can be used to connect local residents to each other and with organizations (Hodge et al. 2016; Stern 2008; Stern, Adams & Boase 2011). Other studies have built on this finding by exploring the relationship between community participation and degree of Internet usage (e.g., Simpson 2005; Stern & Dillman 2006), and show that Internet usage is positively related to community engagement and builds social capital (Bauernschuster, Falck & Woessmann 2014; Salahuddin et al. 2016; Stern & Adams 2010). Social capital is about networks, and broadband Internet use plays an important role in social effects such as connecting family, friends and community. There is a growing body of research that has established that there is a relationship between broadband Internet usage and social capital. Therefore, this study investigates the association between broadband access and usage, and building and maintaining social capital in rural communities. Hence, the following research question is investigated:

RQ3: To what extend does broadband Internet use by households help to build and maintain social capital in the WDR?

Research question 3 is broken down into two testable hypotheses, as shown in Figure 2.8

Broadband Internet provides the platform which supports the running of many communication applications and social networking sites which, in turn, can facilitate connecting community, family and friends either online and offline in a way that otherwise would be impossible (Andrade & Doolin 2016; Reach Out 2015). Broadband Internet seems to be a promising feature in the formation and maintenance of social ties due to the characteristics of the medium, namely, convenience, low entry cost, high speed, easy usage, always connected and ubiquity (Neves 2013). Stern and Adams (2010) indicated that some rural community members are using the Internet to build social capital. They found that some residents are using the Web to learn about local events and local groups (bonding) and these are the same people who connect to interests outside their local area (bridging). Their findings indicate that a community web site with local events information would be quite beneficial for connection and engagement within local communities (Stern & Adams 2010). Similarly, Best and Krueger (2006) suggest that the Internet helps bring people together who otherwise would not connect in the real world. Ellison, Steinfield and Lampe (2007) contend that there is a positive relationship between broadband internet services such as certain kinds of social media use and the maintenance and creation of social capital. Likewise, Neves (2012, 2015) and Salahuddin et al. (2016) found a positive relationship between social capital and Internet usage.

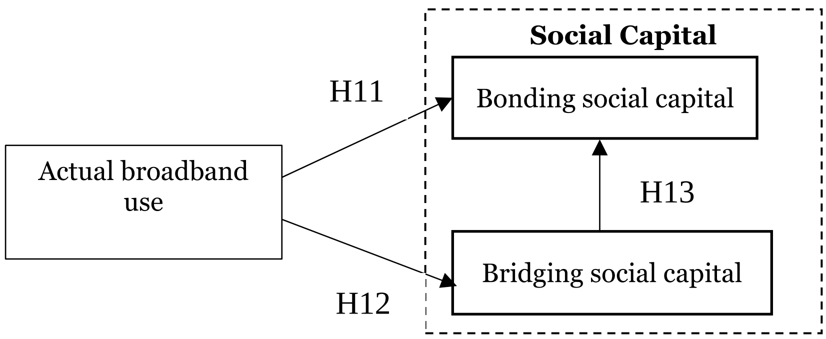

Figure 2-8 Actual broadband Internet use builds and maintains social capital in rural communities

As discussed in section 2.3.4, social capital can be represented by two-dimensions: bonding and bridging social capital. Bonding, which is also known as strong ties, is usually related to homogeneous and close-knit groups such as family, close friends or neighbourhood (Hampton 2011). Bonding social capital can be valuable for strong ties of the society to band together in groups and networks and support and share resources or information as their collective needs (Panth 2010). Strong ties tend to be the source of primary personal interaction and support (Hampton 2011; Haythornthwaite 2005; Neves 2012). Williams (2007) found that more bonding occurs offline than online, however, he found that time spent online was positively associated with higher levels and an increase of bonding. The analysis of bonding that occurs online gained more popularity with studies of social networking sites (Ahmad, Mustafa & Ullah 2016; Chang & Zhu 2012; Ellison et al. 2014) which found a positive relationship between SNS usage and maintaining bonding social capital. Further, Neves (2015) suggested that those who use the Internet more frequently are more likely to have a high level of bonding social capital. Hence, the literature supports the following hypothesis:

H11: Broadband use is positively associated with maintaining bonding social capital in rural communities

Bridging social capital is usually associated with and corresponds to more diverse and heterogeneous groups (Hampton 2011). Bridging social capital is mainly related to the resources potentially available in weak ties (Hampton 2011). These ties are more crosscutting than strong ties and provide access to different (and more varied) resources, such as information on job opportunities or other information that is not available in a close social network (Neves & Fonseca 2015). Neves and Fonseca (2015) found that there is a positive relationship between Internet usage and bridging social capital. Ellison, Steinfield and Lampe (2007) in their study of the relationship between the use of Facebook, a popular online social network site, and the formation and maintenance of social capital found a strong relationship between bridging social capital and SNS use. Similarly, Rice and Barman-Adhikari (2014) found a positive relationship between Internet applications such as E-mail and social networking websites which provide new opportunities for homeless youth in having an easier means to engage in the processes of bridging to other networks. Neves (2013) found that there is a strong relationship between broadband Internet use and bridging social capital. Hence, the literature supports the following hypothesis:

H12: Broadband use is positively associated with building bridging social capital in rural communities

According to Panth (2010) there is a relationship between bonding and bridging social capital, and these two forms of social capital can co-exist as long as they are in harmony and well-balanced. Further, Leonard and Bellamy (2010), also found moderate positive relationship exists between bridging and bonding social capital. Buettner and Debies-Carl (2012) found that there is a correlation between participation in bonding and bridging organizations/activities in their study of the ties that bind: bonding versus bridging social capital and college student party attendance. They suggest that people who start meeting regularly would develop close relations and build bonding social capital over time. He and Wang (2012) suggest that many online communications, social networking sites and online gaming sites are where people often meet online and over time become close friends. Further Hudson et al. (2015) finds that a long-term online virtual relationship on the Internet could, over time, become a close relationship and convert from bridging to bonding capital. Hence, the literature supports the following hypothesis:

H13: Bridging social capital will have positive influence on building bonding social capital in rural communities

2.6 CONCLUSION

This chapter conducted an extensive review of the relevant literature to frame and scope the research problem through the development of a conceptual framework, the broadband ecosystem and related theories. The development of three specific research questions and 13 testable hypotheses from the relevant literature provided the basis for empirical evaluation of the broadband ecosystem in a rural context. Some gaps in the literature were identified that relate particularly to broadband supply, adoption, use and impact on social connection (social capital) in rural communities. Building upon that, this research develops a theoretical and conceptual framework for approaching the research problem in terms of the specific research questions which address the gaps in the literature. Therefore, an appropriate framework for this study was an adaptation of the World Bank Broadband ecosystem which provided a comprehensive conceptual framework to guide this PhD study. The broadband ecosystem was discussed in terms of broadband supply, adoption and use and its impact in building and maintain social capital in rural communities. Finally, the research questions and hypotheses that provide answers to the key components of the general overarching research question of PhD study are specified and justified in the context of the existing literature. In the next chapter (Chapter Three), the research paradigm and methodology that guided the collection and analysis of data in this study in three phases to investigate three research questions and to test 13 hypotheses is described and justified.

Chapter 3: Research design and methodology

3.1 INTRODUCTION

The previous chapter reviewed the relevant research to provide a context and evaluation for the study on the key components of the broadband ecosystem, broadband infrastructure (supply), adoption and use of broadband Internet and its impact for building and maintaining social capital in rural communities. This chapter describes and justifies the research paradigm and methodological approach that was used in this study to investigate the relationship between broadband infrastructure supply and household adoption and use of broadband services in rural Australia; and to determine to what extent broadband use helps in building and maintaining social capital in rural communities. The research design guided collection, analysis and interpretation of data to investigate the three main research questions and 13 related hypotheses developed from the review of the literature in Chapter 2. Figure 3-1 presents an overview of the structure of this chapter.

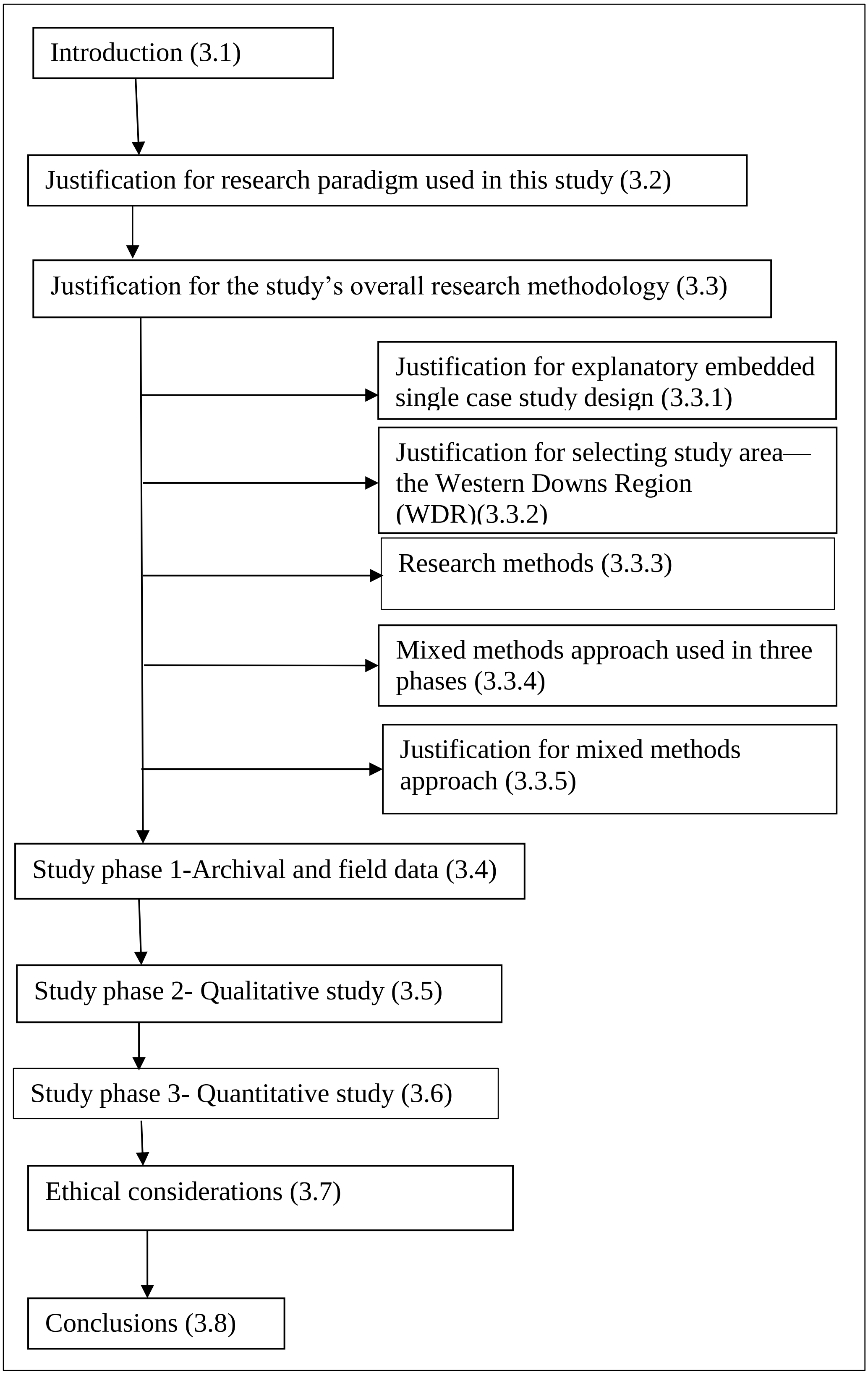

Figure 3-1 Outline of Chapter 3 with section numbers in brackets

3.2 JUSTIFICATION FOR RESEARCH PARADIGM USED IN THIS STUDY

According to Guba and Lincoln (1994, p. 107), a research paradigm is defined as ‘the basic belief system or worldview that guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways’. Guba and Lincoln (1994) discuss four different types of research paradigms in their study: positivism, critical realism, critical theory and constructivism. The key assumptions of these four paradigms are summarised as follows in Table 3-1:

Table 3-1 Four different research paradigms

Paradigms	Definition
Positivism	Driven by immutable natural laws and mechanisms, and apprehendable reality is assumed to exist
Critical realism	Reality is assumed to exist, but is only imperfectly understandable due to the ‘flawed human intellectual mechanisms and the fundamentally intractable nature of phenomena. This is also known as post-positivism.
Critical theory	A reality that is considered to be apprehendable, that was once plastic, but that was shaped by several factors (e.g., social, political and cultural) over time into a series of structures that are now taken as ‘real’.
Constructivism	Realities are apprehendable ‘in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature…and dependent for their form and content on the individual person or groups holding the constructions’.

Adapted from Guba and Lincoln (1994)

Guba and Lincoln (1994) suggest that to select a proper research paradigm for the study, it is best to understand and answer three key questions (see Table 3-2) that inform ontological, epistemological and methodological aspects of a study.

Table 3-2 Three dimensions of research paradigms

	Question	**Response in terms of this study**
Ontology	What is the form and nature of reality and what is there that can be known about it?	This study is based on the assumption of that real existence and these real actions are admissible but within limited capabilities of the human intellectual mechanisms.
Epistemology	What is the nature of the relationship between the respondents or participants and the inquirer, or what can be known?	In this study, there is a direct relationship between the researcher and participants. During the first phase of study secondary data and archival data are obtained through a content analysis of websites. During the second phase (interviewing process) a personal contact is established between researcher and participants. In the third phase, the quantitative surveys were delivered in person to potential survey respondents.
Methodology	How can the inquirer go about finding out whatever he or she believes can be known?	The three phase approach strengthens the validity of the key findings of this PhD study. Using multiple sources of data allowed the researcher to capture a richer picture and deeper understanding of the phenomena of study – broadband ecosystem in terms of infrastructure, adoption and use and its impact for improving social connectivity of households in rural communities by building and maintaining their social capital.

Adapted from Guba and Lincoln (1994)

A study adopting an interpretative approach suggests that there is no real world and people create labels and concepts to be used conveniently as tools to make sense out of the real world. Whereas, on the other side, a positivist study approach suggests that there is a real world external to the individual, and that objects are made up of hard and tangible structures. This is true even if the object is unknown to people and, thus, has not yet been labelled or perceived by people. In the positivist approach, reality is not something the individual creates, but something that already exists.

Ontology refers to the fundamental assumptions made about the primitive elements of reality, specifying what exists or what is the form and nature of reality and what can be known about it (Guba & Lincoln 1994). Ontological assumptions raise philosophical questions about reality, such as: is reality a product of individual subjective thinking and cognition or objective in nature? Is reality just the product of one's mind or is it a given in the world?

According to Cohen, Manion and Morrison (2013) epistemology is concerned with the nature and forms of knowledge. Epistemological assumptions are concerned with how knowledge can be created, acquired and communicated, in other words, what it means to know. Guba and Lincoln (1994) explain that epistemology asks the question, what is the nature of the relationship between reality and researcher?

Methodology is the strategy or plan of action which lies behind the choice and use of particular methods (Crotty 1998). Thus, methodology is concerned with why, what, from where, when and how data is collected and analysed (Scotland 2012). According to Guba and Lincoln (1994), methodology asks the question: how can the inquirer go about finding out whatever they believe can be known?

In this study, it is assumed that a complex reality exists that is observable with the limited capabilities of the human mind, that there is a direct relationship between the researcher and the research participants and that the three-phase research approach increases the external validity of this research. Thereby, 'critical realism' (post-positivism) is considered to be an appropriate research paradigm for this study. The critical realism paradigm recognises both subjective and objective views of reality (Dobson 2002) and abandons the need for multiple paradigms to accommodate both qualitative and quantitative research. This conclusion is supported by Venkatesh, Brown and Bala (2013) and suggests that critical realism is a particularly suitable paradigmatic choice for mixed methods approach in IS research because of the dynamic nature and contextual richness of the IS discipline.

3.3 JUSTIFICATION FOR THE STUDY'S OVERALL RESEARCH METHODOLOGY

The purpose of this study is to investigate

RQ1: What is the status (supply) of broadband infrastructure in the WDR?

RQ2: What is the extent of adoption and use of broadband Internet services by households in the WDR?

RQ3: To what extent does broadband Internet use by households help to build and maintain social capital in the WDR?

To achieve this purpose, an appropriate research methodology has been chosen and justification for selecting appropriate methods is discussed below:

3.3.1 Justification for explanatory embedded single case study design

According to Yin (2014) research design is the strategy of the researcher which guides the collection, analysis and interpretation of the data. The research design is a specific plan for selecting particular sources and types of data or information, and based on this information the researcher conducts the analysis and draws conclusions based on the research questions. According to Yin (2014) there are four different types of case study designs: (1) holistic-single case; (2) embedded-single case; (3) holistic-multiple case and (4) embedded-multiple case. If a single case study involves more than one unit of analysis then the research design is termed an embedded case study. However, if the case study examines only one unit of analysis, the research design is termed a holistic case study. For this research, an embedded single case study approach was considered appropriate for the objectives of this research. As an embedded case study, this study used two units of analysis: (1) broadband infrastructure in the WDR—evaluation of broadband infrastructure; and (2) WDR households—perceptions of broadband adoption, use and its impact. An embedded case study methodology provides a means of integrating quantitative and qualitative methods into a single research study (Scholz & Tietje, 2002; Yin 2003).

Furthermore, the two rationales for a single-case design as suggested by Yin (2014) were fulfilled by this study. First, this study represents a 'critical case' since it conducted a critical evaluation of the key components of an existing broadband ecosystem in a rural Australia context. This study also conducted a critical test of existing theory (i.e., Information Systems Success, MATH, TPB and Social Capital) that attempts to challenge and extend these specific theories (Yin 2014) in the context of a broadband ecosystem in rural Australia. Furthermore, the study setting of a rural region such as the WDR can be considered 'representative', as the research results are considered informative and generalizable to other rural regions in Australia (Yin 2014).

3.3.2 Justification for selecting study area—the Western Downs Region (WDR)

Three phases of data collection were conducted in this explanatory case study of the WDR to provide an in-depth analysis of its broadband ecosystem in terms of supply, adoption and use and its impact on rural communities. The sample population of this study were households residing across the WDR, which is considered representative of rural and remote regions of Australia. Rural and remote regions[2] were classified in this study based on ABS using the Australian Statistical Geography Standard (ASGS) (ABS 2011b) in which geographic boundaries are based on functional areas from which people access services (see chapter 1 section 1.2.1) (AIHW 2014). The researcher also selected the study sites of the WDR because this project is funded for the study of a digital future in rural and regional Australia. The USQ CRN project 2, in which this PhD research resides, was working with the WDR more broadly to assist them in developing their digital economy strategies during the data collection phase of this study.

In selecting the WDR for the study, the researcher compared other rural and remote councils from Queensland and other states and found most rural and remote councils in Australia have a similar population size, employment and living style characteristics. Furthermore, emerging from a collection of rural townships with their

[2] Details of classification are discussed in Chapter 1.

roots in agriculture, the WDR area has become a hive of activity and growth through continued agriculture, manufacturing and resources sector growth and diversification. The region is well-known as a rich agricultural area, growing crops and involved in meat production (WDR 2015). The economy of the WDR has continued to grow at an extensive pace in the last five years to 2014-15, where the annual growth rate of 6.3% is significantly higher than the annual overall growth rate for the State of Queensland (2.5%) over the same period of time (WDRC 2015). However, the region still experiences poor telecommunication services and infrastructure (mobile) in many locations, with many black-spots and poor coverage for both voice and data (internet) communications. In the WDR, there is a range of options available for telecommunications and Internet access such as Dial up, ADSL/ADSL2+, 3G/4G wireless and satellite. Therefore, the WDR is the appropriate site to conduct data collection to investigate the key factors determining adoption, use and impact of broadband Internet services by households in rural Australia. The next section discusses and provides justification for single case study design for this research.

3.3.3 Research methods

Methods are the research techniques used within the chosen methodological framework. It is important to realise the same method can be used from a different methodological perspective by researchers who view and understand the social world in alternative ways (Moses & Knutsen 2012) based on their research paradigm. The choice of methods needs to consider a range of factors including: whether the methods available are considered consistent with the guiding epistemological framework; what methods have been used by other researchers in key studies which inform the research; and whether the structure of the approach used will ensure the research questions are systematically addressed.

This research consists of three phases and methods of data collection, namely, archival (primarily quantitative), exploratory (primarily qualitative) and confirmatory (primarily quantitative). The following next sections discuss each of these three research phases in more detail.

3.3.4 Mixed methods approach used in three phases

The first phase of this study collected archival data and field data (quantitative) to evaluate the status of the broadband Internet infrastructure in the WDR and its relationship with adoption, use and impact of broadband in rural communities such as towns in the WDR. Archival data are any data that are collected prior to the beginning of the research study (Eisenhardt 1989; IRBSBS 2012). Sources of these data are: (1) government website Radio Frequency National Site Archive (RFNSA) (www.rfnsa.com.au); 2) social media website ADSL2 Exchanges (www.adsl2exchanges.com.au); and mobile app Open Signal (www.opensignal.com). For the purpose of this study, archival data and field data are collected for the evaluation of broadband infrastructure in the WDR. This first phase underpinned the second and third phases of this study where the adoption, use and impact of broadband is evaluated in the context of rural communities such as towns in the WDR with insight gained from an evaluation of the broadband infrastructure in phase one.

The second phase collected primarily qualitative data (exploratory) using semi-structured interviews with 25 purposively selected rural households. These semi-structured interviews provided a more holistic understanding of household adoption and use of broadband Internet and its impact on social capital in a rural setting; and were used to verify the constructs measuring broadband adoption and use constructs and social capital in the quantitative components of broadband ecosystem.

The third phase is confirmatory (primarily quantitative). After a content analysis of the interview data collected in the second phase, the researcher carefully modified the constructs measuring broadband adoption, use and social capital in the survey instrument. Then a refined survey instrument was tested in a pilot survey with 20 households to ensure that the constructs used had adequate face validity and the survey generally made sense to the targeted respondents/households (Kim, Shin & Grover 2010; Shin, Hwang & Choo 2013) in rural and remote Australia. Subsequently, a large-scale survey of 1500 households in the WDRC area was conducted with the final survey instrument. The third phase of this study collected primarily quantitative data based on a large-scale survey of households that is representative of rural and remote communities. The third phase aimed to validate the measurement model and test the hypothesized relationships regarding household adoption and use of broadband

Internet services and its impact in building and maintaining social capital model in the broadband ecosystem.

3.3.5 Justification for mixed methods approach

Traditionally, researchers in the IS discipline have tended not to use multiple research methods to collect data. However, more recently, a range of authors promote a mixed or combined approach to research design which crosses the traditional divide between the interpretivist and positivist schools of thought (Creswell & Clark 2007; Williamson 2004). Johnson and Onwuegbuzie (2004) promote the benefits of a multi-method approach saying, 'The bottom line is that research approaches should be mixed in ways that offer the best opportunities for answering important research questions' (p.16). Furthermore, Benbasat, Goldstein and Mead (1987) argue that multiple methods of data collection provide the opportunity for the triangulation of data, thereby offering greater support for the conclusions drawn when examining complex and real world problems. It has been noted that survey and fieldwork approaches are complementary for ICT research, as traditional survey work is strong in areas where field methods are weak (Attewell & Rule 1991; Gable 1994).

To answer the research questions addressing the research gaps identified by this study, neither a qualitative nor a quantitative approach alone is appropriate to achieve this objective. Mixing qualitative and quantitative research methodologies is useful in IS research and the mix 'can yield to a superior piece of research' as the strengths of both methodologies should complement each other (Gable 1994; Kaplan & Duchon 1988; Venkatesh, Brown & Bala 2013). Table 3-3 compares the relative strengths of the secondary archival data, semi-structured interview and survey methods.

Table 3-3 Summary of a comparison of the relative strengths of the secondary archival data, semi-structured interview and survey methods

	Secondary archival data	Semi-structured interview/Case study	Survey method
Controllability	Low	Low	Medium
Deductibility	Medium	Low	Medium
Repeatability	Medium	Low	Medium
Generalisability	High	Low	High
Discoverability (Explorability)	Medium	High	Medium
Representability	Medium	High	Medium

Adapted from Gable (1994, p. 3)

While a quantitative research setting (e.g., survey) can compensate for the weaknesses of secondary and interview-based research regarding aspects of controllability, deductibility, repeatability and generalisability, semi-structured interviews outperform survey research in terms of discoverability and representability (Gable 1994). Thus, it can be concluded that a mixed research methodology combines the relative strengths of secondary archival data analysis, semi-structured interviews and surveys and is thereby considered to be an appropriate approach to achieve the objectives of this study.

The complementary three-phased approach was used by this research with an archival data analysis, an exploratory (qualitative) and a confirmatory (quantitative) phase. A mixed methods approach using multiple sources of data allows the researcher to capture a richer picture and deeper understanding of the phenomena of study (Venkatesh, Brown & Bala 2012). For the purpose of this study archival data and field data are collected for the evaluation of broadband infrastructure in the WDR. Using a mixed methods (qualitative and quantitative) approach in the second and third research phase of this study allows the researcher to extended a qualitative phase theory and findings to inform the development of a quantitative instrument (Venkatesh, Brown & Bala 2012). This study used semi-structured interviews and a survey questionnaire as the tools for data collection from the households. The use of quantitative methods allows generalisations to be made about the broader population based on studying a random stratified sample of sufficient size (Bowling 2005).

3.4 STUDY PHASE 1-ARCHIVAL AND FIELD DATA

3.4.1 Phase 1- Broadband infrastructure data collections

The purpose of the first research phase was to collect publicly-available archival (primarily quantitative) data from the Radio Frequency National Site Archive (RFNSA) website (www.rfnsa.com.au); ADSL2 Exchanges social media website (www.adsl2exchanges.com.au); and quantitative field data from the Open Signal (www.opensignal.com) mobile app to determine and evaluate the status (supply) of broadband infrastructure in the WDR. To achieve this objective, archival (primarily quantitative) data and field data was considered appropriate for the first phase of data collection (Sarac & Almeroth 2000). The Community Tool Box (2016) point out that archival data are information specifically collected for bureaucratic procedures and the like—applications, reports, etc.—that can then be made usable for other purposes.

Radio Frequency National Site Archive (RFNSA)

The Radio Frequency National Site Archive (RFNSA) is a database that contains information on both carrier and non-carrier site data, including electromagnetic energy (EME) site safety documents. The RFSNA website provides the capability to search by a physical address to find current mobile base station sites (physical location of mobile phone towers) across Australia. These documents contain the mobile phone service provider and radio frequencies that are active for a mobile phone tower and proposed mobile phone service provider with proposed radio frequencies for each mobile phone towers.

The RFSNA website was used in this study to compile a spreadsheet of the exact location of each mobile phone tower in the WDR and then to map the coverage of mobile broadband and the mobile broadband services (2G, 3G, 4G) available across the WDR for the three mobile phone operators (Telstra, Optus, Vodafone). This approach also allowed the researcher to identify if any new mobile broadband services were being proposed for a particular mobile phone tower site. Postal codes of the WDR towns were used by the researcher to locate the mobile phone towers across the WDR listed in the RFNSA website.

The OpenSignal App

The OpenSignal app allows end users to test the real time connection performance of their mobile phone network provider, including speed and reliability. It also provides notification of nearby free Wifi hotspots and views of real-world coverage maps so that a user knows which mobile network offers the best coverage and performance in that area. The quality of information provided by Open Signal to a user in regards to mobile network services and mobile network coverage in a particular location is reliant on the number of users using the Open Signal mobile app in a particular location and agreeing to upload their mobile network connection data onto the Open Signal website.

This study used the Open signal mobile app to determine mobile broadband network coverage for a selected range of different sized towns (Dalby, Wandoan, Chinchilla, Bella, Tara and Moonie) across the WDR in real time in the field. The Open signal mobile app was specifically used to conduct testing of download and upload speeds of mobile broadband at different locations in the WDR in real time, together with assessing the strength and reliability of the mobile network radio signal. The Open Signal mobile app also helped the researcher to recognise the different types of mobile network services (2G, 3G, 4G etc.) offered by the mobile service provider in a particular location (towns across the WDR).

ADSL2-Exchanges

The ADSL2exchanges.com.au website provides information on coverage of ADSL services by population location across each of the towns in the WDR—information such as whether a telephone exchange is ADSL enabled and what types of ADSL services are available for different ADSL service providers. The ADSL2 exchanges website plots all telephone exchange locations for a particular population location such as a city, town or village onto Google Maps. This study used the ADSL2 exchanges website to determine ADSL/ADSL2+ services coverage for each of the towns in the WDR. The ADSL 2 exchanges website also helped the researcher collect other useful information, including types of equipment installed (ADSL or ADSL2+) in each telephone exchange, whether unused ADSL ports were available, broadband provider details and status of provider, estimation and time for new broadband providers to come on-board and what is available currently in that particular location. This information helped the researcher understand and evaluate the wired broadband infrastructure across the WDR in terms of its coverage and availability of different types of wired broadband (ADSL1, ADSL2+ etc.) services and possible speeds.

The RFNSA website, ADSL2Exchange website and Open Signal mobile app played an important role for building a complete picture and understanding of the broadband infrastructure in the WDR in terms of coverage, availability, possible speeds and reliability of wireless and wired broadband Internet services. One of the key outcomes of this phase 1 research approach was the construction of Table 4-24 in Chapter 4, Section 4.4.

Data analysis for archival data – Content analysis

Most of the data collected from archival data were in quantitative format and this information is stored in a spreadsheet with location name and status (supply) and type of broadband services in that location (see Table 4-24 in Chapter 4, Section 4.4). A content analysis of the RFNSA website and ADSL2 Exchange website was used to construct a summary description in a spreadsheet of each different type of broadband infrastructure across the towns in the WDR. Diagrams and tables were used to facilitate the description of the archival data and field data collected in phase 1. Field data from Open Signal mobile app allowed the researcher to download a time series report from a mobile phone which provides mobile network access activity including network service provider details, download and upload speeds, type of network service, location (latitude and longitude), date and time of testing and network signal strength for mobile broadband services. Based on field data, the researcher was able to identify the type of network service (such as 3G/4G) and their download and upload speed with signal strength across towns in the WDR.

3.5 STUDY PHASE 2- QUALITATIVE STUDY

3.5.1 Exploratory (qualitative) phase: semi- structured interviews

Semi-structured interviews were used to gather primarily qualitative information for this study to understand adoption and use behaviours and the impact of broadband Internet in Australian rural households. To achieve these research objectives (RQ2, RQ3), a qualitative research methodology was considered to be appropriate for the second phase of data collection (Yin 2003). Marshall (1996, p. 522) point out that the main aim of qualitative research is ‘to provide illumination and understanding of the complex psychosocial issues in the study and are most useful for answering humanistic 'why?' and 'how?' questions.’

The source of evidence for the second phase of this case study research was a series of semi-structured interviews conducted with the aim of providing a richer and deeper understanding of broadband infrastructure, adoption, use and its impact and to assess the theoretical basis (Information Systems Success, TPB, MATH and Social Capital) of the broadband ecosystem in the WDR. Semi-structured interviews were considered appropriate for this study because the researcher used a list of themes and open-ended questions related to the objective of the study, which helped the researcher to capture real and study-related information from the participant(s) of each interview.

Based on the data analysis of the second phase study the researcher is able to validate the findings that emerged from the analysis of the broadband infrastructure and further refine the proposed conceptual model and the survey instrument for the third phase (quantitative) data collection.

Interview protocol development

Based on the theoretical and conceptual model and three specific research questions developed from the literature review conducted in Chapter 2, the researcher designed an interview protocol for this study. The interview protocol consists of three parts. The first part contained general questions about Internet use by households such as who and for how long they are using the Internet, purpose of using the Internet, type of Internet connection, and devices used to access the Internet. The second part consisted of questions related to issues that have been identified in the literature, such as self-efficacy and digital literacy to adopt and use the Internet. Also included were questions about purchase complexity, cost to subscribe to the Internet, future planning and issues of broadband Internet in the region. The third part contained questions relating to demographics of respondents such as occupation, household type, household income, household age, gender and education. The full interview protocol is presented in Appendix C1.

Selection of households for interviews

To capture the real picture of household broadband adoption, use and its impact on social capital in rural communities in the WDR, this study conducted semi-structured interviews in 13 different localities in larger towns such as Dalby through to small towns of the WDR, such as Dulacca. This enabled the researcher to obtain a good cross section of households in terms of their relative remoteness. Details of interview locations and remoteness are presented in Table 3-4.

Table 3-4 Interview location and remoteness

Location	Number of Interviews	Remoteness Classification
Bell	3	Outer regional
Brigalow	1	Outer regional
Chinchilla	3	Outer regional
Condamine	1	Outer regional
Dalby	2	Inner regional
Drillham	1	Outer regional
Dulacca	1	Remote
Jandowae	4	Outer regional
Meandarra	2	Remote
Miles	2	Outer regional
Moonie	2	Remote
Tara	2	Outer regional
Wandoan	1	Remote
Total	25	
Number of Interviews for Inner regional = 2; Outer regional = 17; Remote = 6		

Source: this research

The interviewees were purposely selected across 13 towns and surrounding rural areas to provide a good representative cross-section of households and location remoteness in the WDR. This study has used quota sampling and convenience sampling approach to collect the interview data. Robinson (2014) suggest that quota sampling is a suitable sampling strategy for research requiring fixed numbers of cases in particular categories, quota sampling sets out minimum number of cases required for each one. Quota sampling is nonprobability technique and suggested equivalent of a stratified sampling approach. Like stratified sampling in quota sampling, the researcher first identifies the stratums and their proportions as they are represented in the population (StatPac 2017). Then this study used convenience sampling to select the required number of interview participants. Convenience sampling proceeds by way of locating any convenient cases who meet the required criteria and then selecting those who respond on a first-come-first-served basis until the sample size quotient is full (Robinson 2014). Given the relatively homogeneity of rural communities with respect to characteristics such as socioeconomic status, living conditions, availability of ICT, it seems reasonable to assume that data collected as described constitutes satisfactory estimates (Walvoort, Brus & De Gruijter 2010). The types of households participating in the interviews ranged from single person households through to couples with children living at home. Existing studies (Brown, Venkatesh & Bala 2006; Cameron 2004; Loncar, Fairbrother & Dalziel 2005) have shown the presence of children in the household makes the adoption of a technology more likely. Households participating in the interviews ranged from inner regional, outer regional to remote in terms of their location in the WDR.

Procedures for conducting the semi-structured interviews

According to Pierce and Scherra (2012) it is difficult to collect data from rural communities because of low population densities and the absence of household members during the day time due to work and other commitments. To overcome such difficulties to meet people and undertake the interviews, the researcher asked for an appropriate place for conducting the interview. For this study, most of the interviews were conducted face-to-face at the interview participant(s)' household. However, some of the interviews were conducted at the WDRC library or the WDRC community centre. Each interview was limited to one hour, allowing an average time of 5 minutes per question. Each interview was recorded using a digital audio recording device with the permission of the interview participant.

The semi-structured element of the interviews was used 'to ensure that all interviewees hear roughly the same questions in the same order' (Lindlof & Taylor 2010, p. 194). As some interviewees were not familiar with some of the terms used in the interview, explanations of key terms were provided to interviewees during each interview.

The researcher obtained an USQ Ethics Clearance from the USQ Ethics Committee to conduct the interviews. Interviewees were provided with a participant information sheet and a consent form to sign prior to the commencement of the interview. As part of the interview protocol, permission was sought in every interview to record the interview conversation using a digital audio recording. In addition, the researcher took hand-notes on important points made by the interview participants during the semi-structured interviews such as demographics of each household and any issues associated with the use of broadband Internet in local towns.

Criteria for judging quality of qualitative research semi-structured interviews

This section discusses how the second research phase of this study, semi-structured interviews (qualitative research), achieved quality of research design. A number of authors have clearly demonstrated that validity and reliability can be achieved in qualitative research (Bergman & Coxon 2005; Kitto, Chesters & Grbich 2008; Yin 2014). Lincoln and Guba (1985) proposed four criteria for judging the quality of qualitative research and these four concepts are discussed below, including how this study ensured the quality of the qualitative research conducted in 25 semi-structured interviews was achieved.

i) **Credibility**: Credibility is similar to internal validity in quantitative research (Hirschman 1986; Miles & Huberman 1994; Robson 1993) and is defined as the confidence that can be placed in the truth of the research findings and to take interviewees' responses into account. To achieve credibility, Lincoln and Guba (1985) suggest five techniques which make qualitative case study research more credible and these are: (1) triangulation; (2) peer debriefing; (3) self-monitoring; (4) member checking; and (5) prolonged engagement and persistent observations. This research used all of these five techniques to increase the credibility of the qualitative data.

Firstly, this research enhanced its credibility by using the triangulation techniques as discussed above in section 3.3.5 and detailing that this study used data collected via three different research methods (archival, interview and survey) (Denzin & Lincoln 1994). Secondly, peer debriefing was used to increase credibility during the data analysis phase (Lincoln & Guba 1985). The results and conclusions were discussed with supervisors and other experienced researchers within the University. This technique of peer debriefing was also achieved through regular research seminars, workshops and research colloquiums, as well as through regular discussions with principal and associate supervisors.

Thirdly, credibility of this research was increased through prolonged engagement with the case informants, allowing sufficient time to learn about the ‘culture, build trust and make preliminary contacts to minimise distortion of responses or unintended information’ for each case study interview (Davis 1995, p. 445). The researcher met the interviewees prior to conducting the interviews, to explain the purpose of the research, seek preliminary information about how the Internet is used in their households and to gain their overall confidence (Davis 1995, p. 445). Fourthly, member checking was conducted to establish the credibility of the qualitative inquiry in the semi-structured interviews conducted in the second phase of this study. In this process, the data records and reports of the inquirer are briefed to the members (Creswell & Miller 2000; Lincoln & Guba 1985). Lastly, the credibility of this research was further increased by the researcher’s self-monitoring, clarifying the researcher’s assumptions about his world view and theoretical orientation (Merriam 1988).

ii) **Transferability**: Transferability test is similar to testing the external validity of the quantitative research according to Lincoln and Guba (1985). Transferability is achieved when a critical evaluation of the findings to other similar contexts can be made and when these findings are relevant to current knowledge, policy, and practice (Kitto, Chesters & Grbich 2008). To address these issues of transferability this research provided a detailed description of how the single explanatory case study of the WDR was conducted, how the interview protocol was developed and refined prior to conducting the interviews and how content analysis was used to analyse the qualitative data collected during the semi-structured interviews.

iii) **Dependability**: Dependability test of qualitative research addresses the quality of qualitative research, similar to a reliability test in quantitative research (Miles & Huberman 1994). According to Miles and Huberman (1994), the dependability test attempts to indicate a consistent and stable construction of patterns and structures in the research inquiry process. To increase the dependability of the qualitative research, this study followed Lincoln and Guba (1985) suggestions: firstly, a draft copy of the interview protocol was reviewed and refined several times by the supervisors of this study. Two academic staff who are knowledgeable in qualitative research also reviewed the interview protocol and provided further input into the wording of the interview questions before the interview protocol was finalised. Secondly, the research findings from analysis of interview data were discussed with the PhD student's supervisors and other researchers to ensure consistency of interpretation of research findings. All of these processes helped the researcher to address the dependability of the analysis of the qualitative data collected in the semi-structured interviews and increased the quality of this study.

iv) **Confirmability**: According to Lincoln and Guba (1985), confirmability refers to the degree to which the results could be confirmed or corroborated by others. It is also defined as external reliability with the emphasis on the study being able to be replicated by others. This could be achieved by different kinds of strategies such as procedures for checking and rechecking the data throughout during the research study; colleagues or peers could have verified the results and procedures (Lincoln & Guba 1985). To ensure the confirmability of the findings of this research study, the researcher firstly discussed and reviewed the data analysis results and interpretation of the key findings with his supervisors. Secondly, the researcher published and presented the results of the data analysis and key findings at a number of conferences and in an international journal (see list of publications at the start of this PhD thesis), which enabled the researcher to receive additional review and feedback on results of data analysis and key findings. Thirdly, the researcher imported all the collected data during the interviews such as digital recording and hand-written interview notes into the case study database—which could allow other researchers future reference if required.

Data analysis for qualitative (interviews) – Content analysis

Interviewees' responses to the questions asked during the semi-structured interviews (qualitative) were recorded on a digital audio recorder and/or recorded as hand-written responses in the interview protocol. The digital recording of each household interview was transcribed into a Word document for content analysis. The interview question responses recorded as hand-written responses in the interview protocol for each interview were used to construct a spreadsheet table to summarise the interview participants' responses to the questions. Content analysis is commonly used as an analysis technique in qualitative research and this can be achieved using a thematic analysis or by utilising a computer software package such as NVivo (Kaefer, Roper & Sinha 2015; Leech & Onwuegbuzie 2011). As qualitative research requires an interpretative stance by the researcher it would be nearly impossible to purely automate the analyses of this data through the use of a software package such as NVivo (Flick 2002). Hence, in this case, a thematic analysis requires the researcher to actively analyse data for themes and categories, culminating in a conclusion about the meaning (Flick 2002). In this research, therefore, the semi-structured interview data was analysed both manually through a thematic analysis by the researcher and by a computer program, NVivo. In this research, codes were allocated through the thematic analysis by the researcher in the first instance and these codes were then used in Nvivo to analyse the qualitative data in more detail within and across each of the 25 interviews.

NVivo allows document storage and coding of key words, using judgement analysis and coding. This means that the analysis is under the control of the researcher (Pattinson, 2005). It assists with developing ranking of particular words, however, this can be quite labour intensive until the coding of themes and concepts is completed (Pattinson, 2005). The results of the qualitative data analysis of 25 semi-structured interviews of households are presented and discussed in Chapter 5.

3.6 STUDY PHASE 3- QUANTITATIVE STUDY

3.6.1 Quantitative data collection - survey

The survey was conducted with households in the WDR. The majority of the survey questionnaires were delivered in person where the purpose of the research was explained and the potential survey respondents were invited to participate in the survey; and the completed surveys were returned by postal mail at no charge to the survey respondents as the researcher provided an envelope with a prepaid postal address. Some survey questionnaires were given to Community Centres so that they could be passed on or distributed to households in that town (small town). The survey also could be completed online. The survey url link and a QR Code survey url link was provided in the participant information sheet, along with project details. The Western Down Regional Council also provided information about the survey on their website. The online version of survey was administrated using the survey tool, Qualtrics (www.qualtrics.com) (Qualtrics 2016). The majority of completed surveys were returned by Reply Paid postal mail. The survey was conducted across the entire WDR to enable the researcher to capture a broad representative sample of survey responses from inner regional, outer regional and remote towns and nearby areas.

According to Fowler (2013) there are three essential components of the survey research approach: instrument development, sampling and data collection. He suggested that it is necessary for a good survey design to combine all three components.

Survey questionnaire development

The survey questionnaire is composed of three parts. First part of the survey questionnaire requested general information of households relating to their broadband internet experiences and use. The second part of the survey questionnaire is related to constructs proposed in the adoption, use and impact components of the broadband ecosystem. The statements used to measure these constructs on a 7 point Likert scale are adopted from previous studies—with adjustments to the wording of these statements to improve relevancy to the identified problem and context of the study. The statements measuring these constructs have been used extensively in previous research and are shown in Table 3-5**.** The instruments measuring these constructs have previously demonstrated high reliability and validity, therefore, it is reasonable to reuse these instruments to measure these constructs in this study. The third part of the survey questionnaire comprised questions relating to demographics of respondents such as marital status, employment status, occupation, household types, household income, household age, gender and education, and digital literacy. Details of the survey questionnaire instrument items are presented in Appendix C2.

Table 3-5 Instrument measurement of constructs

Construct	**Source of instrument measuring construct**
Utilitarian outcomes	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
Hedonic outcomes	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
Self-efficacy	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
Perceived cost	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)

Construct	Source of instrument measuring construct
Prior knowledge and experience	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
Purchase complexity	(Adams 2011)
Behavioural intention to adopt broadband	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006)
Actual broadband use	(Tao 2009; Urbach & Müller 2012)
Social capital (Bonding and Bridging capital)	(Williams 2006)

Utilitarian outcomes

To measure the utilitarian outcomes, this study used four items and these were adapted from previous studies conducted by Irani, Dwivedi and Williams (2009), Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006) and Hill, Burgan and Troshani (2011). Table 3-6 presents the items used to measure the utilitarian outcomes construct.

Table 3-6 Items of utilitarian outcomes

Item	Item text	Scale	Source
UO1	Broadband internet can improve activities that my household undertake such as working from home.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
UO2	Having broadband internet supports my household activities e.g. online shopping.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
UO3	Broadband internet is useful for my household (such as bill payment, information search).	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
UO4	Broadband internet is useful for educational purposes in my household.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)

Hedonic outcomes

To measure the hedonic outcomes, this study incorporated five items using a 7-point Likert-type scale and these were composed by adapting statements from previous studies conducted by Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006) and Hill, Burgan and Troshani (2011). Table 3-7. presents the items used to measure the hedonic outcomes construct.

Table 3-7 Items of hedonic outcomes

Item	Item text	Scale	Source
HO1	My household enjoys using broadband internet to listen to music and download music.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
HO2	My household enjoys using broadband internet to watch movies and download movies.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)

HO3	My household enjoys using broadband internet to watch news and current affairs.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
HO4	My household enjoys using broadband internet to play online games and other entertainment.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
HO5	My household enjoys using broadband internet to play online gambling.	7-Likert	Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006)

Self-efficacy

To measure the self-efficacy construct, three items were composed by adapting items measuring self-efficacy from Irani, Dwivedi and Williams (2009), Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006) and Hill, Burgan and Troshani (2011). Table 3-8 presents the items used to measure the self-efficacy construct.

Table 3-8 Items of self-efficacy

Item	Item text	Scale	Source
SE1	My household feels comfortable using broadband internet without assistance.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
SE2	Learning to operate broadband internet is easy for my household.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
SE3	My household clearly understands how to use broadband internet.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)

Perceived cost

To measure the perceived cost construct, five items were composed—with four of the items being adapted from Irani, Dwivedi and Williams (2009), Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006) and Hill, Burgan and Troshani (2011); with one additional new item to measure this construct. Table 3-9 presents the items used to measure the perceived cost construct.

Table 3-9 Items of perceived cost

Item	Item text	Scale	Source
PC1	My annual household income is enough to afford subscribing to broadband internet.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
PC 2	It is not too costly for my household to subscribe to broadband internet.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
PC 3	My household is able to subscribe to broadband internet.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)
PC 4	Broadband internet is not a priority in my household budget.	7-Likert	New
PC5	For my household, subscribing to broadband internet is quite expensive.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009)

Prior knowledge and experience

To measure the prior-knowledge and experience construct, four items were composed. Three of the items were adapted from Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006) and Hill, Burgan and Troshani (2011) and one item measuring this construct is new.

Table 3-10 presents the items used to measure the prior-knowledge and experience construct.

Table 3-10 Items of prior knowledge and experience

Item	Item text	Scale	Source
PKE1	My household does not have difficulty in justifying why using broadband internet may be beneficial.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)

PKE2	My household knows the difference between broadband internet and dial up/narrow-band Internet.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
PKE3	My household knows the benefits that broadband internet offers that cannot be obtained by dial-up/narrow-band.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006; Hill, Burgan & Troshani 2011)
PKE4	My household has the skills (or people who can help us) to use broadband internet for education/other opportunities.	7-Likert	New

Purchase complexity

To measure purchase complexity construct, three items were adapted from Adams (2011). Table 3-11 presents the items used to measure the purchase complexity construct.

Table 3-11 Items of Purchase complexity

Items	**Item text**	**Scale**	**Source**
PCOM1	My household is confused with the process of selecting a suitable broadband internet plan.	7-Likert	(Adams 2011)
PCOM2	Just thinking about shopping for a broadband internet service and having to decide on a particular plan is stressful.	7-Likert	(Adams 2011)
PCOM3	Searching for accurate and relevant information about service/plans of broadband internet is a frustrating process.	7-Likert	(Adams 2011)

Behavioural intention to adopt and use broadband

To measure behavioural intention to adopt and use broadband construct, five items were composed. Two were adapted from Dwivedi, Y. K., Choudrie, J. and Brinkman, W.-P. (2006); one item was adapted from Dwivedi (2005); and two items measuring this construct are new.

Table 3-12 presents the items used to measure the behavioural intention to adopt and use broadband construct.

Table 3-12 Items of behavioural intention to adopt and use broadband

Item	**Item text**	**Scale**	**Source**
BI1	My household intends to continue using broadband internet in the future.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006)

BI2	My household intends to continue using broadband internet for work, household and entertainment related activities.	7-Likert	(Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006)
BI3	My household is satisfied with our current broadband internet service and plan.	7-Likert	New
BI4	My household will upgrade or subscribe to high speed broadband internet (such as NBN) when it’s available.	7-Likert	New
BI5	My household will not continue using broadband internet in future.	7-Likert	(Dwivedi 2005)

Actual broadband use

To measure the actual broadband use construct, three items were adapted from Urbach and Müller (2012) and Tao (2009). Table 3-13 presents the items used to measure the actual broadband use construct.

Table 3-13 Items of actual broadband use

Item	Item text	Scale	Source
FOU1	How often does your household use broadband services each week?	7-point	(Tao 2009; Urbach & Müller 2012)
FOU2	How many hours per week does your household use broadband services?.	7-point	(Tao 2009; Urbach & Müller 2012)
FOU3	Overall, how often does your household use broadband services during each week?	7-Likert	(Tao 2009; Urbach & Müller 2012)

Social capital (Bonding and Bridging capital)

To measure bonding social capital construct, ten items were adapted from Williams (2006). .

Table 3-14 presents the items used to measure the bonding social capital construct.

Table 3-14 Items of bonding social capital

Item	Item text	Scale	Source
BOC1	There are several people online my household trust to help solve our problems.	7-Likert	(Williams 2006)
BOC2	There is someone online my household can turn to for advice about making very important decisions.	7-Likert	Williams 2006)
BOC3	There is no one online that my household would feel comfortable talking to about intimate personal problems.	7-Likert	Williams 2006)
BOC4	When someone in my household feels lonely, there are several people online we can talk to.	7-Likert	Williams 2006)
BOC5	If my household needed an emergency loan of $500, we know someone online we can turn to.	7-Likert	Williams 2006)
BOC6	The people, my household interact with online would put their reputation on the line for my household.	7-Likert	Williams 2006)

BOC7	The people my household interact with online would be good job references for my household.	7-Likert	Williams 2006)
BOC8	The people my household interact with online would share their last dollar with my household.	7-Likert	Williams 2006)
BOC9	My household does not know any people online well enough to get them to do anything important.	7-Likert	Williams 2006)
BOC10	The people my household interact with online would help my household fight an injustice.	7-Likert	Williams 2006)

To measure bridging social capital construct, ten items were adapted from Williams (2006).

Table 3-15 presents the items used to measure the bridging social capital construct.

Table 3-15 Items of bridging social capital

Item	**Item text**	**Scale**	**Source**
BRC1	Interacting with people online makes my household interested in things that happen outside of our town.	7-Likert	(Williams 2006)
BRC2	Interacting with people online makes my household want to try new things.	7-Likert	Williams 2006)
BRC3	Interacting with people online makes my household interested in what people unlike my household are thinking.	7-Likert	Williams 2006)
BRC4	Talking with people online makes my household curious about other places in the world.	7-Likert	Williams 2006)
BRC5	Interacting with people online makes my household feels like part of a larger community.	7-Likert	Williams 2006)
BRC6	Interacting with people online makes my household feels connected to the bigger picture.	7-Likert	Williams 2006)
BRC7	Interacting with people online reminds my household that everyone in the world is connected.	7-Likert	Williams 2006)
BRC8	My household is willing to spend time to support general online community activities.	7-Likert	Williams 2006)
BRC9	Interacting with people online gives my household new people to talk to.	7-Likert	Williams 2006)
BRC10	Online, my household comes in contact with new people all the time.	7-Likert	Williams 2006)

The next section describes the sampling approach used for the third phase of this study. Sampling is defined as the selection of a small subset of a population that is representative of the whole population (ABS 2015a). To achieve a representative sample, the researcher must use a technique that enables all of the population to have an equal chance of being selected as a potential respondent.

Research sample frame for survey

According to Zikmund et al. (2009), a number of decisions need to be made before a sample is obtained. Firstly, the targeted population needs to be specified. Targeted population for this study was estimated to be 10,951 occupied households in the WDR (as census ABS 2011a). For the study, 1,500 households were randomly selected from the different population centres in the WDR, using a stratified sampling approach (Explorable 2009). A similar study approach was followed by Kaplowitz, Hadlock and Levine (2004) and Davern et al. (2010) in a household survey. UN (2005) guidelines suggest that in low population areas it is better to use a simple stratified random selection method in order to gain a representative sample of the target population. This study selected 1,500 households using stratified random sampling to minimize sample error. This study selected the sample from six major towns in terms of population (Dalby, Chinchilla, Miles, Jandowae, Tara and Wandoan) and from small towns near to those larger towns, so each town was proportionally represented in terms of their population in the sample size selected for each town.

The expected number of survey respondents for this study was 300 (20%). According to Golob (2003), the required minimum number of case records for conducting structural equation modelling is 10 times the number of variables in the measurement model. Therefore, with nine variables in the measurement model this expected response rate was sufficient for conducting structural equation modelling.

Techniques used for analysis of quantitative survey data

The collected survey data was analysed using the statistical software packages IBM SPSS (SPSS 2013) and SmartPLS - Partial Least Squares Structural Equation Modeling (PLS-SEM) V3 (Ringle, Wende & Becker 2015). The reason for selecting the SPSS statistical package is that it facilitates the calculation of all essential statistics, such as exploratory data analysis using descriptive statistics. PLS-SEM is used to conduct confirmatory factor analysis and structural equation modelling analysis.

Survey instrument reliability and validity

To ensure that constructs measured by the survey instrument have sufficient stability and consistency, the items measuring each construct were tested for reliability and validity of the survey data—aspects which are discussed in the next section.

To establish and demonstrate rigour in the findings of positivist research, validity should be undertaken both prior to and after final data collection (Straub, Boudreau & Gefen 2004; Straub 1989). Straub, Boudreau and Gefen (2004) recommend that a survey instrument should be validated employing statistical techniques such as a reliability test in order to confirm the internal consistency of measures and factor analysis to confirm the content validity, and construct validity, including both convergent and discriminant validity (Straub, Boudreau & Gefen 2004; Straub 1989).

According to the recommended guidelines, a survey instrument possesses a high internal consistency (i.e. it is reliable) if the estimated Cronbach's alpha is above 0.70. Construct validity (both discriminant and convergent) exists if the latent root criterion (i.e. eigenvalue) is equal to or above 1, with a loading of at least 0.40; and no cross loading of items are above 0.40 (Straub, Boudreau & Gefen 2004).

Straub, Boudreau and Gefen (2004) suggested that if content is adapted from an existing instrument then there is less need to validate it; however, if there are changes made in an instrument then the adapted measures should be subjected to a rigorous validation process (Straub, Boudreau & Gefen 2004). The approach of developing and validating the quantitative survey instrument of this research is similar to previous studies that were focused upon the instrument development process such as Dwivedi, Choudrie and Brinkman (2006a), Hill, Burgan and Troshani (2011) and Moore and Benbasat (1991). The process and purpose for undertaking each stage is shown in Appendix C3.

Reliability

Reliability is considered to be a key aspect of instrument measurement. According to Leary (2011, p. 69), reliability refers to the 'consistency or dependability of measuring instrument'. Micheni, Lule and Muketha (2013) define reliability as the 'degree to which measurements are free from error and therefore yield consistent results on different occasions'. Using Smart- PLS software, this study first conducted the factor analysis which helps to determine reliability of construct items. Composite reliability (CR) and Cronbach's alpha scores are used to estimate the reliability of construct items.

Construct reliability (Composite reliability) (CR)

Construct reliability, which is also called composite reliability, is used to measure the reliability of all the observed variables that represent the construct. The main objective of calculating construct reliability is to test the internal consistency of the measures (Holmes-Smith 2011). The rule of thumb of construct reliability is 0.70 (Hair et al. 2010). However, Bagozzi and Yi (2012) suggest that a value less than 0.70 of construct reliability can be acceptable in some cases if the CFA or causal model achieved satisfactory fit.

Cronbach's alpha

Cronbach's alpha is the most common way to measure internal consistency or reliability (Cronbach 1951; Peter 1979; Sekaran 2003; van Zyl, Neudecker & Nel 2000). This is a test of the consistency of respondents' answers to all the items in a measure. To the degree that items are independent measures of the same concept, they will be correlated with one another (Sekaran 2003). The Cronbach's alpha for each construct was calculated to check the reliability of the scales. The calculation provided a baseline for the analysis of internal consistencies. The recommended level of Cronbach's alpha is 0.70, and 0.60 is acceptable for exploratory research (Hair Jr et al. 2006). George and Mallery (2013) suggested a rule of thumb for Cronbach's alpha: $\alpha > 0.9$ – excellent; $\alpha > 0.8$ – good; $\alpha > 0.7$ – acceptable; $\alpha > 0.6$ – questionable; $\alpha > 0.5$ – poor; and $\alpha < 0.5$ – unacceptable.

Validity

Validity is defined as the extent to which the data collected truly reflects the phenomenon being studied (Zikmund et al. 2012). Accordingly, validity means true and correct (Neuman 2009). Usually, business research faces difficulties about validity, specifically in the measurement of attitudes and behaviour, since there are always doubts about the true meanings of responses made in surveys, interviews and self-reporting of behaviour (Malhotra 2008; Veal 2005). In the context of Structural Equation Modeling (SEM) the measurement model is considered to be the first step in establishing and testing structural models. Thus, testing validity should be conducted before testing the structural model to assure that the items used to measure the constructs are valid. Testing the measurement model provides items to evaluate convergent and discriminant validity, and the structural model can be used to indicate nomological validity (Schumacker & Lomax 2004). Two types of validity are assessed in this study—convergent validity and discriminant validity.

Convergent validity

Convergent validity is considered to be one of the most important aspects in assessing instrument validity. This provides the validity relationship between the constructs and its observed variables (Schumacker & Lomax 2004). In other words, convergent validity proves that all the items (i.e. measured variables) are correctly measuring the designed construct (i.e. latent variable or unobserved variable). The factor loading is the measure used to assess the convergent validity, and this type of validity is achieved when the value of factor loading is significantly different from zero (Holmes-Smith 2011). The statistical significance of factor loading can be evaluated by the t-value (critical ratio) in PLS-SEM. According to Hair Jr et al. (2006), to achieve convergent validity the factor loading value should exceed 0.50 for each item of the construct.

Discriminant validity

Discriminant validity is another important test of the validity of the items in a survey instrument. Farrell (2010, p. 324) suggests that 'without discrimination validity researchers cannot be certain whether results confirming hypothesized structural paths are real or whether they are a result of statistical discrepancies'. To confirm the discriminant validity of constructs, this study assessed the convergent validity by evaluating the constructs in terms of average variance extracted (AVE). A better technique for testing discriminant validity is to compare the AVE for any two constructs with the square correlation between the two constructs (Hair Jr et al. 2006). To achieve discriminant validity, the AVE value for a specific construct should exceed the value of square correlation when compared with the other constructs (Hair Jr et al. 2006).

Partial Least Squares Structural Equation Modeling (PLS-SEM)

Partial Least Squares Structural Equation Modeling is chosen as the main method of quantitative analysis because of its capability to use bootstrapping and make adjustment for measurement error in the data (Hair Jr et al. 2006; Holmbeck 1997). The software package PLS SEM 3 was used to conduct the SEM analysis (Ringle, Wende & Becker 2015). In SEM, more than one dependent and independent variable can be tested at the same time. Moreover, SEM will show how the survey data fits the proposed research model. First, PLS-SEM was used to conduct confirmatory factor analysis to validate the measurement model; then SEM was used to test the hypothesised relationships in broadband adoption, use and impact component of the broadband ecosystem model using structural path analysis and to distinguish between direct, indirect and total effects (Ringle et al. 2016).

Partial Least Squares (PLS) is commonly used in the social sciences, especially in business research disciplines (Hair et al. 2012). More specifically, IS researchers have paid substantial attention to this technique due to its ability to model constructs in the case of small to medium sample sizes and to handle non-normality (Chin, Marcolin & Newsted 2003; Hair et al. 2012; Henseler & Chin 2010).

According to Hair et al. (2012), PLS-SEM performs confirmatory factor analysis including construct measurement, impact performance analysis, response based segmentation techniques, analysing moderating effects, non-liner effects, and hierarchical component tests. Another advantage of PLS-SEM is that it can perform factor analysis along with path analysis, and then these two methods using bootstrapping can be used to estimate significance (t-value) of each path (Gefen, Straub & Boudreau 2000).

Similarly, Strimmer and Boulesteix (2007) suggest that PLS works effectively with small sample sizes and contains a large number of variables items. PLS has a high computational, easy-to-implement and statistical efficiency; and is also flexible and versatile in dealing with the data analysis task. In addition to that, PLS provides indicators used to evaluate reliability and validity of the data, for instance, item reliability, convergent validity, and discriminant validity (Hulland 1999). Furthermore, Tenenhaus, Amato and Esposito Vinzi (2004) suggest that Goodness-of-Fit (GoF) can be evaluated in PLS. However, Henseler and Sarstedt (2013) argued that GoF does not represent a fit measure and should not be used for PLS path models. However, Henseler and Sarstedt (2013) added that GoF could be used in PLS multi-group analysis (PLS-MGA) for different data groups from the same PLS path model. R^2 values and standardized path coefficients are used to evaluate the relationships between the paths in the PLS model.

3.7 ETHICAL CONSIDERATIONS

As human participants are involved in this research project, ethical clearance was required before the actual research could commence so that ethical considerations were observed and accommodated in the research design (Miles, Huberman & Saldaña 2013; Neuman 2009). Research ethics refers to a code of conduct or expected social norm of behaviour that is adhered to while conducting research (Sekaran & Bougie 2009, p. 15). Ethical conduct should also be reflected in the behaviour of the researchers who conduct the investigation, the participants who provide the data, the analysts who evaluate the results and the presentation of the interpretation of the results and suggestions of alternative solutions. Thus, ethical behaviour should pervade each step of the research process including data collection, data analysis and reporting; and even dissemination of information on the Internet (Sekaran & Bougie 2009, p. 15). How the subjects are treated and how confidential information is safeguarded, are all guided by business ethics (Sekaran 2003; Sekaran & Bougie 2009).

For this study, the researcher followed the rules and regulations of USQ ethical clearance procedures. The researcher obtained ethical clearance to conduct this research from the Office of Research and Higher Degrees, University of Southern Queensland on 06 September, 2013, with approval number H13REA159 (Appendix C4). This research did not contain any potential risks for the participants in the interviews or for the respondents completing the survey questionnaire.

The researcher gained consent from all of the study's participants before conducting each the semi-structured interviews and gained consent from each respondent for his/her participation in this study before conducting the survey. The researcher carefully explained the purely academic intent of the research, its purpose, and the interest and benefit to households, community and policy makers. The researcher emphasised that the anonymity of each participant in this study was guaranteed. Even though some questions relate to personal information (e.g., gender, age, and income), participants were not required to give their name. To minimise potential risks, this study kept all data regarding personal information safe and used it only for this study. Thereby, all the information collected from the interviews and questionnaires was kept strictly confidential. Data are stored in the researcher's database and no other parties, except supervisors, have access to this information. It is used only for academic purposes and is presented in aggregate form. In addition, no undisguised information was given to a third party or made public.

3.8 CONCLUSION

This study used a post-positivist multi mixed-method research approach underpinned by the critical realism research paradigm to collect data regarding broadband supply, adoption, use and impact on social connection in the WDR in order to address the three research questions investigated and 9 related hypotheses. In this chapter, the archival data analysis, semi-structured interviews and survey instrument data collection and analysis and procedures were described and justified

The development of an interview protocol and case study database guided the conduct of 25 semi-structured interviews. A content analysis was used to analyse the primarily quantitative data collected in archival data analysis of the RFNSA website, ADSL2Exchange website and OpenSignal App Testing Results (ADSL2-Exchanges 2016; OpenSignal 2016; RFNSA 2016). A content analysis was also used to analyse the primarily qualitative data collected in the semi-structured interviews.

An existing broadband adoption and use survey instrument was adapted, pre-tested and pilot tested to ensure maximum validity and reliability. A description of the sampling plan was provided. The statistical software packages IBM SPSS V22 (2013) and SmartPLS - Partial Least Square Structural Equation Modelling (PLS-SEM) V3 (Ringle, Wende & Becker 2015) were used to analyse the primarily quantitative data collected in the survey. How this study was conducted in an ethical manner in adherence with the University of Southern Queensland ethical standards is explained with reference to research phase 2 (interviews of households) and research phase 3 (survey of households). In the next chapter, the results of the analysis of broadband infrastructure in the WDR is presented and discussed.

Chapter 4: Supply of broadband infrastructure: A case study of the WDR

4.1 INTRODUCTION

Chapter 3 described and justified the research paradigm and methodology used to collect and analyse the case study data. This chapter presents the results of a detailed analysis of the broadband infrastructure, the fixed wired and wireless telecommunications which currently underpin broadband infrastructure in the WDR in terms of current coverage and quality (reliability and speed). Figure 4-1 presents an overview of the structure of this chapter.

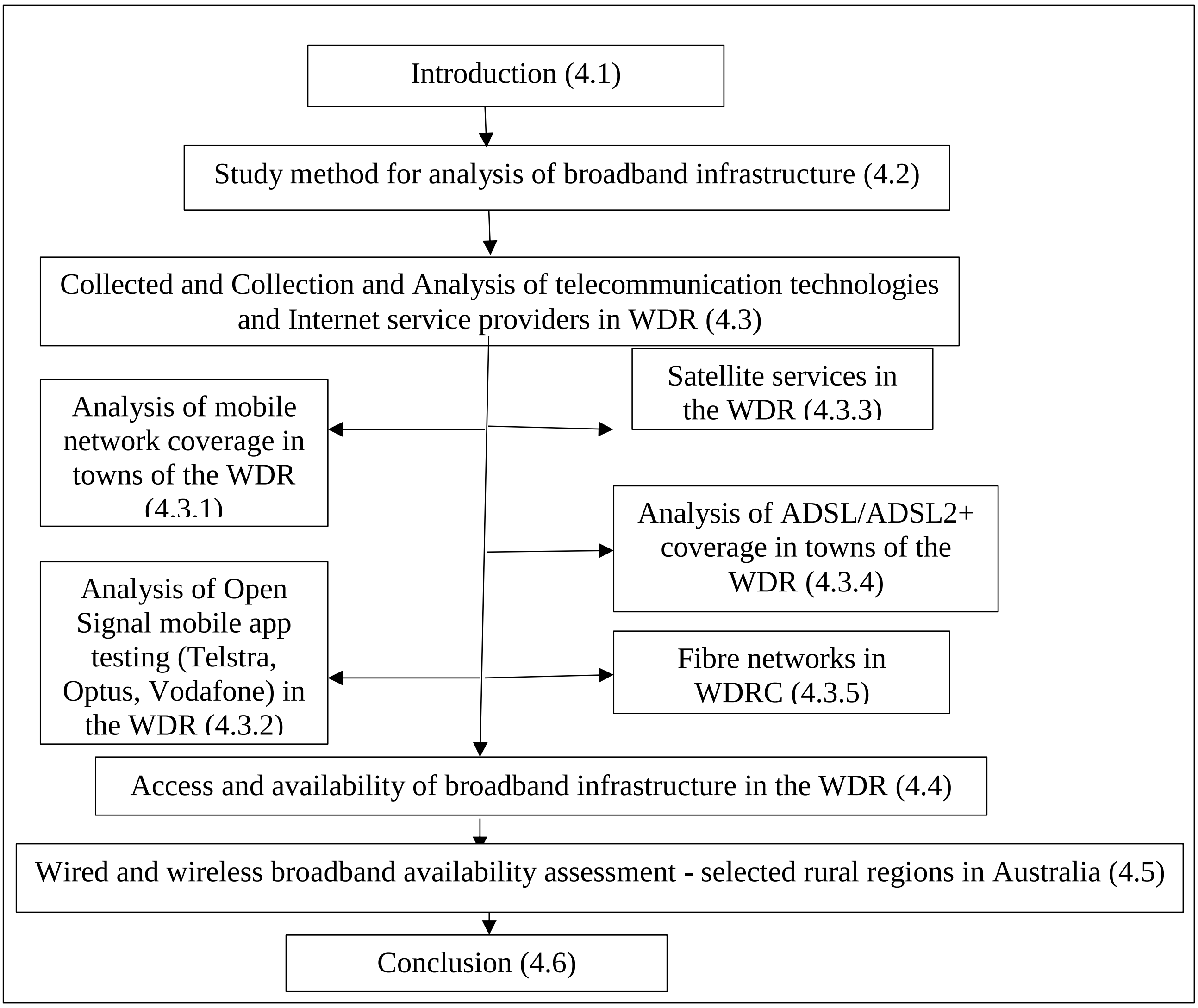

Figure 4-1 Outline of Chapter 4 with section numbers in brackets

4.2 STUDY METHOD FOR ANALYSIS OF BROADBAND INFRASTRUCTURE

The purpose of the first research phase was to collect publicly-available archival (primarily quantitative) data from the Radio Frequency National Site Archive (RFNSA) website (www.rfnsa.com.au), ADSL2 Exchanges social media website (www.adsl2exchanges.com.au) and quantitative field data from the Open Signal (www.opensignal.com) mobile app to determine and evaluate the status (supply) of broadband infrastructure in the WDR (RQ1).

4.3 COLLECTION AND ANALYSIS OF TELECOMMUNICATION TECHNOLOGIES AND INTERNET SERVICE PROVIDERS IN WDR

4.3.1 Analysis of mobile network coverage in towns of the WDR

An analysis of the data available in the RFNSA site regarding the mobile network towers for each of the three mobile network service providers is presented and discussed in this section for each of the towns in the WDR. For town a map is provided that indicates the particular location of individual mobile phone towers. Additionally, a summary table provides details of on the available mobile network infrastructure for each mobile network carrier with a presence in each town. This includes the location of mobile network towers and mobile network services available or proposed for each mobile network tower in terms of radio frequency bands and generation of mobile network service (2G, 3G, 4G). Each of these maps and tables were constructed based on data available from the RFNSA website.

Analysis of Dalby mobile network services coverage

Figure 4-2 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Dalby region and their specific physical location.

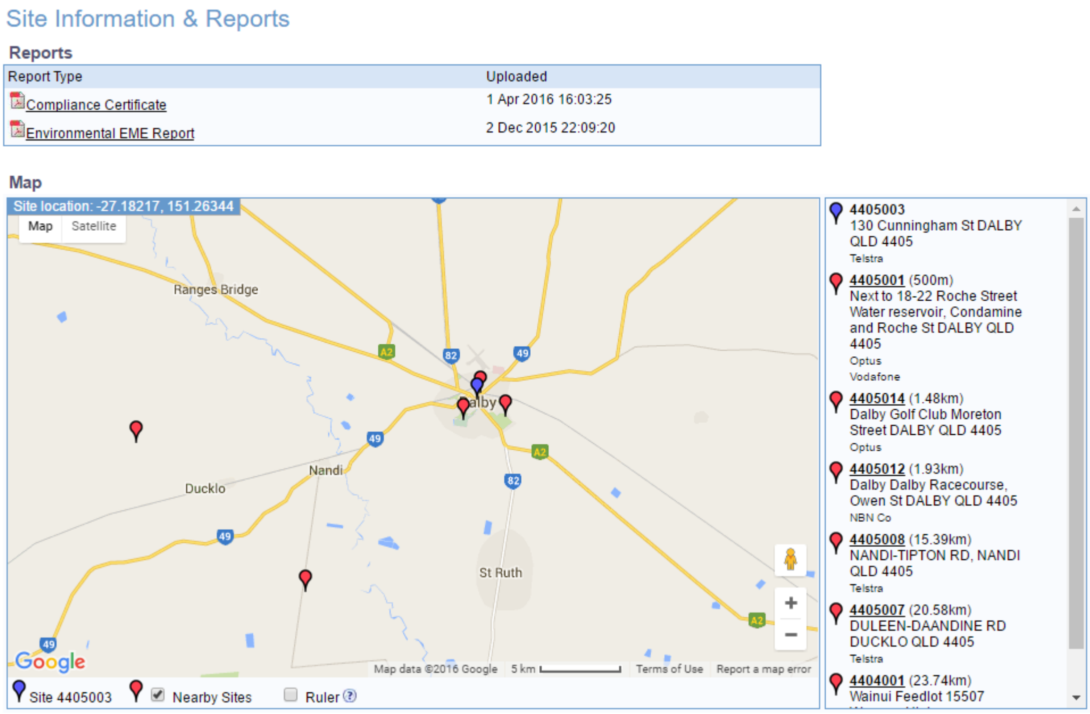

Figure 4-2 Mobile Carrier sites in Dalby, WDR

Source from RFNSA (2016)

Table 4-1 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Dalby in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-1 Summary of mobile network towers in Dalby

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
Dalby, Qld 4405	Optus	4405001	GSM900	2G	Active
			WCDMA900, WCDMA2100	3G	
			LTE700, LTE2600	4G	
	Vodafone		GSM900	2G	
			WCMDA900	3G	
			LTE850	4G	
	Telstra	4405003	GSM900	2G	
			WCMDA850, WCMDA2100	3G	
			LTE1800	4G	

Location	Carrier	Tower Site No	Mobile Network Radio Frequencies	Mobile Network Generation	Radio Frequency Status
		4405006, 4405007, 4405009, 4405010	No information on Base Radio systems	N/A	Unknown
	NBN Co	4405012	LTE2300	4G	Proposed
	Optus	4405014	WCDMA900, WCDMA2100	3G	
			LTE700, LTE2600	4G	

Source from RFNSA (2016)

Table 4-1 present the details of mobile network towers in Dalby where three different mobile network service providers, namely Telstra, Optus and Vodafone, are available and active. All three mobile network carriers have 2G, 3G and 4G network coverage in Dalby.

Moreover, NBN Co currently has a proposed site for a fixed wireless mobile network tower with a 4G LTE2300 mobile radio frequency system to provide NBN fixed wireless 4G network services in Dalby, but there is no indication when this will be available. The mobile network tower numbered (4405001) is shared by Optus and Vodafone. However, the rural areas surrounding Dalby are not well serviced by mobile network coverage. The search of the RFNSA website also identified a number of other Telstra mobile towers nearby Dalby, but they are inactive and there is no indication of their status (see shaded cells in Table 4-1).

Analysis of Chinchilla mobile network services coverage

Figure 4-3 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Chinchilla region and their specific physical location.

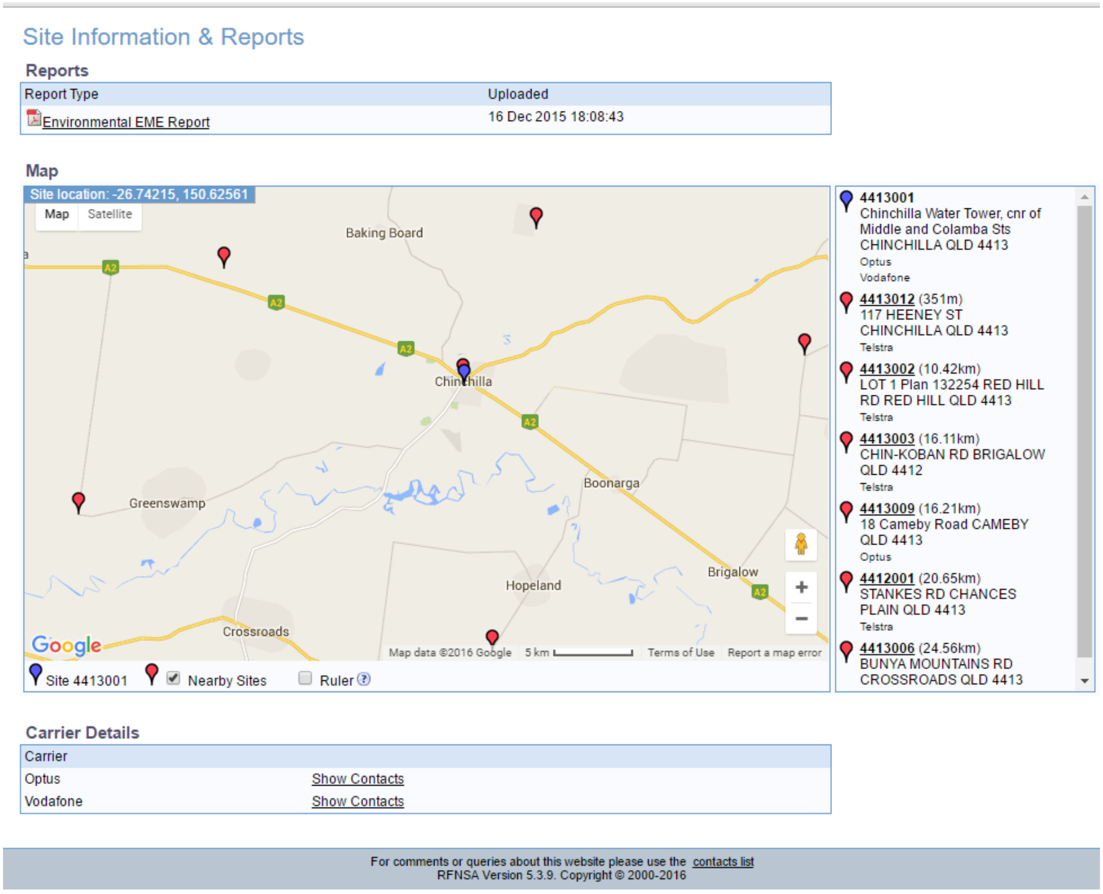

Figure 4-3 Mobile Carrier sites in Chinchilla, WDR

Source from RFNSA (2016)

Table 4-2 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Chinchilla in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-2 Summary of mobile network towers in Chinchilla

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
Chinchilla Qld, 4413	Optus	4413001	GSM900	2G	Active
			WCDMA900, WCDMA2100	3G	
			LTE700, LTE2600	4G	
	Vodafone		WCDMA900	3G	
			GSM900	2G	
	Telstra	4413003 4413004 4413006 4413007 4413008	No information on Base Radio systems	N/A	Unknown

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
		4413010 4413014			
	Optus	4413009	GSM900	2G	Active
			WCDMA900	3G	
			LTE700	4G	
	Telstra	4413012	GSM900	2G	
			WCDMA850 WCDMA2100	3G	
			LTE1800, LTE700	4G	
		4413013	WCDMA850	3G	
			LTE1800	4G	

Source from RFNSA (2016)

Table 4-2 presents the details of mobile network towers in Chinchilla where three different mobile network service providers namely Telstra, Optus and Vodafone are available and active. All of these mobile network carriers have 2G, 3G and 4G networks coverage in Chinchilla.

The mobile tower numbered 4413001 is shared by Optus and Vodafone. Moreover, the search of the RFNSA website found a number of other Telstra mobile towers nearby Chinchilla, but they are inactive and there is no indication of their status (see shaded cells in Table 4-2). Also, the rural areas surrounding Chinchilla are not well serviced by mobile network coverage.

Analysis of Miles mobile network services coverage

Figure 4-4 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Miles region and their specific physical location.

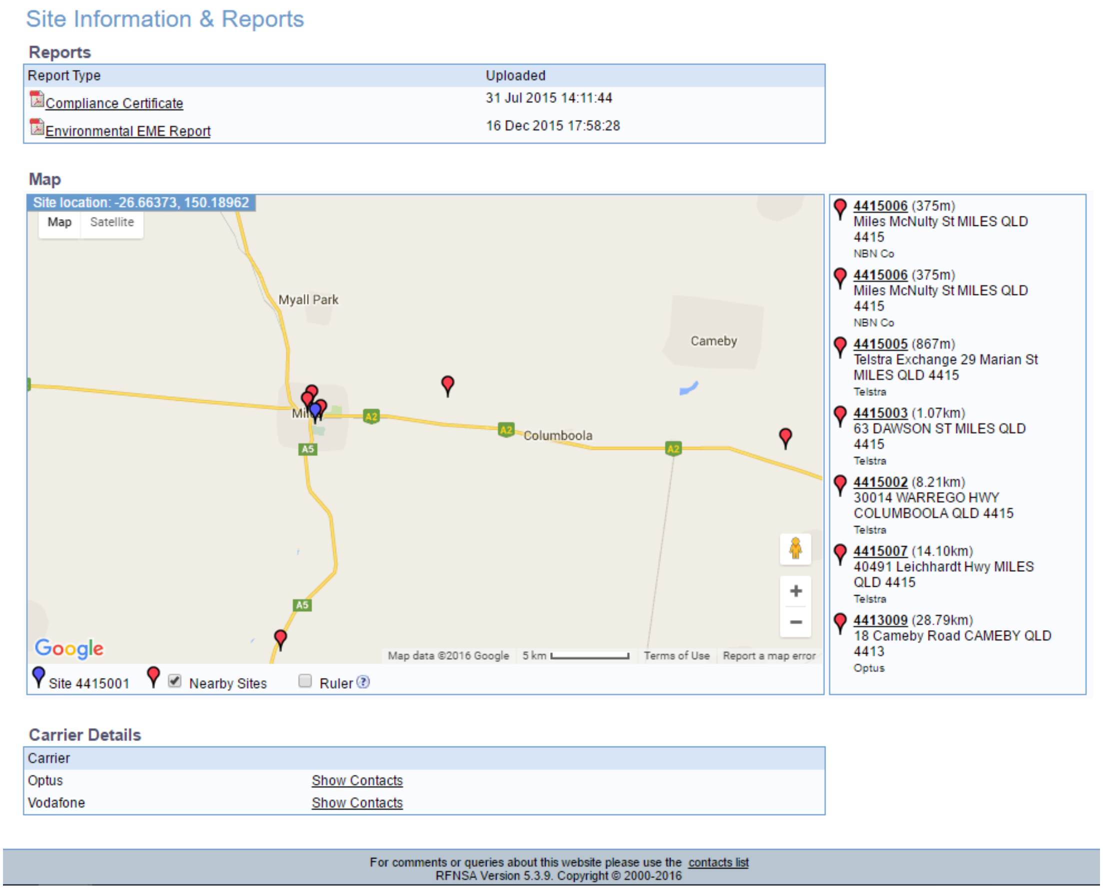

Figure 4-4 Mobile Carrier sites in Miles, WDR

Source from RFNSA (2016)

Table 4-3 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Miles in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-3 Summary of mobile network towers in Miles

<table>
<tr><th>Location</th><th>Carrier</th><th>Tower Site No</th><th>Mobile Network Radio Frequencies</th><th>Mobile Network Generation</th><th>Radio Frequency Status</th></tr>
<tr><td rowspan="9">Miles, Qld, 4415</td><td rowspan="3">Optus</td><td rowspan="6">4415001</td><td>GSM900</td><td>2G</td><td rowspan="8">Active</td></tr>
<tr><td>WCDMA900
WCDMA2100</td><td>3G</td></tr>
<tr><td>LTE700
LTE2600</td><td>4G</td></tr>
<tr><td rowspan="3">Vodafone</td><td>GSM900</td><td>2G</td></tr>
<tr><td>WCDMA900</td><td>3G</td></tr>
<tr><td>LTE850</td><td>4G</td></tr>
<tr><td rowspan="3">Telstra</td><td rowspan="3">4415002</td><td>GSM900</td><td>2G</td></tr>
<tr><td>WCDMA850</td><td>3G</td></tr>
<tr><td>LTE700</td><td>4G</td><td>Proposed</td></tr>
</table>

<table>
<tr><th>Location</th><th>Carrier</th><th>Tower Site No</th><th>Mobile Network Radio Frequencies</th><th>Mobile Network Generation</th><th>Radio Frequency Status</th></tr>
<tr><td rowspan="7"></td><td rowspan="4"></td><td rowspan="3">4415003</td><td>GSM900</td><td>2G</td><td rowspan="3">Active</td></tr>
<tr><td>WCDMA850</td><td>3G</td></tr>
<tr><td>LTE1800</td><td>4G</td></tr>
<tr><td>4415005</td><td>WCDMA850</td><td>3G</td><td>Proposed</td></tr>
<tr><td>NBN Co</td><td>4415006</td><td>LTE2300</td><td>4G</td><td>Proposed</td></tr>
<tr><td rowspan="2">Telstra</td><td rowspan="2">4415007</td><td>WCDMA850</td><td>3G</td><td rowspan="2">Active</td></tr>
<tr><td>LTE1800</td><td>4G</td></tr>
</table>

Table 4-3 presents the details of mobile network towers in Miles where three different mobile network service providers, namely Telstra, Optus and Vodafone are available and active. All of these mobile network carriers have 2G, 3G and 4G network coverage in Miles.

The mobile tower numbered 4415001 is shared by Optus and Vodafone. Telstra has currently proposed a 4G LTE700 and 3G WCDMA850 mobile radio frequency system in tower number 4415002 and 4415005 respectively. Moreover, NBN Co currently has a proposed site for a fixed wireless mobile network tower with a 4G LTE2300 mobile radio frequency system in Miles, but there is no indication when this will be available. However, similar to others towns in the WDR, rural areas surrounding Miles are not well serviced by mobile network coverage.

Analysis of Tara mobile network services coverage

Figure 4-5 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Tara region and their specific physical location.

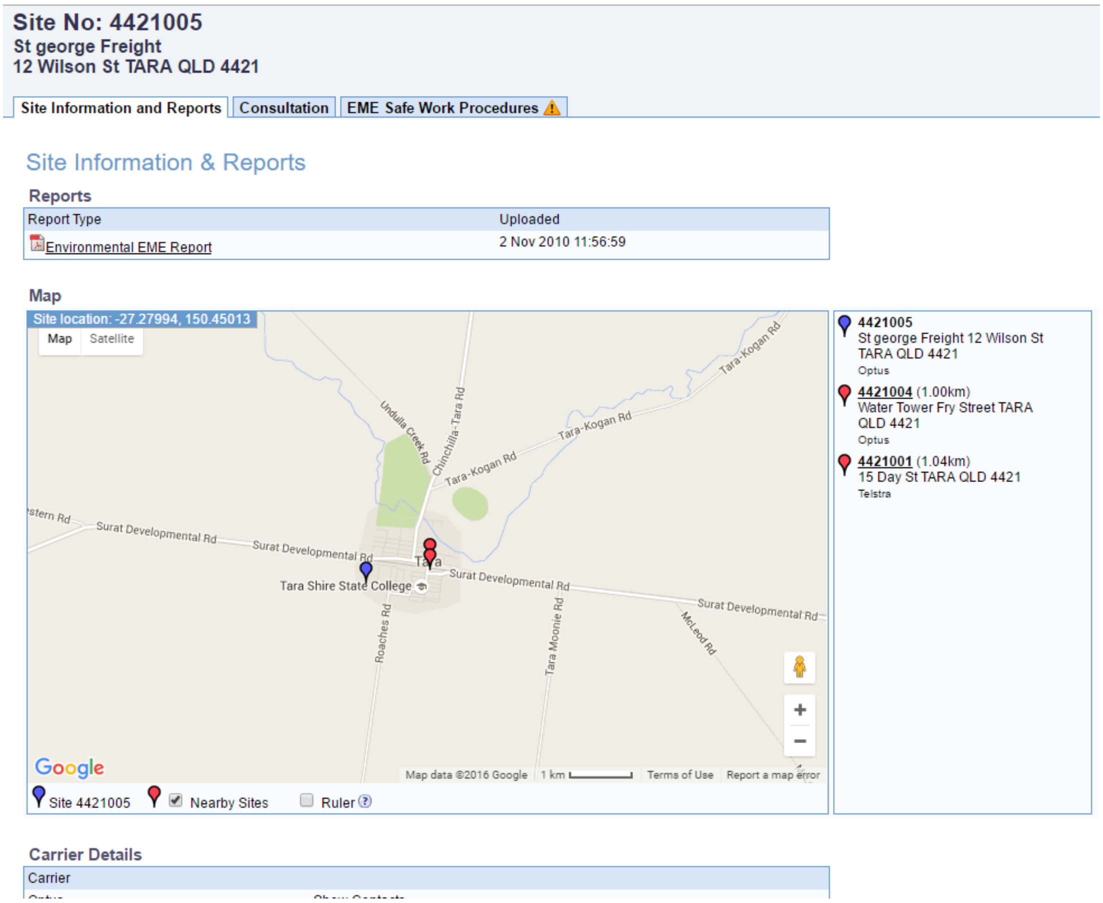

Figure 4-5 Mobile Carrier sites in Tara, WDR
Source from RFNSA (2016)

Table 4-4 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Tara in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-4 Summary of mobile network towers in Tara

Location	Carrier	Tower Site No	Mobile Network Radio Frequencies	Mobile Network Generation	Radio Frequency Status
Tara, Qld, 4421	Telstra	4421001	WCDMA850	3G	Active
		4421002			
		4421003	No information on Base Radio systems	N/A	Unknown
	Optus	4421004	GSM900	2G	Proposed
			UTMS900, UTMS2100	3G	
		4421005	GSM900	2G	
			WCDMA900, WCDMA2100	3G	
	Telstra	4413005	WCDMA850	3G	Active

			LTE700	4G	Proposed

Source from RFNSA (2016)

Table 4-4 present the details of mobile network towers in Tara where only Telstra 3G mobile network service is available. However, Optus network has proposed to install equipment for transmitting GSM900, UTMS900, UTMS2100, WCDMA900 and WCDMA2100 mobile radio frequency systems to provide 2G and 3G network services in Tara. Moreover, Telstra has proposed a 4G LTE700 mobile radio frequency system in tower number 4413005 in Tara in the near future. Again, there is no indication when these services would be available. Furthermore, the search of the RFNSA website found Telstra mobile tower number 4421003 nearby to Tara, but this is inactive and no indication of their status (see shaded cells in Table 4-4). Also, the rural areas surrounding Tara are not well serviced by mobile network coverage.

Analysis of Jandowae mobile network services coverage

Figure 4-6 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Jandowae region and their specific physical location.

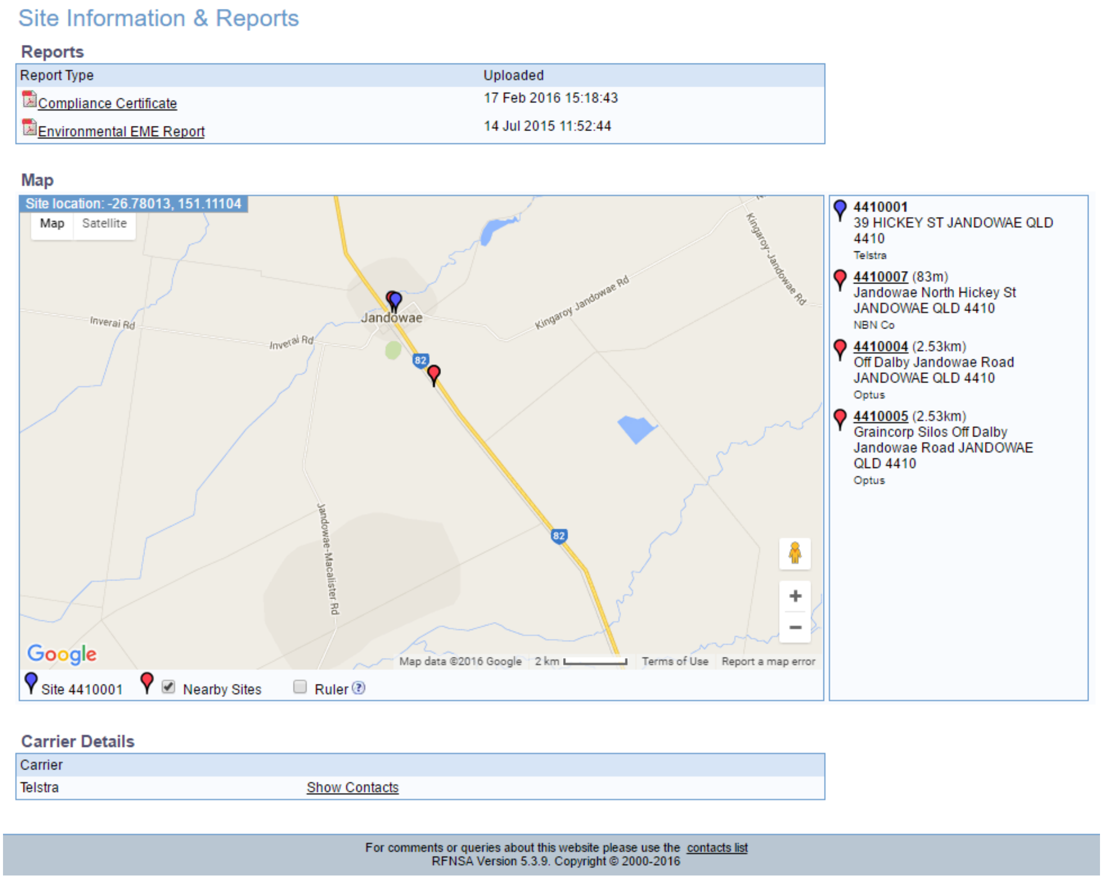

Figure 4-6 Mobile Carrier sites in Jandowae, WDR

Source from RFNSA (2016)

Table 4-5 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Jandowae in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-5 Summary of mobile network towers in Jandowae

<table>
<tr><th>Location</th><th>Carrier</th><th>Tower Site No</th><th>Mobile Network Radio Frequencies</th><th>Mobile Network Generation</th><th>Radio Frequency Status</th></tr>
<tr><td rowspan="10">Jandowae, Qld, 4410</td><td rowspan="4">Telstra</td><td rowspan="3">4410001</td><td>GSM900</td><td>2G</td><td rowspan="3">Active</td></tr>
<tr><td>WCDMA850</td><td>3G</td></tr>
<tr><td>LTE700
LTE1800</td><td>4G</td></tr>
<tr><td>4410002, 4410003</td><td>No information on Base Radio systems</td><td>N/A</td><td>Unknown</td></tr>
<tr><td rowspan="5">Optus</td><td rowspan="3">4410004</td><td>GSM900</td><td>2G</td><td rowspan="3">Proposed</td></tr>
<tr><td>WCDMA900</td><td rowspan="2">3G</td></tr>
<tr><td>WCDMA2100</td></tr>
<tr><td rowspan="2">4410005</td><td>WCDMA900</td><td>3G</td><td rowspan="2">Active</td></tr>
<tr><td>LTE700</td><td rowspan="2">4G</td></tr>
<tr><td>NBN Co</td><td>4410007</td><td>LTE2300</td><td>Proposed</td></tr>
</table>

Source from RFNSA (2016)

Table 4-5 presents the details of mobile network towers in Jandowae, where two mobile network service providers, namely Telstra and Optus, are available and active. Both of these mobile network carriers have 2G, 3G and 4G networks coverage in Jandowae.

Optus has currently proposed a site for a 2G GSM900 and 3G WCDMA 900 and WCDMA2100 mobile radio frequency system and NBN CO have proposed site for a fixed wireless mobile tower with a 4G LTE2300 mobile radio frequency system. Furthermore, the search of the RFNSA website also found a number of other Telstra mobile towers nearby Wandoan, but they are inactive and there is no indication of their status (see shaded cells in Table 4-5). Also, the rural areas surrounding Jandowae are not well serviced by mobile network coverage.

Analysis of Wandoan mobile network services coverage

Figure 4-7 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Wandoan region and their specific physical location.

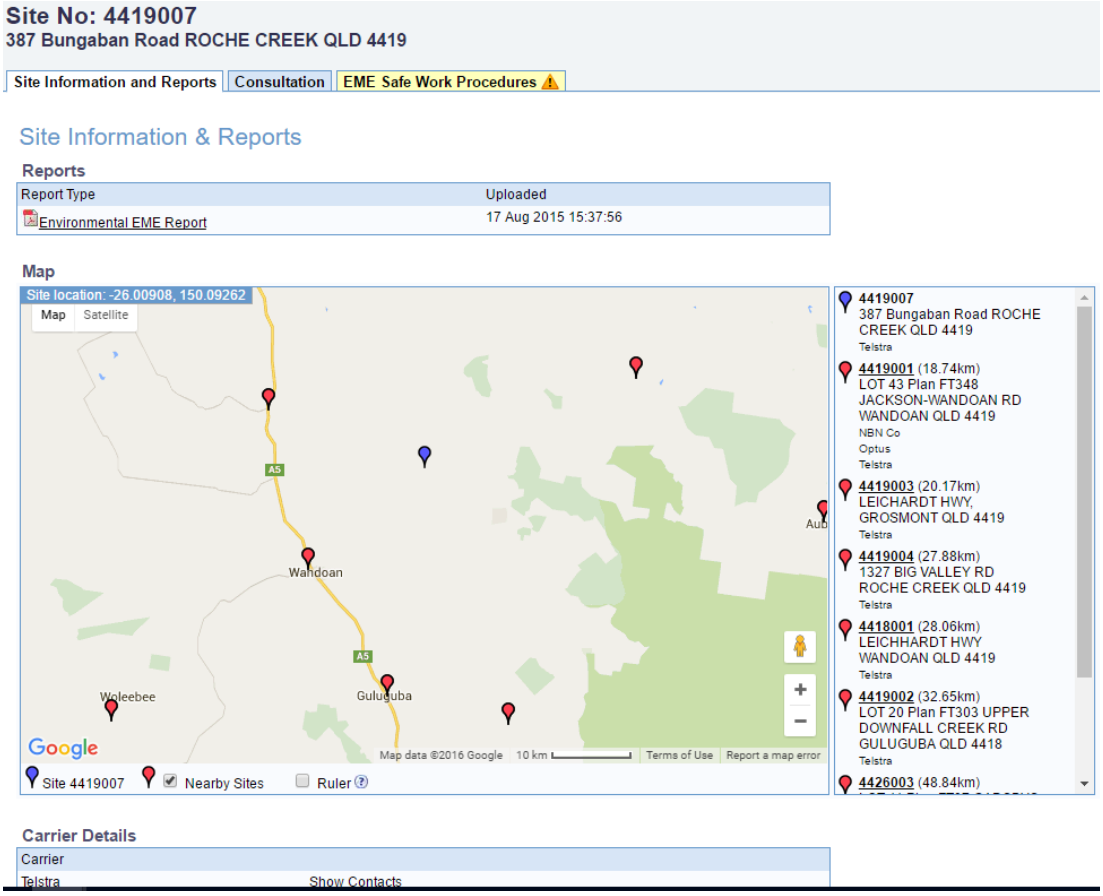

Figure 4-7 Mobile Carrier sites in Wandoan, WDR
Source from RFNSA (2016)

Table 4-6 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Wandoan in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-6 Summary of mobile network towers in Wandoan

<table>
<tr><th>Location</th><th>Carrier</th><th>Tower Site No</th><th>Mobile Network Radio Frequencies</th><th>Mobile Network Generation</th><th>Radio Frequency Status</th></tr>
<tr><td rowspan="4">Wandoan</td><td rowspan="2">Optus</td><td rowspan="4">4419001</td><td>WCDMA900
WCDMA2100</td><td rowspan="2">3G</td><td>Active</td></tr>
<tr><td>LTE700, LTE900</td><td>Proposed</td></tr>
<tr><td rowspan="2">Telstra</td><td>WCMDA850</td><td>3G</td><td rowspan="2">Active</td></tr>
<tr><td>LTE700
LTE2600</td><td>4G</td></tr>
</table>

	NBN Co		LTE2300		Proposed
	Telstra	4419002 4419003 4419004	No information on Base Radio systems	N/A	Unknown
	Telstra	4419007	WCDMA850	3G	Proposed
			LTE700	4G	Proposed

Source from RFNSA (2016)

Table 4-6 presents the details of mobile network towers in Wandoan where two different mobile network service providers, namely Telstra and Optus, are available and active. Both mobile network carriers have 2G and 3G networks coverage and, in addition, Telstra also has 4G services in Wandoan.

The mobile tower numbered 4419001 is shared by Telstra and Optus. Also, Optus has currently proposed 4G LTE700 and LTE900 and NBN CO has proposed a 4G fixed wireless LTE2300 mobile radio frequency system in tower number 4419001. Telstra also has currently proposed another additional mobile network tower site for a 4G LTE700 and 3G WCDMA850 mobile radio frequency system. Furthermore, the search of the RFNSA website found a number of other Telstra mobile towers nearby Wandoan, but they are inactive and there is no indication of their status (see shaded cells in Table 4-6). Also, the rural areas surrounding Wandoan are not well serviced by mobile network coverage.

Analysis of Bell mobile network services coverage

Figure 4-8 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Bell region and their specific physical location.

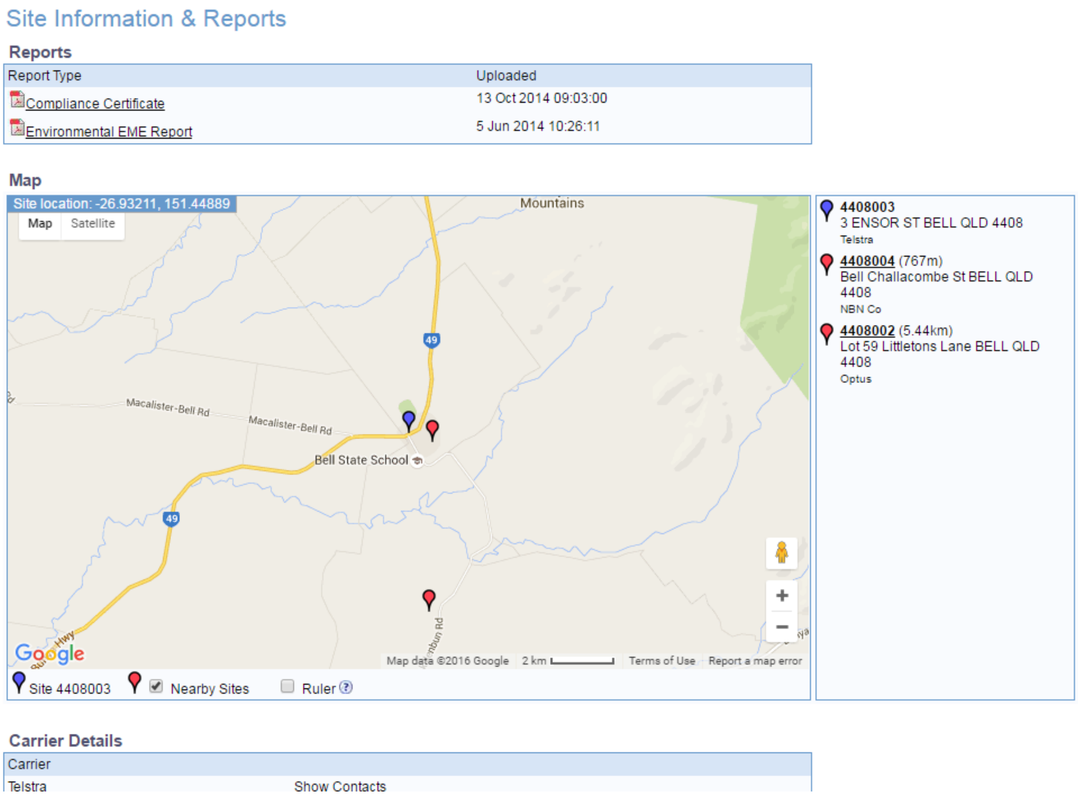

Figure 4-8 Mobile Carrier sites in Bell, WDR
Source from RFNSA (2016)

Table 4-7 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Bell in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-7 Summary of mobile network towers in Bell, WDR

Location	Carrier	Tower Site No	Mobile Network Radio Frequencies	Mobile Network Generation	Radio Frequency Status
Bell Qld, 4408	Telstra	4408001	No information on Base Radio systems	N/A	Unknown
	Optus	4408002	WCDMA900	3G	Active
			LTE700	4G	
	Telstra	4408003	WCDMA850	3G	
	NBN Co	4408004	LTE2300	4G	Proposed

Source from RFNSA (2016)

Table 4-7 presents the details of mobile network towers in Bell where Telstra 3G and Optus 3G and 4G mobile network services are available. NBN CO have a proposed site for a fixed wireless mobile tower with a 4G LTE2300 mobile radio frequency system, but there is no indication when these services would be available. Furthermore, a search of the RFNSA website found another Telstra mobile tower number 4408001 nearby at Tara, but this is inactive and there is no indication of its status (see shaded cells in Table 4-7). Also, the rural areas surrounding Bell are not well serviced by mobile networks coverage.

Analysis of Meandarra mobile network services coverage

Figure 4-9 lists the specific physical location of the mobile phone towers that are available and active in Meandarra.

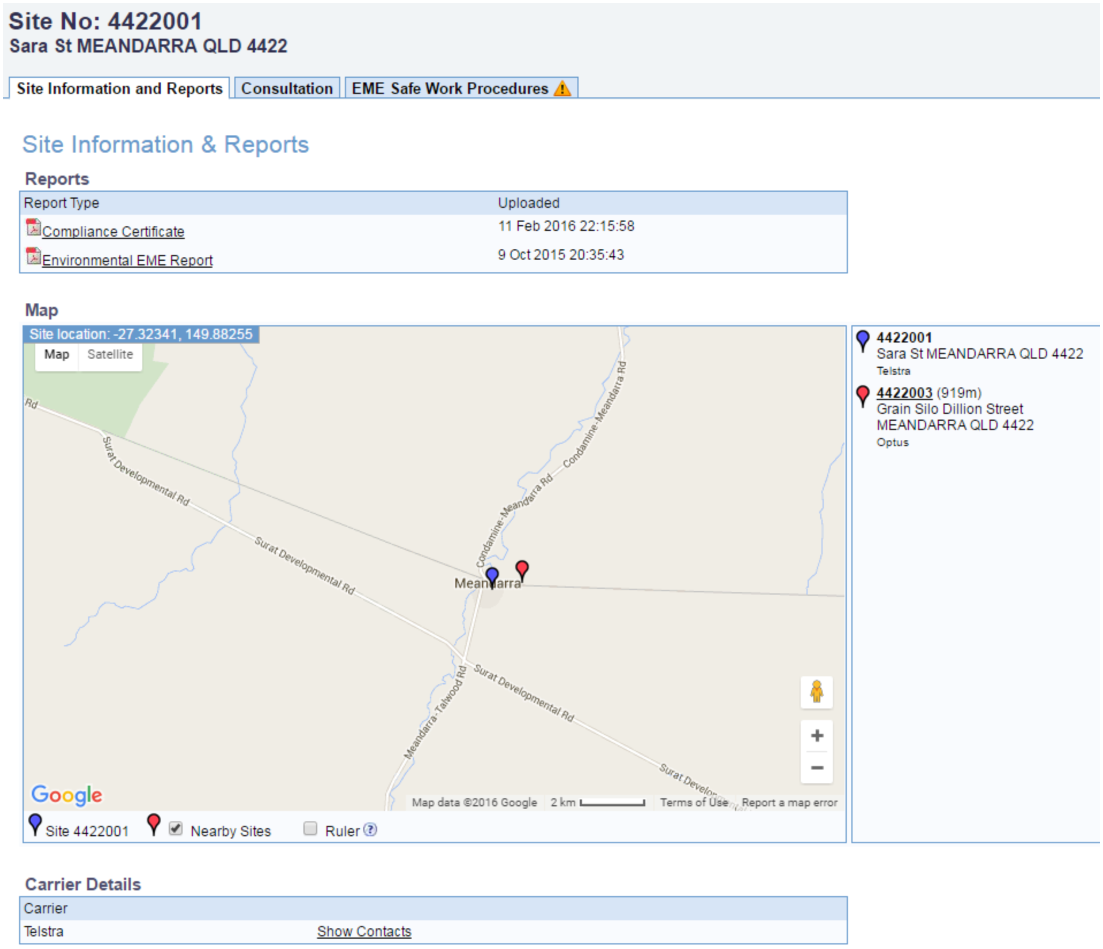

Figure 4-9 Mobile Carrier sites in Meandarra, WDR
Source from RFNSA (2016)

Table 4-8 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Meandarra in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-8 Summary of mobile network towers in Meandarra, WDR

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
Meandarra Qld, 4422	Telstra	4422001	LTE700	4G	Active
			WCDMA850	3G	
		4422002			
	Optus	4422003	No information on Base Radio systems	N/A	Unknown

Table 4-8 also presents the details of mobile network towers in Meandarra where only Telstra 3G and 4G mobile network services are available. Furthermore, a search of the RFNSA website found Optus mobile tower number 4422003 nearby Meandarra is inactive and there is no indication of its status (see shaded cells in Table 4-8 Summary of mobile network towers in Meandarra, WDR). Also, the rural areas surrounding Meandarra are not well serviced by mobile networks coverage.

Analysis of Condamine mobile network services coverage

Figure 4-10 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Condamine region and their specific physical location.

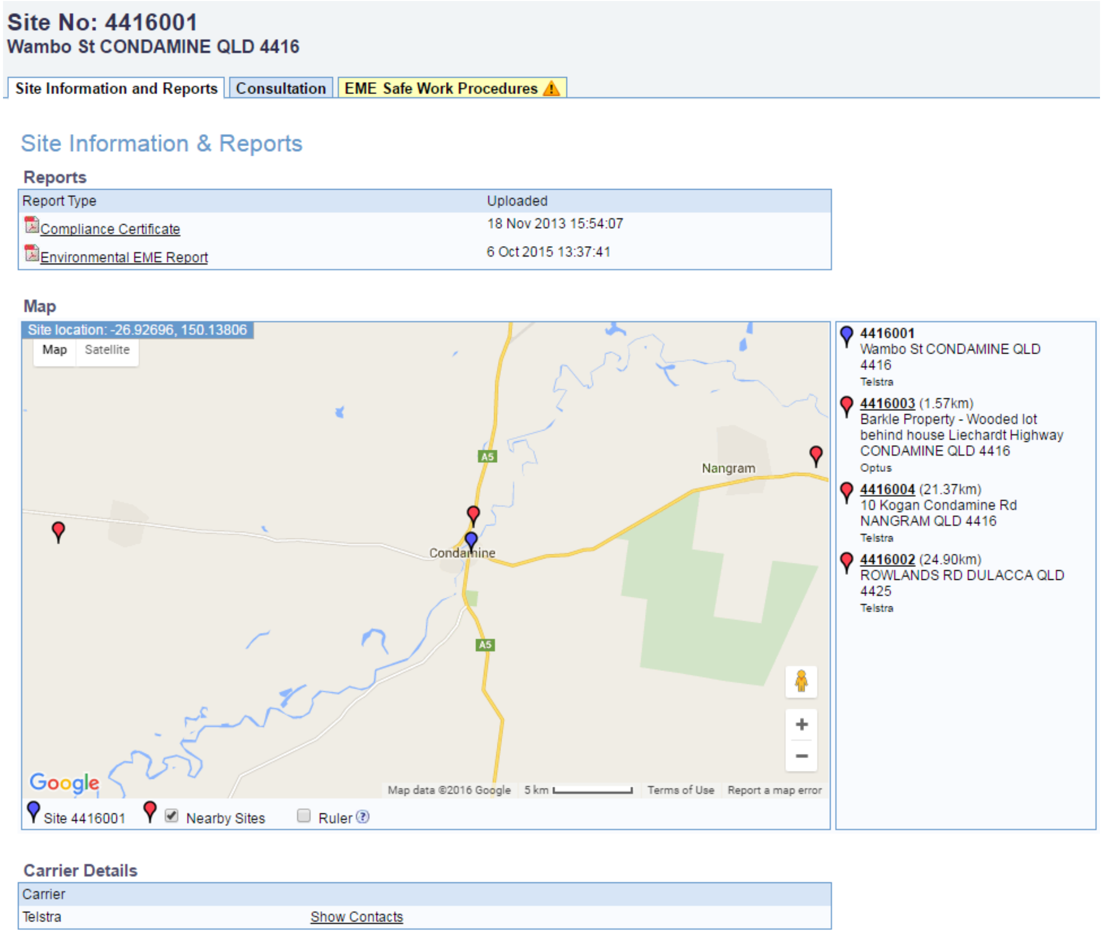

Figure 4-10 Mobile Carrier sites in Condamine, WDR
Source from RFNSA (2016)

Table 4-9 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Condamine in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-9 Summary of mobile network towers in Condamine, WDR

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
Condamine, Qld, 4416	Telstra	4416001	LTE700	4G	Proposed
			WCDMA850	3G	Active
		4416002	No information on Base Radio systems	N/A	Unknown
	Optus	4422003	UMTS900	3G	Proposed
	Telstra	4422004	WCDMA850		Active
			LTE700	4G	Proposed

Source from RFNSA (2016)

Table 4-9 presents the details of mobile network towers in Condamine where only Telstra 3G mobile network service is available. However, Telstra has proposed a 4G LTE700 mobile radio frequency system in tower number 4416001 and 4422004. Optus network has also proposed sites to install equipment for transmitting UTMS900 mobile radio frequency systems to provide 3G network services in Condamine, however, there is no indication when these services would be available. Furthermore, a search of the RFNSA website found Telstra mobile tower site number 4416002 nearby Condamine, but this is inactive and there is no indication of its status (see shaded cells in Table 4-9). Also, the rural areas surrounding Condamine are not well serviced by mobile networks coverage.

Analysis of Dulacca and Drillham mobile network services coverage

Figure 4-11 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Dulacca and Drillham and their specific physical location.

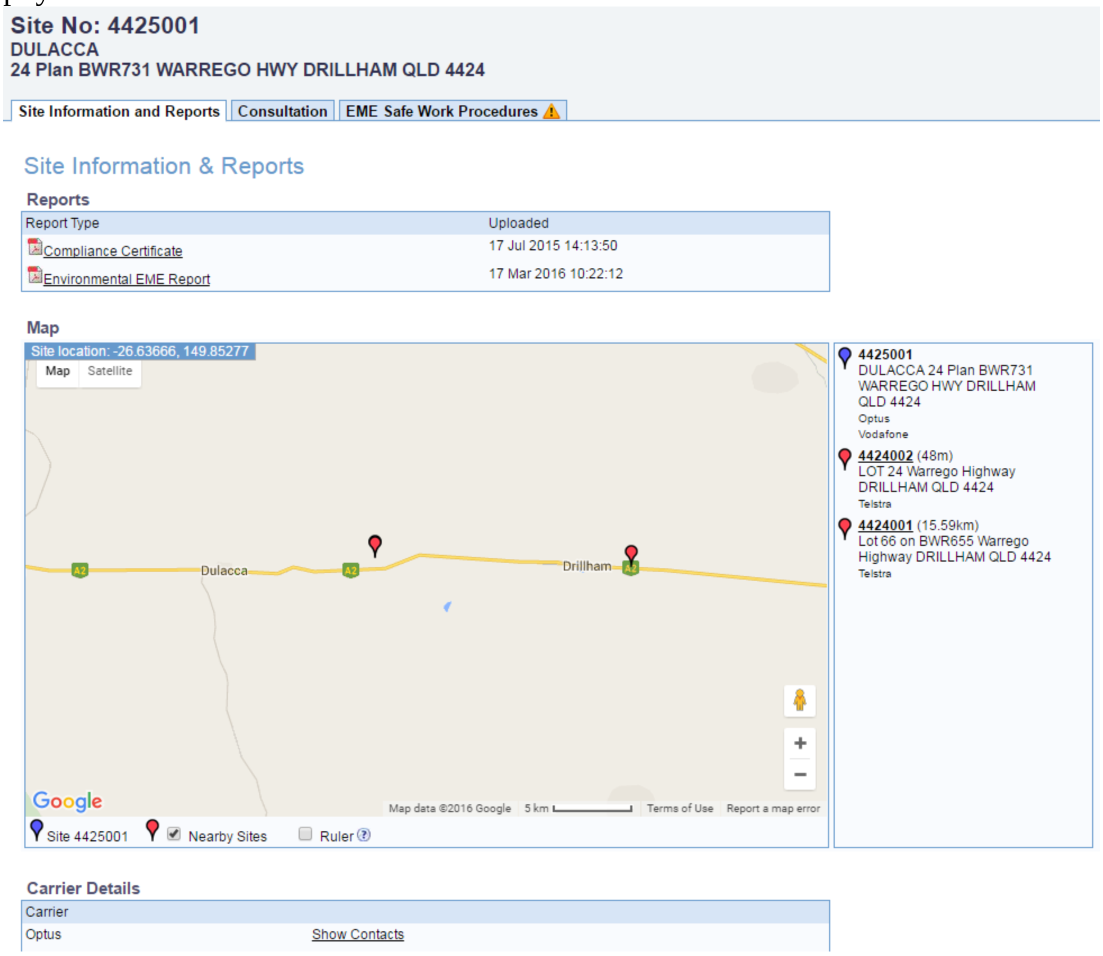

Figure 4-11 Mobile Carrier sites in Dulacca and Drillham, WDR
Source from RFNSA (2016)

Table 4-10 provides an analysis and breakdown of the mobile network services available from each mobile phone tower in Dulacca and Drillham in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-10 Summary of mobile network towers in Dulacca and Drillham, WDR

<table>
<tr><th>Location</th><th>Carrier</th><th>Tower Site No</th><th>Mobile Network Radio Frequencies</th><th>Mobile Network Generation</th><th>Radio Frequency Status</th></tr>
<tr><td rowspan="4">Dulacca Qld, 4425</td><td rowspan="2">Optus</td><td rowspan="4">4425001</td><td>LTE700</td><td>4G</td><td rowspan="2">Active</td></tr>
<tr><td>WCDMA900</td><td>3G</td></tr>
<tr><td rowspan="2">Vodafone</td><td>LTE850</td><td>4G</td><td rowspan="3">Proposed</td></tr>
<tr><td>WCDMA900</td><td>3G</td></tr>
<tr><td rowspan="3">Drillham Qld, 4424</td><td rowspan="3">Telstra</td><td>4424001</td><td>WCDMA800</td><td>3G</td></tr>
<tr><td rowspan="2">4424002</td><td>WCDMA850</td><td>3G</td><td rowspan="2">Active</td></tr>
<tr><td>LTE700</td><td>4G</td></tr>
</table>

Source from RFNSA (2016)

Table 4-10 presents details of mobile network towers in Dulacca and Drillham where Optus 3G and 4G mobile network services are available in Dulacca; and where in Drillham Telstra 3G and 4G mobile network services are available. Interestingly, Vodafone proposed a 4G LTE700 and 3G WCDMA900 mobile radio frequency system in tower number 4425001 in Dulacca, however, there is no indication when these services would be available. Furthermore, a search of the RFNSA website found that Optus and Vodafone would like to share their mobile tower site number 4425001 (see Table 4-10).

Analysis of Warra mobile network services coverage

Figure 4-12 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Warra and their specific physical location.

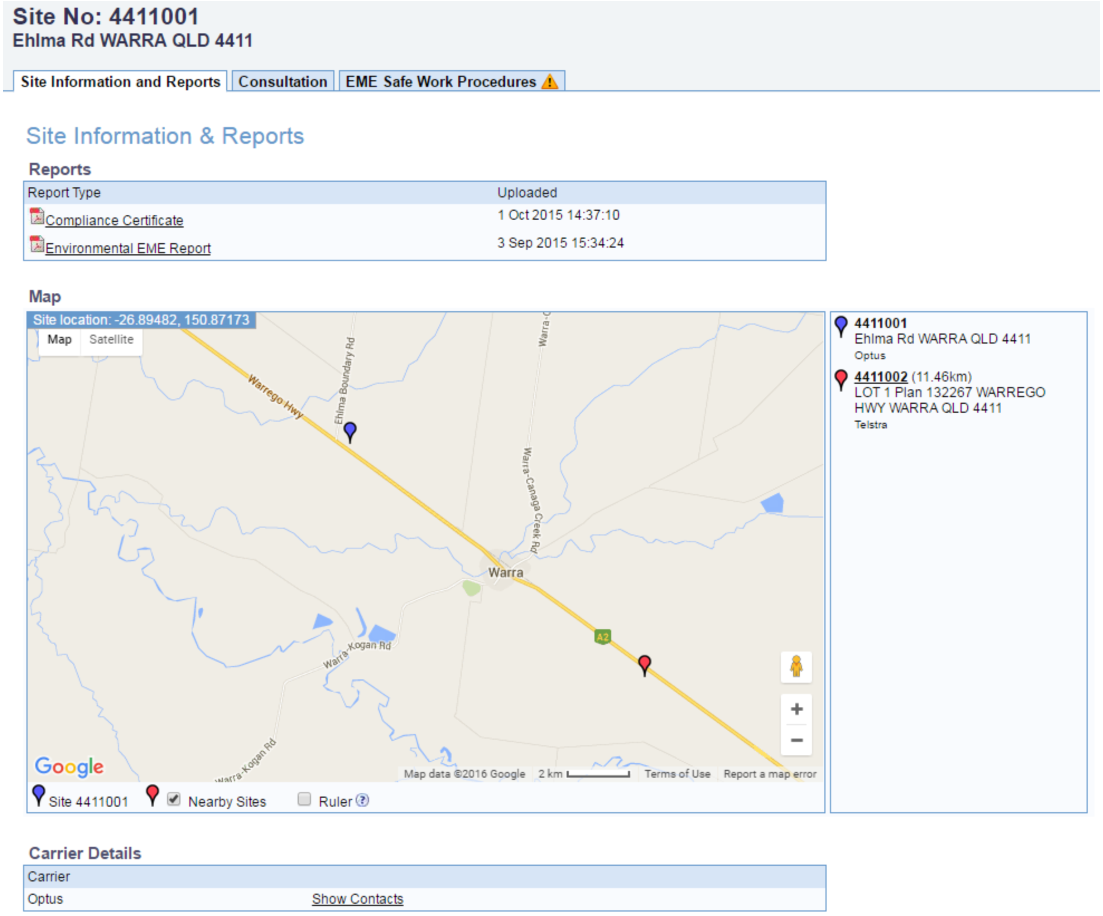

Figure 4-12 Mobile Carrier sites in Warra, WDR
Source from RFNSA (2016)

Table 4-11 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Warra in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-11 Summary of mobile network towers in Warra, WDR

Location	**Carrier**	**Tower Site No**	**Mobile Network Radio Frequencies**	**Mobile Network Generation**	**Radio Frequency Status**
Warra Qld, 4411	Optus	4411001	LTE700	4G	Active
			GSM900	2G	
			WCDMA900	3G	
	Telstra	4411002	WCDMA850		
			LTE700	4G	

Source from RFNSA (2016)

Table 4-11 presents details of mobile network towers in Warra where Telstra and Optus 2G, 3G and 4G mobile network services are available. However, the rural areas surrounding Warra are not well serviced by mobile networks coverage.

Analysis of Kogan mobile network services coverage

Figure 4-13 shows the search result from the RFNSA website for the number of mobile phone radio frequency towers located in Kogan and their specific physical location.

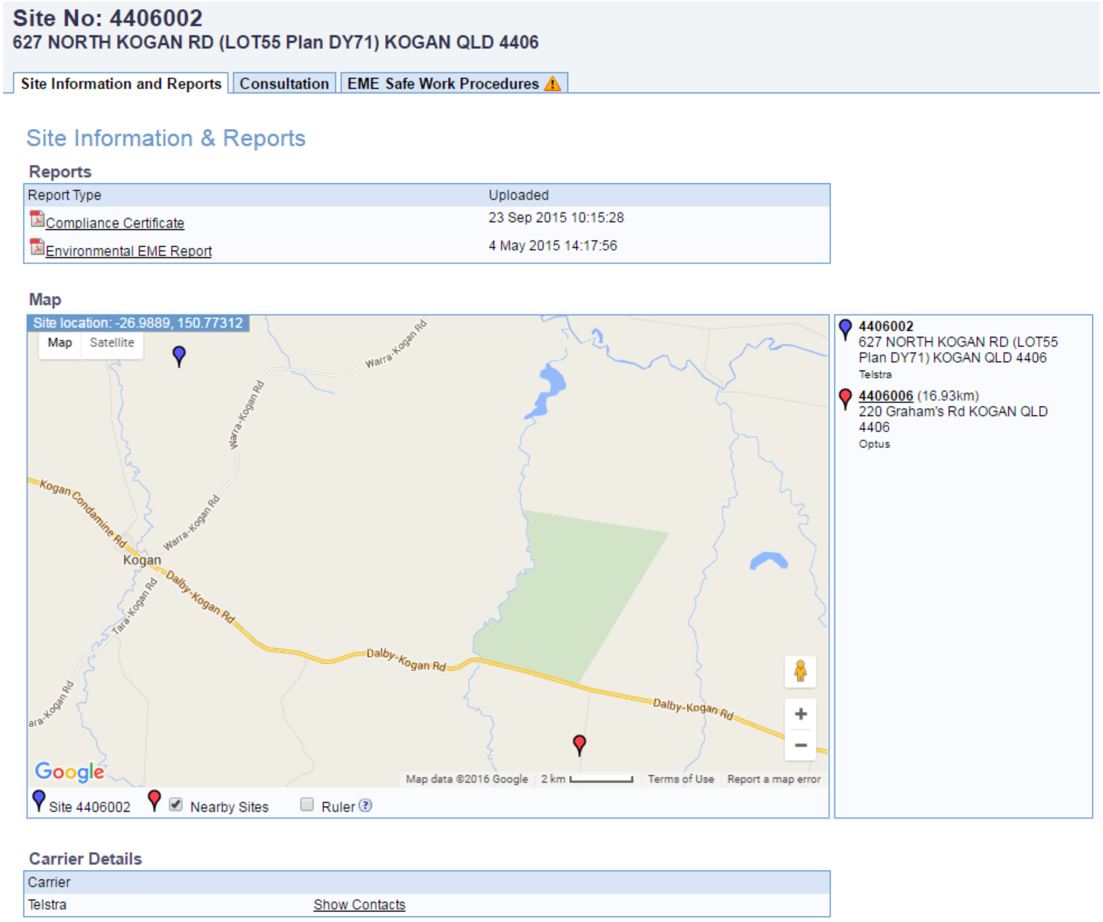

Figure 4-13 Mobile Carrier sites in Kogan, WDR
Source from RFNSA (2016)

Table 4-12 provides an analysis and breakdown of the mobile networks services available from each mobile phone tower in Kogan in terms of the carrier, radio frequency system, network type and status of the mobile radio frequencies associated with each network type.

Table 4-12 Summary of mobile network towers in Kogan, WDR

Location	**Carrier**	**Tower Site No**	**Radio systems**	**Network types**	**Frequency Status**
Kogan, Qld 4406	Telstra	4406002	LTE700	4G	Active
			WCDMA850	3G	

	Optus	4406006	WCDMA900, WCDMA2100		Proposed
			LTE700, LTE2600	4G	

Source from RFNSA (2016)

Table 4-12 presents details of mobile network towers in Kogan where Telstra 3G and 4G mobile network services are available. Optus proposed a site for mobile tower with a 4G (LTE700 and LTE2600) and 3G (WCDMA900 and WCDMA2100) mobile radio frequency system, however, there is no indication when these services would be available. Also, the rural areas surrounding Kogan are not well serviced by mobile networks coverage.

Analysis of remaining small towns of Kaimkillenbun, Macalister, Moonie, Brigalow, Jimbour, Glenmorgan and Guluguba mobile network services coverage

Table 4-13 Summary of mobile network towers in Kaimkillenbun, Macalister, Moonie, Brigalow, Jimbour, Glenmorgan and Guluguba, WDR

Location	**Carrier**	**Tower Site No**	**Radio systems**	**Network types**	**Frequency Status**
Kaimkillenbun Qld 4406	N/A	N/A	N/A	N/A	N/A
Macalister Qld 4406	N/A	N/A	N/A	N/A	N/A
Moonie Qld 4406	Telstra	4406005	No information on Base Radio systems	N/A	Unknown
Brigalow Qld 4412		4411002			
Jimbour Qld 4406		4352006			
Glenmorgan Qld 4406		4423001			
Guluguba Qld 4418		4418001			
		4419002			

Source from RFNSA (2016)

Finally, Table 4-13 shows that there are number of small towns such as Kaimkillenbun and Macalister in the WDR where there are no mobile network towers located in or nearby those towns. Furthermore, the small towns of Moonie, Brigalow, Jimbour, Glenmorgan and Guluguba have Telstra towers nearby, but these towers are inactive (see shaded cells in Table 4-13). Although, some of these towns have partial mobile network signal coverage from the mobile towers located in neighbouring towns, the mobile network signal and coverage is very patchy and unreliable.

4.3.2 Analysis of Open Signal mobile app testing (Telstra, Optus, Vodafone) in the WDR

The selective testing of the three mobile network services providers, Telstra, Optus and Vodafone, using the Mobile App Open Signal www.opensignal.com on 26-27th February and 10th, 14th and 21st March 2014 across the WDR is summarised in Table 4-14. Table 4-14 presents the selective mobile network testing using OpenSignal Mobile App with three carriers in the WDR—Telstra, Optus and Vodafone.

Table 4-14 Selective testing using OpenSignal mobile app with three carriers - mobile networks in the WDR

Location	Date	Time	Service provider	Download	Upload	Network type	Remoteness
Dalby	26/02/14	7:15 am	Telstra	13.24 Mbps	3.48Mbps	4G	Inner regional
			Vodafone	7.15 Mbps	2.67 Mbps	HSPA	
			Optus	1.82 Mbps	484 Kbps	3G	
		4:13 pm	Telstra	16.01 Mbps	4.07 Mbps	4G	
	27/02/14	1:47pm	Telstra	17.33 Mbps	3.30 Mbps	4G	
Chinchilla	26/02/14	11:10 am	Telstra	28.1 Mbps	2.9 Mbps	4G	Outer regional
			Vodafone	2.4 Mbps	2 Mbps	3G	
			Optus	677 Kbps	409 Kbps	3G	
Miles	14/01/14	1:52pm	Optus	1.54 Mbps	410 Kbps	3G	Outer regional
	14/03/14	8:22am	Telstra	19.52 Mbps	17.7 Mbps	LTE-4G	
			Vodafone	9.14 Mbps	2.22 Mbps	HSPA	
			Optus	1.52 Mbps	420 Kbps	3G	
Tara	10/03/14	1:09 pm	Telstra	9.32 Mbps	930 Kbps	HSPA-4G	Outer regional
	21/03/14	8:39 am	Telstra	2.631 Mbps	248 Kbps	HSPA-4G	
Jandowae	27/02/14	8:47 am	Telstra	14.4 Mbps	1.9 Mbps	HSPA-4G	Outer regional
			Optus	1.6 Mbps	499 Kbps	3G	
Wandoan	14/01/14	8:45 am	Optus	2.22 Mbps	384 Kbps	HSPA	Remote
		4:32 pm		479 KB	387 Kbps	HSPA	
	14/03/14	3:58 pm	Telstra	3.4 Mbps	582 Kbps	HSPA-4G	
Meandarra	21/03/14	9:59 am	Telstra	9.297 Mbps	1.145Mbps	HSPA-4G	Remote
		1:41 pm		3.569 Mbps	308 Kbps	HSPA-4G	
Condamine	26/02/14	12:12 pm	Telstra	9.46 Mbps	769 kbps	HSPA	Outer regional
Dulacca	14/03/14	11:39 am	Telstra	5.082Mbps	1.40Mbps	3G	Remote
			Optus	830 Kbps	330 Kbps	3G	
Warra	26/02/14	8:05am	Telstra	6.4 Mbps	665 Kbps	3G	Outer regional
			Optus	641 Kbps	553 Kbps	3G	
Drillham	14/03/14	10:29 am	Telstra	2.53 Mbps	476 Kbps	3G	Outer regional
			Optus	470 Kbps	80 Kbps	3G	
Kogan	26/02/14	3:45 pm	Telstra	5.18 Mbps	627 Kbps	HSPA	Outer regional
	10/03/14	3:51pm	Telstra	9.89 Mbps	1.419 Mbps	HSPA	
Moonie	10/03/14	8:39 am	Telstra	3.5 Mbps	99 Kbps	3G/ HSPA (with signal booster)	Remote
			Telstra	N/A	105 Kbps	HSPA (without signal booster)	

Note: these download and upload speeds were captured during the study which may be differ at a later point in time (Source: this research).

The testing conducted in Dalby, Chinchilla and Miles using the OpenSignal Mobile App revealed that Telstra had a good 4G mobile service (download speed range from 13.24 Mbps to 28.1 Mbps and upload speed range from 2.94 Mbps to 17.7 Mbps). The testing using across these three towns showed that Optus and Vodafone had a good 3G mobile service with reasonable download (1.52 Mbps to 2.4 Mbps) and upload speeds (409 Kbps to 2 Mbps). Additionally, Vodafone provided a HSPA service in Dalby (download 7.15 Mbps and upload 2.67 Mbps) and Miles (download 9.14 Mbps and upload 2.22 Mbps) which demonstrated faster download and upload speeds. However, outside of the boundaries of these towns, usually beyond 5-10 km, none of the three mobile phone services providers had network coverage at the time this testing was conducted using the Open Signal mobile app.

Table 4-14 shows that some of the small towns such as Tara, Jandowae, Condamine, Meandarra and Kogan have access to the Telstra HSPA service with reasonable download speeds (range between 2.63 Mbps to 14.4 Mbps) and upload speeds (range between 248 Kbps to 1.9 Mbps). Most of these towns also have access to the Optus 3G mobile service with reasonable download and upload speeds. In Wandoan, Optus provided a HSPA service available at the time this testing with the Open Signal mobile app was conducted.

In Moonie, there was only the Telstra mobile network signal available when testing of mobile phone network access and speed was conducted on 10th March 2014; and testing found there is very poor network signal and it was not possible to access any mobile Internet services. Because of the poor reception of mobile network signal and Internet access, Moonie Road House has installed an external aerial for boosting the mobile network signal. With signal booster equipment at Moonie Road House, Telstra had a good 3G service with reasonable download speed (3.5 Mbps) but poor upload speed (99 Kbps) at the time of this testing with the Open Signal mobile app. Table 4-14 also reveals that mobile Internet download and upload speeds varied over the duration of a day from morning, afternoon through to evening time.

In summary, the analysis of OpenSignal testing data revealed that the three largest towns in the WDR (Dalby, Chinchilla, Miles) all experience good mobile network speed and reliability of service. In contrast, selective testing in smaller towns in the WDR (Tara, Jandowae, Wandoan, Meandarra, Condamine, Dulacca, Warra, Drillham, Kogan, Moonie) of mobile network services provided by Telstra, Optus and Vodafone showed that speed and reliability of service varied greatly from good, to poor, to non-existent—depending on the coverage of mobile phone carrier and the time of day.

4.3.3 Satellite services in the WDR

The WDR is covered by the wireless Interim Satellite Service (ISS) which was launched on 1 July 2011 to provide an improved broadband internet service to rural and remote communities. The Interim Satellite Service (ISS) shut down on February 2017 (NBN 2016d). Recently NBN Co launched two new dedicated Long Term Satellites—Sky Muster One in October 2015 and Sky Muster Two in October 2016—to reach 3% of rural and remote communities that currently do not have any access to broadband internet services and offer wholesale services configured for a planned 25 Mbps download and 5Mbps upload (NBN 2016a).

4.3.4 Analysis of ADSL/ADSL2+ coverage in towns of the WDR

In this section, maps and summary tables of the ADSL/ADSL2+ services available were constructed from archival data available in ADSL2exchanges.com.au website. The maps and summary tables show the availability or lack of availability of ADSL and ADSL2+ broadband services across the towns in WDR due to some telephone exchanges not having ADSL enabled connection ports.

Analysis of ADSL Network Services coverage in Dalby

Dalby is largest town in the WDR. In Dalby, there are three different ADSL Exchange equipment providers: namely, Agile (Internode); Chime (iiNet); and Telstra ADSL1 and 2+ and their status is active except Telstra ADSL2+ has no ports available (ADSL2-Exchanges 2016) (see Figure 4-14and Table 4-15).

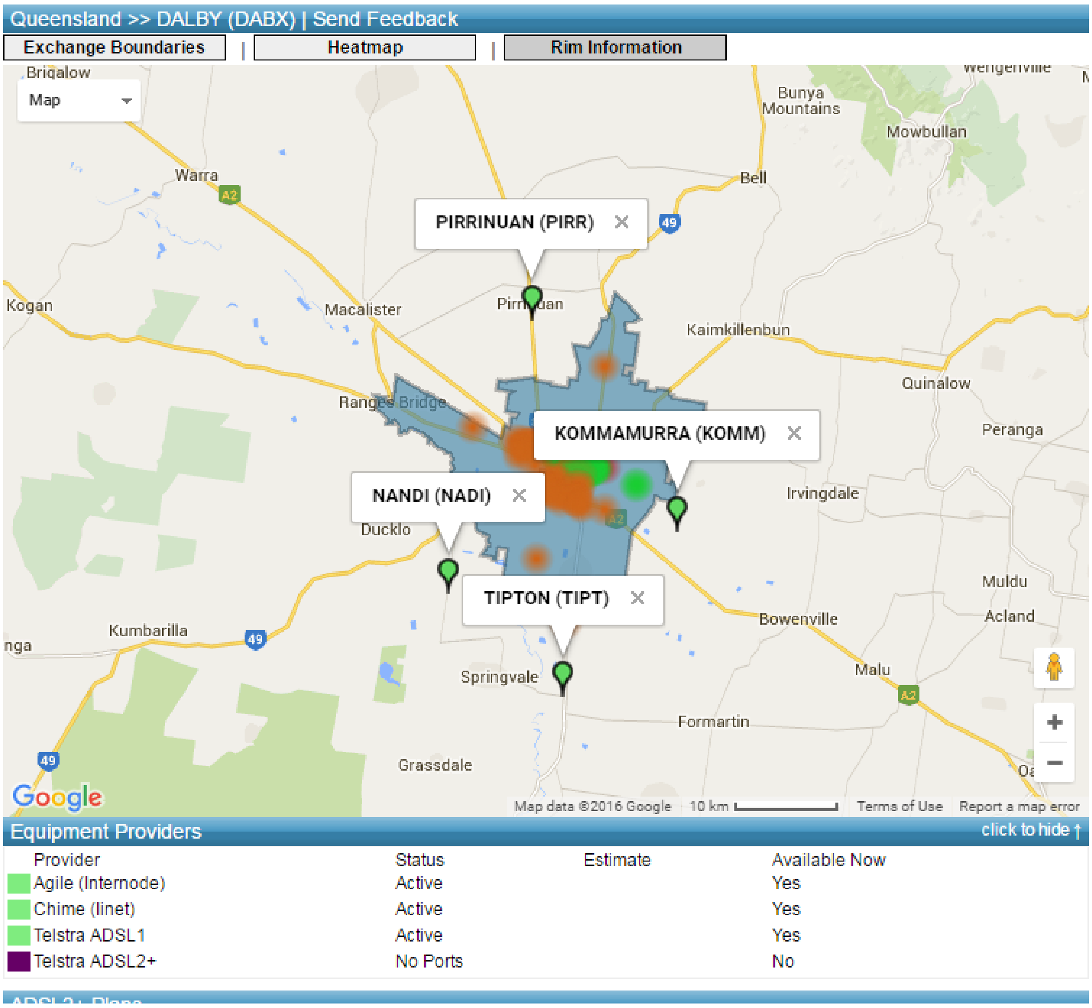

Figure 4-14 ADSL provider and coverage in Dalby, WDR
Source from ADSL2-Exchanges (2016)

Table 4-15 ADSL Exchange equipment provider in Dalby and nearby Dalby, WDR

Location	ADSL/ADSL2+ Equipment providers	Status	Available Now
Dalby	Agile (Internode)	Active	Yes
	Chime (iiNet)	Active	Yes
	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	No ports	No
ADSL Exchange equipment nearby Dalby			
Pirrinuan	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Kommamurra	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Tipton	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Nandi	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are four other ADSL exchanges near Dalby, namely in the smaller towns of Pirrinuan, Kommamurra, Tipton and Nandi. But these telephone exchanges have no ports for ADSL1 connection, although ADSL2+ is listed as planned for the telephone exchanges (see Table 4-15). Telstra would need to upgrade these telephone exchanges to enable support for ADSl2+ services in these smaller towns surrounding Dalby.

Analysis of ADSL Network Services coverage in Chinchilla

Chinchilla is the second largest town in the WDR. In Chinchilla, only Telstra provides the ADSL equipment in the telephone exchange and they offer both ADSL1 and ADSL2+ services (see Figure 4-15 and Table 4-16).

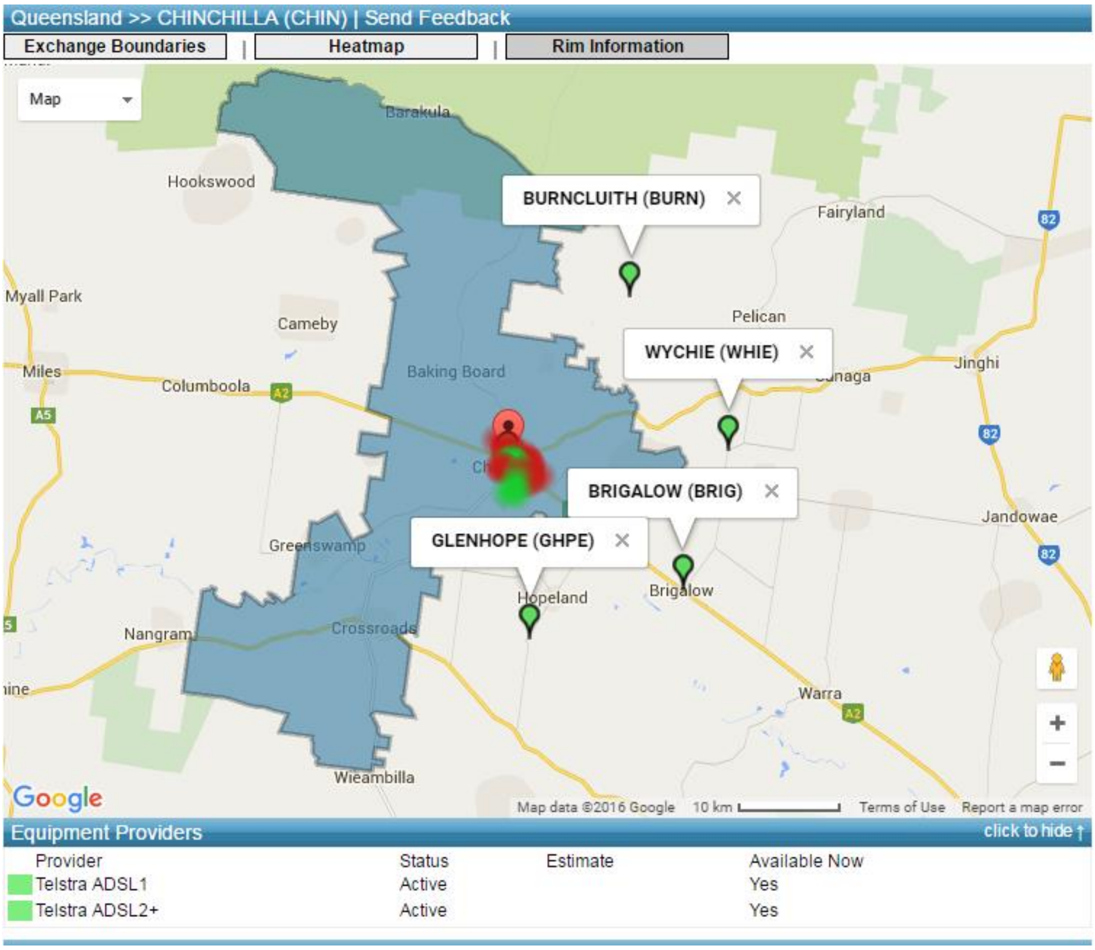

Figure 4-15 ADSL provider and coverage in Chinchilla, WDR
Source from ADSL2-Exchanges (2016)

Table 4-16 ADSL Exchange equipment provider in Chinchilla and nearby Chinchilla, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Chinchilla	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Chinchilla			
Burncluith	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Wychie	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Brigalow	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Glenhope	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are also four other ADSL telephone exchanges in small towns nearby Chinchilla, namely, Burncluith, Wychie, Brigalow and Glenhope. But these telephone exchanges have no ports available for ADSL1 connections and ADSL2+ is still listed as planned for these telephone exchanges. Telstra would need to upgrade the telephone exchanges in these smaller towns in order to support ADSl2+ services.

Analysis of ADSL Network Services coverage in Miles

Miles is another larger town in the WDR with 1450 population size. Similar to Chinchilla, only Telstra provides the ADSL equipment in the telephone exchange and they offer both ADSL1 and ADSL2+ services in Miles (see Figure 4-16 and Table 4-1).

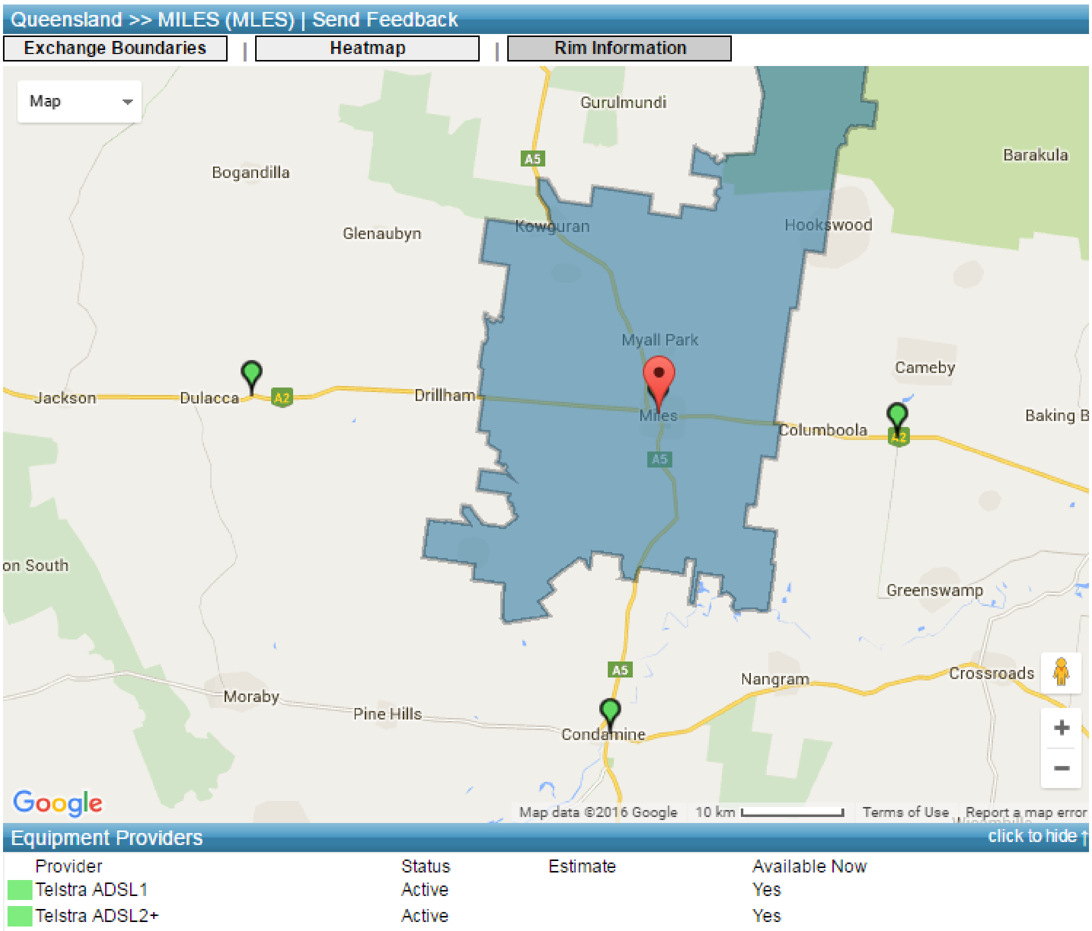

Figure 4-16 ADSL provider and coverage in Miles, WDR
Source from ADSL2-Exchanges (2016)

Table 4-17 ADSL Exchange equipment provider in Miles, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Miles	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Miles			
Goombi	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Condamine	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
Dulacca	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

In the nearby smaller towns of Goombi, Condamine and Dulacca the telephone exchanges all have ADSL services enabled. But for two of the towns, Goombi and Dulacca, the telephone exchanges have no ports available for ADSL1 connections and ADSL2+ is still listed as planned. So Telstra would need to upgrade these two telephone exchanges in order provide ADSL2+ services. Conversely, the telephone exchange for the town of Condamine has both ADSL1 and ADSL2+ services available.

Analysis of ADSL Network Services coverage in Tara

Tara is another larger town in the WDR. In Tara, only Telstra provides the ADSL equipment in the telephone exchange and they provide both ADSL1 and ADSL2+ services. However, currently, there are no more ADSL2+ ports available for customers (see Figure 4-17 and Table 4-18).

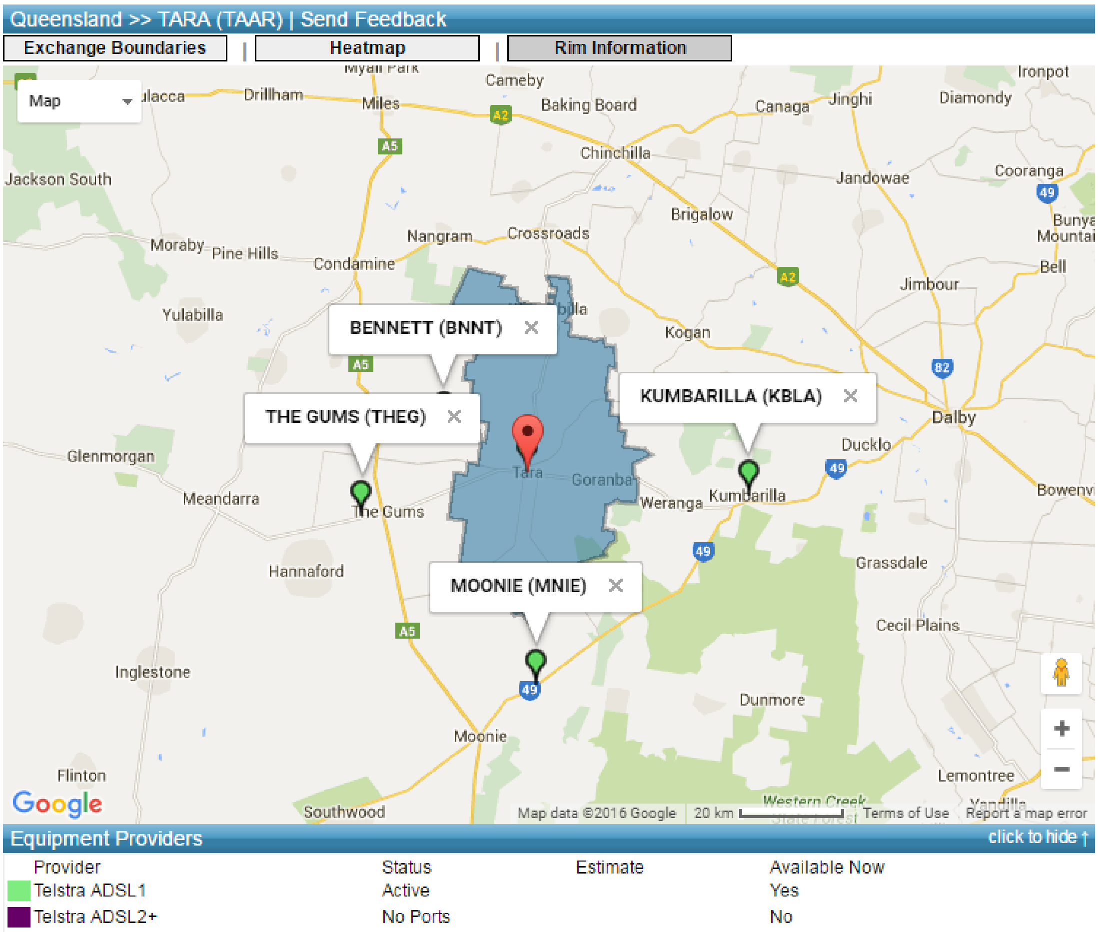

Figure 4-17 ADSL provider and coverage in Tara, WDR
Source from ADSL2-Exchanges (2016)

Table 4-18 ADSL Exchange equipment provider in Tara, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Tara	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	No ports	No
ADSL Exchange equipment nearby Tara			
Bennett	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Moonie	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
The Gums	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Kumbarilla	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

Some other ADSL exchanges are available near Tara, namely, in Bennett, Moonie, The Gums and Kumbarilla. However, these telephone exchanges have no ports for ADSL1 connection—although ADSL2+ is listed as planned as an update to these telephone exchanges Thus, Telstra would need to upgrade these telephone exchanges in order to provide ADSL2+ services.

Analysis of ADSL Network Services coverage in Jandowae

Jandowae is the fifth largest populated town in the WDR. In Jandowae, similar to Chinchilla, Miles and Condamine only Telstra provides the ADSL equipment in the telephone exchange and they offer both ADSL1 and ADSL2+ services (see Figure 4-18 and Table 4-19).

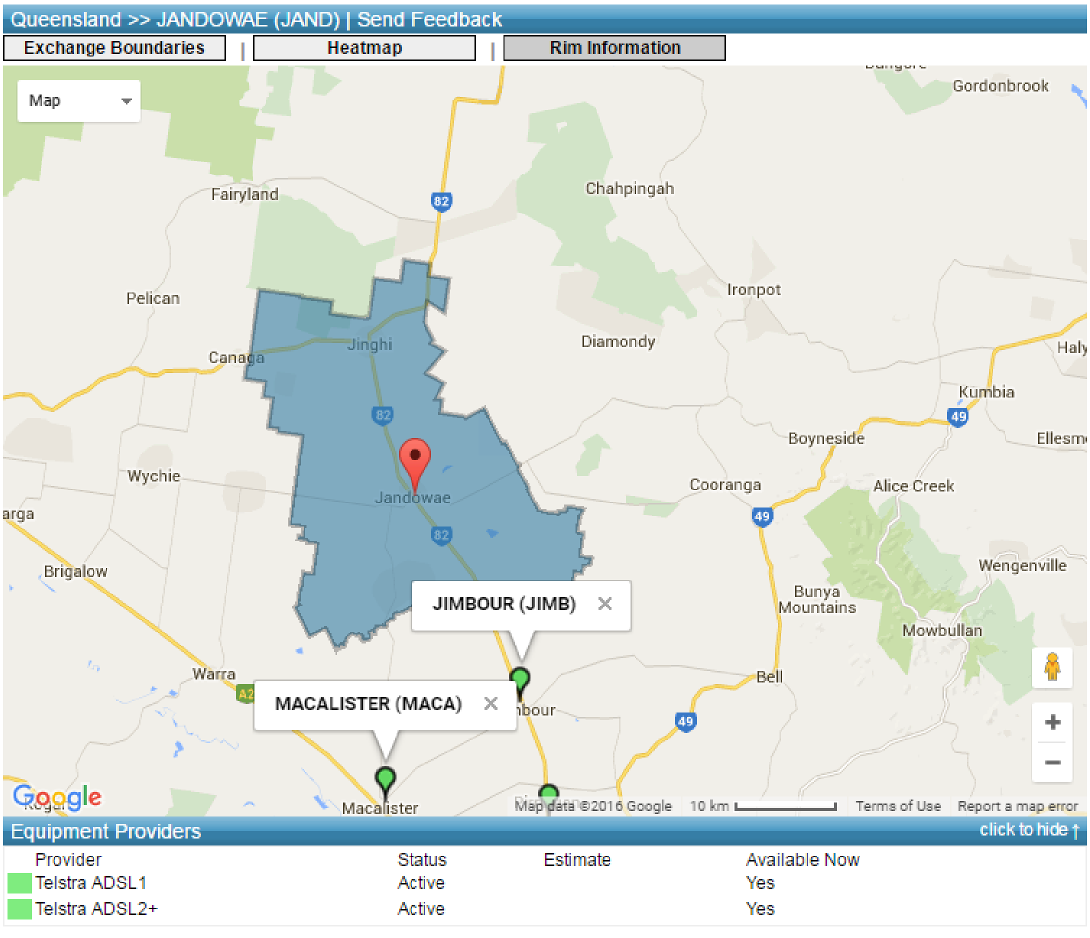

Figure 4-18 ADSL provider and coverage in Jandowae, WDR
Source from ADSL2-Exchanges (2016)

Table 4-19 ADSL Exchange equipment provider in Jandowae, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Jandowae	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Jandowae			
Eschol	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Diamondy	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Jimbour	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Macalister	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are four other ADSL exchanges nearby to Jandowae, namely in the smaller towns of Eschol, Diamondy, Jimbour and Macalister. However, these telephone exchanges have no ports for ADSL connection although ADSL2+ is listed as planned as an update to these telephone exchanges (see Table 4-19). Thus, Telstra would need to upgrade these telephone exchanges to support ADSL2+ services in these smaller towns surrounding Jandowae.

Analysis of ADSL Network Services coverage in Wandoan

Wandoan is small town in the WDR with a population of 400 people. In Wandoan, similar to Chinchilla, Miles and Condamine, Telstra provides the ADSL equipment in the telephone exchange and they offer both ADSL1 and ADSL2+ services (see Figure 4-19 and Table 4-20).

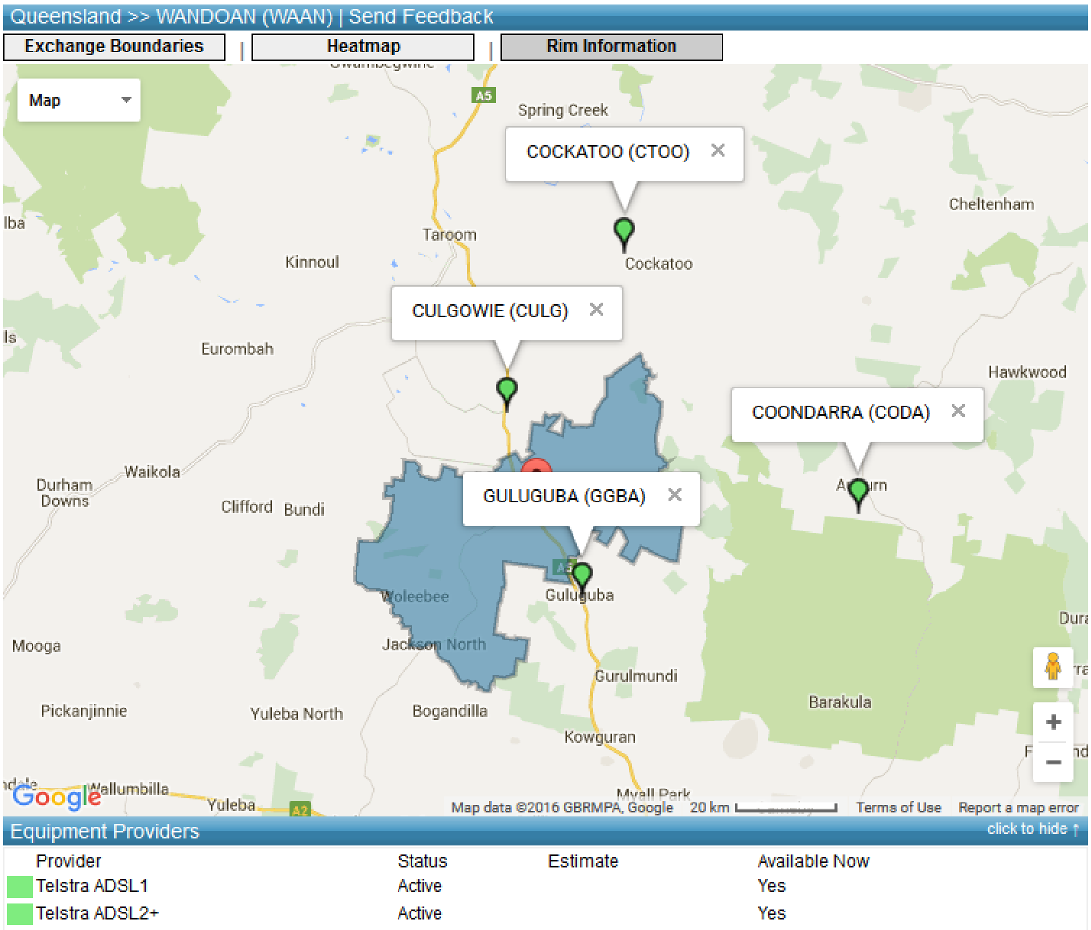

Figure 4-19 ADSL provider and coverage in Wandoan, WDR
Source from ADSL2-Exchanges (2016)

Table 4-20 ADSL Exchange equipment provider in Wandoan, WDR

Location	ADSL/ADSL2+ Equipment providers	Status	Available Now
Wandoan	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Wandoan			

Guluguba	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Culgowie	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Cockatoo	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Coondarra	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are also four other ADSL telephone exchanges in small towns nearby to Wandoan namely, Guluguba, Culgowie, Cockatoo and Coondarra. However, these telephone exchanges have no ports available for ADSL1 connections and ADSL2+ services are listed as planned for these telephone exchanges. Thus, Telstra would need to upgrade the telephone exchanges in these smaller towns in order to support ADSl2+ services.

Analysis of ADSL Network Services coverage in Bell

Bell is a small town in the WDR with a population of 300 people. Similar to a number of towns in the WDR, Telstra provides the ADSL equipment in the telephone exchange, but currently only provides ADSL1—although ADSL2+ services are listed as planned for the telephone exchange (see Figure 4-20 and Table 4-21).

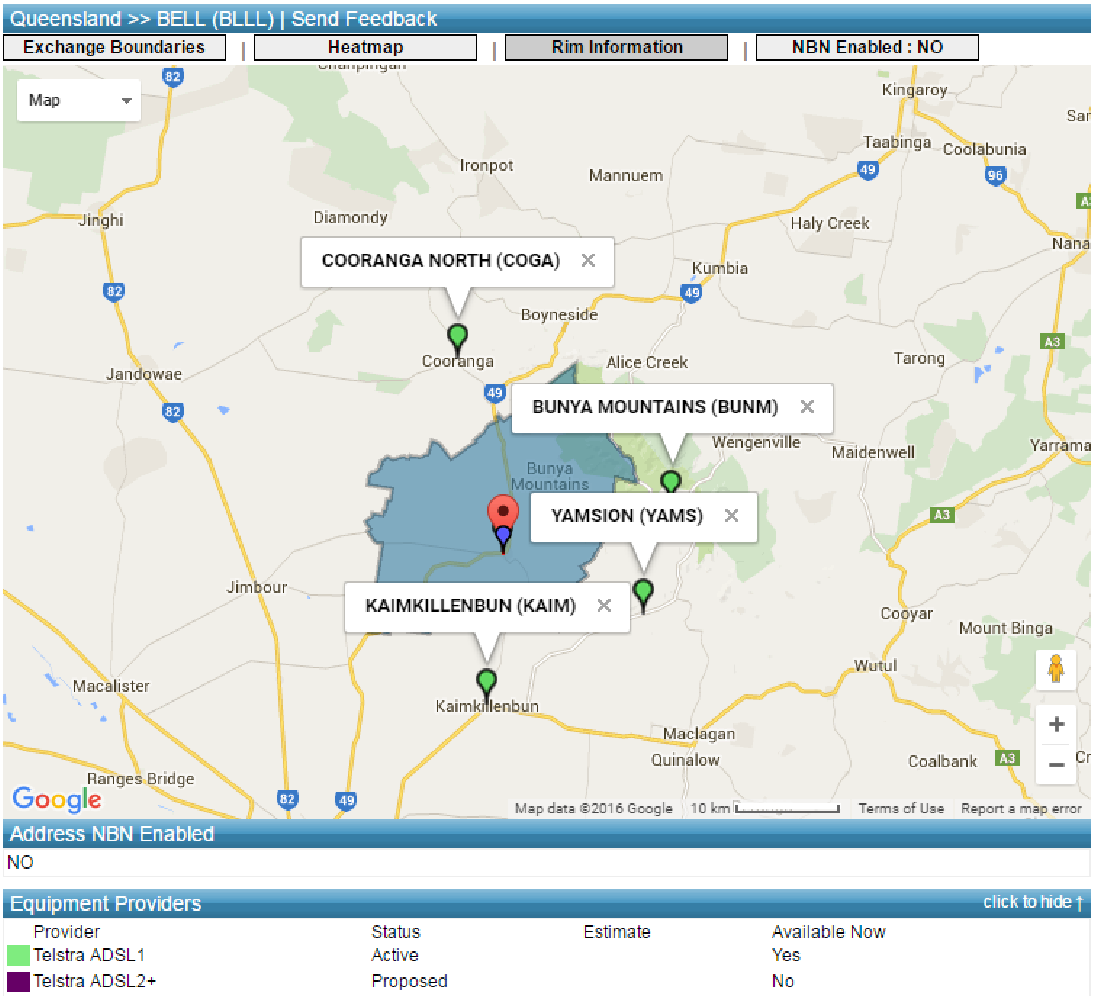

Figure 4-20 ADSL provider and coverage in Bell, WDR
Source from ADSL2-Exchanges (2016)

Table 4-21 ADSL Exchange equipment provider in Bell, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Bell	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Proposed	No
ADSL Exchange equipment nearby Bell			
Kaimkillenbun	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Yamsion	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Bunya Mountains	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Cooranga North	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are also four other ADSL telephone exchanges in small towns near Bell, namely, Kaimkillenbun, Yamsion, Bunya Mountains and Cooranga North. However, these telephone exchanges have no ports available for ADSL1 connections and ADSL2+ services are listed as planned for these telephone exchanges. Thus, Telstra would need to upgrade these telephone exchanges to support ADSL2+ services.

Analysis of ADSL Network Services coverage in Meandarra

Meandarra is a small town of the WDR with a population size of 250 people. In Meandarra, similar to Chinchilla, Miles, Wandoan and Condamine, Telstra provides the ADSL equipment exchange and they offer both ADSL1 and ADSL2+ services (see Figure 4-21 and Table 4-22).

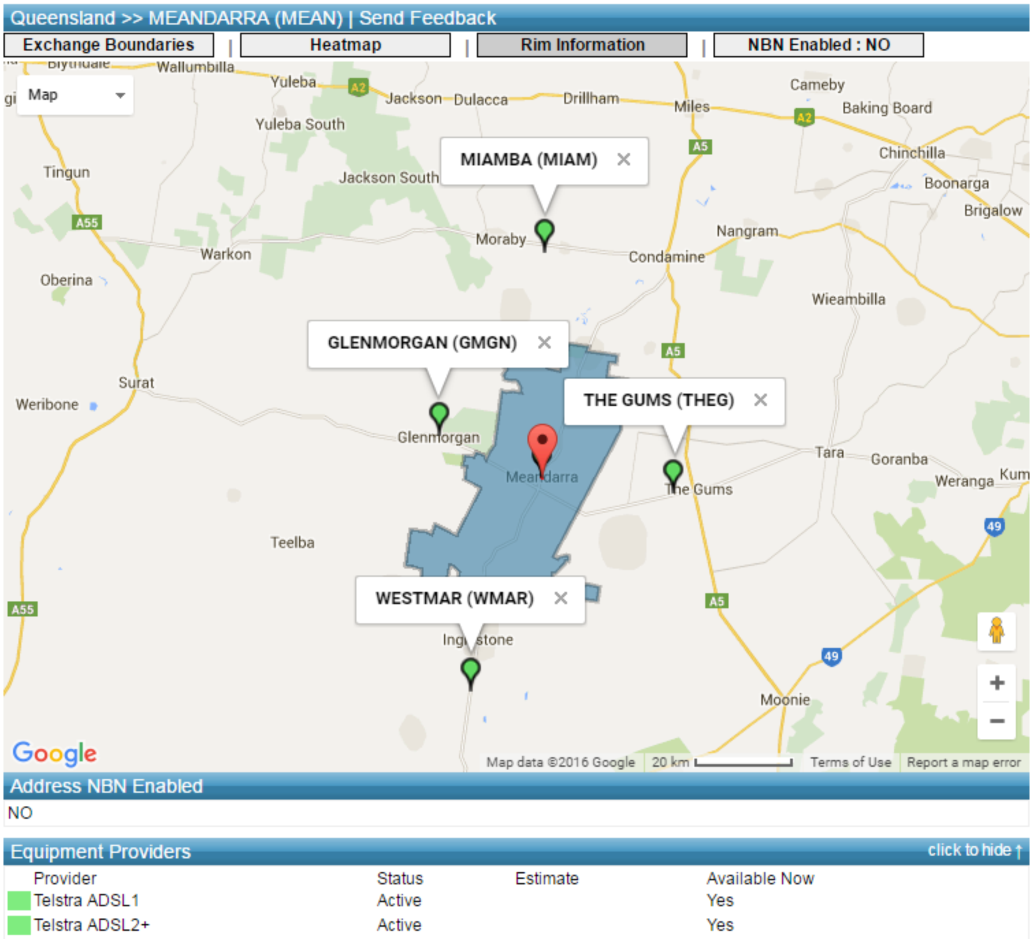

Figure 4-21 ADSL provider and coverage in Meandarra, WDR
Source from ADSL2-Exchanges (2016)

Table 4-22 ADSL Exchange equipment provider in Meandarra, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Meandarra	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Meandarra			
Glenmorgan	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Miamba	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Westmar	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

There are three other ADSL telephone exchanges in small towns nearby Meandarra, namely, Glenmorgan, Miamba and Westmar. However, these telephone exchanges have no ports for ADSL1 connection and ADSL2+ is listed as planned to these telephone exchanges (see Source from ADSL2-Exchanges (2016)
Table 4-22). Thus, Telstra would need to upgrade these telephone exchanges to enable support for ADSl2+ services in these smaller towns surrounding Meandarra.

Analysis of ADSL Network Services coverage in Kogan

Kogan is a very small town with a population of 40 people in the WDR. In Kogan, similar to other towns in the WDR, Telstra provides the ADSL equipment in the telephone exchange. However, currently there are no more ports available for ADSL1 and ADSL2+ services listed as planned for the telephone exchange by Telstra (see Figure 4-22 and Table 4-23).

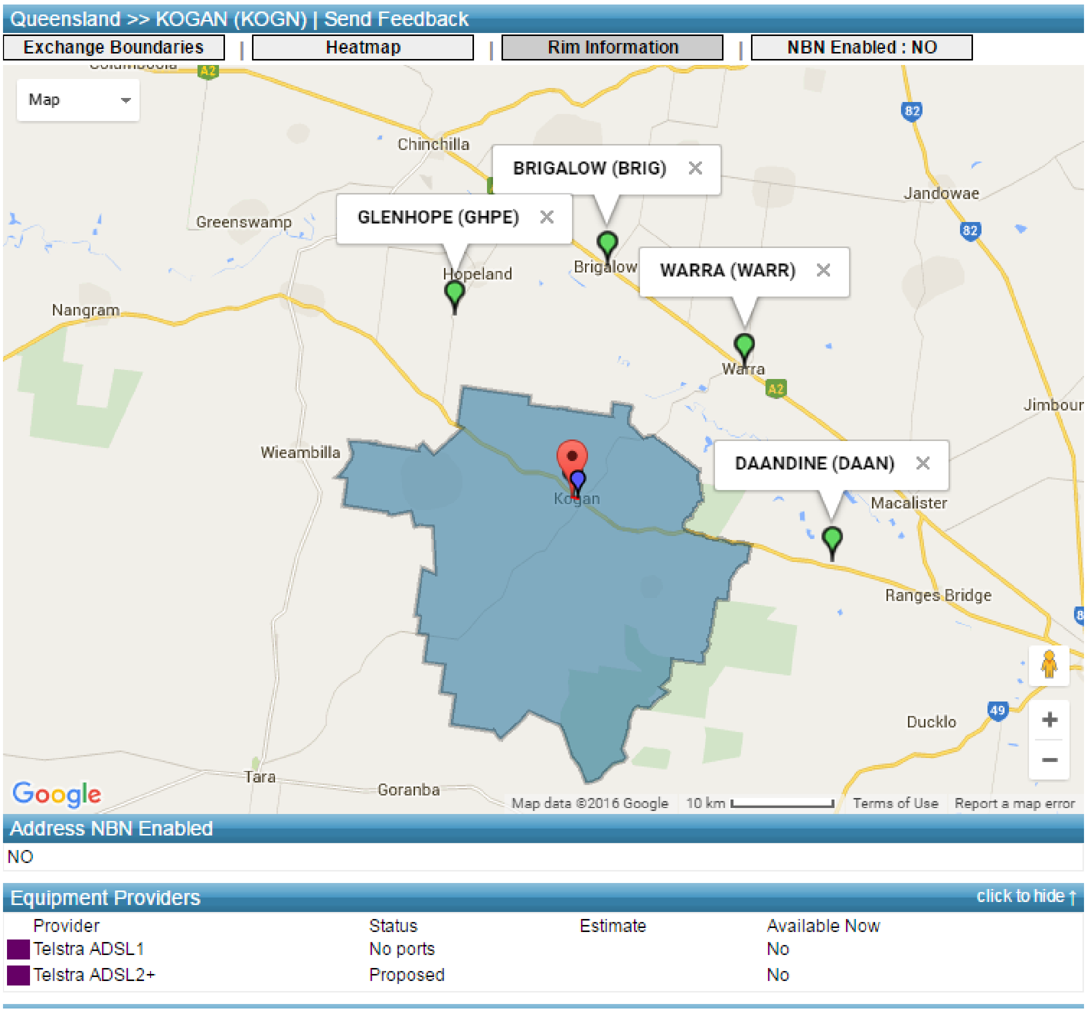

Figure 4-22 ADSL provider and coverage in Kogan, WDR
Source from ADSL2-Exchanges (2016)

Table 4-23 ADSL Exchange equipment provider in Kogan, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Kogan	Telstra ADSL1	Active	Yes
	Telstra ADSL2+	Active	Yes
ADSL Exchange equipment nearby Kogan			
Warra	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Glenhope	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No
Daandine	Telstra ADSL1	No ports	No
	Telstra ADSL2+	Proposed	No

Source from ADSL2-Exchanges (2016)

In the telephone exchanges of the small towns nearby Kogan—namely, Warra. Glenhope and Daandine—only ADSL1 services are available and no additional ports are available. ADSL2+ is listed as planned for the telephone exchanges in these small towns. Thus, Telstra would need to upgrade these telephone exchanges to support ADSl2+ services.

Analysis of ADSL Network Services coverage in Drillham

Drillham is another small town in the WDR with a population size of 70 people. In Drillham, there is no ADSL telephone exchange provider. The nearest ADSL telephone exchanges to Drillham are located in Dulacca, which is about 18 Km away; and Miles which is about 20 Km away (see Figure 4-23 and Table 4-24).

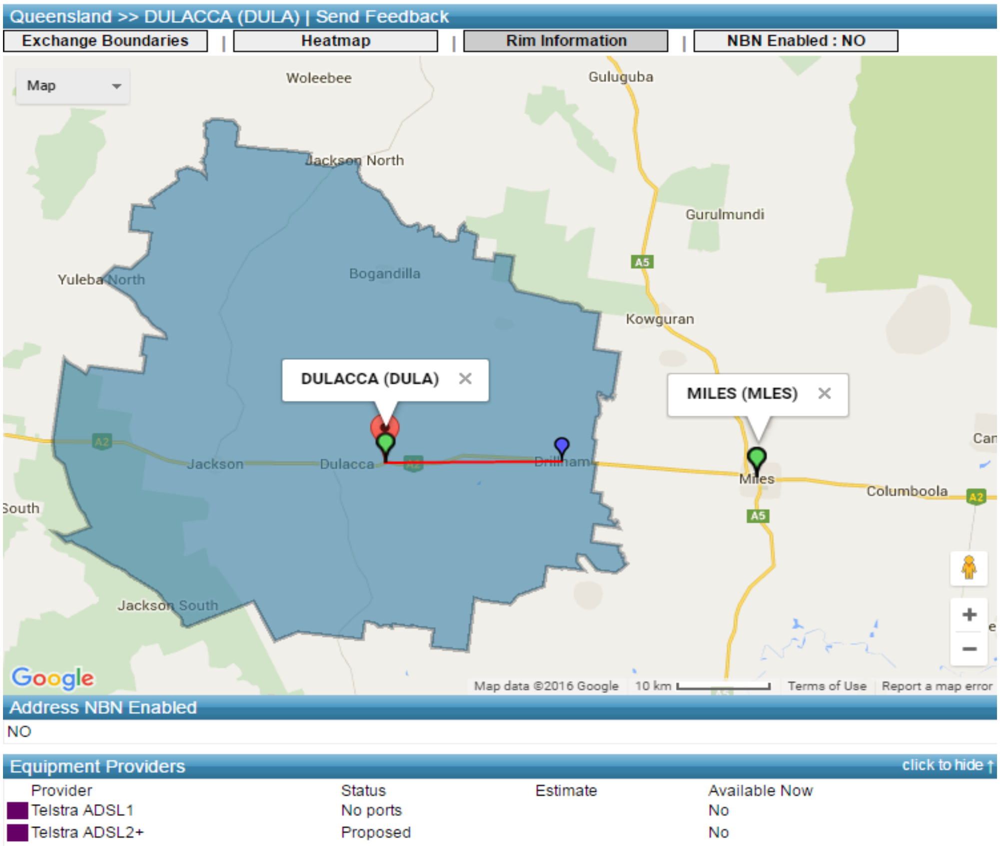

Figure 4-23 ADSL provider and coverage in Drillham, WDR
Source from ADSL2-Exchanges (2016)

Table 4-24 ADSL Exchange equipment provider in Drillham, WDR

Location	**ADSL/ADSL2+ Equipment providers**	**Status**	**Available Now**
Drillham	None	Not available	No

Source from ADSL2-Exchanges (2016)

4.3.5 Fibre networks in WDRC

There are two commercially-available fibre optic backbone networks in the WDR, namely, Nexium Telecommunication and NextGen Group. Nexium Networks is owned by Ergon Energy and provides a high-capacity bandwidth fibre optic network for the State of Queensland, Australia to service the data communications needs of Ergon Energy as a utility providing an electricity network. This fibre optic backbone network runs through three main towns in the WDR, namely, Dalby, Chinchilla and Miles (see Figure 4-24; (Nexium 2016).

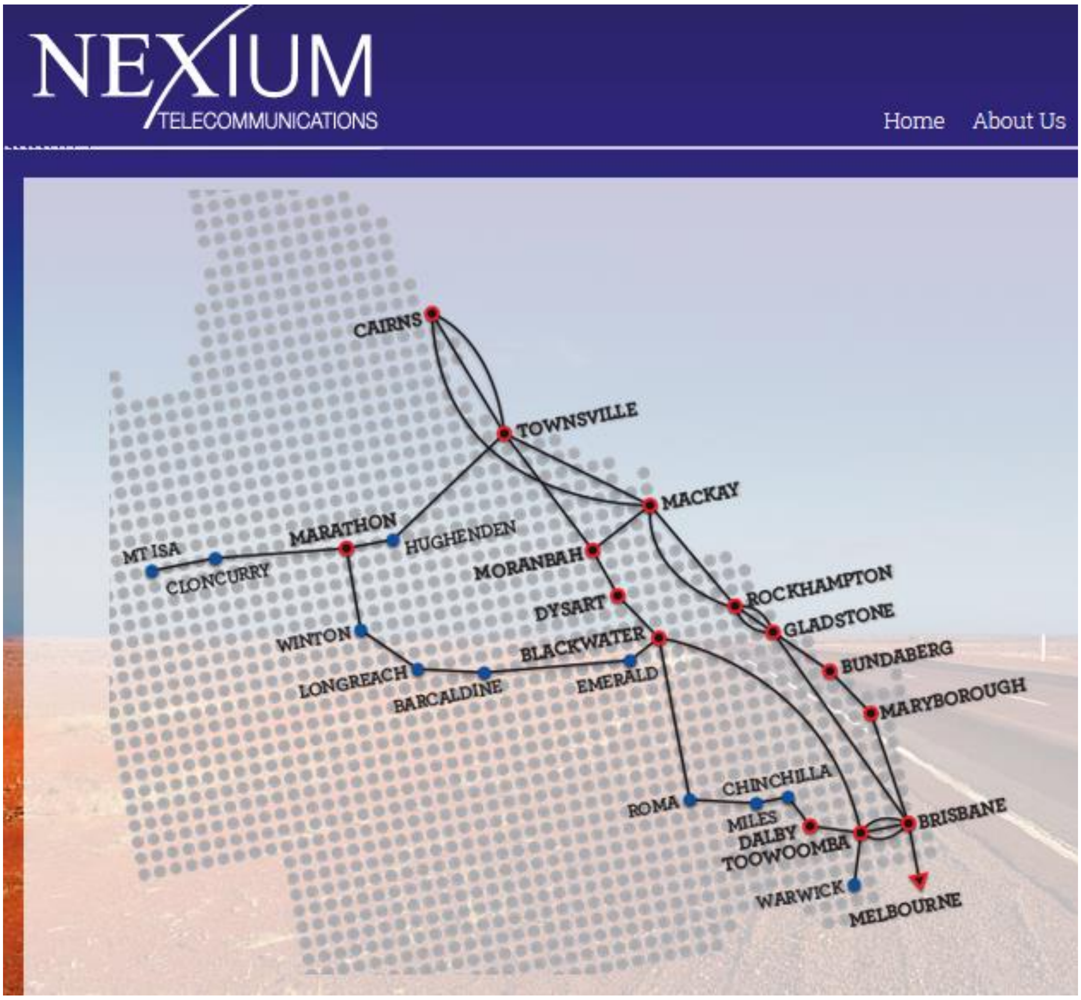

Figure 4-24 Nexium fibre optic backbone network in Queensland Australia
Source from Nexium (2016)

Similarly, Nextgen Group networks own and operate one of Australia's largest fibre optic networks, spanning over 16,000 kilometres and connecting to mainland capital cities and across regional and remote areas. Nextgen works on behalf of the Australian Government, which initiates the regional backbone blackspots program (RBBP) to address and provide competitive wholesale backbone services to under-serviced rural and regional markets. Similar to Nexium, Nextgen fibre optic backbone network runs through the three main population centres of Dalby, Chinchilla and Miles in WDRC (see Figure 4-25).

Figure 4-25 NextGen group fibre optic backbone network
Source from Nextgen (2015)

In their response to questions about the availability of Internet services, the researcher noted during the interviews with households that some households reported they have a fibre optic cabling running outside their gate, but they were unable to use it because there is no drop off points and these are extremely expensive to build.

The researcher was unable to find any documentation or maps regarding dark fibre that has been laid in the WDR. During the many field visits to the WDR it has been observed by the researcher that there is extensive dark fibre that has been laid throughout the WDR by coal seam gas (CSG) mining companies such as Queensland Gas Company (QGC–BG Group), Australia Pacific LNG (Origin Energy, ConocoPhillips and Sinopec). These are private commercial fibre optic networks with limited access granted to government for emergency services only.

4.4 ACCESS AND AVAILABILITY OF BROADBAND INFRASTRUCTURE IN THE WDR

Table 4-25 provides an summaryof the digital infrastructure, including broadband infrastructure that is available across all of the towns in the WDR.

Table 4-25 Mapping of digital infrastructure coverage in the WDR

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	Remoteness
Dalby	16000	Y	Y (* T)	Y(*±)	Y (C)	Y (All)	Y (All)	Inner Regional
Chinchilla	7200	Y	Y (T)	Y (T)	Y (C)	Y (All)	Y (All)	Outer Regional
Miles	1450	Y	Y (T)	Y (T)	Y (C)	Y (All)	Y (All)	Outer Regional
Tara	1100	Y	Y (T)	Y (±T)	N	Y (T)	N	Outer Regional
Jandowae	1000	Y	Y (T)	Y (T)	N	Y (TO)	Y (TO)	Outer Regional
Wandoan	400	Y	Y (T)	Y (T)	N	Y (TO)	Y (T)	Remote
Bell	300	Y	Y (T)	Proposed (T)	N	Y (TO)	Y(O)	Outer Regional
Meandarra	250	Y	Y (T)	Y (T)	N	Y(T)	Y (T)	Remote
Condamine	135	Y	Y (T)	Y (T)	N	Y (T)	N	Outer Regional
Dulacca	120	Y	N (±T)	Proposed (T)	N	Y (O)	Y(O)	Remote
Warra	120	Y	N (±T)	Proposed (T)	N	Y (TO)	Y(TO)	Outer Regional
Kaimkillenbun	100	Y	N (±T)	Proposed (T)	N	N^	N	Outer Regional
Drillham	70	Y	N	N	N	Y(T)	Y(T)	Outer Regional
Brigalow	40	Y	N (±T)	Proposed (T)	N	N^	N	Outer Regional
Kogan	40	Y	N (±T)	Proposed (T)	N	Y(T)	Y(T)	Outer Regional
Moonie	40	Y	N (±T)	Proposed (T)	N	N^	N	Remote
Jimbour	40	Y	N (±T)	Proposed (T)	N	N^	N	Outer Regional
Glenmorgan	20	Y	N (±T)	Proposed (T)	N	N^	N	Remote
Macalister	15	Y	N (±T)	Proposed (T)	N	N^	N	Outer Regional
Guluguba	10	Y	N (±T)	Proposed (T)	N	N^	N	Remote

Legend Y = Available; N = Not Available; N^ = Rely on signal from mobile phone tower in neighbouring town; C = Commerical Use Only; T= Telstra; O= Optus; V=Vodafone Y(All)= Telstra, Optus & Vodafone; TO= Telstra & Optus; TV= Telstra & Vodafone, * = Agile (Internode) and Chime (iiNet); ± = Telstra no ports available.
[Notes: **Satellite broadband** - Coverage of entire region but only available to households and businesses in remote areas with no access to alternative broadband services
Radio networks - Proprietary radio networks cover the entire region but are not available to general public and are beyond the scope of this study]
Source from ADSL2-Exchanges (2016); and RFNSA (2016)

In Table 4-25, the green colour indicates that the broadband infrastructure for a particular service is available in those locations' whereas yellow indicates it is available, but reliability and speed are limited. Blue colour indicates a particular service provider proposes to install the network equipment necessary for a broadband service in that location, but there is no indication when this broadband service would be available. Red colour indicates the broadband infrastructure for a particular service is not available at all. Y (All) indicates three mobile network service providers—Telstra, Optus and Vodafone—are available in those locations. Similarly, **T** indicates Telstra mobile network service is available in that location, **O** indicates Optus mobile network service is available in that location and **V** indicates Vodafone mobile network service is available in that location. When examining the towns across the WDR by AGSC classification for remoteness it can clearly be seen that the more remote towns and surrounding localities have poor broadband infrastructure coverage. Some of the remote towns do not have ADSL-enabled telephone exchanges and have limited or no 3G mobile network coverage.

Table 4-25 clearly shows that the Public Switched Telephone Network (PSTN) coverage of the population centres in the WDR is complete. PSTN is the international analogue circuit switched telephone system designed primarily for voice traffic. This is an important technology as it provides the underlying broadband infrastructure for DSL-enabled telephone exchanges. Almost all of the larger towns in the WDR have ADS-enabled exchanges and 9 larger towns—Dalby, Chinchilla, Miles, Tara, Wandoan, Bell, Jandowae, Meandarra and Condamine—have access to ADSL1 and ADSL2+ broadband services, while Bell does not have ADSl2+ services. However, most of the smaller towns have telephone exchanges, but these exchanges are not active with ADSL services and ADSL2+ is listed as planned as an update to these telephone exchanges but with no indication of when that will occur.

This research analysis of the three mobile networks (Telstra, Optus and Vodafone) providing mobile phone coverage in Australia was based on the location of mobile cell towers across 20 towns and localities in the WDR drawing on the data available in the RFNSA website and on testing of the speed and reliability of mobile network services using the OpenSignal App (see Table 4-14). From the analysis of these data sources this study was able to determine the availability and reliability of mobile broadband services as follows. The eleven towns in the WDR, namely Dalby, Chinchilla, Miles, Jandowae, Wandoan, Bell, Meandarra, Dulacca, Warra, Drillham and Kogan have 4G coverage. All of the towns have access to some form of 3G mobile broadband service, although the reliability and signal strength is highly variable—particularly in the smaller towns in the WDR as evidenced by the analysis of mobile network services in terms of download and upload speeds using the Mobile App OpenSignal (see Table

4-14). Telstra has the most complete mobile network coverage in the WDR, while the footprint of the Optus mobile network is currently restricted to seven towns: namely, Dalby, Chinchilla, Miles, Jandowae, Bell, Warra, Wandoan and Dulacca; and the Vodafone mobile network footprint is limited to three large towns in the WDR — Dalby, Chinchilla and Miles. Interestingly, there are small towns such as Kaimkillenbun and Macalister in the WDR where no mobile network towers are located in those towns or nearby. Although these towns have partial mobile network signal coverage from the mobile towers located in neighbouring towns, the mobile network signal and coverage is very patchy and unreliable. Satellite broadband services theoretically cover the entire region of the WDR, but are only available to households that can establish that they do not have access to fixed line broadband services such as ADSL/ADSL2+ or mobile broadband services.

Fibre optic backbone networks of Nexium and Nextgen run through the three main towns of Dalby, Chinchilla and Miles in the WDR, but these networks are limited to access solutions for ISP business and government agencies only. Other proprietary radio networks which have extensive coverage in the WDR (not listed in Table 4-25) were built by mining companies (such as QGC and Origin Energy) and Queensland Rail. These networks are dependent on the capability of specific organisations and individuals to set up and maintain the infrastructure to these radio networks. These networks are not available to the general public and access is limited to local government emergency services in the case of emergencies.

Finally, this infrastructure analysis of the WDR revealed that there is significant broadband infrastructure which is proprietary and is currently not fully utilised, despite there being significant impediments in broadband infrastructure provided by the three national telecommunications carriers. Telstra provides the PSTN network that underpins the current fixed line ADSL broadband services and provides extensive coverage of the wireless mobile broadband network services. There is also satellite broadband, but access is limited to residents who do not have access to any existing wired or wireless broadband service.

Further, an analysis of the broadband infrastructure in other rural regions of Queensland, Tasmania and New South Wales using the same methodology revealed a similar picture in terms of the availability of broadband infrastructure in rural Australia.

4.5 WIRED AND WIRELESS BROADBAND AVAILABILITY ASSESSMENT - SELECTED RURAL REGIONS IN AUSTRALIA

This section provides a summary of the digital infrastructure, including broadband infrastructure, available in the Southern Downs Regional Council, Goondiwindi Regional Council**,** Southern Midlands Council, West Coast Council, Gilgandra Shire, Narrabri Shire. The same methodology was used to determine the status (supply) of broadband infrastructure for these rural regions as was used for Western Downs Region.

Queensland

Table 4-26 Southern Downs Regional Council

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Warwick	16,000	Y	Y	Y	N	Y (All)	Y (All)	Inner Regional
Stanthorpe	5,500	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Allora	1,276	Y	Y	Y	N	Y(T)	Y(T)	Inner Regional
Killarney	911	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
The Falls	197	Y	N (±T)	Proposed (T)	N	N	N	Outer Regional

Table 4-27 Goondiwindi Regional Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Goondiwindi	6,397	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Inglewood	1,069	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Texas	1,159	Y	Y	Y	N	Y(TO)	Y(TO)	Remote
Yelarbon	493	Y	Y	Proposed (T)	N	Y(TO)	Proposed (TO)	Outer Regional
Toobeah	218	Y	N (±T)	Proposed (T)	N	Proposed (T)	Proposed (T)	Remote
Bungunya	189	Y	N	N	N	N	N	Remote

Tasmania

Table 4-28 Southern Midlands Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Bagdad	1,266	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Mangalore	521	Y	N	N	N	Y (T)	Y (T)	Outer Regional
Kempton	353	Y	Y	Y	N	Y(T)	Proposed (T)	Outer Regional

Table 4-29 West Coast Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Queenstown	1975	Y	Y	Y	N	Y (TO)	Y (O)	Remote
Strahan	824	Y	Y	Y	N	Y (T)	Y (T)	Remote
Rosebery	922	Y	Y	Y	N	Y (TO)	Y (O)	Remote

New South Wales

Table 4-30 Gilgandra Shire (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Gilgandra	2,700	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Tooraweenah	371	Y	Y	N	N	Y (TV)	Y(V)	Outer Regional
Armatree	284	Y	N (±T)	Proposed (T)	N	Y (T)	N	Outer Regional

Table 4-31 Narrabri Shire (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Narrabri	7,392	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Wee Waa	2,089	Y	Y	Y	N	Y(TO)	Y(T)	Outer Regional
Baan Baa	525	Y	N (±T)	Proposed (T)	N	Y(TO)	Y(T)	Outer Regional

Legend Y = Available; N = Not Available; T= Telstra; O= Optus; V=Vodafone Y (All) = Telstra, Optus & Vodafone; TO= Telstra & Optus; ±T = Telstra no ports
[Note: this figures were captured during the study which may be different other time]
Source from ADSL2-Exchanges (2016); and RFNSA (2016)

Table 4-26 to Table 4-31 shows that similar to WDR the PSTN coverage is complete throughout all of the population centres across the selected 6 rural areas across three states, Queensland, Tasmania and New South Wales. Similar to WDR, almost all of the larger towns in the selected rural regions have ADSL-enabled exchanges. Similar to WDR, most of the smaller towns have telephone exchanges, but these telephone exchanges are not enabled for supporting ADSL services. However, ADSL2+ is listed as a planned update to these telephone exchanges but with no indication of when that will occur. The results of this comparison of 6 other rural regions across three states shows that the larger towns of the rural regions are generally well serviced by both ADSL and mobile phone networks such as 3G and 4G, although the coverage by the Optus and Vodafone mobile phone networks is not anywhere as extensive as Telstra's mobile phone network. However, small and less populated towns have limited ADSL coverage or ADSL2+ is only listed as a proposed service and limited mobile phone network coverage. Thes results revealed and suggest that most of the rural Australia has similar picture as WDR in terms of the availability of broadband infrastructure.

4.6 CONCLUSION

This chapter presented the results of a detailed analysis of digital infrastructure, including broadband infrastructure availability in the WDR. The data for this analysis of the broadband infrastructure in the WDR were archival data and data from publicly-contributed data from the social media website ADSL2 Exchanges, the government website RFNSA and field data collected using Open Signal mobile app. This allowed the researcher to construct a mapping table that provided an overview of the wired and wireless broadband infrastructure availability across the WDR. The result of the study highlighted that the populated areas of the WDRC are generally well-serviced by both ADSL and mobile phone networks, although the coverage by the Optus and Vodafone mobile phone networks is not anywhere as extensive as Telstra’s mobile phone network. Comparative analysis of the status (supply) of broadband infrastructure in other rural regions using the same methodology used for WDR suggest that the most of the rural Australia has a similar condition to WDR in terms of the availability of broadband infrastructure.

In the next chapter, the results of the analysis of household interviews are presented and discussed.

Chapter 5: Data analysis of interview sample

5.1 INTRODUCTION

The previous chapter, Chapter 4, presented the results of a detailed analysis of broadband infrastructure availability (including coverage and quality) in the Western Downs Region (WDR) based on archival and field data. This chapter presents and discusses the results of the data analysis of 25 semi-structured interviews of households in the WDR regarding broadband adoption, use and its impact in rural communities. This chapter addressed research questions 1, 2 and 3 from the household perspective and insights and understanding provided of their broadband adoption and use of broadband and its impact on household through 25 interviews of the major decision maker in each household. Most of the quantitative data present in this chapter were recorded in spread sheets by interview participant and interviewerduring the interview. NVivo has used to coding with each individual questions to analysis the interview questions. Figure 5-1 presents an overview of the structure of this chapter.

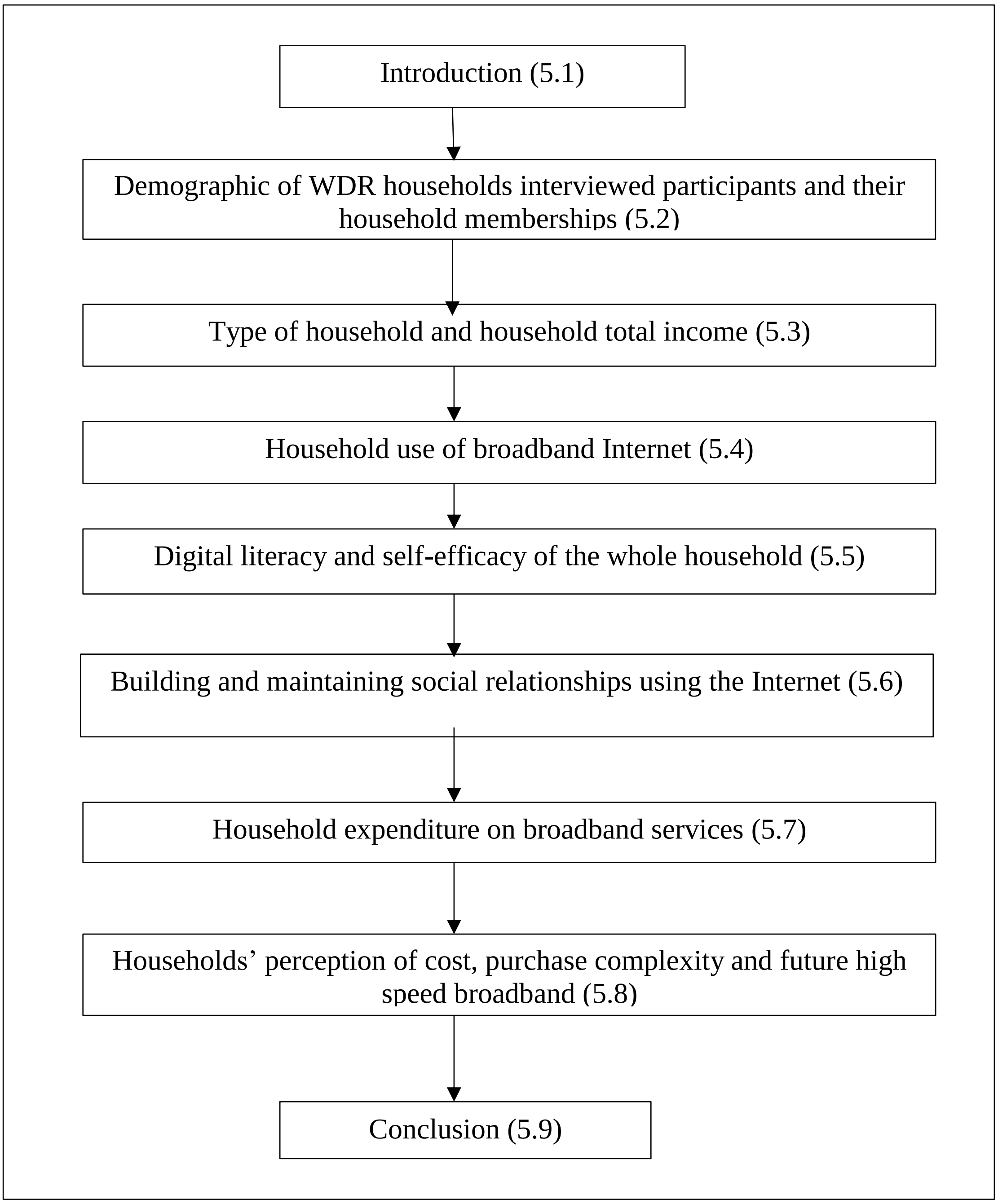

Figure 5-1 Outline of Chapter 5 with section numbers in brackets

5.2 DEMOGRAPHIC OF WDR HOUSEHOLDS INTERVIEWED PARTICIPANTS AND THEIR HOUSEHOLD MEMBERSHIPS

Prior to discussing the key findings from the interviews of 25 households across 13 towns in the WDR, it is essential to have an understanding of the interview participants and the make-up of their households. Table 5-1 shows the geographical distribution of the interview participants across the WDR by town and ASGC remoteness classification. To ensure a good representation the researcher conducted 25 interviews across 13 towns in the WDR of both major population locations and less populated and more remote locations.

Table 5-1 Number of Interviews in the WDR by town and ASGC remoteness classification

Location in WDR	**Population**	**Number of Interview**	**Percentage**	**Remoteness**
Jandowae	1000	4	16%	Outer Regional
Chinchilla	7200	3	12%	Outer Regional
Bell	300	3	12%	Outer Regional
Tara	1100	2	8%	Outer Regional
Moonie	40	2	8%	Remote
Miles	1450	2	8%	Outer Regional
Meandarra	250	2	8%	Remote
Dalby	16000	2	8%	Inner Regional
Wandoan	400	1	4%	Remote
Dulacca	120	1	4%	Remote
Drillham	70	1	4%	Outer Regional
Condamine	135	1	4%	Outer Regional
Brigalow	40	1	4%	Outer Regional
Total		25	100%	

The demographic characteristics of the households presented in Table 5-2 include the gender, age and education of each household member. The researcher stated in Chapter 3 that the interviews were conducted with the major decision-maker(s) of each household. In most cases, the household member is coded as household member number (HM1) and is the adult and major decision-maker interviewed for each household in this study. However, in some cases, both HM1 and HM2 (male and female, etc.) were both present during the interview. An asterisk (*) sign in Table 5-2,

Table 5-5 and Table 5-6 indicates which particular household members were present during the interview.

Table 5-2 Summary of household membership by gender, age and education level

	Households Member (HM) Gender M- Male; F- Female					**Households Member (HM) Age**					**Households Member (HM) Education level** P- primary; S- secondary; T- training; D- diploma; U- under-graduate; PG- post graduate					
Interview Number	**HM 1**	**HM 2**	**HM 3**	**HM 4**	**HM 5**	**HM 1**	**HM 2**	**HM 3**	**HM 4**	**HM 5**	**HM 1**	**HM 2**	**HM 3**	**HM 4**	**HM 5**	**Mode Education level for household**
ID1	**F***	M	F	M		23	24	6	4		S	T	P			N/A
ID2	**F***	F	F	F	F	61	36	34	32	30	U	U	PG	D	U	U
ID3	**F***	M	F	F	F	68	48	45	40	31	D	D	U	D	U	D
ID4	**M***	F	M	M	M	49	51	17	14	12	S	U	S	S	P	S
ID5	**M***	M	**F***			42	48	45			T	T	T			T
ID6	**M***	**F***	M	F	M	40	38	12	10	6	U	S	S	P	P	S, P
ID7	**M***	F	F	M	M	50	48	25	21	14	U	U	U	U	S	U
ID8	**M***	**F***	F	F	M	60	56	38	26	24	S	S	S	S	S	S
ID9	**M***	F	M	F		64	69	34	32		S	P	D	U		N/A
ID10	**M***	**F***	F			52	53	17			S	S	S			S
ID11	**F***	M	M	M		26	34	5	2		S	S	P			S
ID12	M	**F***	M	F		62	50	11	9		T	S	P	P		P
ID13	**F***	M	F	F		59	59	33	24		S	S	S	S		S
ID14	**F***	M	F	F	F	42	37	8	6	4	D	D	P	P	P	P
ID15	**F***	M	M			55	65	25			U	U	D			U
ID16	**M***	F	F			32	32	3			U	U				U
ID17	**F***	M	F	M		42	47	16	13		D	S	S	S		S
ID18	**M***	F				24	23				U	D				N/A
ID19	**F***	M	F	M		41	42	11	8		S	S	P	P		S, P
ID20	**M***	**F***	F	F	F	75	65	47	46	44	S	S	U	U	U	U
ID21	**F***	M	F	F		49	53	22	19		U	S	U	U		U
ID22	**F***	M	F	F	F	63	69	35	33	32	S	S	S	S	S	S
ID23	**F***	M				20	26				D	S				N/A
ID24	**F***	M	F	M		41	45	17	18		S	S	S	S		S
ID25	**F***	**M***	F	M		31	31	10	6		D	S	P	P		P

Table 5-2 shows that the majority (13) of the interview participants in each household were above the age of 45. Almost half (11) of the interview participants have secondary level education, followed by under-graduate education (7). Moreover, most common (mode) highest education level for the whole household is secondary level (10), followed by undergraduate (6) and primary (5).

5.3 TYPE OF HOUSEHOLD AND HOUSEHOLD TOTAL INCOME

Table 5-3 shows the different configurations of households that participated in interviews across the WDR. Twelve of the household interview participants were a couple, or family with children not living at home; followed by 10 households which comprised a couple, or family with children living at home. Two of the household interview participants were a couple, or family with no children; and one household interview participant was a single person living with others.

Table 5-3 Demographic of households—Type and Income

<table>
<tr><th>Variable</th><th>Category</th><th>Count</th><th>Percentage</th></tr>
<tr><td rowspan="5">Household Types</td><td>Single person living with others</td><td>1</td><td>4%</td></tr>
<tr><td>Couple/family with no children</td><td>2</td><td>8%</td></tr>
<tr><td>Couple/family with children at home</td><td>10</td><td>40%</td></tr>
<tr><td>Couple/family with children not living at home</td><td>12</td><td>48%</td></tr>
<tr><td>Total</td><td>25</td><td>100%</td></tr>
<tr><td rowspan="8">Annual Household Income</td><td>under $19,999</td><td>0</td><td>0%</td></tr>
<tr><td>$20,000 - $39,999</td><td>4</td><td>16%</td></tr>
<tr><td>$40,000 - $59,999</td><td>6</td><td>24%</td></tr>
<tr><td>$60,000 - $79,999</td><td>2</td><td>8%</td></tr>
<tr><td>$80,000 - $99,999</td><td>5</td><td>20%</td></tr>
<tr><td>$100,000 - $120,000</td><td>2</td><td>8%</td></tr>
<tr><td>Over $120,000</td><td>6</td><td>24%</td></tr>
<tr><td>Total</td><td>25</td><td>100%</td></tr>
</table>

The majority of the interview participants, 10 (40%), indicated that their household's annual income fell between the range $20,000–$59,999. A total of 9 (36%) of the interview participants indicated that their household had a middle range annual income between $60,000-$120,000. In comparison, 6 (24%) of the interview participants had an annual household income over $120,000.

5.4 HOUSEHOLD USE OF BROADBAND INTERNET

The interview participant responses to the following questions provided descriptive information about their households' use of broadband Internet services in the WDR.

- Who (including you) in your household uses the Internet?
- How long has your household been using the Internet?
- What kind of Internet connections are used by your household?
- Where do members of your household access the Internet?
- Which of these devices are used by household members to access the Internet?
- What activities do your household members use the Internet for?
- What has influenced your household's adoption of the Internet?

5.4.1 Who (including you), in your household uses the Internet?

Table 5-4 shows how many members of a household for each of the interview participants are using the Internet or, in other words, the density of Internet users in a household. The researcher asked 'Who, including yourself, in the household uses the Internet?' to determine how many household members are using the Internet.

Table 5-4 Number of household members using the Internet

Interview Number	**Some comments on: "Who including you in your household uses the Internet?"**	**Number of household member using Internet**
ID1	I do and my partner does, and sometimes the children do, but very rarely	4
ID2	Just me	1
ID3	Just me	1
ID4	My fiancé and then two of my sons	4
ID5	All of us. There's 3 of us	3
ID6	All of us. Yeah like two adults and then three kids from 6 to 12.	5
ID7	It's pretty much all of us, so that's me, my wife and my young son	3
ID8	That would be me. Colleen can, but she doesn't.	1
ID9	Myself and my wife. There is only two of us living in here. When my son and daughter are home once or twice a year they may use it but they've usually got their own laptops with them.	2
ID10	There's 3 of us	3
ID11	Myself, my husband and my little man is just starting to use the computer because he's in prep, does mathematical things.	3
ID12	I'm the main user, but we have two school aged children.	3

ID13	Well I use it, my husband uses it. And we're the only two at home - the two daughters live here and they both use it, so.	2
ID14	There's myself who's a mediocre user, more so at work. My husband who is a heavy user. And then I was just about to say my eight, six and four year old do use the Internet as well.	5
ID15	Myself, my husband doesn't want to touch it.	1
ID16	So myself and my wife. And I guess you could say, our 2 year old daughter	3
ID17	My husband and 2 teenage children	3
ID18	Just me	1
ID19	Well my partner's the main one, he's always using it. We don't let the kids on the Internet.	2
ID20	I don't use it, Just wife	1
ID21	My husband, the (kids) both live away now, but when they're home they use it but then they complain about how little we've got and how bad it is.	2
ID22	My husband and myself. Just the two of us – there is only two of us in the house.	2
ID23	Yeah both me and my partner use the Internet	2
ID24	It just mum myself and yeah partner	3
ID25	Yes I do, [Husband] A little bit and [Kids] at school they do	4

These direct quotes from the interviews show most household members are using Internet—even young children these days are likely to use a device like an iPad to access the Internet for educational and entertainment activities.

5.4.2 How long has your household been using the Internet for?

Figure 5-2 shows how long households have been using the Internet. The distribution is slightly skewed to the right. Interestingly, more than three quarters (84%) of households interviewed have been using the Internet for more than 11 years, when the primary means of accessing the Internet was via narrowband and a dialup modem. This finding would suggest that most households have well and truly moved beyond the adoption phase to the use phase. Sixteen percent of households started using the Internet since 2005. ADSL broadband Internet services become readily available in 2005 across Australia when Telstra upgraded their telephone exchanges *en masse* to support ADSL broadband services (Fletcher 2009; Islam, Selvadurai & Town 2008).

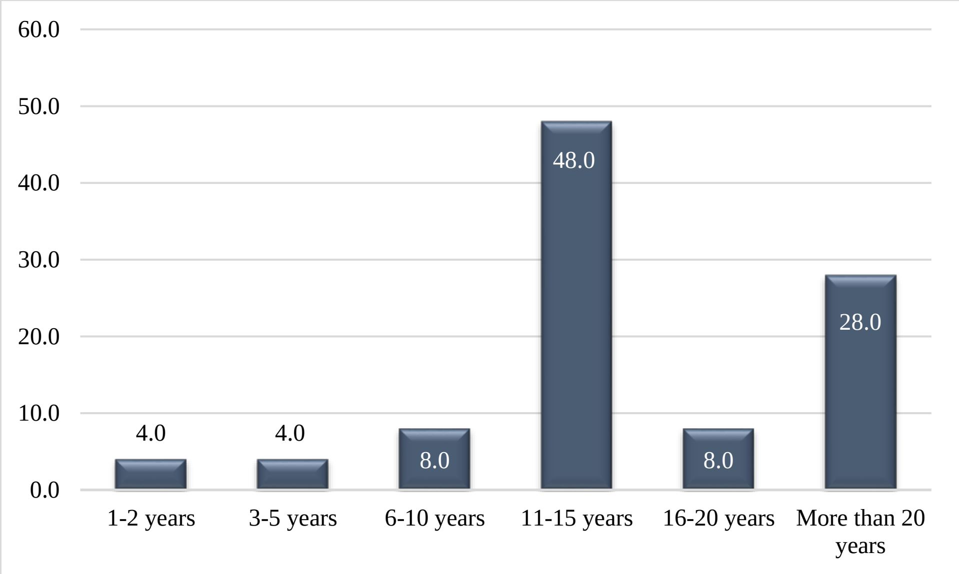

Figure 5-2 Number of years since household first started using the Internet

Below are some of the quotes from interview participants regarding number of years that they have been using the Internet:

As soon as it was available in Chinchilla – '90 – I'm not sure about the exact year. It would have been in the nineties, yeah – fives, sixes, somewhere around there. [ID7]

It would have been early 2 – oh for me it wouldn't been- Earlier than that. Probably '80, '98 '97, '98 was when I started using … It was dialup (Makes noise of modem). [ID5]

When it first came out, so …so it was back in the 90s [ID8]

I was using it back in '95 when I was a teenager- [ID16]

About 2000 because we got it before we got married. About 2000. It was the year we got married. We started off with dial up- [ID6]

A number of years – 10+. It could be 10 – it could be 15. [ID9]

Yeah, well that was a long time ago, I don't know, ten years ago. [ID11]

About 2002 in … That was dialup. [ID12]

These quotes show that majority of the interview participants have been using the Internet from the early days of Internet being available for public use in Australia when the dominate access technology was narrowband dial-up.

5.4.3 What kind of Internet connections are used by your households?

Figure 5-3 shows what type of Internet connection technology is used by households to access the Internet. Note that households are increasingly using more than one type of Internet connection technology, but the most widely-used Internet connection technologies in the WDR are 3G/4G mobile broadband (92%), ADSL/ADSL2+ broadband (64%) and satellite broadband (8%). Not surprisingly, none of the participant households are using dial-up modems to access the Internet anymore.

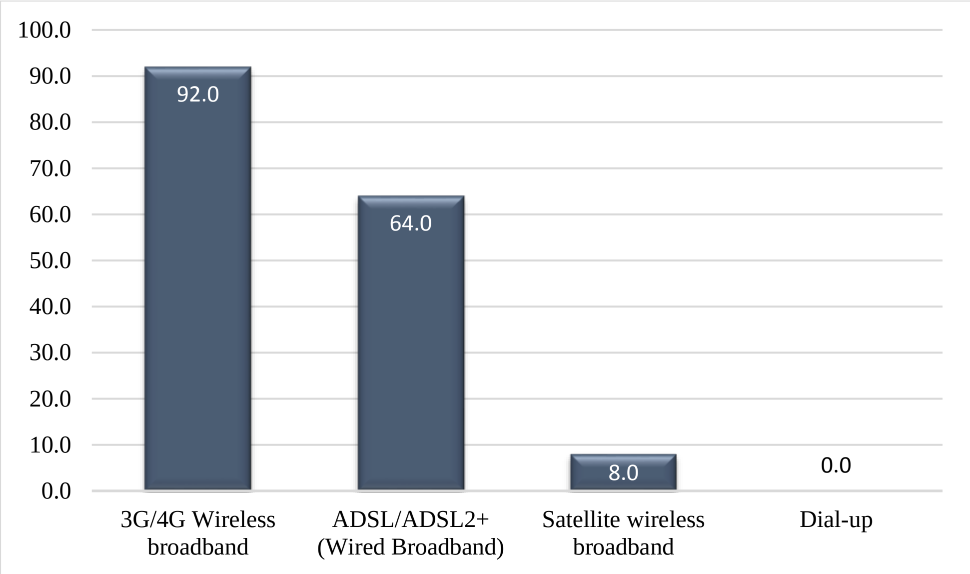

Figure 5-3 Type of Internet connection used by households

As early as 2005 ADSL broadband Internet services became readily available across Australia; however, ADSL enabled telephone exchanges were later updated with ADSL2 in the major towns in the WDR. In recent years wireless broadband has become much more widely available and, hence, used as a broadband access technology as mobile phone networks have evolved and moved to 3G and 4G capability. The following quotes from the interview participants regarding the type of Internet connection used by households highlight many of these points:

It's ADSL2, so it's better than ADSL1, and we have 3G wireless connection. There's a tower out there, as well. [ID16]

Well yeah, 3G that's what we've got here. [ID8]

Satellite was way out past Taroom in the middle of nowhere, that's the only thing you can get out there. ADSL was in Miles… And the 3G broadband well I used that, it was a portable one so you sat it anywhere. [ID11]

We purchased our house here 6½ years ago, we still had dialup at the time. We've had broadband Internet probably for just over a year, 2012. [ID12]

I was using 3G for 4 years. [ID17]

First we had the broadband unlimited and then we went to 3G when we moved here. [ID19]

These quotes from the interviews show that the majority of households are using wireless broadband such as 3G/4G as it is the most widely available broadband service in the WDR (as evidenced in Chapter 4 Table 4-25), but are also using wired broadband such as ADSL and ADSL2+ when it is available in their location.

5.4.4 Where do members of your household access the Internet?

Figure 5-4 shows that all households interviewed are accessing the Internet from their home, while almost 92% of households are accessing the Internet from work; 88% from public places; 52% from school, TAFE or university; and 10% from libraries. Interestingly, 47% are accessing the Internet while on the move (travelling), which indicates that the increasing availability and influence of wireless mobile networks is helping rural households to gain access to the Internet.

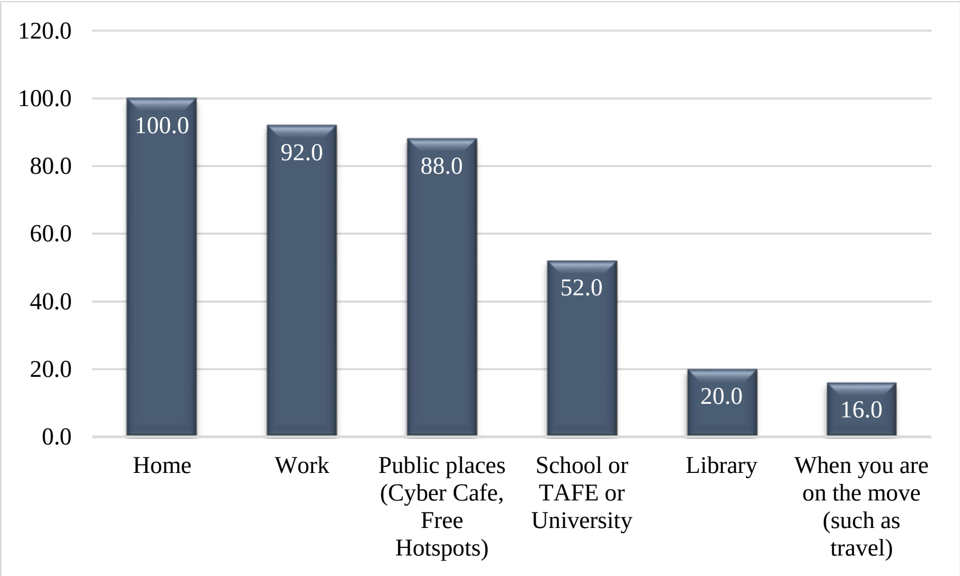

Figure 5-4 Where members of households access the Internet

Some direct quotes from the household interviews highlight where households are accessing the Internet:

Yeah, I use it anywhere, like even if I go to a friend's house I'll be using it up there. For partner so, at home, work, and public places, Yep. And then children, it would be at home and at school, I suppose, Yeah. [ID1]

I don't think there's many jobs where you're not using it these days is there? [ID3]

Home and work. Well, yeah if we go travelling we take a little wireless broadband thing with us. [ID7]

Would access it at home, at work, at school, Public places, yeah. [ID11]

No just here [Home]. The children do access it in the school. [ID12]

So, in terms of using the Internet, using it at home, work, and in public places with the 3G wireless, yeah [ID16]

These direct quotes from the interview participants show that nowadays the Internet is becoming more accessible everywhere due to the increased coverage of wireless mobile networks, and most businesses, workplaces and schools are now using the Internet.

5.4.5 Which of these devices are used by household members to access the Internet?

Figure 5-5 shows that at 92% laptops and Netbooks are the most common devices used by households to access the Internet. At 72% each, Smart phones and desktop computers are equally the second most common devices used by households to access the Internet; while at 61%, tablets are the fourth most common device used by households to access the Internet. To a lesser extent at 8% Internet TV is one way to access the Internet, while there none of the households indicated they are using gaming consoles to access the Internet.

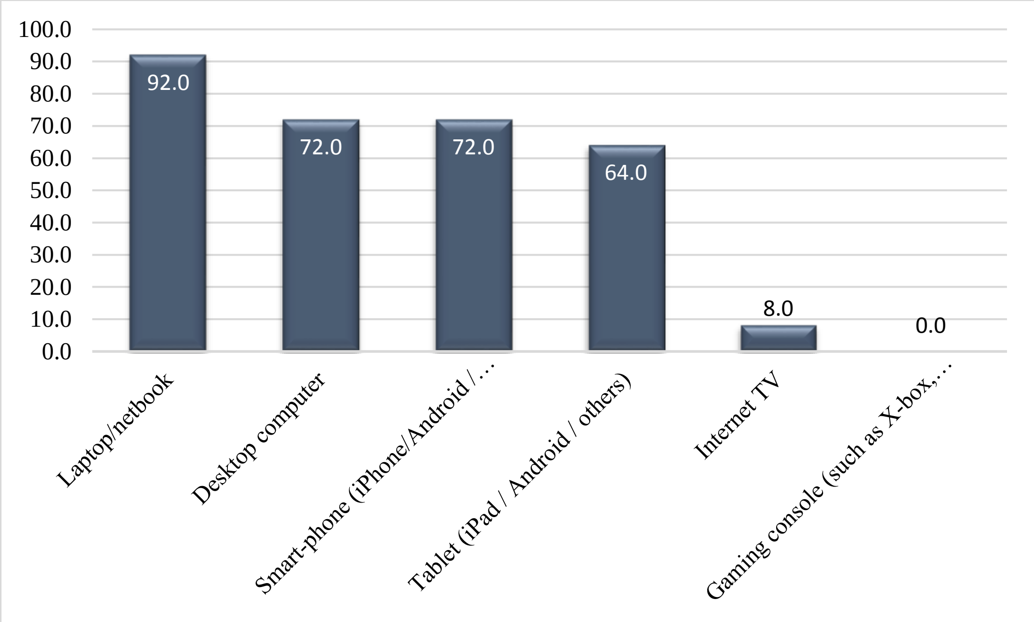

Figure 5-5 Different devices used by households to access the Internet

Some direct quotes from the interview participants highlight the types of devices that are used by their household to access the Internet:

Yeah my husband's got a laptop that we use and I've got a little notebook one I just call it. Like a little laptop. Yeah one desktop, quite a few years – I don't know probably five or so years could be longer. [ID22]

Yes desktop, No we don't have a laptop. [ID9]

No we don't have (Desktop). I have a laptop and we've got iPad too, four, one for everybody. Yeah, smart-phone I have one and he's got one, yes [ID1]

I have a desktop and a laptop. The desktop is just about on its last legs but it still works. Probably about 1996 I got the first computer in the house and that was only one of those real small ones like 1 megabyte of memory back where they were in those days. Oh the one I've got now probably about 8 years. I don't have an iPad I have a sort of tablet. Daughter have iPads, 3 out of the 4 have got an iPad. [ID2]

No (desktop), we have a laptop. I've just got one (smart-phone). Hubby's too old fashioned. I've got an iPad and so does my little fella. He's got an Android. [ID11]

Yeah we did have a laptop. It has died. We'd usually get 5-10 years' service out of a laptop- it was actually the same day that I bought that iPad Air that came out, my laptop died, that's (TV) Internet capable, yeah, and you see we've got a Skype camera on top, as well as X-Box connection [ID16]

These quotes from the interview participants show that majority of the interviewing households are using laptops to access the Internet, but a few indicated that they are also using a desktop computer to access the Internet. Results also highlight that portable devices such as an iPad, tablet or smartphone are now becoming more attractive to households to access Internet.

5.4.6 What activities do your household members use the Internet for?

Figure 5-6 shows the Internet based digital services that are used by the interview participants' household in the WDR. Information search is the most widely used digital service (100%) and, not surprisingly, E-mail, social media (Facebook), paying bills and online banking also figure prominently. Eighty percent of interview participants indicate that they are using e-government and educational services via the Internet.

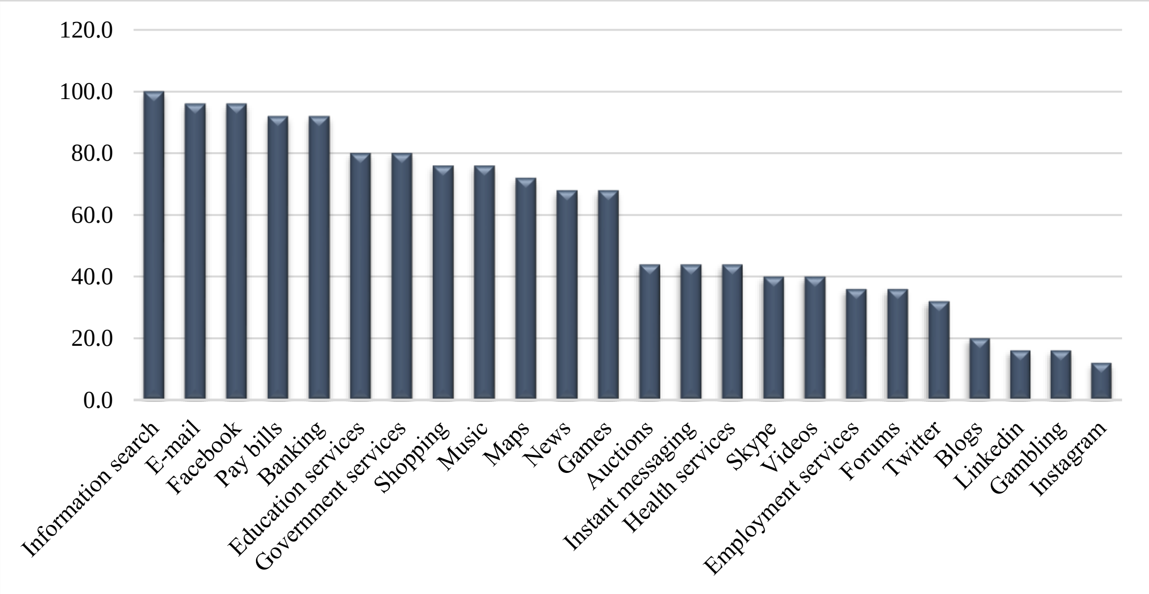

Figure 5-6 Household use of Internet-based digital services

5.4.7 What has influenced your household's adoption of the Internet?

To understand why households have adopted the Internet, interview participants were asked, 'What has influenced your household's adoption of Internet (work, family, relatives, friend, news and advertisement)?' Figure 5-7 shows that 68% of the participants' were influenced to adopt Internet by work and 60% were influenced by family members. Furthermore, 52% were influenced to adopt Internet by education requirements; followed by relatives or friends (32% each). A further 36% indicates that they were influenced to adopt Internet due to other circumstances, as well as for their own motivation to learn and for business purposes (like banking, weather reports, accounting, finance, information).

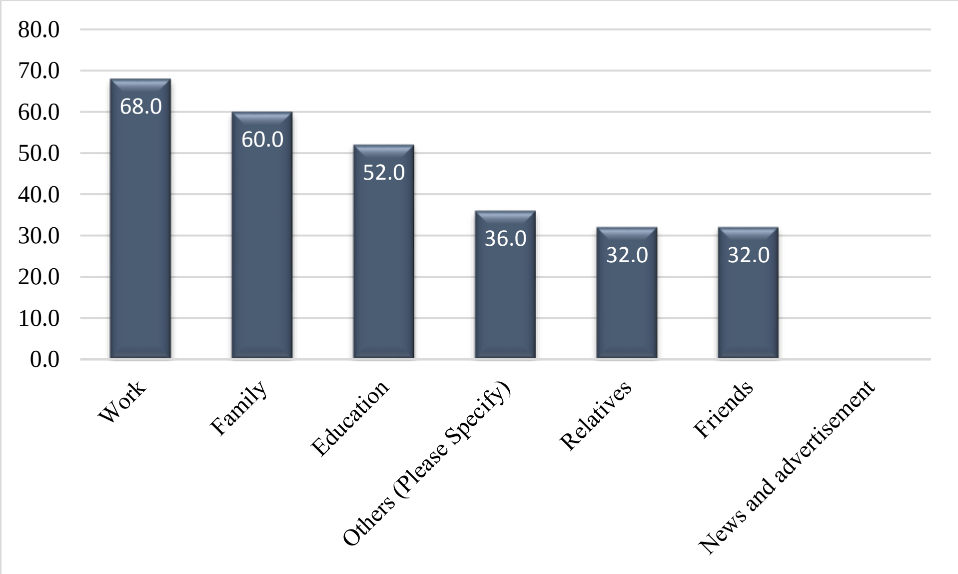

Figure 5-7 Households influence to adopt Internet

Some direct quotes from the interview participants highlight what has influenced their household to use the Internet:

Yeah, when Facebook basically came, well yeah my cousin, she had the social media first, and I was like-. He'd (Husband) been the same, except like he might have used it a bit more doing like your YouTube and things like that. [ID1]

Probably the fact that I had 2 children overseas. To keep in touch. And also I had years off of school and study. And of course the kids being at high school would have yeah so family, work, study. [ID2]

Yeah I guess just having it at school sort of- I needed it for the online study. [ID2]

Oh it would be for school- With the boys. And then ours is just yeah general stuff so- Google and whatever. Facebook I guess …. [ID4]

Information I think-… It's more, access anything around the world … [ID5]

Because the obvious answer would be work, but no, not necessarily – yeah, personal development really, access to the vast information pool which is the Internet. I mean it's just a day doesn't go by that it amazes me how much you can get contact to information. You know, I've never been a person that goes to the library; the Internet's my library, and I'm sure everyone is … this day, as well because, like I can talk to people that manufacture stuff overseas, something you've bought or whatever, *and if you've got a problem with it- without the Internet, and I mean I just can't imagine a time where you could talk to-[ID7]*

I suppose first up, when it first came out, it was just interest – something- [ID8]

Communication with other people via Facebook- search for information such as purchase of products; information about that particular product that you may be interested in; searching for travelling information. Numerous other incidental little things which I just can't think of at the time but- [ID9]

School work to start off with, researching stuff and that and then it went to so I could pay all my accounts and everything on-line because we live too far to town so it was just – and everything these days now it's, you get a penalty from bloody paying it at the post office or something, so if you pay it- work would've done too. [ID11]

Findings from the interviews show that the majority of the interview participant household members are using the Internet for work; however, participants also indicated that education and communication are other important factors that influence them to start using the Internet.

5.5 DIGITAL LITERACY AND SELF-EFFICACY OF THE WHOLE HOUSEHOLD

5.5.1 Digital literacy of the household membership

The researcher defines digital literacy as 'the capability to use digital technology, communication tools or networks to locate, evaluate, use and create information and knowing when and how to use it'. Based on this definition of digital literacy, the interview participants were asked to rate their household members' digital literacy on a scale of 1 being lowest to 7 being highest. Table 5 5 shows the digital literacy rating of the households overall and for individual members.

Table 5-5 Digital literacy scores for each household member and household overall

Interview Number	Households Member Digital literacy (1-Lowest, 2-Low, 3-Somewhat Low, 4-Average, 5-Somewhat High, 6-High, 7-Highest)									St Deviation
	HM 1	HM 2	HM 3	HM 4	HM 5	Average	Highest	Lowest	Mode	
ID1	6*	6	3	2		4.25	6	2	6	2.06
ID2	4*	6	6	6	6	5.6	6	4	6	0.89
ID3	3*	5	7	7	7	5.8	7	3	7	1.79
ID4	2*	6	6	5	4	4.6	6	2	6	1.67
ID5	6*	3	3*			4	6	3	3	1.73
ID6	5*	6*	5	5	4	5	6	4	5	0.71
ID7	6*	6	7	7	5	6.2	7	5	6	0.84
ID8	7*	4	7	7	7	6.4	7	4	7	1.34
ID9	3*	3	7	6		4.75	7	3	3	2.06

Interview Number	Households Member Digital literacy (1-Lowest, 2-Low, 3-Somewhat Low, 4-Average, 5-Somewhat High, 6-High, 7-Highest)									St Deviation
	HM 1	**HM 2**	**HM 3**	**HM 4**	**HM 5**	**Average**	**Highest**	**Lowest**	**Mode**	
ID10	2*	5*	7			4. 67	7	2	N/A	2.52
ID11	5*	5	4			4.67	5	4	5	0.58
ID12	2	1*	6	6		3.75	6	1	6	2.63
ID13	6*	2	6	6		5	6	2	6	2.00
ID14	6*	7	5	4	2	4.8	7	2	N/A	1.92
ID15	6*	2	7			5	7	2	N/A	2.65
ID16	7*	6	1			4.67	7	1	N/A	3.21
ID17	3*	2	6	6		4.25	6	2	6	2.06
ID18	4*	4				4	4	4	4	0.00
ID19	6*	4	2	2		3.5	6	2	2	1.91
ID20	1*	4*	6	6	6	4.6	6	1	6	2.19
ID21	7*	4	7	7		6.25	7	4	7	1.50
ID22	3*	4	6	5	5	4.6	6	3	5	1.14
ID23	6*	4				5	6	4	N/A	1.41
ID24	7*	5	7	7		6.5	7	5	7	1.00
ID25	4*	2*	4	4		3.5	4	2	4	1.00

Legend: *Participants in interview

Table 5-5 shows that the majority (23) of households have an above-average level (1-lowest to 7- highest) of digital literacy overall. It must be noted from Table 5-3 that almost half of the households that participated in the interviews were a couple/family with children not living at home (48%). So, when the results of digital literacy assessment for each household are only considered for the interview participant or major decision-maker who lives in the house, then most of the interview participants fell into the aged group of over 55 and have lower digital literacy compared to younger age groups within the same household.

5.5.2 Self-efficacy of households using broadband Internet

The researcher defines self-efficacy as ‘the capability and comfortability in using and accessing broadband Internet’. The interview participants were asked to rate the self-efficacy of each of their household members in using broadband Internet on a scale of 1 being- lowest through to 7 being- highest. Table 5-6 shows the self-efficacy rating of households and individual household members to use broadband Internet.

Table 5-6 Self-efficacy scores of each household member and overall household score on using broadband Internet

Interview Number	**Households Member Self-efficacy (1-Lowest, 2-Low, 3-Somewhat Low, 4-Average, 5-Somewhat High, 6-High, 7-Highest)**									**St Deviation**
	HM 1	**HM 2**	**HM 3**	**HM 4**	**HM 5**	**Average**	**Highest**	**Lowest**	**Mode**	
ID1	7*	7	3	2		4.75	7	2	7	2.63
ID2	4*	7	7	7	7	6.4	7	4	7	1.34
ID3	3*	5	7	7	7	5.8	7	3	7	1.79
ID4	2*	6	6	5	4	4.6	6	2	6	1.67
ID5	6*	4	2*			4	6	2	N/A	2.00
ID6	5*	5*	5	5	4	4.8	5	4	5	0.45
ID7	5*	5	6	6	4	5.2	6	4	5	0.84
ID8	7*	4*	7	7	7	6.4	7	4	7	1.34
ID9	5*	5	7	6		5.75	7	5	5	0.96
ID10	2*	5*	7			4.67	7	2	N/A	2.52
ID11	6*	6	6			6	6	6	6	0.00
ID12	3	1*	6	6		4	6	1	6	2.45
ID13	5*	2	6	6		4.75	6	2	6	1.89
ID14	7*	7	5	4	2	5	7	2	7	2.12
ID15	7*	1	7			5	7	1	7	3.46
ID16	7*	6	1			4.67	7	1	N/A	3.21
ID17	4*	2	6	6		4.5	6	2	6	1.91
ID18	5*	5				5	5	5	5	0.00
ID19	6*	4	2	2		3.5	6	2	2	1.91
ID20	1*	4*	6	6	6	4.6	6	1	6	2.19
ID21	6*	2	7	7		5.5	7	2	7	2.38
ID22	4*	4	7	6	6	5.4	7	4	4	1.34
ID23	7*	4				5.5	7	4	N/A	2.12
ID24	7*	5	7	7		6.5	7	5	7	1.00
ID25	6*	2*	3	3		3.5	6	2	3	1.73

Legend: *Participants in Interview

Similar to the digital literacy ratings of households, Table 5-6 shows that the majority (23) of the households have above average levels (1- lowest to 7- highest) of self-efficacy overall. Most of the interview participants that fell into the age group over 55 years have a lower level of self-efficacy compared to younger age groups in the same household. For example, from Table 5-5 and Table 5-6, ID12 household overall has an average level of digital literacy and self-efficacy, but interview participants and major decision-makers of this household who were aged 62 and 50 respectively have 2 (Low) and 1 (Lowest) levels of digital literacy, respectively, and 3 (Somewhat Low) and 1 (Lowest) levels of self-efficacy; whereas young children aged 11 and 9 in the same household have a higher level digital literacy (6 (High), 6 (High) respectively) and self-efficacy (6 (High), 6 (High) respectively). It is also noted that the standard deviation scores for digital literacy and self-efficacy for some households is highly variable, which means some household members possess high digital literacy and self-efficacy while, conversely, some members in the same household have low levels of digital literacy and self-efficacy.

It was also noted that households with higher education levels generally had higher digital literacy and self-efficacy compared to households with lower education levels. For example ID2 household with an average of higher education level (5) has an average of higher digital literacy (5.6) and self-efficacy (6.4). Similarly, ID15 household with an above average education level (4.67) has an above average digital literacy level (5) and an above average self-efficacy level (5). Conversely, ID19 household with a much lower average education level (1.5) has an average digital literacy level (3.5) and an average self-efficacy level (3.5) compared to households with higher education levels overall. Similarly, ID25 household with lower education level (2) has an average digital literacy level (3.5) and an average self-efficacy level (3.5) compared to households with higher levels of education and which have higher levels of digital literacy and self-efficacy. It was also noted that individual household members with higher digital literacy levels tended to have higher self-efficacy levels.

Due to the variation of education level, digital literacy and self-efficacy of households there might be a need to focus on training for household members who have lower levels of digital literacy and self–efficacy in using broadband Internet to enable them to engage more proactively in using the internet and engaging and succeeding in the digital economy.

5.5.3 Training to improve digital literacy and self-efficacy

To understand whether the households interviewed felt that providing training to household members with lower level of digital literacy and self-efficacy would improve their digital literacy and self-efficacy to use broadband Internet more effectively the researcher asked the interview participants, the following question: ‘Do you think that some training would improve the digital literacy of you and your household and help you and your household to make better use of broadband Internet?’

Table 5-7 Interview participants' perception on improving digital literacy by training

Interview Number	**Training would improve the digital literacy**
ID1	Yes
ID2	Yes
ID3	Maybe
ID4	Yes
ID5	Yes
ID6	Yes
ID7	Yes
ID8	Maybe
ID9	Yes
ID10	Yes
ID11	Yes
ID12	Yes
ID13	Maybe
ID14	Yes
ID15	Yes
ID16	Yes
ID17	Yes
ID18	Yes
ID19	Yes
ID20	Yes
ID21	Yes
ID22	No
ID23	Maybe
ID24	Yes
ID25	Yes
Total	Yes = 80% Maybe = 16% No = 4%

Table 5-7 shows that the majority (80%) of interview participants indicated that training would be beneficial for improving the digital literacy of their household in order to make better use of broadband Internet; whereas 16% of the interview participants indicated it *may* be beneficial; and only 4% indicated it would not be helpful.

It is not surprising that most of the older interview participants indicated that they have limited skills to use the Internet. But they indicated that if they could gain some support in terms of training and education (such as online activities), they could participate more effectively in their use of the internet. Listed below are some thoughts of an interview participant regarding whether training could help in making better use of the Internet:

> *That's pretty well it I think – just my skills and my wife's skills are probably limited (to use Internet and computer).. If the council run*

workshops- I believe they run workshops at the library now actually – we just haven't been there – my wife has. She's a bit more switched on than I am. [ID9].

Even technology-savvy interview participants thought that technology is changing so rapidly that they need to learn more or need some further training to keep up with technological changes.

Technologies changing every several months but you've got to- It's moving very quickly. You've got to keep up with it and- So would benefit from training [ID5]

I teach people here but those people are in their sixties, seventies, eighties so their knowledge is less than mine so it's easy to teach. If I run across someone who has more knowledge than me I give them to Violi. So I need to update myself [ID14]

Have some sort of technology background, Well, ...if there's something new to learn always [ID15]

But I'm always, even at work we always just, what we did was just work related, but yes, probably need to learn more. [ID20]

I can do pretty much everything, but oh it's always good – always wanting to do different things…. a few people are doing workshops and things [ID24]

I'm yeah quite comfortable with it all, Yeah I'm still learning it. I don't think I'll ever fully learn computers. Yeah well I ... know how to use computers but like with extra stuff [ID25]

I didn't know how to use computer and Internet and Steve tried to teach me because he was using them at work. [ID22]

Findings from the interviews show that most of the interview participants believe that training is very important to keep up-to-date with rapidly-changing technology, and enable them to participate more effectively in online activities.

Table 5-8 shows the relationship between household activities which involved using the Internet and household averages for digital literacy levels and for self-efficacy levels.

Table 5-8 Household use of the Internet based digital services with average digital literacy and self-efficacy

	Information search	E-mail	Facebook	Pay bills	Banking	Education services	Government services	Shopping	Music	Maps	News	Games	Auctions	Instant messaging	Health services	Skype	Videos	Employment services	Forums	Twitter	Blogs	LinkedIn	Gambling	Instagram	Sum of Activities	Digital Literacy	Self- Efficacy
ID1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y						Y		Y			Y		14	4.25	4.75
ID2	Y	Y	Y	Y	Y	Y	Y		Y			Y				Y				Y					11	5.6	6.4
ID3	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y	Y	Y								15	5.8	5.8
ID4	Y	Y	Y	Y		Y	Y	Y					Y												8	4.6	4.6
ID5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	23	4	4
ID6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	23	5	4.8
ID7	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y			Y	Y	Y	Y			19	6.2	5.2
ID8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y						Y		16	6.4	6.4
ID9	Y	Y	Y					Y	Y																5	4.75	5.75
ID10	Y	Y	Y	Y	Y	Y	Y		Y	Y		Y				Y		Y							12	4. 67	4.67
ID11	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y			Y	Y						15	4.67	6
ID12	Y	Y	Y	Y	Y	Y		Y		Y	Y		Y	Y	Y		Y								13	3.75	4
ID13	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y												12	5	4.75
ID14	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	Y					Y	Y					14	4.8	5
ID15	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y		Y							14	5	5
ID16	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	24	4.67	4.67
ID17	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y		Y		Y						16	4.25	4.5
ID18	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y				Y			Y					14	4	5
ID19	Y	Y	Y	Y	Y	Y					Y	Y													8	3.5	3.5
ID20	Y	Y	Y		Y					Y	Y														6	4.6	4.6
ID21	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y		Y			Y		Y				15	6.25	5.5
ID22	Y	Y	Y	Y	Y		Y	Y	Y	Y		Y		Y	Y	Y		Y	Y						15	4.6	5.4
ID23	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y		Y	Y		Y	Y							15	5	5.5
ID24	Y		Y	Y	Y		Y	Y					Y				Y								8	6.5	6.5
ID25	Y	Y	Y	Y	Y	Y	Y		Y			Y													9	3.5	3.5
Total	25	2 4	24	23	23	20	20	19	19	18	17	17	11	11	11	10	10	9	9	8	5	4	4	3			

Table 5-8 shows that majority of households that perform a large number of activities online using the Internet have higher levels of digital literacy and self-efficacy while, conversely, households with less activity have lower levels of digital literacy and self-efficacy. However, high level (score) of participation in online activities does not always translate into higher levels of digital literacy and self-efficacy for the household overall. For example, ID5 household has a higher number of online activities (23 out of 24), but has only average level digital literacy (4) and self-efficacy (4). Similarly, ID16 household has a higher number of online activities (24 out of 24), but has only just above an average level of digital literacy (4.67) and self-efficacy (4.67). On the other hand, ID2 household has a higher level of digital literacy (5.6) and self-efficacy (6.4) score, but the number of online activities were below average (11 out of 24). Similarly, ID24 household has a higher level of digital literacy and self-efficacy score, but a number of online activities were below average (8 out of 24). This could be because interview participants have reflected on what they normally do personally online rather than reflecting on online activities of the whole household.

On the other hand, ID5 household which is using a majority of online activities (23 out of 24) listed in Table 5-8 has only an average level of digital literacy and self-efficacy scores. This could be explained because, as noted in Table 5-5 and Table 5-6, HM1 has a higher level of digital literacy (6-high) and self-efficacy (6-high) than the other two household members who have a lower level of digital literacy (3- Somewhat Low) and self-efficacy (4- Average and 2- Low). This could also be because interview participants reflect their own online activities rather than those of their family. So for this particular interview, ID5, the interview participant indicated that most of the activities were carried out online and that might not be a true reflection of their household members' use of online digital services.

From Table 5-8 it is also noted that some of the senior or elderly interview participants in a household have lower levels of online activity. For instance, ID9 and ID20 interview participants were above the age of 60 (see Table 5-2) and they indicated that they participated in online activities in very limited manner.

5.6 BUILDING AND MAINTAINING SOCIAL RELATIONSHIPS USING THE INTERNET

To understand whether households are building and maintaining social relationships using the Internet, especially through the use of social media, interview participants were asked, ‘Have you and your household built or maintained relationships and networks within your local community and /or with outside communities by using the Internet?’ Table 5-9 compares the interview participants’ responses to this question regarding their use of social media. Table 5-9 shows that 96% of the interview participants indicated that their household members have been using the Internet to build or maintain relationships and networks with family, the community and outside the community; whereas only 4% indicated they are not using the Internet as a tool to connect with their families, friends, the community and outside the community.

Table 5-9 Interview participants responses on building and maintaining social relations using the Internet

Interview Number	**Building and maintaining social relationships using Internet and social media**	**Type of social media uses**									**Sum**
		Email	Instant message	Skype	Facebook	Twitter	LinkedIn	Instagram	Forums	Blogs	
ID1	Yes	Y			Y	Y					3
ID2	No	Y		Y	Y	Y					4
ID3	Yes	Y		Y	Y						3
ID4	Yes	Y			Y						2
ID5	Yes	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
ID6	Yes	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
ID7	Yes	Y	Y	Y	Y	Y	Y		Y	Y	8
ID8	Yes	Y	Y		Y						3
ID9	Yes	Y			Y						2
ID10	Yes	Y		Y	Y						3
ID11	Yes	Y			Y				Y		3
ID12	Yes	Y	Y		Y						3
ID13	Yes	Y			Y						2
ID14	Yes	Y	Y		Y	Y			Y		5
ID15	Yes	Y	Y	Y							3
ID16	Yes	Y	Y	Y	Y	Y	Y	Y	Y	Y	9
ID17	Yes	Y			Y				Y		3
ID18	Yes	Y			Y	Y					3
ID19	Yes	Y			Y						2
ID20	Yes	Y			Y						2
ID21	Yes	Y	Y	Y	Y				Y	Y	6
ID22	Yes	Y	Y	Y	Y				Y		5
ID23	Yes	Y	Y		Y						3
ID24	Yes				Y						1
ID25	Yes	Y			Y						2
Total	Yes = 96% No = 4%	24 (96%)	11 (44%)	10 (40%)	24 (96%)	8 (32%)	4 (16%)	3 (12%)	9 (36%)	5 (20%)	

The majority of households indicated that they have been connecting with family, friends and community members by using social media such as social networking sites (Facebook, LinkedIn), E-mail, Instant messages, Blogs and Micro-blogs (Twitter), photo-sharing (Instagram), forums and Skype. E-mail and Facebook are the most widely-used social media (96%), followed by Instant messages (44%), Skype (40%), Forum (36%), Twitter (32%), Blogs (20%), LinkedIn (16%) and Instagram (12%). Social media has become a popular and an integral part of modern society for everyday communication. Social media sites enable sharing of photos, videos, status updates, meeting of new people and to connect with families and friends (Hu & Ma 2010).

The following quotes from interview participants indicate how important the Internet and social media has become for households for connecting with family members when they are far away from home:

> *Facebook is that's been a fabulous thing. Yeah it's really good. Get their (families) pictures because one of the daughters is over in WA so we've seen the kids grow by photos and videos. That's a great way to catch up with grandchildren isn't it and see all the things? [ID22]*

> *....now with Facebook and all that, and to be honest I'm not a heavy user of that either. It's only because our daughter in Brisbane, the only time we ever get to see what she's doing is on Facebook. But, yeah it certainly bridges the gap, you know, we don't – here in Chinchilla, obviously we're remote to some degree from a lot of places and it does close that barrier. [ID7]*

> *...keep in touch with family – my dad is on Facebook too – he's 83 this year and that's the best way because everyone is busy at a different time. [ID21]*

Some of the interview participants also indicated that social media such as Twitter and Facebook are excellent in facilitating online business and for advertisements; and to meet and communicate with likeminded business people with whom they can share their thoughts and to do business with. Here are some thoughts of interview participants on the use of social media for business:

> *Twitter in a big way, He's got grain traders that talk to him to find out what the season's like so then they can determine how much they're going to be paying and- Yeah and he uses it to do forward marketing of our grain and- Yeah and he's in contact with people in America and other growers and yeah, he's sharing information. [ID14]*
>
> *I even use Facebook for work. ... I used to work at the day care centre in Miles but now I'm a day care provider at home. The families that come here I'll just message them on Facebook much easier. [ID11]*
>
> *We do use it (Facebook) to.., we have a horse business and we just sell horses on Facebook, advertising. [ID11]*
>
> *I've recently promoted it [business] on there [Facebook]. And we had a little fruit and veg shop here that we put on Facebook as well, didn't we? Yeah, and we've got friends that are in business at ... as well, and we all like each other's businesses so that it gets out there. [ID8]*

Interview participants also indicated that social media is nowadays widely used to build and maintain social capital in communities, as evidenced by the following comments from two interview participants.

> *There's organisations out here that put things on Facebook when something's on. [ID17]*
>
> *Moonie Visual Arts group has a page on Facebook, and that's been a fabulous thing. Yeah it's really good [ID22]*

5.7 HOUSEHOLD EXPENDITURE ON BROADBAND SERVICES

Cost is another important factor that determines adoption and use of broadband (Choudrie & Lee 2004; Hill, Burgan & Troshani 2011). Therefore, the researcher asked interview participants how much their household was spending to subscribe or connect to the Internet. Table 5-10 shows the type of Internet connections being used by each household and the subscription cost for each type of Internet connection.

Table 5-10 Household Internet subscriptions by cost, data quota, Internet access technology, service provider and remoteness classification

Interview Number	Mobile wireless Internet			Wireless Modem Internet			Wired broadband-ADSL Internet			Total Cost Internet subscription	Remoteness
	Cost	Data	Service provider	Cost	Data	Service provider	Cost	Data	Service provider		
ID1	$100	3GB	Optus	$50	5GB	Optus-Prepaid				$150	Outer regional
ID2	$180	1-2GB	Optus					No-idea	Dodo- Bundle	$180	Outer regional
ID3							$80	5GB	Telstra - Bundle	$80	Outer regional
ID4				$29.95	4-5GB	Telstra				$30	Outer regional
ID5	$180	3GB	Telstra				$120	100GB	Westnet	$250	Outer regional
ID6	$80	1.5GB	Telstra				$100	250GB	Telstra - Bundle	above $300	Outer regional
ID7	$40	1GB	Telstra				$59	160GB	Telstra	$100	Outer regional
ID8	$50	2GB	Telstra	$50	8GB	Telstra- Prepaid				$100	Outer regional
ID9							$125	Unlimited	Bundle	$125	Inner regional
ID10	$50	3GB	Telstra and Optus				$90	Unlimited	Dodo- Bundle	$180	Inner regional
ID11				$49.95	4GB	Telstra				$49.95	Outer regional
ID12				$45	4GB	Telstra				$45	Remote
ID13				$35	4GB	Telstra- Tablet	$130	Unlimited	Telstra Bundle	$165	Outer regional
ID14	$130	4.5GB	Telstra-Mobile				$50	No-idea		$180	Outer regional
ID15	$60	500Mb (Not sure)	Telstra				$60	Unlimited	Telstra	$120	Outer regional
ID16	$130	2GB	Telstra				$120	500GB	Telstra- Bundle	$250	Outer regional
ID17	$150	4GB	Telstra				$150	500GB	Telstra- Bundle	Over $300	Remote

Interview Number	Mobile wireless Internet			Wireless Modem Internet			Wired broadband-ADSL Internet			Total Cost Internet subscription	Remoteness
	Cost	Data	Service provider	Cost	Data	Service provider	Cost	Data	Service provider		
ID18	$140	4GB	Telstra - Business phone							$140	Remote
ID19				$50	No-idea	Telstra- Prepaid				$50	Outer regional
ID20	$9.99	2GB	Telstra-Pensioner							$9.99	Outer regional
ID21	$30	1GB	Telstra	$39.95	8GB					$70	Remote
ID22	$40		Telstra	$69	5GB			No-idea		$139	Remote
ID23	$190	5.5GB	Telstra							$190	Inner regional
ID24	$60	2GB	Telstra-prepaid				$39.99	No-idea	Westnet	$100	Inner regional
ID25							$89	Unlimited	Dodo-Bundle	$89	Remote

Table 5-10 shows that majority of households were paying over $100 in total to subscribe to the Internet. It is also noted that mobile wireless broadband Internet is much more expensive than wired broadband Internet in terms of data quotas. For instance, Household ID6 is paying $80 for 1.5 GB data to access mobile Internet, whereas the same household is paying only $100 for access to wired broadband (ADSL) for 250GB data quota.

5.8 HOUSEHOLDS' PERCEPTION OF COST, PURCHASE COMPLEXITY AND FUTURE HIGH SPEED BROADBAND

After discussing the cost of connecting to the Internet, the researcher asked the interview participants whether they thought their Internet subscription cost is reasonable for their household. Participants were also asked how difficult it was to decide on what kind of Internet connection would be required for their household and whether they would be willing to subscribe to higher speed Internet if this become available for their household with the roll-out of the NBN in the future. Based on the responses of the interview participants Table 5-11 shows households' perceptions about cost and purchase complexity of broadband Internet subscriptions and future subscriptions to high speed broadband Internet if this become available in their localities.

Table 5-11 Household perceptions of cost and purchase complexity of current broadband services and their intention to subscribe to high speed broadband service

Interview Number	**reasonable subscription rate**	**Comment - subscriptio n rate**	**Difficult to decide which broadband service or plan (1-Very easy to 7-Very difficult)**	**Planning to subscribe to a high-speed broadband Internet if this becomes available**	**Comment- plannin g to subscribe**
ID1	Yes		Somewhat easy	Yes	Would check cost, speed and reliability of services before subscribe to it
ID2	Yes		Somewhat easy	May be	Depends upon cost and speed and financial situations.
ID3	Yes		Easy	Yes	If cost is cheap and reasonable
ID4	Yes		Somewhat difficult	Yes	Depending upon cost and reliability of services
ID5	Yes		Easy	Yes	If speed and reliability
ID6			Easy	No	Happy with what we've got
ID7	Yes		Somewhat easy	Yes	Cost should be reasonable

ID8	Yes	Cost is not an issue	Easy	Yes	Definitely yes if speed and reliability service provides
ID9	No		Easy	Yes	If cost is cheap and reasonable
ID10	Yes		Easy	May be	Depends upon cost and speed
ID11	No	Expensive and limited data	Easy	Yes	Depending upon cost and reliability of services
ID12	Yes	Cost is issue	Neutral	Yes	If cost is cheap and reasonable
ID13	No	Expensive	Somewhat Easy	No	Waste of money
ID14	No	Expensive	Somewhat easy	May be	There is not available NBN
ID15	No		Somewhat easy	Yes	
ID16	Yes		Somewhat easy	Yes	Happy to upgrade for better fast Internet
ID17	No		Somewhat easy	Yes	Depending upon cost and reliability of services
ID18	No		Easy	Yes	Cost would be the thing
ID19	Yes	Cost is not an issue	Somewhat easy	Yes	Consider
ID20	Yes		Difficult	Yes	Consider
ID21	Yes	Expensive	Neutral	Yes	But cost, speed and reliability of services matters
ID22	Yes	Reasonable	Somewhat easy	Yes	Depending upon cost and reliability of services
ID23	Yes	Expensive	Somewhat easy	Yes	If cost is cheap and reasonable
ID24	Yes		Easy	Yes	
ID25	No		Somewhat easy	Yes	Cost will impact
Total	Yes = 16 (64%) No = 8 (32%) Missing = 1 (4%)		Easy 2 = 36% Somewhat Easy 3 = 48% Neutral 4 = 8% Somewhat difficult 5 = 4% Difficult 6 = 4%	Yes = 20 (80%) May be = 3 (12%) No = 2 (8%)	

5.8.1 Household perception of cost

Table 5-11 shows the majority of households 16 (64%) indicated that their Internet subscription rate is reasonable for their household; whereas only 8 (32%) of households indicated their Internet subscription rate is unreasonable. Although the majority of households indicate that the cost is reasonable, interview participants also noted that subscription cost for broadband Internet is expensive compared to their city counterparts. Below are some thoughts of the interview participants regarding broadband cost:

> *I think is expensive, it is. The cost is a major factor. ... Yeah, I will say one thing that is very annoying is you sit back and see all the deals down on the coast, you know, 20GB for $20 a month and all this sort of thing, and we're getting 4 for $45. And that's with a discount, because of the home phone. [ID12]*

> *Absolutely, the cost factors,.. one daughter in Brisbane what she gets for less than half the price,, what we got,.... is ridiculous- [ID21]*

Satellite Broadband Services theoretically cover the entire region of the WDR, but are only available to households which can establish that they do not have access to fixed line Broadband Services such as ADSL/ADSL2+ or Mobile Broadband services. Satellite broadband services are much more expensive compared to fixed line ADSL and mobile broadband. Furthermore, the speed and reliability of satellite broadband services is considered poor, as evidenced by the following direct quote from a participant household interview:

You just don't get service. Yeah exactly and then if you can get service like that satellite,... it was quite expensive, it was quite expensive. And then as I said it's not reliable, it's not a constant signal. Yeah not a strong signal either..[ID24]

5.8.2 Purchase complexity of Internet subscriptions

To understand whether households in the WDR considered making a decision to subscribe to a broadband Internet service to be a complex undertaking, interview participants were asked the following question: 'How difficult has it been or it would be to decide which broadband service or plan will meet the needs of your household? Please rate between 1 (very easy) to 7 (very difficult)'. Table 5-11 shows that the majority (84%) of interview participants indicated it was not difficult to decide on which Internet service to choose; whereas only 8% of interview participants indicated it is sometimes difficult to choose the right Internet service for their household.

The following few comments are from the interview participants who emphasise complexity in broadband service purchase decisions:

..we're out of town and Telstra is all you can use – haven't got an option. [ID6]

It's still a Telstra network but with home phones and stuff – that's it it's Telstra and to get any phone signal – any mobile service out here it's Telstra. You cannot even have Optus or anything – there is no choice so you just don't even look at anywhere else for you mobile and stuff and your home phone. [ID21]

..you can't go to a different provider or anything particularly – there's a limited choice. Like there are different providers and things but it's a fairly limited choice..[ID21]

Well, I had no choice, the only thing that we can get out here, I've got a 3G wireless broadband….. and I get one or two bars if I'm lucky and I've got to have an external antenna for that. I've got the antenna that goes outside onto the roof in order to get better service. Nothing works out here, so they don't really give me much of an option….Even on our phones we don't get much service; I have to stand in a certain spot [ID21]

Well it wasn't too difficult, as the services here weren't that great when we first come here. So you had very limited option to what you could join [ID5]

I guess it's not difficult but it is, because we really only have one service provider so don't have choices. You didn't have big options, so you just had to go with the one you have. [ID18]

Furthermore, sometimes when participants have more options to choose from they experience confusion as to which particular service to choose, as shown by the following comment:

There's not a lot of choice and stuff is there really? But you have to try and work out what is good for you and that makes it hard doesn't it?..[ID22]

Findings from the interviews show that rural communities do not have many options available in selecting a suitable broadband Internet service because they have a limited number of Internet services providers to choose from. Moreover, an analysis of the broadband infrastructure (Chapter 4) available in rural communities in the WDR revealed that in many towns and localities there are a limited number of broadband services providers available because of a low level of wired and wireless broadband network coverage in the more remote locations. The majority of the interview participants indicated that Telstra has the most comprehensive mobile network coverage in the WDR region compared to the other mobile network providers (Optus, Vodafone).

5.8.3 Planning to subscribe to a high speed Internet service if available in the future

Although interview participants indicated that they have been using the Internet for a long time, they also indicated they had a number of issues to deal with in rural areas in accessing broadband Internet such as poor network coverage, slow Internet speed, and limited service providers and Internet options to choose from. The researcher asked the participant household interviewees whether or not, with the subsequent roll out of the NBN, they would like to subscribe to a high speed broadband Internet service if this become available in the region. Table 5-11 shows the majority (20) (80%) of the households acknowledged that they would subscribe to high speed broadband if this become available. Conversely, only 3 (12%) households indicated that they may subscribe; however, they also indicated that reliability, speed and cost would be factor in making that decision. Moreover, only 2 (8%) households indicated they are happy with what they currently have. Below are some of the participant household interviewees' comments relating to subscribing to high speed broadband if this becomes available in their region and location:

Consider something cost, but also the speed and reliability of the service [ID9]

Yeah well that would be good but it would depend on the cost because they – they are saying it's going to be expensive. A lot more expensive so would just – would depend on the cost of the – the service. [ID3]

Depending on the cost and depending on whether I'm working at the time [ID2]

Yes if – if it was better definitely [ID4]

..consideration that an improvement and the cost or more the speed and reliable…More the speed and reliability of it I suppose [ID5]

Could be an improved ADSL service. Yeah, that would be good.[ID10]

Yes I would subscribing to that -if it was faster. If it was faster and more cost effective [ID9]

Probably cost to be honest I think it's – everything depends on the cost.[ID23]

If something like that came to Tara it would be huge. I think a lot of people would be extremely happy. [ID24]

Telstra is the only one in Jandowae that will get you service; we have a Telstra tower; if you Optus or anything else you don't really get that much service. [ID14]

5.9 CONCLUSION

This chapter presented the results of the analysis of the qualitative interview data collected for this research. A total of 25 interviews were conducted across the WDR with the major decision-maker for each household. This chapter started by presenting the demographics of the location and profile of each household that participated in the interviews in terms of its members. Next, the results of the qualitative data analysis in relation to household use of broadband Internet are presented. Then this chapter presented the results of data analysis in relation to the digital literacy and self-efficacy of each participant household in the context of broadband adoption and use of best practice, and their association with households' characteristics. Next, the results of the qualitative data analysis in relation to participant households' use of broadband services and social media for building and maintaining social capital was presented. Finally, this chapter presented the results of qualitative data analysis in relation to household expenditure on broadband services and perceptions of each household participant interviewee regarding broadband adoption issues such as cost, purchase complexity and the intention to subscribe to high speed broadband Internet if it becomes available in the future.

Chapter 6: Data analysis of survey sample

6.1 INTRODUCTION

In Chapter 3, a description was provided of the methodological approach used to conduct the survey to collect data regarding the adoption and use of broadband Internet services by households in the WDR, Queensland. Households are considered to be a major user of broadband in rural and regional Australia. Thus, their opinions about the different factors can provide an important assessment of broadband adoption and use and its impact in building and maintaining social capital in rural Australia. Hence, this chapter addressed research questions 2 and 3 and presented the results of testing 13 related hypotheses. Ten constructs and one single item were used in the quantitative component of broadband ecosystem to evaluate household adoption and use of broadband Internet services and its impact on building and maintaining social capital using broadband services in rural Australia. These were namely: utilitarian outcomes; hedonic outcomes; perceived cost; self-efficacy; prior knowledge and experience; purchase complexity; intention to adopt and use broadband Internet; actual broadband use; and social capital (bonding and bridging capital); and number of years using Internet would be considered as a single item. Figure 6-1 presents an overview of the structure of this chapter.

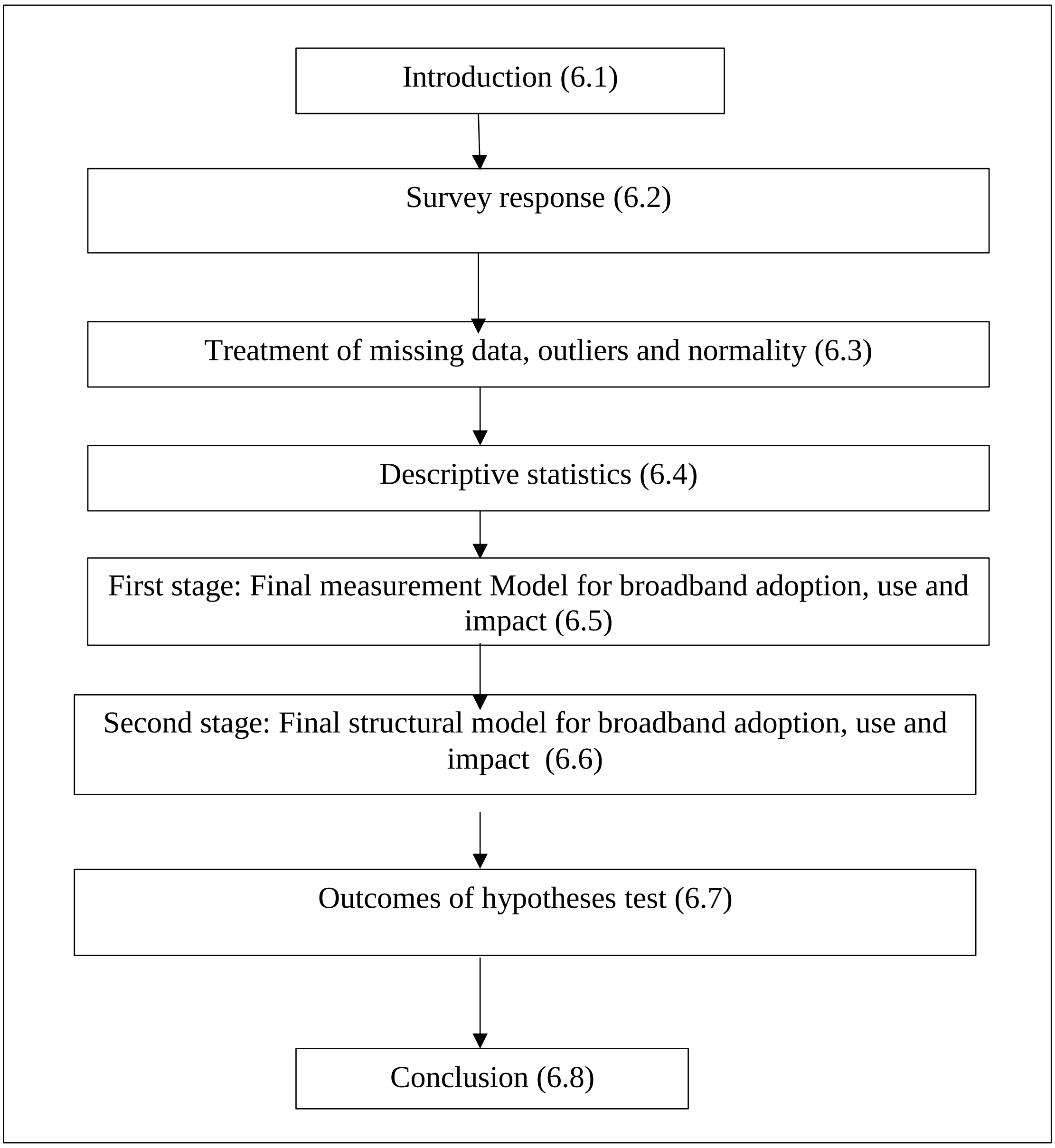

Figure 6-1 Outline of Chapter 6 with section numbers in brackets

6.2 SURVEY RESPONSE

The surveys were returned by postal mail or by completion of an online version of the survey. Three hundred and fifteen usable survey responses were obtained (see Table 6-1). A response rate of 21% was achieved, which is comparable to similar previous studies of broadband adoption and use by households (Brown & Venkatesh 2005; Dwivedi, Alsudairi & Irani 2010; Dwivedi, Y. K., Choudrie, J. & Brinkman, W.-P. 2006). The breakdown of the survey responses is shown in Table 6-1. In the total of 315 responses, 44 responses were completed using online survey links provided to households; and 271 responses were completed via a hardcopy of the survey and returned by reply-paid post. Of the returned surveys which were not usable, 15 were returned blank and, in the case of 1, only the demographics section was partially completed. Those surveys which were returned blank or incomplete were excluded from the analysis.

Table 6-1 Survey responses

Type of survey response	**Number of responses**
Number of surveys returned	331
Total number of usable (completed) surveys	315
Number of surveys completed online	40
Number of hardcopy surveys completed	271
Number of incomplete surveys	16

6.2.1 Geographical distribution of survey responses

In order to check if the geographical location of the survey responses was representative of the population distribution across the towns and locations in the WDR, the survey respondents were asked to indicate which main town they lived in or to which main town they lived closest. Table 6-2 revealed that almost half (47%) of the responses were from Dalby and surrounding district, which is the most densely populated town in the WDR. The survey responses were distributed across WDR population centres as follows in percentage terms of the total responses (315): Chinchilla (13%); Miles (7%); Tara (7%); Jandowae (7%); Wandoan (6%); and the rest of the WDR (10%). Table 6-2 also indicates the relative remoteness of each district within the WDR. The total number of inner regional (those living in Dalby) survey responses was 40%; whereas the total number of outer regional and remote survey responses was 36% and 24%, respectively.

Table 6-2 Geographical distribution of response households in WDR survey

Location in WDR	Household Responses	Percentage	Combined district percentage	Remoteness
Live in Dalby	126	40%	Dalby district combined 47%	Inner/ Outer regional
Nearest to Dalby	23	7%		
Live in Chinchilla	32	10%	Chinchilla district combined 14%	Outer Regional
Nearest to Chinchilla	13	4%		
Live in Tara	10	3%	Tara district combined 7%	Outer Regional
Nearest to Tara	13	4%		
Live in Miles	14	4%	Miles district combined 7%	Outer Regional
Nearest to Miles	10	3%		
Live in Wandoan	15	5%	Wandoan district combined 7%	Remote
Nearest to Wandoan	5	2%		
Live in Jandowae	15	5%	Jandowae district combined 7%	Outer Regional
Nearest to Jandowae	7	2%		
Other place (please specify)	32	10%	Other places in WDR 10%	Remote
	315	100%		

Table 6-2 shows that the geographical distribution of the survey responses is reasonably representative of the population distribution across the main towns and localities in the WDR.

Data Screening and Entry

When the completed surveys were received by postal mail, they were checked and then keyed into the online Qualtrics system by the researcher for uniformity. Online survey responses were automatically entered into online Qualtric survey system once the online survey was completed and submitted by the survey respondent. After preliminary checking for completeness, the survey data was exported from the

Qualtrics survey tool as a SPSS sav file and a MS Excel file and then imported into SPSS software package which was used to perform the descriptive statistical analysis, including assessment of normality of the collected data.

6.3 TREATMENT OF MISSING DATA, OUTLIERS AND NORMALITY

To assure that the data collected for quantitative study is clean and ready before conducting the main data analyses, data screening of the survey data set was undertaken. The purpose of this subsection is to present the results of the data screening. In this study, the investigation of missing data, outliers, normality, and multicollinearity are considered appropriate data screening activities (Tabachnick & Fidell 2007) before conducting a multivariate analysis using PLS-SEM.

Different methods could be used to treat missing data. However, the researcher only entered the surveys that had been fully completed as the surveys with missing data were not useable.

Outliers are classified as those responses which are significantly different from the rest of the responses (Huck 2012). Outliers have the potential to significantly skew the distribution of the data set and distort the analysis if they are caused by incorrect data entry or a misunderstanding of the question by respondents (Field 2009; Huck 2012). However, Huck (2012) points out that outliers can be of legitimate interest and should be investigated before transforming or removing them from the data set. Using the Q-Q Plot in SPSS, several outliers for a number of the survey questions were found. Looking at the original data set the entries were checked for correct coding. No errors were found. Thus, outliers did not occur in this study due to data entry because the data was not coded manually. However, the outliers were checked via frequency distributions and the values were confirmed to be valid values between 1 and 7 (the range of scale used in this study). To determine whether to remove the data for these questions which were outliers and problematic, a normality test was conducted.

For normality test, this study first explored skewness and kurtosis values using SPSS, followed by the Kolmogorov-Smirnov test (K-S) and Shapiro-Wilk (S-W) test which are designed for normality testing. With regard to the issues with normality, high levels of both skewness and kurtosis was detected for certain items, namely, Utilitarian outcomes (UO3); Hedonic Outcomes (HO5); and Intention to adopt and use broadband (ITUB1). Kurtosis was detected for certain items of Intention to adopt and use broadband (ITUB2, ITUB4, ITUB5_Rev). Deviations from what is considered acceptable ranges for normality, skewness and kurtosis were detected for some items other than the abovementioned items. However these were below threshold (+/-2) for this study (see Appendix E1 Table E1-1). Secondly, the researcher ran the Kolmogorov-Smirnov test (K-S) and Shapiro-Wilk (S-W) test for normality testing—which was also found significant for all of the items (see Appendix E1 Table E1-2). To normalize the non-normal items identified, different types of transformation approaches (e.g., using square root and logarithm) were attempted based on the recommendations of Tabachnick and Fidell (2007), but this did not improve normality of the items. It should also be pointed out that one limitation of the normality tests is that the larger the sample size, the more likely it is to obtain significant results for Kolmogorov-Smirnov (K-S) test and Shapiro-Wilk (S-W) test. This study accepted some minor issues identified with normality given the data set was large enough with 315 complete cases; and considered these issues when selecting PLS-SEM as the multivariate statistical technique for evaluating the measurement model and testing the hypothesized relationships in the proposed research model.

Finally, there are no issues with multicollinearity, based on the coefficients outputs-collinearity statistics as the variance inflation factor (VIF) for all relevant independent variables was below the threshold between 1 to 10 (See Appendix E1 Table E1-3). It can be concluded that no multicollinearity symptoms exist in the broadband Internet adoption and use and building social capital model constructs.

6.4 DESCRIPTIVE STATISTICS

In this section, the results of a descriptive analysis of the survey responses are provided. The completion of descriptive statistics is an essential stage in statistical analysis procedures. Zikmund et al. (2009) define descriptive statistics as 'Statistics which summarize and describe data in a simple and understandable manner'. The main function of descriptive statics is to check variables for any violation of the assumptions that are the basis of the multivariate statistical techniques adopted to test the research hypotheses (Pallant 2011).

6.4.1 Demographic characteristics of responses

The results of an analysis of demographic characteristics of the survey responses are presented in Table 6-3 and included gender, age, marital status, and education of the survey respondents.

Table 6-3 Demographic characteristics of survey responses

Variable	Category	Count	Percentage
Gender	Female	100	32
	Male	210	67
	Missing	5	2
	Total	310	100
Age group	18-24	8	3
	25-34	50	16
	35-44	62	20
	45-54	77	24
	55-64	43	14
	65-74	30	10
	Above 75	7	2
	Missing	38	12
	Total	315	100
Marital status	Single/Never Married	37	12
	Married	237	75
	Separated	9	3
	Divorced	21	7
	Widowed	11	4
	Total	315	100
Responses education	Primary	9	3
	Secondary school	141	45
	Diploma	52	17
	Undergraduate	37	12
	Post Graduate	37	12
	Training	25	8
	Missing	14	4
	Total	315	100

The majority of respondents are male (67%) with the almost all the remainder being female (32%). However, 2% of users did not want to disclose their gender. The survey responses had least representation in the age group of 18- 24 years (3%) and over 75 years (2%). The age group of 45-54 years represented the largest group of responses (24%), followed by 35-44 years (20%), which was not surprising given the targeted respondent was the major decision-maker in each household. The age groups 25-34 and 55-64 years represented 16% and 14% of the responses respectively. The majority of the respondents indicated they are married (75%); followed by single/never married (12%); divorced (7%); widowed (4%); and separated (3%). The highest number of respondents (45%) possessed a secondary school education level. One hundred twenty-six (41%) respondents had a higher education level of at least diploma, undergraduate or post graduate degree, followed by 25 (8%) who had undertaken some training course/s, and less than 3% have only primary education.

The results of the analysis of the demographics of the respondent households are presented in Table 6-4, and include the household type and total household income.

Table 6-4 Demographic characteristics of household survey responses

Variable	**Category**	**Count**	**Percentage**
Household types	Single person living alone	21	7
	Single person living with others	14	4
	Single parent with children at home	21	7
	Couple/family with no children	43	14
	Couple/family with children at home	152	48
	Couple/family with children not living at home	64	20
	Total	315	100
Annual Household Income	under $19,999	22	7
	$20,000 - $39,999	43	14
	$40,000 - $59,999	52	17
	$60,000 - $79,999	39	12
	$80,000 - $99,999	33	11
	$100,000 - $120,000	51	16
	Over $120,000	61	19
	Missing	14	4
	Total	315	100

Out of 315 valid responses, 152 (48%) respondents classified their households as a couple or family with children at home, followed by 64 (20%) of households classified as a couple or family with children not living at home. A total of 95 (31%) respondents stated that their annual household income fell between the ranges of $20,000–$59,999. Almost 40% (123) of the survey respondents stated that their household had a middle-range income between $60,000 to $120,000. In comparison, 61 (19%) respondents had an annual household income over $120,000 and 4% of the respondents do not wish to disclose their household income.

Non-response Bias

To check for the possibility of non-response bias, the researcher split the sample into subgroup (early and late responses) based on the time when each response group was received. Then the researcher conducted a Chi-square test to compare the early and late responses with demographic data. Twenty responses were randomly selected from the first 50 early responses and, similarly, from the last 50 responses 20 were randomly selected as late responses. The results revealed no significant difference ($P > 0.05$) between the early and late responses and suggest that non-response bias is not a problem in this study (Armstrong & Overton 1977). Table 6-5 shows the non-response analysis results.

Table 6-5 Non-response analysis on demographic data of responses

Demographic Variable	**Chi**	**d.f**	**p-value**
Gender	0.107	1	0.774
Age-group	10.514	5	0.062
Marital status	2.537	3	0.469
Responses education	4.556	4	0.336
Households types	2.029	5	0.845
Annual household income	7.124	6	0.310

6.4.2 Demographic characteristics of households' Internet adoption and use

The survey responses to following questions provided descriptive information about household adoption and use of broadband Internet services in the WDR.

- Does your household have access to the Internet? (filter question)
- How long has your household been using Internet?

- What kind of Internet connections are used in your household?
- How often does your household use Internet services each week?
- How many hours per week does your household use Internet services?
- Where do member of your household access the Internet?
- Which of these devices are used by households to access the Internet?
- What activities does your household use the Internet for?

Figure 6-2 shows how long households have been using the Internet. The distribution is remarkably representative of a normal distribution. Three-quarters of households have been using the Internet for six or more years. Interestingly, almost 40% of households started using the Internet more than 11years ago when the primary means of accessing the Internet was via narrowband and a dialup modem. Moreover, 60% of households started using the Internet since ADSL broadband Internet services became readily available across Australia from 2005 when Telstra started to ADSL-enable telephone exchanges *en masse* across the country (Fletcher 2009; Islam, Selvadurai & Town 2008).

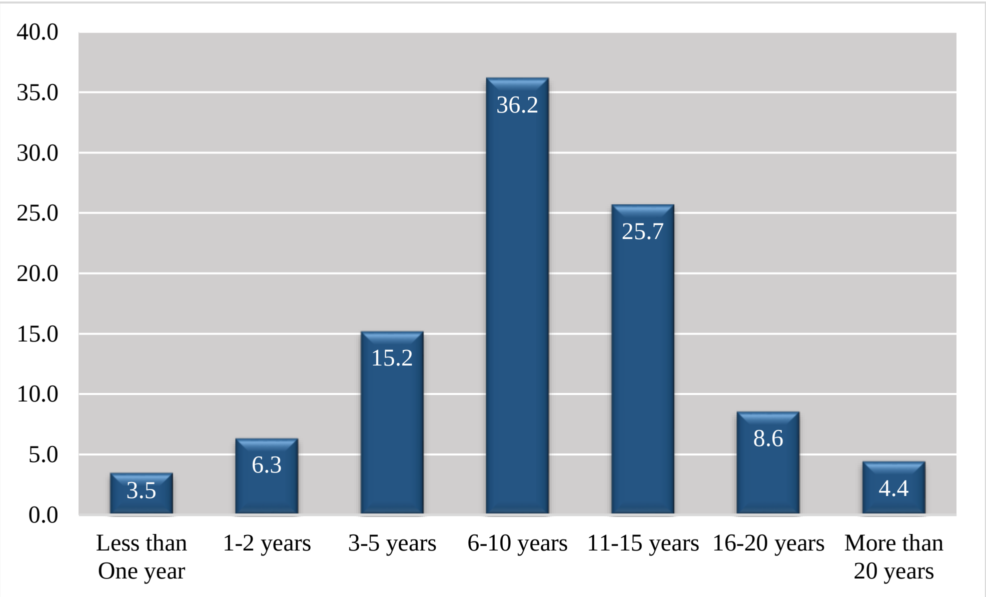

Figure 6-2 Number of years since a household first started using the Internet

Figure 6-3 shows what type of Internet connection technology is used by households to access the Internet. Note that households are increasingly using more than one type of Internet connection technology, but the most widely-used Internet connection technologies in the WDR are 3G/4G mobile broadband (60%), ADSL/ADSL2+

broadband (47%) and satellite broadband (11%). Not surprisingly, less than 2% of households are using dial-up modems to access the Internet.

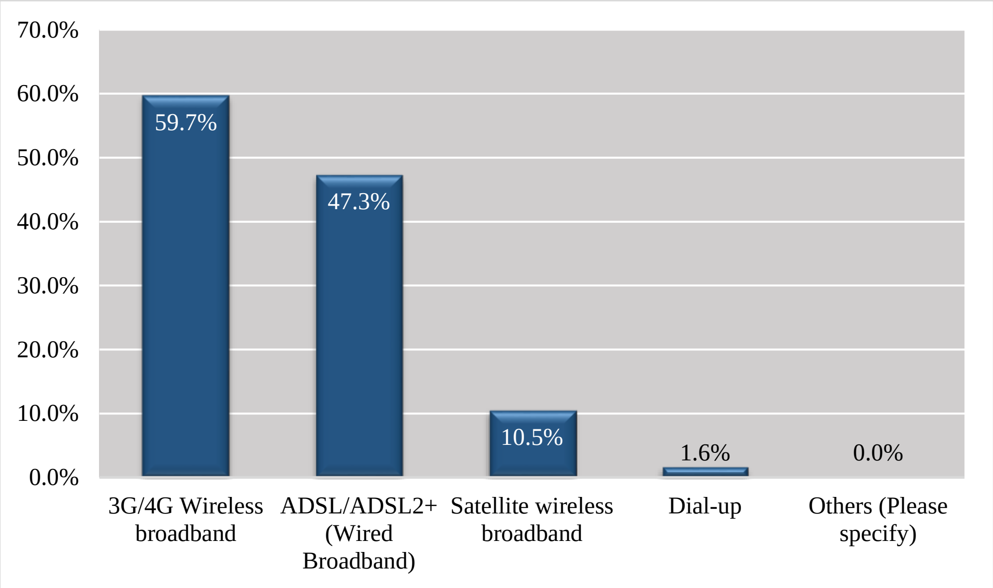

Figure 6-3 Type of Internet Connection used by Households

Figure 6-4 shows how frequently households are accessing the Internet over the time interval of a week. Clearly, the majority of households (86%) are accessing the Internet on a daily basis. A further 13% of households are accessing the internet on a weekly basis, while only 1% of households are accessing the internet on less than a weekly basis.

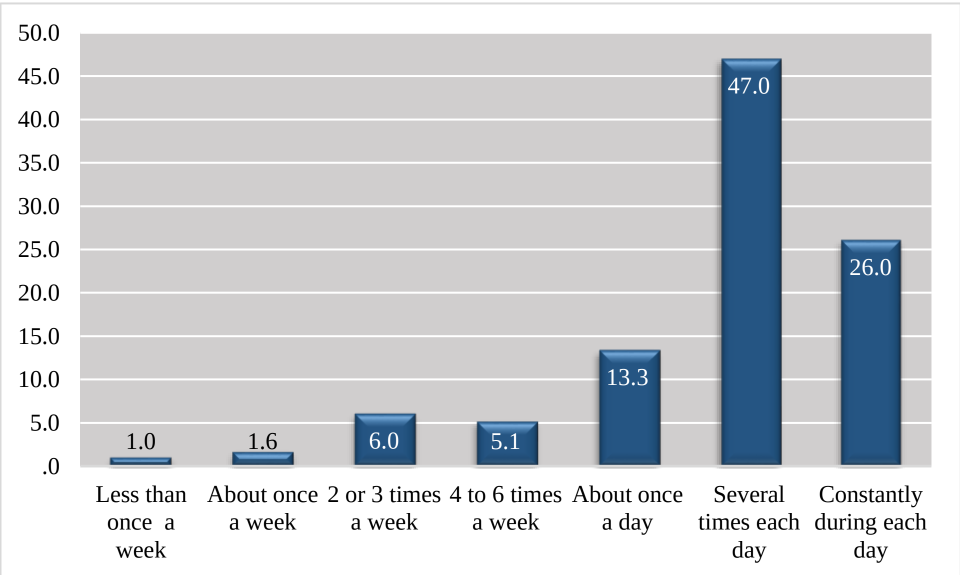

Figure 6-4 Household weekly frequency of Internet access

Figure 6-5 shows how many members of a household across the respondent households are using the Internet or, in other words, the density of internet users in a household.

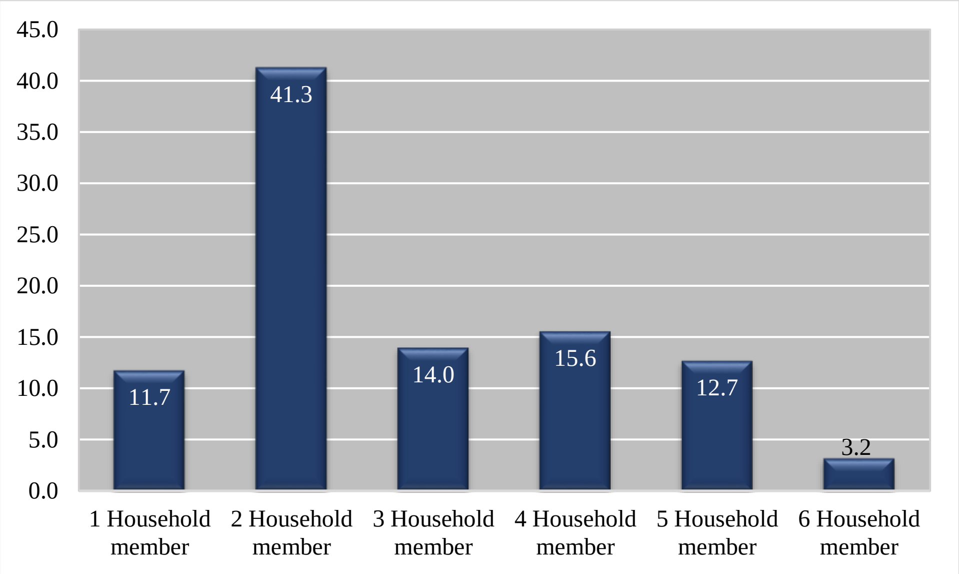

Figure 6-5 Household Internet use density

Interestingly more than half of the households have only 1 to 2 members using the Internet, while more than 45% of households have 3 or more members using the Internet.

The internet is available and accessible in different ways, such as fixed line broadband ADSL/ADSL2+, WiFi LANS and via mobile broadband Internet; and in different locations such as home, work, school, library and even in public places. So in this study households were asked where they are accessing the Internet. Figure 6-6 shows where household members are accessing the Internet.

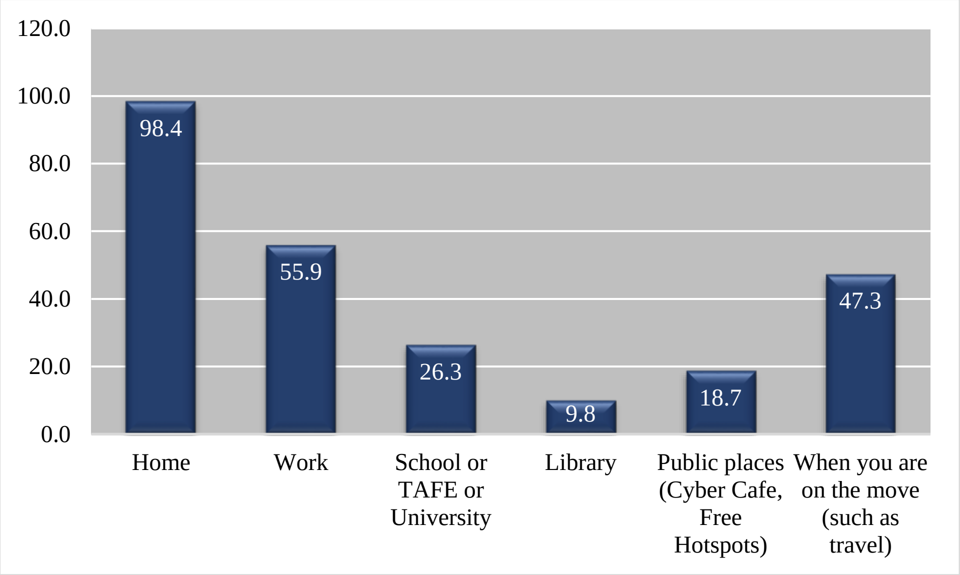

Figure 6-6 where do members of household access the Internet

Ninety-eight percent of households are accessing the Internet from their home, while almost 56% of households are accessing the Internet from work; 26% from school, TAFE or university; 19% from public places; and 10% from a library. Interestingly, 47% are accessing the Internet while on the move (travelling)—which, again, indicates the increasing influence of mobile devices and mobile broadband services which are connected to mobile networks, and WiFi networks when these are available.

Figure 6-7 shows the different devices used by households to access the Internet.

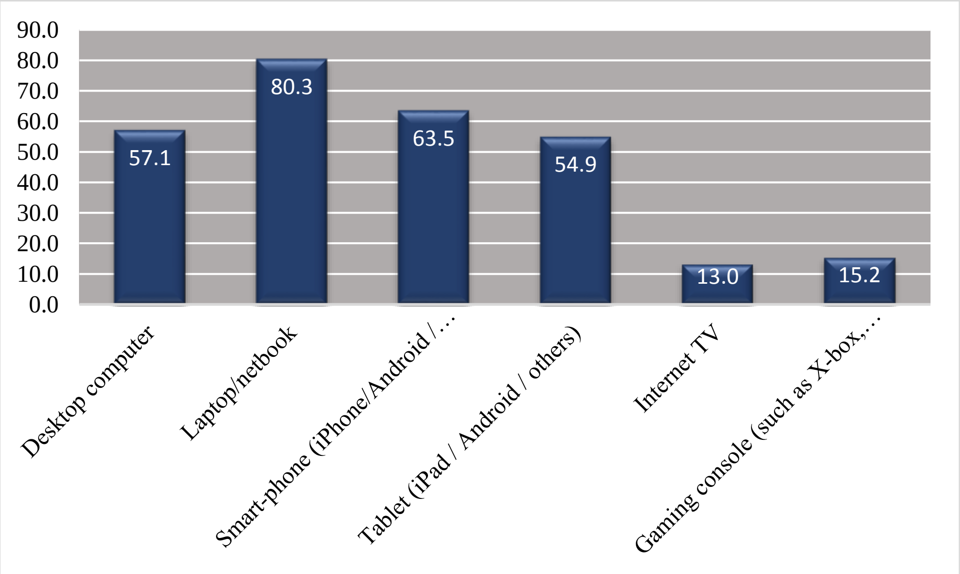

Figure 6-7 Different devices used by households to access the Internet

At 80% laptops and netbooks are the most common device used by households to access the Internet. Next, 64% Smart phones are the second most common device used by households to access the Internet. At 57% Desktop computers are the third most common device used by households to access the Internet; while at 55% tablets are also the fourth most common device used by households to access the Internet. To a lesser extent, at 15% and 13% respectively, gaming consoles and Internet TV are the fifth and sixth most common ways to access the Internet.

Figure 6-8 shows the Internet-based digital services used by households in the WDR. Not surprisingly, email is most widely used (97%); and online banking and social media (Facebook) also figure prominently. E-Government services come in at number 10 (47%) with almost half of the respondent households indicating they use government internet-based digital services.

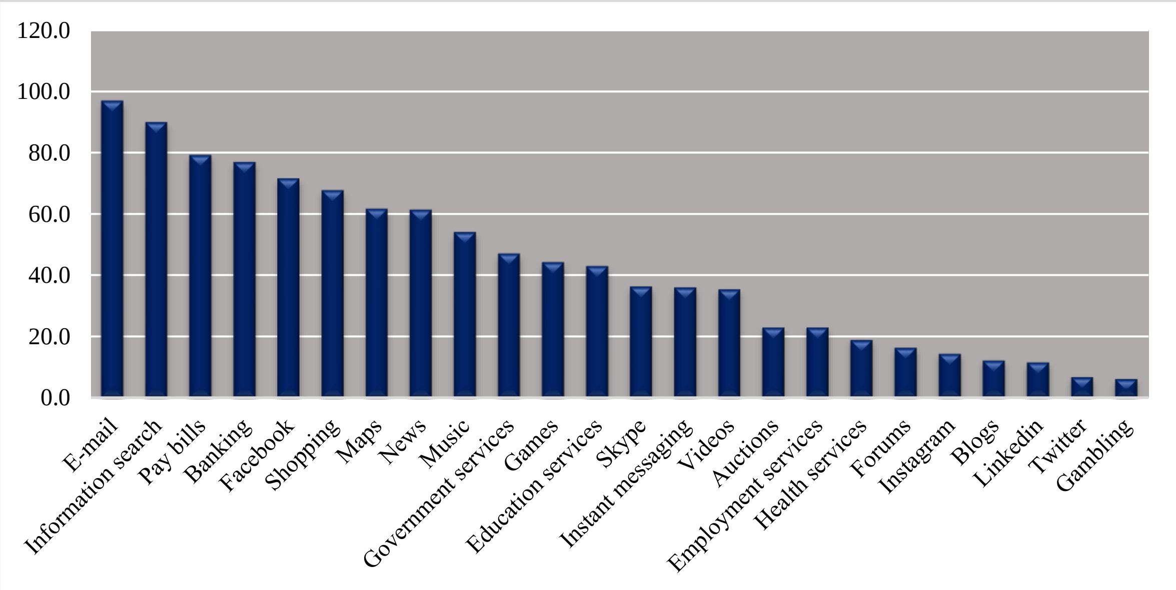

Figure 6-8 Household use of Internet based digital services

The broadband adoption, use and impact components of the broadband ecosystem were analysed quantitatively in two stages: measurement model and structural model. Results of this quantitative analysis of the final measurement model and final structural model are presented here. The results of the initial quantitative analysis of the two stages— measurement model and structural model—are presented in Appendix E2.

6.5 FIRST STAGE: FINAL MEASUREMENT MODEL FOR BROADBAND ADOPTION, USE AND IMPACT

6.5.1 Validation of measurement model

In this study, both formative and reflective measurements are used and component-based SEM is recommended for formative and mixed models (Chin 1998a; Petter, Straub & Rai 2007).

The purpose of testing the reflective measurement model is to understand the relationship between observed variables and their related construct (Guo et al. 2011). Other important steps such as reliability and validity testing can be performed through the reflective measurement model. Testing each item's reliability is considered a key indicator of the measurement model. Given this study model consists of both reflective and formative items, in this case analysis should be carried out separately for each part of the model to observe carefully outer loading and outer weights for reflective and formative items respectively. In this chapter the reflective measurement model is examined, followed by an examination of the formative measurement model.

Analysis of reflective measurement model

Carmines and Zeller (1979) suggest that the factor loading of construct items should be 0.70 as an acceptable level of items' reliability. However, a factor loading of 0.50 is considered acceptable by Hulland (1999), and even 0.40 can be an acceptable level; but a factor loading below 0.40 should be removed from the measurement model (Chin 1998b). SmartPLS3 is used to test the measurement model of the quantitative aspect of the research model in this study. This model includes 9 constructs with reflective items which are Utilitarian outcomes (UO); Hedonic outcomes (HO); Actual broadband use (ABU); Perceived cost (PC); Self-efficacy (SE); Prior knowledge and Experience (PKE); Intention to adopt and use of broadband Internet (ITUB); Bridging Social capital (BRSC); and Bonding Social capital (BOSC). Table 6-6 presents the factor loadings of the items for each of these 9 constructs that have met the minimum threshold of 0.5 (Hulland 1999). The items listed in the table below with a low factor loading were dropped (i.e. UO5, PC5_Rev, ITUB3 and BOSC3_Rev). Length of Internet use (HLUI) would be considered as a single item.

Table 6-6 Factor loadings of the final measurement model

	ABU	BOSC	BRSC	HLUI	HO	ITUB	PERC	PKE	SE	UO
BOSC1		0.753								
BOSC10		0.722								
BOSC2		0.738								
BOSC3_Rev		0.304								
BOSC4		0.889								
BOSC5		0.632								
BOSC6		0.640								
BOSC7		0.746								
BOSC8		0.671								
BOSC9_Rev		0.672								
BRSC1			0.907							
BRSC10			0.637							
BRSC2			0.862							
BRSC3			0.888							
BRSC4			0.862							
BRSC5			0.876							
BRSC6			0.857							
BRSC7			0.826							
BRSC8			0.881							
BRSC9			0.826							
FOU1	0.850									
FOU2	0.764									
FOU3	0.810									
HLUI1				1.000						
HO1					0.755					
HO2					0.769					
HO3					0.712					
HO4					0.661					
HO5					0.237					
ITUB1						0.861				
ITUB2						0.918				
ITUB3						0.201				
ITUB4						0.594				
ITUB5_Rev						0.730				
PKE1								0.847		
PKE2								0.728		
PKE3								0.751		
PKE4								0.914		
PerC1							0.697			
PerC2							0.383			
PerC3							0.709			
PerC4_Rev							0.655			
PerC5_Rev							0.136			
SE1									0.954	

	ABU	BOSC	BRSC	HLUI	HO	ITUB	PERC	PKE	SE	UO
SE2									0.953	
SE3									0.967	
UO1										0.811
UO2										0.862
UO3										0.746
UO4										0.681

The average variance extracted (AVE), composite reliability (CR) and Cronbach's alpha scores of the final reflective measurement model for broadband adoption and use and social capital is presented in

Table 6-7.

Table 6-7 AVE, CR and Cronbach's alpha of the measurement model

Construct	AVE	CR	Cronbach's Alpha
ABU	0.65	0.85	0.85
BOSC	0.52	0.90	0.91
BRSC	0.71	0.96	0.96
HLUI	1.00	1.00	1.00
HO	0.52	0.81	0.81
ITUB	0.62	0.87	0.85
PerC	0.35	0.61	0.61
PKE	0.66	0.89	0.89
SE	0.92	0.97	0.97
UO	0.61	0.86	0.86

UO Utilitarian outcome
HO Hedonic outcome
PerC Perceived cost
PKE Prior knowledge and experience
ABU Actual broadband use
ITUB Intention to adopt and use of broadband Internet
HLUI Length of Internet use
SE Self-efficacy
BOSCI Bonding social capital
BRSC Bridging social capital

Table 6-7 shows that the AVE, CR and Cronbach's alpha scores for each construct are within acceptable ranges. In regard to average variance extracted, all the constructs are above the acceptable level of 0.50, with the exception of Perceived cost (PerC). However, Fornell and Larcker (1981) assert that if AVE is less than 0.5, but composite reliability is higher than 0.6, the convergent validity of the construct is still adequate. Thus, this result indicates high construct reliability of the reflexive measurement model.

Composite reliability is also used to assess the internal consistency of the measurement model. According to Tseng, Dörnyei and Schmitt (2006) the acceptable level of this indicator of composite reliability is 0.60. All the constructs except Perceived Cost-which was 0.61-exceeded the 0.70 level for CR. Accordingly, all of the constructs in this study achieved an acceptable level of reliability based on the CR indicator.

Furthermore, Cronbach's alpha is a key test to assess the reliability of internal consistency. Nunnally (1978) indicated that newly-developed measures can be accepted with an alpha value of 0.60, otherwise, 0.70 should be the threshold. However, Churchill Jr and Peter (1984) suggested an accepted level for the alpha coefficient value of alpha is 0.60; and below 0.60 is undesirable. All the constructs in the model exceeded the acceptable level as the Cronbach Alpha values were between .61 and .97.

To check the discriminant validity, this study used Heterotrait-Monotrait Ratio (HTMT), although examination of cross-loadings and use of the Fornell-Larcker criterion are accepted methods for assessing the discriminant validity of a PLS model. According to Henseler, Ringle and Sarstedt (2015), these methods have shortcomings. Henseler, Ringle and Sarstedt (2015) used simulation studies to demonstrate that lack of discriminant validity is better detected by the heterotrait-monotrait (HTMT) ratio they developed. According to Henseler, Ringle and Sarstedt (2015) heterotrait correlations should be smaller than monotrait correlations, meaning that the HTMT ratio should be below 1.0 and suggest that if the HTMT value is below 0.90, discriminant validity has been established between a given pair of reflective constructs. However, they also suggest that if the constructs are conceptually different-and they may be difficult to distinguish when correlated with values close to 1.0-then the criterion is unlikely to indicate a lack of discriminant validity, particularly when the loadings are homogeneous and high or the sample size is large. Based on the results shown in Table 6-8, discriminant validity is established for all research constructs as HTMT ratio is below 0.9, except for SE -> PKE which is slightly high-although below 1.0. To this point, no further modifications to the model are necessary.

Table 6-8 Heterotrait-Monotrait Ratio (HTMT) for discriminant validity of the measurement model for the broadband adoption and building social capital

	ABU	BOSC	BRSC	HLUI	HO	ITUB	PERC	PKE	SE	UO
ABU										
BOSC	0.213									
BRSC	0.273	0.653								
HLUI	0.380	0.035	0.037							
HO	0.691	0.379	0.424	0.116						
ITUB	0.605	0.145	0.274	0.251	0.542					
PERC	0.672	0.296	0.326	0.320	0.581	0.736				
PKE	0.551	0.250	0.247	0.260	0.499	0.767	0.618			
SE	0.572	0.246	0.255	0.201	0.491	0.696	0.568	0.910		
UO	0.598	0.184	0.314	0.247	0.632	0.651	0.701	0.663	0.620	

UO Utilitarian outcome
HO Hedonic outcome
PerC Perceived cost
PKE Prior knowledge and experience
ABU Actual broadband use
ITUB Intention to adopt and use of broadband Internet
HLUI Length of Internet use
SE Self-efficacy
BOSCI Bonding social capital
BRSC Bridging social capital

The first stage of component-based SEM analysis was focused on the evaluation of the measurement model of broadband adoption, use and its impact. Three items were used to measure the reliability: Cronbach's Alpha; composite reliability; and Heterotrait-Monotrait Ratio (HTMT). These items confirmed that the model constructs achieved a good level of reliability. Two types of validity were tested: convergent validity; and discriminant validity. Face validity was assessed in the pre-test and pilot test of the survey. The results of the validity tests showed that the measurement model achieved adequate convergent validity and a satisfactory level of discriminant validity.

Common Method Variance (CMV) Bias is a major systematic contributor to measurement error in survey research (Bagozzi & Yi 1991). So it is necessary for a researcher follow certain methods and steps both ex-ante and ex-post to avoid or correct CMV. In order to reduce the likelihood of CMV occurring at the ex-ante and ex-post stages of this study, the research employed a number of proven strategies. The researcher has followed Podsakoff et al. (2003)'s recommendation to avoid potential CMV at the ex-ante stage by designing the survey questionnaire in terms of mixing the order of the questions measuring the research constructs and also using different scale types, which can help to reduce the likelihood of CMV. In addition, research also used the marker variable technique to reduce the CMV at ex-ante stage. This consists of including an additional variables into the study that is theoretically unrelated to the study (Craighead et al. 2011). Further, some of the survey instrument items measuring the research constructs were worded negatively or in reverse order in order to detect if CMV is present when the survey data is collected. Furthermore this research has collected data from multiple sources so the interpretation of the key findings of the survey was not solely dependent on the results of statistical tests. Therefore the researcher had confidence that the findings of the survey result were indeed valid and reliable (Craighead et al. 2011).

The researcher also checked at the ex-post stage for common method bias in the measurement model, which is the variance attributable to the measurement method. To test for the extent of bias caused by CMV, Harman's single factor test was conducted using an exploratory factor analysis in SPSS (Podsakoff et al. 2003). The result is obtained by running un-rotated, a single-factor constraint of factor analysis in SPSS statistics (Roni 2014). As more than one factor emerged from an exploratory factor analysis to explain the total variance in the factor analysis, it can be inferred that common methods bias in this case is not high. As the results show, 30.56% variance (see Appendix E1 Table E1-4 Harman's single factor test), which explained by a single factor, shows that the common method is not a major concern in this study as this is less than 50% cut-off point. Hence, common methods bias has been shown to have minimal effect and is not considered to be a concern in this study.

Analysis of formative measurement model

As described earlier, this study consists of one construct, Purchase Complexity, with formative measurement. For a formative measurement model it is not required to analyse indicator reliability, internal consistency reliability, or discriminant validity because the researcher would not expect that the formative items would be highly correlated, implying that composite reliability and Cronbach's alpha might not be high. Instead, for a formative measurement model there is a need to analyse the model's outer weights, convergent validity, and collinearity of items (Wong 2013).

Table 6-9 and Table 6-10 show Outer Weights and Outer Loadings for formative items respectively. The results show that PurC2 (0.102) indicator is not significant in the Outer Weights, although PurC2 (5.133) indicator is significant in Outer Loadings, thus, none of the items are removed. The researcher only needs to remove the indicator if both of its outer weights and outer loadings are not significant (Wong 2013).

Table 6-9 Outer weights for formative items of purchase complexity

	Original Sample (O)	Standard Error (STERR)	T Statistics (|O/STERR|)	P Values
PurC1 -> PURC	1.152	0.157	7.316	0.000
PurC2 -> PURC	0.026	0.253	0.102	0.919
PurC3 -> PURC	-0.370	0.181	2.040	0.042

Table 6-10 Outer loadings for formative items of purchase complexity

	Original Sample (O)	Standard Error (STERR)	T Statistics (|O/STERR|)	P Values
PurC1 -> PURC	0.956	0.046	20.953	0.000
PurC2 -> PURC	0.638	0.124	5.133	0.000
PurC3 -> PURC	0.320	0.147	2.172	0.030

To establish convergent validity, a ‘redundancy analysis’ was carried out for each latent variable separately. This involves the use of an existing formative latent variable (PurC) as an exogenous latent variable to predict an endogenous latent variable (ITUB) operationalized through reflectively measured items; and to check the correlation (path coefficient) between the latent variables. If beta value is 0.80 or higher, convergent validity is established (Hair et al., 2013). However, path- coefficient value for PurC ->ITUB is -0.351 so the correlation between these two variables does not establish convergent validity.

Further, formative measurement model may have the problem of indicator collinearity if items are highly correlated to each other, hence, this study needed to test the collinearity of the formative measurement model items. Consequently, this study used SPSS to generate VIF and Tolerance values for collinearity checking. The formative items of a latent variable (PurC) are set as independent variables, with the items of another latent variable (ITUB) as the dependent variable. Looking at Table 6-11, all of the items’ VIF values are lower than 5 and their tolerance values are higher than 0.2, so there is no collinearity problem with the formative construct Purchase complexity.

Table 6-11 Tolerance and VIF values for collinearity test

Model	Unstandardized Coefficients	Standardized Coefficients	t	Sig.	Collinearity Statistics

		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	6.569	.135		48.586	.000		
	PurC1	-.183	.041	-.374	-4.501	.000	.417	2.398
	PurC2	-.004	.047	-.009	-.088	.930	.304	3.285
	PurC3	.060	.038	.122	1.579	.115	.480	2.085

a. Dependent Variable: ITUB

However, construct purchase complexity (PurC) has convergent validity issues and this study dropped PurC construct from the final model for structural model assessment as the relationship between PurC and ITUB was found to be not significant in the final quantitative study model.

The next section looks into second stage inner model assessment, the evaluation of the structural model and the hypothesised relationships in the model.

6.6 SECOND STAGE: FINAL STRUCTURAL MODEL FOR BROADBAND ADOPTION, USE AND IMPACT

Firstly, this study focuses on testing the paths between the constructs in the component based structural model and reports on the results of the testing of the hypothesised relationships in the research model.

Two main statistical results were used to evaluate the relationships between the paths in the PLS structural model: standardized path coefficient, and R^2 (coefficient of determination) values. Consistent bootstrapping method was used to test the significance of paths in the study model. Dijkstra and Henseler (2015) advise using consistent bootstrapping method to test a path model where all LVs are connected for the estimation of the latent variables scores to achieve more stable results. Table 6-12 and Figure 6-9 show the results of testing the paths between model constructs. Table 6-12 summarises the path coefficients of the structural model for broadband adoption and building social capital for the significant relationships.

Three levels of cut-off were adopted to assess the strength of path coefficient: 0.2 weak; value between 0.2 and 0.5 is moderate; and more than 0.5 is strong (Cohen 1988; Sridharan et al. 2010). Thirteen hypothesised relationships were tested in the PLS structural model.

Table 6-12 Path coefficient of the structural model for broadband adoption, use and building and maintaining social capital

Relationships	Original Sample (O)	Sample Mean (5000)	Strength	T Statistics (|O/STERR|)	P Values
ABU -> BOSC	0.04	0.04	Weak	0.70	0.50
ABU -> BRSC	0.28	0.28	Moderate	4.74***	0.00
BRSC -> BOSC	0.66	0.66	Strong	16.64***	0.00
HLUI -> ABU	0.25	0.25	Moderate	4.89***	0.00
HO -> ABU	0.49	0.49	Moderate	7.52***	0.00
HO -> ITUB	0.07	0.06	Weak	0.752	0.45
ITUB -> ABU	0.17	0.17	Weak	1.88*	0.05
PERC -> ITUB	0.40	0.40	Moderate	2.80***	0.01
PKE -> ITUB	0.50	0.49	Moderate	4.23***	0.00
PURC-> ITUB	0.01	0.01	Weak	0.08	0.93
SE -> ABU	0.17	0.17	Moderate	2.16**	0.03
SE -> ITUB	-0.08	-0.10	Weak	0.40	0.69
UO -> ITUB	0.03	0.03	Weak	0.22	0.83

* 90% significance level; ** 95% significance level; *** 99% significance level

UO	Utilitarian outcome	HLUI	Length of Internet use
HO	Hedonic outcome	SE	Self-efficacy
PerC	Perceived cost	BOSCI	Bonding social capital
PKE	Prior knowledge and experience	BRSC	Bridging social capital
ABU	Actual broadband use		
ITUB	Intention to adopt and use of broadband Internet		

Thereby, it was determined that intention to adopt and use broadband Internet is significantly affected by perceived cost (0.40), and prior knowledge and experience (0.50). However, utilitarian outcome (0.03), hedonic outcomes (0.07), self –efficacy (-0.08) and purchase complexity (0.01) have no effect on intention to adopt and use broadband. Actual use of broadband is significantly affected by hedonic outcomes (0.49), self-efficacy (0.17), intention to adopt and use broadband Internet (0.17) and how long respondents have been using Internet (0.25). Bridging social capital is significantly affected by actual use of broadband (0.28); however, there is no effect regarding actual use of broadband on bonding social capital (0.04), although bridging social capital has a significant positive effect on bonding social capital (0.66).

Table 6-13 summarises the analysis for the coefficient of determination (R^2) for this study's dependent variables in the quantitative study model.

Table 6-13 R^2 of structural model

Construct	R^2	Interpretation
ABU	0.62	Moderate
BOSC	0.43	Moderate
BRSC	0.07	Weak
ITUB	0.68	Substantial

R^2 indicates the amount of variance in the dependent variable that can be explained in the model by the independent variables. According to Tabachnick and Fidell (2007) the higher a dependent variable's R^2 value, the higher is its prediction accuracy. Based on the results provided in Table 6-11, it can be concluded that the values of R^2 for three variables are above the critical threshold of 0.19 and one is below the threshold (Chin 1998b; Henseler, Ringle & Sinkovics 2009). Regarding measuring the power of R^2, three levels were suggested: 0.670 substantial; 0.333 moderate; and 0.190 weak (Chin 1998b; Urbach & Ahlemann 2010). The results of intention to adopt and use broadband (0.68) are considered to be substantial in terms of statistical power of R^2. Actual use of broadband (0.33), building bonding social capital (0.36) is considered to be moderate in terms of statistical power of R^2 while bridging social capital (0.07) is considered to be weak in terms of statistical power of R^2. This low R^2 value means the variance explained by actual broadband use in the dependent variable bridging social capital is very weak and almost non-existent although the significant relationship between actual broadband and bridging social capital. This could be because actual broadband use do not directly help much in building bridging social capital in rural communities but broadband actual use could be work as a catalyst to increasing and building bridging social capital. It could be that the research model needs to be extended in future work to add other variables together with actual broadband use as independent variables for bridging social capital to see if the model has better fit in terms of R^2 for the dependent variable bridging social capital as may also be the case for bonding social capital as well.

Table 6-14 below summarises the results of the total effects of f-square in PLS structural model. The f-square expresses how large a proportion of unexplained variance is accounted for by R^2 change (Hair et al. 2016).

Table 6-14 Total effects of f^2

	f^2	Effect size

ABU -> BOSC	0.002	Small
ABU -> BRSC	0.082	Small
BRSC -> BOSC	0.678	High
HLUI -> ABU	0.155	Medium
HO -> ABU	0.437	High
HO -> ITUB	0.008	Small
ITUB -> ABU	0.035	Small
PERC -> ITUB	0.233	Medium
PKE -> ITUB	0.351	High
PURC -> ITUB	0.000	Small
SE -> ABU	0.038	Small
SE -> ITUB	0.003	Small
UO -> ITUB	0.001	Small

According to Cohen (1988), 0.02 represents a ‘small’ f^2 effect size, 0.15 represents a ‘medium’ effect, and 0.35 represents a ‘high’ effect size. The result of effect on dropping actual broadband use, intention to continue use of broadband, purchase complexity, self-efficacy and utilitarian outcomes from the model reflects minimal effect. Effect of dropping perceived cost and how long using Internet from the model shows a medium effect; and, on the other hand, dropping bridging social capital, hedonic outcomes and prior knowledge and experience from the model show a high effect.

Table 6-15 summarises the results for prediction relevance of this study's dependent variables.

Table 6-15 Prediction relevance of the structural model

Dependent variable	Q^2	Has prediction relevance?
ABU	0.37	Yes
BOSC	0.21	Yes
BRSC	0.05	Yes
ITUB	0.37	Yes

As all values for prediction relevance Q^2 shown in Table 6-13 are above the threshold of 0, the model's prediction relevance is granted.

To this point, with assessment of the measurement and structural model being completed, the final structural model with all valid items and relationships can be presented. Figure 6-9 depicts the final structural model for broadband adoption use and building and maintaining social capital.

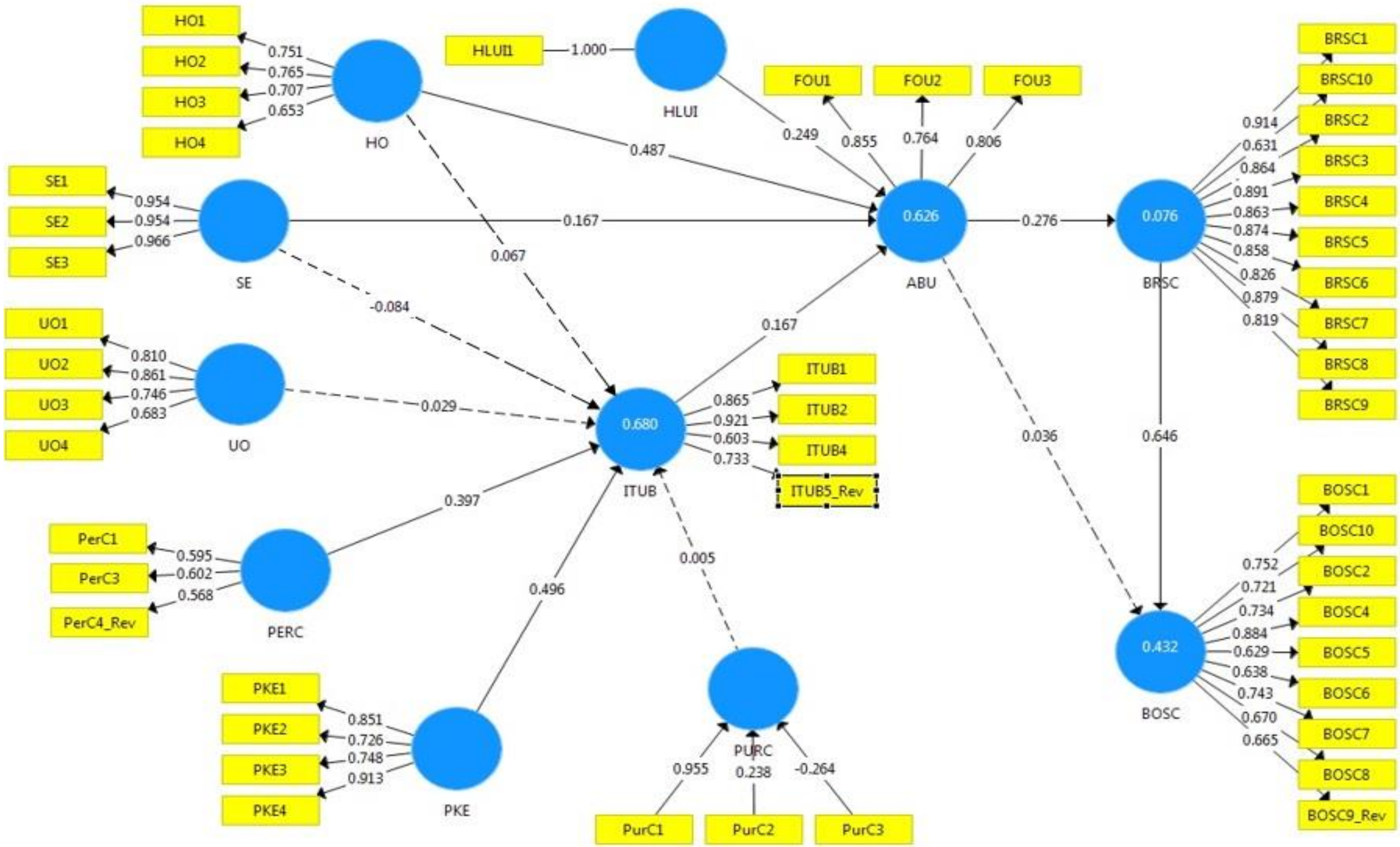

Figure 6-9 Revised broadband adoption, use and impact components of broadband ecosystem broken down into testable hypotheses

6.6.1 Overall goodness of fit (GoF) of the model

Table 6-16 summarises the results for R^2, communality and redundancy of the relevant research constructs to assess the overall Goodness of Fit (GoF) of the structural model for broadband adoption use and building and maintaining social capital.

Table 6-16 R^2 Communality, redundancy and GoF of the structural model

Dependent variable	R^2	Communality	Redundancy
ABU	0.62	0.52	0.37
BOSC	0.43	0.46	0.21
BRSC	0.07	0.68	0.05
HLUI		1.00	
HO		0.40	
ITUB	0.68	0.53	0.37
PERC		0.20	
PKE		0.57	
PURC		0.03	
SE		0.84	
UO		0.49	
AVERAGE	0.45	0.52	0.25
GOODNESS OF FIT (GOF)	0.48		

Regarding the cut-off predictive relevance Q^2, all the constructs achieved values more than zero, as shown in the above table (Table 6-16). These values indicate that the structural model has a good predictive relevance. All the values of cross-validated communality were well above the threshold level of zero. Regarding the overall quality of the research model, this study computed the GoF following the guiding principles of Tenenhaus et al. (2005). The GOF is calculated as:

$$\text{GOF} = \sqrt{\overline{\text{communality}} \times \overline{R^2}}$$

The value of GoF is between 0 and 1, and the high level of GoF points to better path model estimation (Karim 2009). Therefore, the results show that for broadband adoption and building and maintaining social capital, the model's overall effect size can be considered to have a good level of fit (0.48).

6.7 OUTCOMES OF HYPOTHESES TESTING

The construct intention to adopt and use broadband Internet was initially assumed to be determined by six constructs: utilitarian outcomes; hedonic outcomes, self-efficacy, perceived cost; purchase complexity and prior knowledge and experience. Actual broadband use was assumed to be determined by two constructs: intention to adopt and use broadband Internet; and length of Internet use. Building and maintaining social capital using Internet (bonding and bridging capital) were assumed to be determined by actual broadband use.

The results of the analysis of the component based structural model confirms the statistical significance and direct impact of perceived cost and prior knowledge and experience on intention to adopt and use broadband Internet. Similarly, the statistical significance and direct impact of hedonic outcomes, self-efficacy, intention to adopt and use broadband Internet and length of Internet use on actual broadband use were confirmed. Additionally, actual broadband use has a statistical significance and direct impact on building bridging social capital. However, this study confirms that utilitarian outcomes, hedonic outcomes, self-efficacy and purchase complexity do not have a significant impact on intention to adopt and use broadband Internet. Similarly, actual broadband use does not have a significant impact on maintaining bonding social capital.

The results of the analysis of the component based structural model confirms the statistical significance and direct impact of perceived cost (i.e., β 0.40, T-value 2.80, P 0.01) and prior knowledge and experience (i.e., β 0.50, T-value 4.23, P 0.00) on intention to adopt and use broadband Internet. These results support the two following hypotheses:

(H6) *'Perceived cost of broadband will have a negative influence intention to adopt and use broadband Internet';*

(H7) *'Prior knowledge and experience will have a positive influence on intention to adopt and use broadband Internet'*.

However, direct effect of utilitarian outcomes (i.e., β 0.03, t-value 0.22, p 0.83), hedonic outcome (i.e., β 0.07, t-value 0.75, p 0.45), self-efficacy (i.e., β 0.08, t-value 0.40, p 0.69) and purchase complexity (i.e., β 0.01, t-value 0.08, p 0.93) on intention to adopt and use broadband Internet was not significant. Based on the results of the analysis of the component based structural model, the hypotheses H1 H2, H4 and H8 were rejected:

(H1) *'Utilitarian outcomes will have a positive influence on intention to adopt and use broadband Internet';*

(H2) *'Hedonic outcomes will have a positive influence on intention to adopt and use broadband Internet';*

(H4) *'Self-efficacy will have a positive influence on intention to adopt and use broadband Internet';*

(H8) '*A high level of purchase complexity will have a negative influence on intention to adopt and use broadband Internet'.*

According to the revised final structural model in this study, actual broadband use was determined by four constructs: hedonic outcomes; self-efficacy; intention to adopt and use broadband Internet; and length of Internet use. The results of the analysis of the component based structural model confirms the significant and direct impact of hedonic outcomes (i.e., β 0.49, t-value 7.52, p 0.00); self-efficacy (i.e., β 0.17, t-value 2.16, p 0.03); intention to adopt and use broadband Internet (i.e., β 0.17, t-value 1.88, p 0.05); and length of Internet use on actual broadband use (i.e., β 0.25, t-value 4.89, p 0.00). These results supported the following three additional (H3, H5 and H10) and (H9) hypotheses:

(H3) *'Hedonic outcomes will have a positive influence on actual broadband use';*

(H5) *'Self-efficacy will have a positive influence on actual broadband use';*

(H9) *'Intention to adopt and use broadband Internet will have a positive influence on actual broadband use';*

(H10) *'Length of Internet use will have a positive influence on actual broadband use'*.

Bridging social capital was hypothesized to be determined by actual broadband use. The outcome of component based structural model analysis supports the significant and direct effect of actual broadband use (i.e., β 0.28, t-value 4.74, p 0.00). According to the results hypothesis H12 was accepted:

(H12) *'Actual broadband use will have a positive influence on building bridging social capital in communities.*

Similarly, bonding social capital was hypothesized to be determined by actual broadband use. The results of the analysis of the component based structural model does not support the significant and direct effect of actual broadband use (i.e., β 0.04, t-value 0.70, p 0.50) on bonding social capital. According to the results, hypothesis H10 was rejected:

(H11) *'Actual broadband use will have a positive influence on maintaining bonding social capital in communities.*

However, bonding social capital was also assumed to be built through bridging social capital, which has a strong and significant relationship (i.e., β 0.66, t-value 16.64, p 0.00). Based on the results, hypothesis H13 was accepted:

(H13) '*Bridging social capital will have positive influence on building bonding social capital in communities'.*

The results of the hypotheses testing for the 13 hypothesised relationships in the quantitative study model are summarised in Table 6-17.

Table 6-17 Summary of Supported and unsupported hypotheses of this study

Hypotheses	**Relationship investigated**	**Supported or Not**	**Regression outcomes**
H1	*Utilitarian outcomes will have a positive influence on actual broadband use.*	**No**	(β 0.03, t-value 0.22, p 0.83)
H2	*Hedonic outcomes will have a positive influence on actual broadband use.*	**No**	(β 0.07, t-value 0.75, p 0.45),
H3	*Hedonic outcomes will have a positive influence on actual broadband use.*	**Yes**	(β 0.49, t-value 7.52, p 0.00)
H4	*Self-efficacy will have a positive influence on intention to adopt and use broadband Internet*	**No**	(β 0.08, t-value 0.40, p 0.69)
H5	*Self-efficacy will have a positive influence on actual broadband use.*	**Yes**	(β 0.17, t-value 2.16, p 0.03)
H6	*Perceived cost of broadband will have a negative influence intention to adopt and use broadband Internet*	**Yes**	(β 0.40, t-value 2.80, p 0.01)
H7	*Prior knowledge and experience will have a positive influence on intention to adopt and use broadband Internet.*	**Yes**	(β 0.50, t-value 4.23, p 0.00)

Hypotheses	Relationship investigated	Supported or Not	Regression outcomes
H8	*A high level of purchase complexity will have a negative influence on intention to adopt and use broadband Internet.*	**No**	(β 0.01, t-value 0.08, p 0.93)
H9	*Intention to adopt and use broadband Internet will have a positive influence on actual broadband use*	**Yes**	(β 0.17, t-value 1.88, p 0.05)
H10	*Length of Internet use will have a positive influence on actual broadband use*	**Yes**	(β 0.25, t-value 4.89, p 0.00)
H11	*Actual broadband use will have a positive influence on maintaining bonding social capital*	**No**	(β 0.04, t-value 0.70, p 0.50)
H12	*Actual broadband use will have a positive influence on building bridging social capital*	**Yes**	(β 0.28, t-value 4.74, p 0.00)
H13	*Bridging social capital will have positive on building bonding social capital*	**Yes**	(β 0.66, t-value 16.64, p 0.00)

6.8 CONCLUSION

This chapter presented the results of the statistical analysis of phase 3-quantitative (survey) data of broadband adoption, use and its impact on social capital in rural communities. Descriptive analysis was used to provide a profile of survey respondents and their households. Then the results of normality, reliability and validity tests of the construct items and constructs overall were presented to ensure appropriate statistical significance of the reflective measurement model and formative measurement model. Then the structural model for evaluating the adoption and use of broadband and its impact on building and maintaining social capital in rural communities was assessed by testing the proposed hypothesised relationships in the structural model. Finally, results of the hypotheses testing of quantitative components of the broadband ecosystem were presented.

Next, in Chapter 7, a detailed discussion of the key findings from the results of the data analyses presented in Chapters 4 and 5, and this Chapter 6, is provided in relation to each of the three research questions investigated and the 13 hypotheses tested

Chapter 7: Discussion of results

7.1 INTRODUCTION

In this chapter, the key findings from Chapter 4 ‘Analysis of Broadband Infrastructure’; Chapter 5 ‘Analysis of Household Interviews’; and Chapter 6 ‘Analysis of Household Survey’ are discussed for each of the three research questions investigated and 13 hypotheses tested in this study in relation to the existing knowledge and relevant literature.

Figure 7-1 presents an overview of the structure of this chapter.

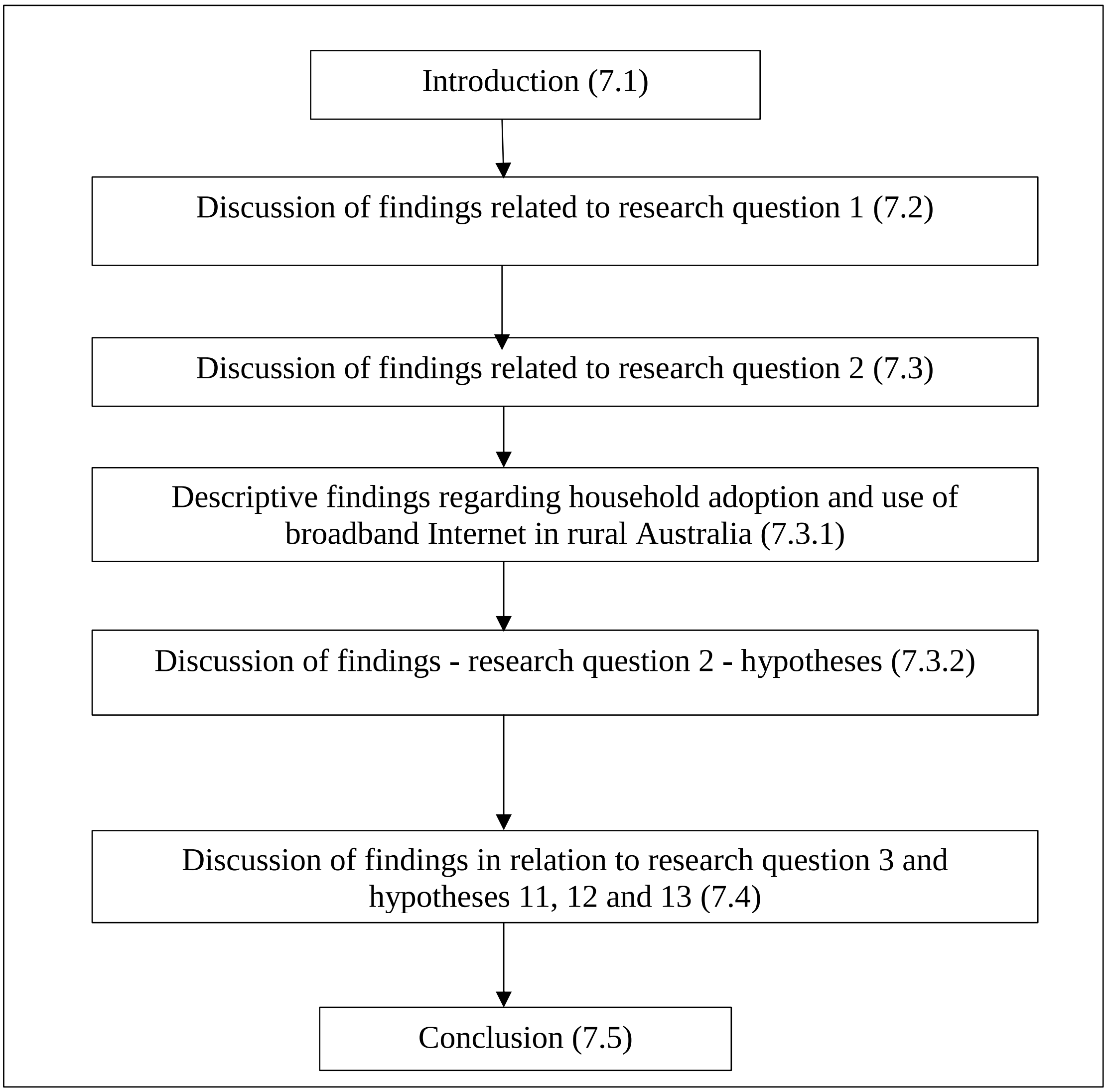

Figure 7-1 Outline of Chapter 7 with section numbers in brackets

7.2 DISCUSSION OF FINDINGS RELATED TO RESEARCH QUESTION 1

The first research question for this study is: *What is the status (supply) of broadband infrastructure in the WDR?*

Chapter 4, Section 4.4 (Table 4-24) shows that there is significant existing telecommunications infrastructure in the WDR in terms of wired and wireless broadband access technologies. The WDR is extensively covered by the Public Switched Telephone Network (PSTN) (which underpins the current wired broadband access technology – ADSL/ADSL2+), mobile networks and, more recently, NBN satellite. These digital infrastructures potentially have the capability to deliver broadband internet services via ADSL/ADSL2+ and 3G and 4G mobile broadband in major towns in the WDR. However, there is limited broadband infrastructure in terms of network coverage and unreliable network services, that is, poor download and upload speed of in the smaller towns in the WDR such as Dulacca, Kaimkillenbun, Drillham, Brigalow, Moonie, Jimbour, Glenmorgan, Macalister and Gulugaba. (see Table 4-24). The reach of satellite broadband Internet is ubiquitous across the WDR, but is limited to remote residents who do not have access to ADSL/ADSL2+ or 3G/4G mobile broadband Internet. Moreover, there are major issues of speed and connection reliability with the NBN interim satellite broadband services up until recently when the NBN Co launched new and upgraded satellite broadband services (RTIRC 2015; Wilken et al. 2014)

ADSL and ADSL2+ broadband is available in almost half (9 out of 20) of the largest towns in the WDR namely, Dalby, Chinchilla, Miles, Jandowae, Wandoan, Meandarra, Bell, Condamine and Tara. However, even in Dalby—which is the largest town in the WDR-some households depending on their residential location are unable to access ADSL because there are no additional ADSL ports available in the Dalby telephone exchange. Small towns such as Dulacca, Warra, Kaimkillenbun, Brigalow, Kogan, Moonie, Jimbour, Glenmorgan, Macalister and Gulugaba do not have ADSL-enabled telephone exchanges and, thus, have no access to an ADSL service. Although Telstra has listed these telephone exchanges for planned updates with ADSL2+ equipment, there is no indication of when that will occur (ADSL2-Exchanges 2016). Moreover, the PSTN which underpins ADSL/ADSL2+ broadband services in towns in the WDR is currently lacking, due to the state of the PSTN local loop copper network which, in many cases, is at least 30-40 years old, or older, and is considered a degraded network infrastructure (Ross 2013)

Mobile broadband is the dominant broadband access technology in the WDR and is available in most of the towns (13 out of 20 towns have mobile phone towers deployed in town boundaries). Telstra, Optus and Vodafone all have mobile networks deployed in varying degrees across the WDR (RFNSA 2016). However, the Telstra mobile network has the highest coverage across the WDR, as is the case in most of rural and regional Australia (Freeman et al. 2016; Lane, Tiwari & Alam 2016); while the Optus mobile network has limited coverage beyond the three main towns of Dalby, Chinchilla and Miles. The Vodafone mobile network has very limited coverage beyond these three towns. All the three mobile network service providers have deployed 4G wireless mobile broadband in the three largest towns in the WDR-Dalby, Chinchilla and Miles. Some of the smaller towns-Jandowae, Wandoan, Bell, Meandarra, Dulacca, Warra, Drillham, and Kogan-have 3G and 4G wireless services; whereas Tara and Condamine have only 3G services. However, 7 small towns, namely, Brigalow, Kaimkillenbun, Moonie, Jimbour, Glenmorgan, Macalister and Guluguba do not have any mobile wireless network infrastructure (mobile phone towers) and depend on the nearest town for a mobile network connection (RFNSA 2016).

Moreover, mobile broadband Internet services are highly variable in terms quality of speed and reliability across the region. For instance, as discussed in Chapter 5 Section 5.8.2, an interview participant highlighted that parts of the WDR have a poor quality and patchy wireless broadband services and not much an option to select.

Moreover, due to limited and old copper wire backhaul capacity, 3G and 4G mobile broadband networks are slow and congested and struggle to support large volumes of data traffic at peak usage times (Ross 2012). Interview participant highlights the lack of capacity of mobile phone towers in many towns in the WDR and half of the time can’t connect to Internet.

The selective testing of mobile network services provided by Telstra, Optus and Vodafone using the Open Signal Mobile App shows that the three largest towns in the WDR (Dalby, Chinchilla, Miles) all experience good mobile network speed and reliability of service. In contrast, selective testing in smaller towns in the WDR (Condamine, Kogan, Moonie, Drilham) of mobile network services provided by

Telstra, Optus and Vodafone showed that speed and reliability of service varied from good, to poor, to non-existent, depending on the coverage of the mobile phone carrier. Also, testing of the mobile network coverage indicates that as soon as one moved beyond town boundaries, mobile network coverage and speed start to drop significantly, even for the larger towns in the WDR with reasonable mobile broadband network coverage.

There is also significant backbone broadband network infrastructure in the WDR in terms of two fibre optic backbone networks (Nexium and Nextgen) running through the three main population centres of the WDC (Dalby, Chinchilla, Miles) (Nexium 2016; Nextgen 2015). However, these fibre optic networks cannot be accessed by the general public and only local government and businesses can access these fibre optic networks. There are other dark fibre networks (Toledano & Roorda 2014) in the WDR that have been laid by mining companies to service and manage their coal seam gas wells, but these are closed proprietary networks which does not help the current situation of a lack of reliable high speed broadband internet services across the WDR (Lane, Tiwari & Alam 2016). These are the private commercial networks with limited access given to only government for emergency services.

This study also shows that while there is NBN Co satellite broadband Internet coverage across all of the WDR, it is only available to households who do not have access to fixed line broadband services such as ADSL/ADSL2+ or mobile broadband services (NBN 2015). Moreover, the findings from chapter 4 and chapter 5 suggests that satellite broadband services are expensive to access and provide poor quality services.

Hence, the key findings of this study in relation to Research Question 1 highlight that most of the rural communities in the WDR are left behind in terms of quality and reliable broadband access, except for major towns such as Dalby and, to a lesser degree, Chinchilla and Miles. These findings are supported by and consistent with results of national studies such as the Australian Regional Telecommunications Review (RTR) 2014-15, which highlighted rural communities have limited options in choosing a broadband provider; and they typically have lower internet connection speeds and availability and limited mobile broadband availability (RTIRC 2015). While the RTR study shows the aggregate results at national level, it does not provide details at local or micro level-which can vary greatly across a particular region, as highlighted in this study. This study's findings also provide further support for the findings of Middleton and Chang (2008) that found Australian rural communities have poor telecommunication infrastructure to support current increasing demand for data and, also, average speeds are slow, prices are high and download caps are restrictive. In addition, this study provides further support and aligns with the key findings of Freeman and Park (2015) on rural realities of digital communication in Australia which suggest that many rural areas have no, or poor quality, broadband Internet access.

This study highlights that system and service quality or quality of broadband infrastructure in terms of network coverage, reliability and speed are equally important for rural communities to be able to adopt and use broadband Internet services, as discussed. Picot and Wernick (2007) suggest that broadband Internet infrastructure plays a critical role in enhancing household activities such as information access, entertainment, communication and media, as well as access to other sectors. In addition to these business growth and economic opportunities, broadband is also seen to bring about various kinds of social benefits and connection (Picot & Wernick 2007; Qiang 2010). The findings of this study also support the notion that the quality of broadband infrastructure (supply) available to rural communities will encourage the residents to participate more proactively in the digital economy and the use of digital services.

7.3 DISCUSSION OF FINDINGS RELATED TO RESEARCH QUESTION 2

In this section, the key findings from Chapter 5 and Chapter 6 in relation to household broadband adoption, use and impact in rural Australia are discussed within the context of the existing literature. The second research question asked: What is the extent of adoption and use of broadband Internet services by households in the WDR?

7.3.1 Descriptive findings regarding household adoption and use of broadband Internet in rural Australia

As presented in Chapter 6 (Section 6.2), descriptive findings about household broadband Internet adoption and use in the WDR show that the majority of households (180, 60%) have had an Internet connection for 6-10 years. It is most likely that these households started using the internet after ADSL broadband internet become widely accessible to the Australian public from 2005 (Fletcher 2009; Islam, Selvadurai &

Town 2008). Interestingly, around 40% of the households were using the Internet more than 10 years ago when the primary means of accessing the Internet was via narrowband and a dialup modem. The majority of the survey and interview participants have adopted and are using wireless broadband such as 3G and 4G, followed by, to a slightly lesser extent, wired broadband-ADSL/ADSL2+. These findings in terms of household adoption and use of wireless and wired broadband services are similar and consistent with the findings of a recent national level study by the ABS (2016c) where mobile wireless broadband was found to be the most widely used broadband service used by households, followed by wired broadband.

Broadband Internet has become increasingly available and accessible wirelessly through mobile broadband or by using Wi-Fi in a range of locations such as home, work, school, library and public places such as shopping complexes. The findings of this study, based on the survey responses and interview data, suggest that the majority of households access the Internet in their home; followed by work, when people are on the move and in education institutes such as schools, TAFE or universities. These findings are consistent with the findings of ACMA (2015) *Australians' Digital Lives Report* which shows that the home remains the prime location where household members go online. However, it may be that this will change over time as mobile broadband becomes increasingly available and pervasive (Kvalbein et al. 2014; Liu et al. 2016; Winzer & Massarczyk 2015).

Most common devices used by households to access the Internet are laptops and netbooks, followed by smart phones, desktop and tablets. These findings are partially aligned with the findings of the ABS 2016 *Household Use of Information Technology Study* (ABS 2016c) which found that most households accessed the Internet through a desktop or laptop computer (94%), followed by mobile or smart phones (86%) and tablets (62%). Households may have used one or more of these types of devices to access the Internet. Interestingly, many of these devices can access the Internet via one or more broadband services such as fixed line broadband ADSL/ADSL2+ and WiFi LAN and/or via mobile broadband Internet. The findings of this study are similar to ACMA (2015) shows that laptop and desktop computers are still the most commonly-used devices to access the Internet, but an increasing number of people are opting to use portable smart devices like mobile phones and tablets to access Internet services such as email and social media.

In this study, for the majority of households that participated in interviews or responded to the survey, the most common categories of digital services used by their households were (in the following order): (1) communication (email, instant messaging, VoIP); followed by (2) information seeking (information search, news, maps); (3) e-commerce activities (pay bills, banking, auctions, shopping); (4) social media and social networking (Facebook, twitter, LinkedIn, Instagram, blog, forum); (5) entertainment activities (music, games, videos, gambling); and (6) e-organizational services (education services, health services, employment services, government services). Overall, the findings regarding household use of Internet services from the analysis of the interviews and survey responses is similar to the findings of the 2014–15 ABS *Study of Household Use of Information Technology* (ABS 2016c) which established that the four most popular internet services were banking, social networking, purchasing goods/services or online shopping/services and entertainment. Also, the findings are similar to the *Australians' Digital Lives Report* (ACMA 2015) which determined that the most popular online activities were communication, research and information, banking and finance, entertainment, shopping, blogs and online communities.

7.3.2 Discussion of findings - research question 2 - hypotheses

In this section, the key findings from testing ten specific research hypotheses are discussed in relation to existing knowledge and literature on broadband adoption and use by households, and the key findings from Chapter 5, analysis of 25 household interviews.

H1: Utilitarian outcomes will have a positive influence on intention to adopt and use broadband Internet

Utilitarian outcomes was used in this study to evaluate the intention to use broadband Internet in terms of the perceived utility of broadband in enhancing a range of households' activities including information search, job search, online shopping, paying bill, working from home and educational activities (Hill, Burgan & Troshani 2011; Hill, Troshani & Burgan 2014; Irani, Dwivedi & Williams 2009; Venkatesh & Brown 2001). Most of these previous studies found that utilitarian outcomes has a significant impact on the adoption and use of technology. However, quantitative results of this study found that the impact of utilitarian outcomes on intention to adopt and use broadband Internet is not significant. This finding is not consistent with previous studies where utilitarian outcomes is an important factor in terms of influencing intention to adopt and use broadband Internet (Hill, Burgan & Troshani 2011; Irani, Dwivedi & Williams 2009; Lurudusamy & Ramayah 2016). However, this finding is aligned with the findings of Brown, Venkatesh and Hoehle (2015). They suggest that utilitarian outcomes is actually measuring the usefulness of technology for households and users. Hence, if the households already own and have been using technology over a long period for different activities, then utilitarian outcomes have less impact on intention to adopt technology.

This is an important finding, indicating that most households have moved beyond the adoption phase to the use phase with many households using broadband for 10 or more years. This indicates that once households have been using broadband Internet for these services from number of years they become accustomed to using these services through Internet. Their use of broadband internet becomes habitual and they do not think of utilitarian outcomes as an important adoption factor.

H2: Hedonic outcomes will have a positive influence on intention to adopt and use broadband Internet

Similar to utilitarian outcomes, hedonic outcomes has been used in many previous technology adoption and use studies in evaluating the impact of entertainment on the adoption and use of technology in households (Brown, Venkatesh & Bala 2006; Brown, Venkatesh & Hoehle 2015; Hill, Troshani & Burgan 2014; Irani, Dwivedi & Williams 2009). Most of these studies found that hedonic outcomes has a significant influence on adoption and use of technology. However, findings of this study suggest that hedonic outcomes do not have a significant effect on intention to adoption and use broadband Internet. This could be because this study's findings show that most of the households have already using the Internet for hedonic purposes for a number of years. According to Brown, Venkatesh and Hoehle (2015), if households have been using the technology for a long time, then they become accustomed to using the technology and it is not an adoption decision but, rather, hedonic outcomes influence their actual use.

Therefore, this study tested an additional hypothesis to see whether hedonic outcomes have any influence on actual broadband use.

H3: Hedonic outcomes will have a positive influence on actual broadband use

This study found that hedonic outcomes has a much stronger influence on actual use of broadband Internet by households. This finding shows that most of the households are already using Internet for hedonic purposes. Therefore, this study considered hedonic outcomes as a variable that strongly influence the actual use of broadband Internet. This finding is supported by previous studies using MATH model that showed that hedonism plays a significant role for those who have already adopted household technologies (Brown & Venkatesh 2005; Brown, Venkatesh & Hoehle 2015). This is also an important finding for broadband adoption studies in general, indicating that most households have moved beyond the adoption phase to the use phase with many households using broadband for number of years for various entertainment purposes such as watching news, movies, or playing games (see Section 5.4.6 and 6.4.2 of Chapter 6). This indicates that households that have been using broadband Internet for hedonic (entertainment) services for a number of years have become familiar with using these services through the Internet and regard hedonic outcomes as a factor that reflects their actual use of broadband Internet.

H4: Self-efficacy will have a positive influence on intention to adopt and use broadband Internet

A number of previous studies found that self-efficacy has a significant influence on intention to adopt and use technology (Igbaria & Iivari 1995; Luarn & Lin 2005; Maillet, Mathieu & Sicotte 2015; McFarland & Hamilton 2006; Shiau & Chau 2016; Wang 2003; Wang et al. 2003). However, findings of this study suggest that self-efficacy does not have a significant effect on intention to adopt and use broadband Internet in the WDR households. This could be because the findings of from Chapter 5 and Chapter 6 show that most of the households have already been using the Internet for a few years, which indicates they are reasonably capable of using the Internet. This study's finding is similar to the finding of Hill, Troshani and Burgan (2014) and suggests that self-efficacy does not contribute to broadband adoption in rural and regional households. (Hill, Troshani & Burgan 2014) further added that this may be indicative that households are already adopters of broadband Internet and are generally already familiar with Internet technologies and possess the related knowledge and ability to use broadband Internet services. Moreover, the findings from interview participants (Chapter 5), which indicate that the number of years of using the Internet could result in more confidence and become comfortable using broadband Internet:

Thus, this study finding is consistent with and provides further support for a previous study conducted by Hill, Troshani and Burgan (2014) that found regional households have moved beyond the adoption phase and that self-efficacy is a significant predictor of actual broadband Internet use (Hill, Troshani & Burgan 2014).

Therefore, this study tested an additional hypothesis to determine whether self-efficacy has any influence on actual broadband use.

H5: Self-efficacy will have a positive influence on actual broadband use

This study found that self-efficacy has a positive influence on actual broadband use and it is an important factor that influences the actual use of broadband Internet. This is supported and consistent with other technology adoption studies (Brown, Venkatesh & Hoehle 2015; Dwivedi, Alsudairi & Irani 2010). This may be because, as discussed previously, households are already adopters of broadband Internet and are generally already familiar with internet technologies and possess the related knowledge and ability to use broadband Internet services (Hill, Troshani & Burgan 2014). This study finding is consistent with a previous study that found that self-efficacy has a significant influence on actual broadband Internet use (Hill, Troshani & Burgan 2014).

Brown, Venkatesh and Hoehle (2015) also indicated that self-efficacy is an important factor and predictor of household use of technology and the purchase decision-making process. To use the broadband requires the skills of using a computer or other digital devices (Dwivedi 2005). The ease or difficulty of use and requisite knowledge and skills for using a digital device and the Internet were expected to have an impact upon broadband use. Choudrie and Lee (2004) and Shim (2013) finding suggest that government policy to support (training) households to use a computer and Internet was found to have boosted the adoption and use of Internet. Dwivedi (2005) suggest that basic skills for accessing narrowband Internet and broadband are similar, although Oh, Ahn and Kim (2003) suggest that a person using broadband Internet is expected to possess a higher self-efficacy than a person using narrowband Internet.

The results from the interview data section 5.5.3 show that many household in the WDR would be willing to take advantage of some kind of support and training that would be beneficial for improving the digital literacy and skills of their household in order to make better use of computer and broadband Internet. Hence, the finding of this study suggest that self-efficacy of Internet use would have a stronger influence on actual broadband use.

H6: Perceived cost of broadband will have a negative influence intention to adopt and use broadband Internet

Findings of this study suggest that cost is an important factor that influences adoption and use of broadband Internet and hypothesis H2 is supported by the findings. The results from testing of hypothesis (H2) is consistent with a study conducted by Hill, Troshani and Burgan (2014) on broadband adoption in regional and urban households. They found that cost is one of the most important factors explaining regional household consumers’ broadband adoption decisions; and further suggest that affordability remains an unresolved issue that is impacting negatively on broadband adoption in these areas. The WDR has a low socio-economic status (Alam & Mamun 2017) and Choudrie and Dwivedi (2005) suggest that socio-economic status has a significant impact and drives the usage of technology such as broadband Internet. This is similar to the finding of Haucap, Heimeshoff and Lange (2015) which concluded that socio-economic factors affect broadband demand and use. Therefore, similar to previous studies, the findings of this study suggest that cost and household income directly influence households in their decision to adopt and use broadband Internet (Dauvin & Grzybowski 2014; Kongaut & Bohlin 2016). Furthermore, many households in the WDR do not have access to ADSL/ADSL2+ and are using a mobile broadband service (see chapter 5 section 5.4.3 and chapter 6 section 6.4.2), which is much more expensive in terms of data quotas and is often slower and less reliable (Staples 2016).

This study found that, similar to previous studies on the adoption of other household technologies, cost is one of the strongest predicators as to whether a household will adopt and use broadband (Dwivedi, Alsudairi & Irani 2010; Hill, Troshani & Burgan 2014; Kapoor, Dwivedi & Williams 2013). A study on broadband adoption in the UK also suggested that a high monthly cost was a major barrier inhibiting the adoption of broadband in households (Dwivedi, Choudrie & Gopal 2003). A number of large-scale studies on broadband adoption have also showed that lower broadband adoption among low-income communities is due to high subscribing costs (Dauvin & Grzybowski 2014; Dwivedi & Lal 2007; Koutroumpis 2009). Therefore, it is expected that if the monthly cost to subscribe to broadband is perceived as low, then the level of adoption will be high. Lee and Choudrie (2002) and Dwivedi, Alsudairi and Irani (2010) suggest that the South Korean Government recognised an affordable monthly cost of broadband as an important factor that led to high rates of adoption for middle-income households in South Korea. Seymour and Naidoo (2013) suggest that while broadband usage is impacted by high monthly fees, there are also concerns around the hidden costs such as broadband connection equipment and upgrades or the purchase of new computing devices to access broadband Internet.

Although majority of the households in the WDR indicated that the cost of subscribing to a broadband Internet is reasonable, interview participants also noted that subscription cost for broadband Internet is expensive compared to their city counterparts-and this was more problematic in the smaller towns where only mobile broadband was available. A number of interview participants with regard to cost of subscribing to broadband (from chapter 5 section 5.8 and Table 5-10) highlight that a number of households considered the cost of subscribing to a broadband Internet to be expensive, particularly in relation to data quotas:

Therefore, the costs incurred with subscription to a mobile broadband service can be considered an economic barrier to the adoption and use of broadband in households in Australian rural regions such as the WDR, which is highly reliant on mobile broadband to access Internet services.

H7: Prior knowledge and experience will have a positive influence on intention to adopt and use broadband Internet.

The findings of the study concluded that hypothesis (H3) was supported and that prior knowledge and experience had a significant impact on intention to adopt and use broadband Internet. The finding is consistent with previous studies on technology adoption by households, including adoption of PCs (Brown, Venkatesh & Bala 2006), mobile services (Gillwald et al. 2013; Rao & Troshani 2007), Internet (Hill, Burgan & Troshani 2011; LaRose et al. 2007), e-commerce and e-government services (Colesca 2009; Karimi, Papamichail & Holland 2015; Lee & Coughlin 2015)-factors which were found to be influenced by prior knowledge and experience.

Oh, Ahn and Kim (2003) argued that previous experience and knowledge of the Internet makes it easier to adopt and use broadband Internet. Moreover, Rogers (2010) suggested that the level of knowledge about an innovation, its risks and benefits affect its adoption rate. Most people in the WDR were already aware of how and what they could do with the Internet for daily activities. Many of the survey respondents and interview participants have been using the internet for more than 10 years at the time this study was conducted. They were, therefore, ready to accept the new and compatible services that broadband Internet offered compared to slower narrowband Internet.

LaRose et al. (2011) and Zickuhr and Smith (2013) suggest that lack of knowledge and experience about how to use the Internet and its relevant applications is the most significant reason that some of the rural residents could not effectively use the Internet; or why some of them do not even have Internet connection. A higher level of awareness and training would benefit the users and make it more likely that an innovation such as broadband Internet is adopted (Dwivedi, Alsudairi & Irani 2010). The findings from the interviews (Chapter 5, section 5.5.3) show that some household members in the WDR that felt they lacked sufficient knowledge and experience about using the Internet. These household members were willing to take advantage of different kinds of support and training, if available, that would be beneficial in improving their computer and Internet skills in order to make better use of broadband Internet.

Findings from the study show that previous knowledge and experience is a very important factor which influences the adoption and use of a technology such as broadband Internet, which help household members to participate more effectively in online activities and make better use of broadband Internet overall.

H8: A high level of purchase complexity will have a negative influence on intention to adopt and use broadband Internet

Findings of this study suggest that purchase complexity does not have a significant effect on broadband Internet adoption and use in the WDR. Strebel, O'Donnell and Myers (2004) suggest that frustration with the purchase process for technology goods has a significant effect on consumer commitment to purchase technology goods. In case of a broadband subscription, there are number of Internet service providers with different packages with a range of speeds and data quotes, which can sometimes create confusion and frustration for a customer trying to select the right broadband service for their household (Tobin & Bidoli 2006). When a customer has less knowledge, it becomes more difficult to decide. Adams (2011), in his study of high-speed broadband adoption in Australia, found purchase complexity has a significant impact on broadband adoption. However, findings of this study suggest that purchase complexity does not have any significant influence on intention to adopt and use broadband Internet. This may be because this study was conducted in a part of rural Australia where most of the towns do not have many options to choose from different Internet service providers. The findings from Chapter 4 (Section 4.4: Access and Availability of Broadband Infrastructure in the WDR) shows that the majority of small towns only have access to Telstra mobile network services and, in many cases, a similar situation exists for ADSL, which is often only offered by Telstra in these small towns.

Chapter 5 (Section 5.8.2) shows that the majority of interview participants indicated it was not difficult to decide on which Internet service to use because they do not have many options to choose from in terms of broadband Internet service providers, especially if they only have access to mobile broadband and live in one of the smaller towns.

Findings from the analysis of broadband infrastructure in the WDR (Chapter 4) and from the analysis of interviews (Chapter 5) show that households in rural communities have limited options available in selecting a suitable broadband Internet service for their household. Therefore, this study found that purchase complexity does not have a great deal of influence on a household's intention to adopt and use broadband Internet in rural Australian regions such as the WDR.

H9: Intention to adopt and use broadband Internet will have a positive influence on actual broadband use

According to Martins, Oliveira and Popovič (2014), behavioural intention is considered to have a direct influence on use. This study found that intention to adopt and use broadband Internet has a positive influence on actual broadband use. This finding is consistent with previous studies such as Goyal et al. (2013), Laukkanen (2016) and Wu and Wang (2005) who conducted a study on drivers of mobile commerce technology adoption and found that behavioural intention to use has a positive influence on actual use of mobile technology in business. Irani, Dwivedi and Williams (2009) conducted a study on UK consumer broadband adoption and their findings suggest that consumer intention to use broadband had a positive influence on actual broadband use. Similarly, Lurudusamy and Ramayah (2016) conducted a study on broadband Internet adoption and continuance usage in the Malaysian household context. The findings of this study are consistent with previous studies that found intention to adopt and use broadband has a positive influence on actual broadband use.

The following additional hypothesis was also tested to determine whether number of years of Internet usage has any influence on actual broadband use.

H10: Length of Internet use will have a positive influence on actual broadband use

This study found that the number of years previously spent on the Internet or online has a significant impact on broadband use. This finding is supported by Lurudusamy and Ramayah (2016) who found that there is a significant correlation between the duration and frequency of Internet access and broadband adoption. Similarly, the findings of this study are consistent with previous study findings suggesting that length of Internet use in years will have a positive influence on actual broadband use (Dwivedi 2007). Dwivedi (2007) suggests that using the Internet for a longer timeframe will develop trust in the technology and using the Internet will become habitual, therefore, the length of the Internet subscription is likely to influence actual use of broadband Internet.

7.4 DISCUSSION OF FINDINGS IN RELATION TO RESEARCH QUESTION 3 AND HYPOTHESES 11, 12 AND 13

In this section, the key findings from Chapter 5 and Chapter 6 in relation to household broadband use and impact in rural Australia are discussed within the context of the existing literature. The third research question asked: To what extent does broadband Internet use by households help to build and maintain social capital in the WDR?

H11: Actual broadband use will have a positive influence on maintaining bonding social capital in communities

Many previous studies (Ahmad, Mustafa & Ullah 2016; Chang & Zhu 2012; Ellison et al. 2014; Hampton 2011; Haythornthwaite 2005; Neves 2012, 2015) found that Internet usage has a positive influence on bonding social capital; however, findings in Chapter 6 (Section 6.6) show that actual broadband use does not have a significant influence on bonding social capital. The reason might be that households with strong ties had already strong bonding connections and would prefer to meet and talk face-to-face with family and close relatives rather than online. Moreover, frequent online Internet users tend to be already rich in bonding social capital, so their use of the broadband does not directly increase the value of those relationships (Burke, Kraut & Marlow 2011). Burke, Kraut and Marlow (2011) also contend that different media and technology may help to communicate with our closest family and friends over many channels, including face-to-face. Boase et al. (2006) found that the Internet is used to supplement communication, rather than replace traditional face-to-face communication such as in-person visits and the landline telephone conversations, which are the primary means by which people keep in contact with those who are very close to them.

However, analysis of interviews in Chapter 5 (Section 5.6) provide deeper insights and show that broadband Internet helps to maintain bonding social capital among the rural communities with family and friends that have become geographically dispersed over time-a finding which is consistent with previous studies (Ahmad, Mustafa & Ullah 2016; Chang & Zhu 2012; Ellison et al. 2014; Hampton 2011; Haythornthwaite 2005; Neves 2012, 2015). It was also noted from the interviews that rural communities are using the Internet to connect with their family, friends and close community members, which help to strengthen and maintain bonding capital among rural communities.

H12: Actual broadband use will have a positive influence on building bridging social capital

The findings of the study concluded that hypothesis (H9) was supported and the actual broadband use has a positive influence on building bridging social capital in communities. This finding is consistent with findings from previous studies (Ahmad, Mustafa & Ullah 2016; Chang & Zhu 2012; Ellison et al. 2014; Hampton 2011; Haythornthwaite 2005; Neves 2012, 2013, 2015). Neves (2013) found that bridging social capital is strongly influenced by use of the Internet. Neves (2013) also suggests that Internet seems to be the most used, inexpensive, and convenient medium to connect with weak ties—which not only contributes to building social capital through social connections it supports but also through the general information and resources that it affords to users. A number of different studies have linked building and maintaining social capital by means of different internet applications such as social media and email which was only possible through the use of broadband Internet (Ahmed 2014; Ei Chew et al. 2011; Lampe, Vitak & Ellison 2013; Stern & Adams 2010). Differences in the levels of bridging social capital have also been found between SNS users and non-users. In a longitudinal study, Brandtzaeg (2012) compared SNS users with non-users. The result showed that Facebook users have greater bridging social capital than non-users. Lampe, Vitak and Ellison (2013) made a distinction between non-users, light, and heavy users. They found that light and non-users of the SNS site were associated with lower levels of bridging social capital. In conclusion, a number of previous studies suggest that broadband Internet use has a positive relationship with bridging social capital.

The results from the qualitative data described in Chapter 5 (Section 5.6) found that many households in the WDR are using social media, such as social networking sites (Facebook, LinkedIn) and other Internet applications such as E-mail, instant messages, blogs and micro-blogs (Twitter), photo-sharing (Instagram), forums and Skype, to build their bridging social capital through contact with outside communities. Some of the interview participants indicated that social media such as Facebook and Twitter are very good for facilitating online business and for advertisement and to meet similar business people with whom they could share their thoughts and to do business with. It was also noted from interviews that rural communities are using Internet services to communicate and link with outside communities. Thus, these communications and links strengthen the bridging social capital of the communities.

H13: Bridging social capital will have positive influence on building bonding social capital

This study also found that there is a strong relationship between bridging social capital and bonding social capital. The finding of this study is supported by Leonard and Bellamy (2010), who found moderate positive relationship exists between bridging and bonding social capital. Further, Panth (2010) suggested that bridging and bonding social capital can co-exist as long as they are in harmony and well-balanced, thus, there is a relationship between bonding and bridging social capital. This study found that that bridging capital has an influence on building bonding capital. A long-term online virtual relationship on the Internet could, over time, become a close relationship (Hudson et al. 2015) and convert from bridging to bonding capital. This finding is evident in many online communications, social networking sites and online gaming sites where people often meet online and over time become close friends (Ellison, Steinfield & Lampe 2007; He & Wang 2012; Hudson et al. 2015).

7.5 CONCLUSION

The key findings from Chapters 4, 5 and 6 for three research questions investigated and 13 hypotheses tested in this study were discussed in detail in the context of the existing literature. From these discussions it can be concluded that the supply and demand components of the broadband ecosystem are very important factors influencing rural communities' adoption and use of broadband internet which, in turn, impact on building and maintaining social capital in rural communities.

From the discussion of the key findings regarding the first research question it can be concluded that broadband infrastructures potentially have the capability to deliver broadband internet services via ADSL/ADSL2+ and 3G and 4G mobile broadband in major towns in the WDR. However, there is limited broadband infrastructure in terms of coverage, speed and reliability of the network in the majority of small towns. Although major populated towns have wired (ADSL/ADSL2+) broadband, some of the households in the study were unable to access services because there are no additional ports available in the telephone exchange. In addition, the state of the copper network is ageing and considered a degraded network infrastructure. The majority of the smaller towns are forced to used wireless (mobile and satellite) broadband Internet because of the limitation of wired broadband infrastructure. Moreover, wireless broadband Internet services are highly variable in terms of quality of speed and reliability across the region. Some of the towns depend on the nearest towns for a mobile network connection since they do not have any broadband infrastructure (no mobile phone towers and no ADSL-enabled telephone exchange) in their town.

The key findings from Chapter 5 and Chapter 6 regarding the second research question investigated, together with the related hypotheses tested to determine the extent of adoption and use of broadband Internet in the WDR, were discussed in relation to the existing literature. Hedonic outcomes, self-efficacy, intention to adopt and use of broadband and number of years of Internet use have a positive impact and influence on actual use of broadband. Perceived cost and previous knowledge and experience have a positive impact and influence on intention to adopt and to use broadband.

However, factors such as utilitarian outcomes and purchase complexity had little influence on intention to adopt and use broadband Internet.

The key findings from Chapter 5 and Chapter 6 regarding research question 3 and the related hypotheses 11, 12 and 13 were discussed in relation to the existing literature. Three hypotheses tested the relationship between actual broadband use and social capital (bridging and bonding). Findings suggested actual use of broadband has a moderate influence on building bridging social capital, whereas actual use of broadband Internet has little influence on maintaining bonding social capital in rural communities. Findings also suggest that there is a positive relationship between bridging and bonding social capital and bridging social capital. This suggests that bridging social capital plays an important role in building and maintaining bonding social capital in rural communities.

The next chapter concludes this PhD thesis. It provides an overall summary of this study and discusses the implications of this study for theory and practice, acknowledges the limitations of this study, and suggests areas worthy of further research and investigation.

Chapter 8: Conclusion and recommendations

8.1 INTRODUCTION

Chapter 8 concludes this study. First, this final chapter provides a high-level summary of this study in terms of the three research questions investigated and 13 hypotheses tested in this research, the methodological approach used, and the key findings. This chapter then discusses the key contributions this study has made to theory and practice. Finally, the limitations of this study are acknowledged and topic areas worthy of future research are suggested. Figure 8-1 presents an overview of the structure of this chapter.

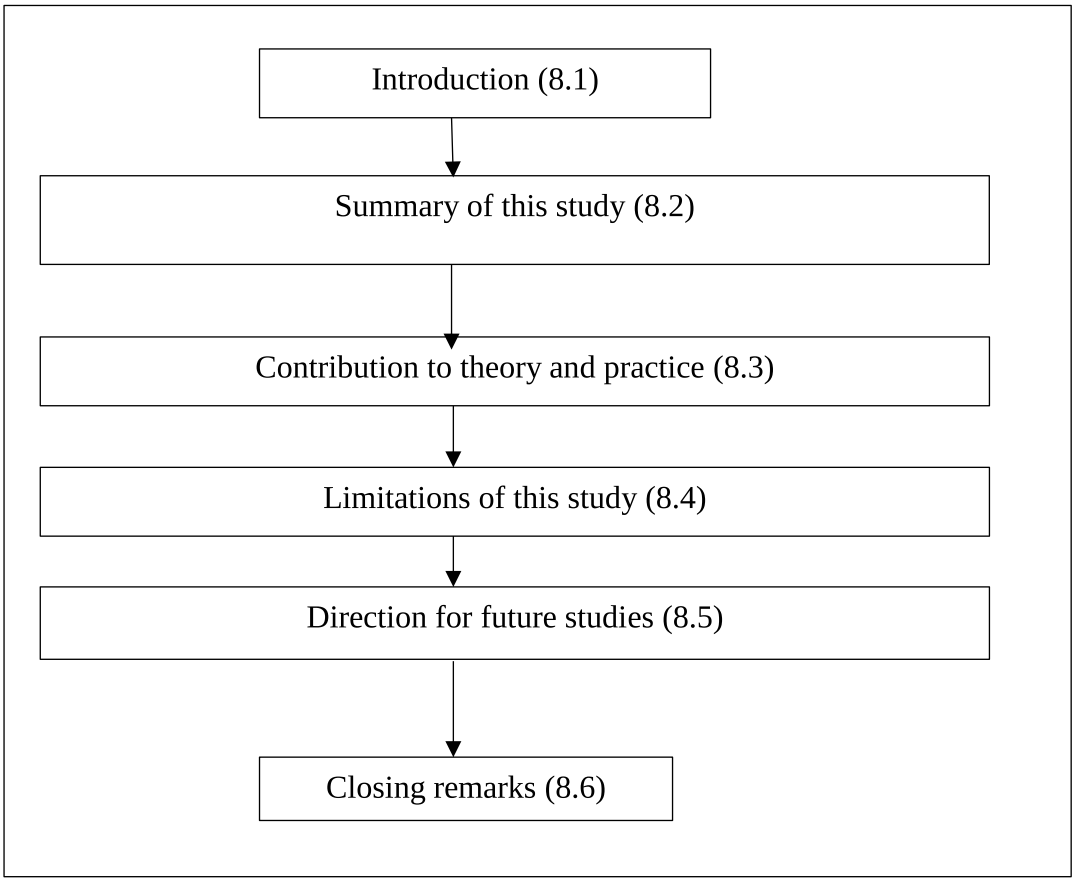

Figure 8-1 Outline of Chapter 8 with section numbers in brackets

8.2 SUMMARY OF THIS STUDY

The purpose of this section is to provide a summary of this research in terms of the research problem, three research questions and 13 hypotheses which were investigated, the methodological approach used to conduct this study and the major findings and contributions of this study.

8.2.1 Research problem

This study addressed the following general research question:

What is the relationship between broadband infrastructure supply and household adoption and use of broadband services in the WDR and to what extend does broadband use help to build and maintain social capital in rural communities?

This study is based on the broadband ecosystem framework and examined the important relationship between supply of broadband infrastructure, household adoption and use of broadband and the impact of building and maintaining social capital in rural communities. When supply, adoption and use (demand) are co-ordinated, the benefits of broadband in rural communities will be significant in terms of economic, human and social capital. This research specifically assessed the impact and potential net benefits in terms of building and maintaining social capital through broadband connectivity. Figure 8-2 below provides an overview of the broadband ecosystem, as the overarching conceptual framework for the three research questions investigated in this study.

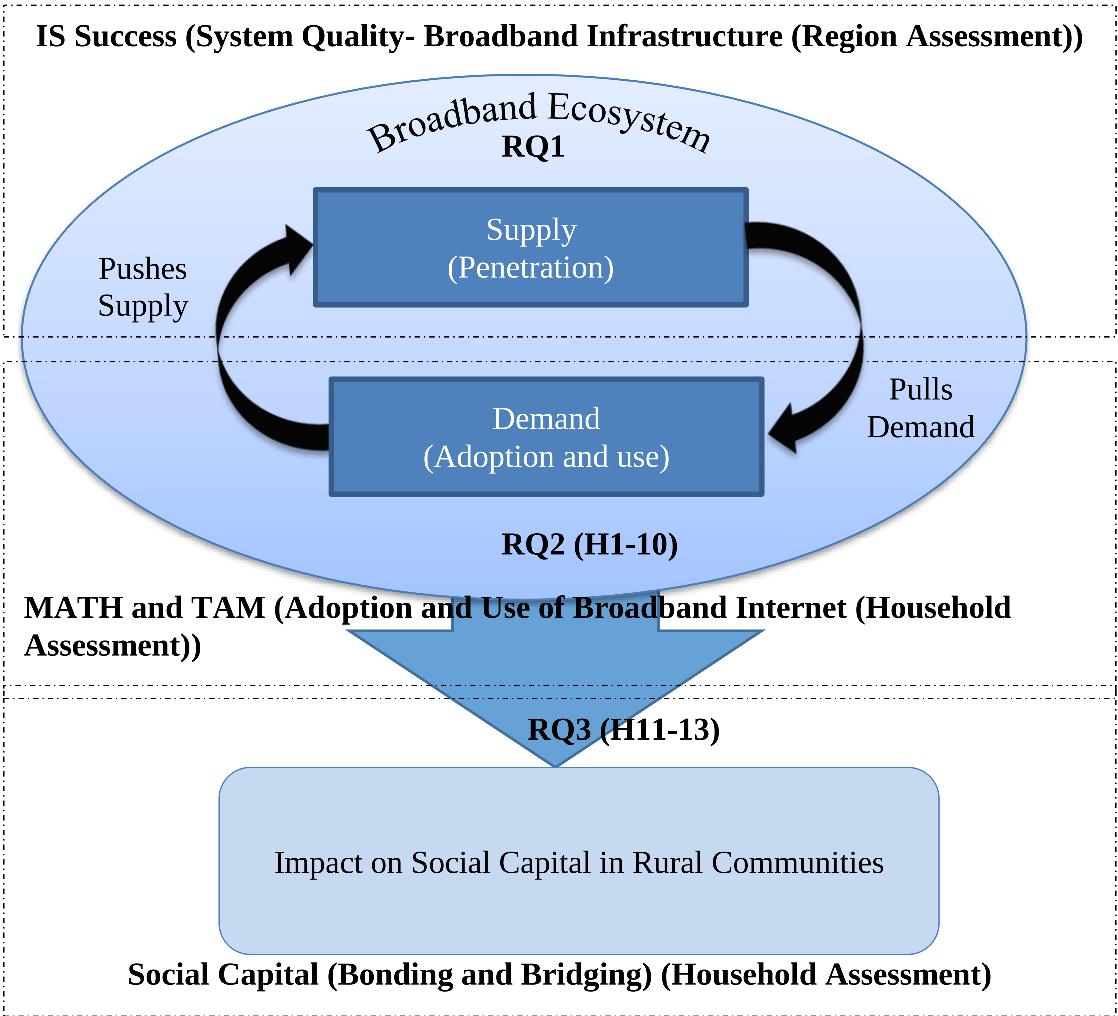

Figure 8-2 Broadband ecosystem - overarching conceptual framework; (World Bank 2012)

To achieve the research objectives of this study, three specific research questions and 13 specific hypotheses were developed and justified from an extensive review of the relevant literature and investigated and tested using a three-phase research design. Research Question was investigated in Phase 1, and thirteen hypotheses are tested to answer RQ2 and RQ3 based on phase two (primarily qualitative) and three (quantitative).

8.2.2 Research methodology

Three research phases and a multiple–methods approach were used to conduct an explanatory case study of the Western Downs Region to evaluate broadband supply, adoption, use and its impact to rural communities through building and maintaining social capital. The first research phase collected publicly-available archival (primarily quantitative) data and field data to determine and evaluate the status (supply) of broadband infrastructure in the WDR and address the first research objective (RQ1) of this study. The second research phase collected primarily qualitative data using semi-structured interviews to address the second and third research objectives (RQ2 and RQ3). Based on the analysis of the data collected in the second research phase, a pre-test and pilot test, the researcher further refined the instruments adapted from previous studies. The third phase collected quantitative data to validate and test the survey instrument for broadband adoption, use and impact components of broadband ecosystem and to address the research objectives (RQ2, RQ3). Thereby, the third research phase determined the extent of adoption and use of broadband Internet services by households and its impact in building and maintaining social capital in rural communities in the WDR.

8.2.3 Summary of research question, hypotheses, research phase and revised research model

Table 8-1 provides a summary of the three research questions and related hypotheses which were supported or not supported; and the research phase of this study. Figure 8-3 provides a diagrammatic representation of results of hypothesis testing for adoption, use and impact of broadband components of the broadband ecosystem.

Table 8-1 Summary of research questions, related hypotheses and research phases

Hypotheses	**Relationship investigated**	**Supported?**	**Research phase**
RQ1: What is the status (supply) of broadband infrastructure in WDR?			**Research phase 1**
	Quality of broadband infrastructure and influence on adoption and use		
RQ2: What is the extent of adoption and use of broadband Internet services by households in WDR?			**Research phase 2 and 3**
H1	Utilitarian outcomes will have a positive influence on intention to adopt and use broadband Internet	No	
H2	Hedonic outcomes will have a positive influence on intention to adopt and use broadband Internet	No	
H3	Hedonic outcomes will have a positive influence on actual broadband use	Yes	
H4	Self-efficacy will have a positive influence on intention to adopt and use broadband Internet	No	
H5	Self-efficacy will have a positive influence on actual broadband use	Yes	
H6	Perceived cost of broadband will have a negative influence intention to adopt and use broadband Internet	Yes	
H7	Prior knowledge and experience will have a positive influence on intention to adopt and use broadband Internet.	Yes	
H8	A high level of purchase complexity will have a negative influence on intention to adopt and use broadband Internet	No	

H9	Intention to adopt and use broadband Internet will have a positive influence on actual broadband use	Yes	
H10	Length of Internet use will have a positive influence on actual broadband use	Yes	
RQ3: To what extent does broadband Internet use by households help to build and maintain social capital in WDR			**Research phase 2 and 3**
H11	Actual broadband use will have a positive influence on maintaining bonding social capital in communities	No	
H12	Actual broadband use will have a positive influence on building bridging social capital	Yes	
H13	Bridging social capital will have positive influence on building bonding capital	Yes	

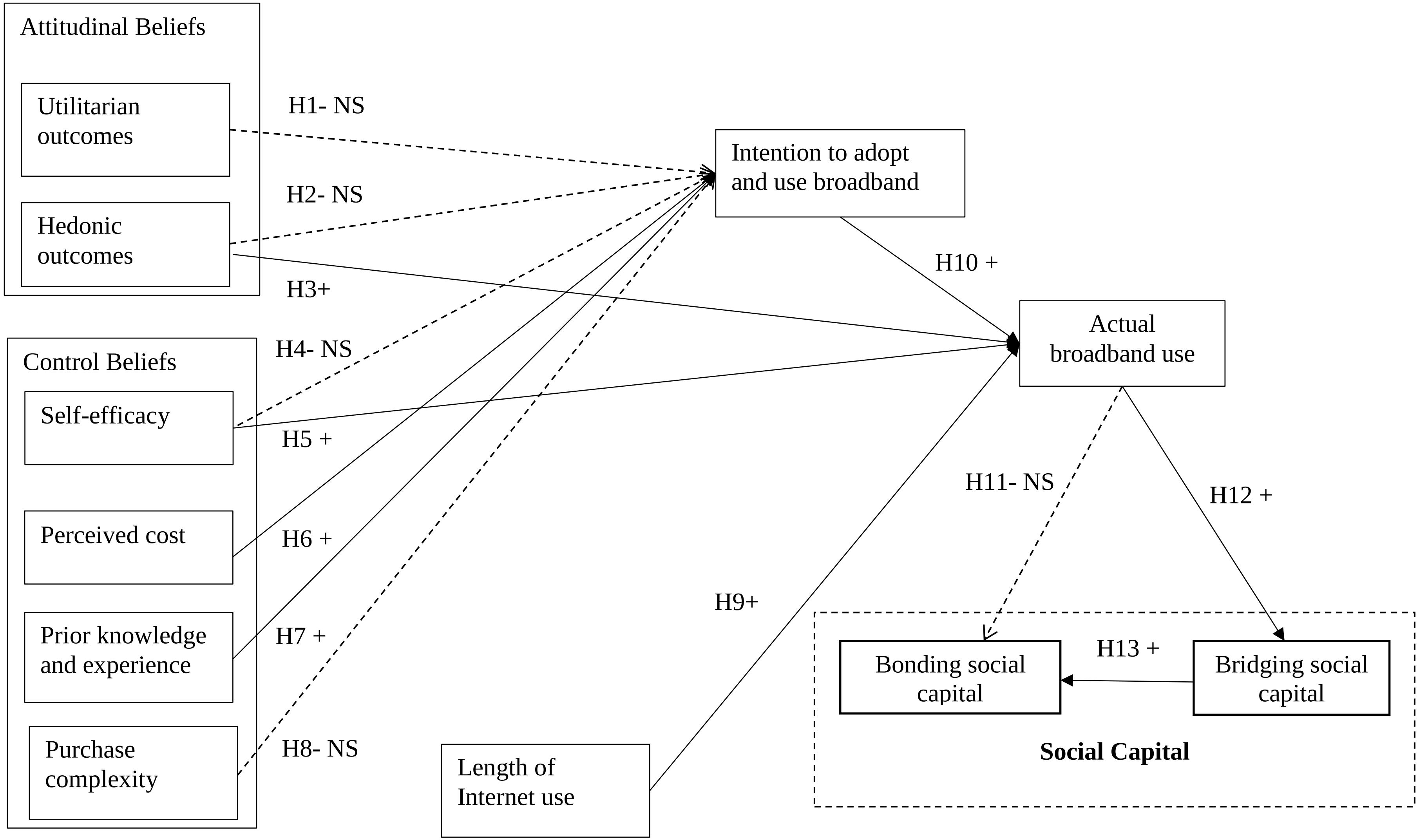

Figure 8-3 Revised broadband adoption, use and impact components of broadband ecosystem broken down into testable hypotheses

-Legend + Significant; NS: Not significant

8.2.4 Summary of key findings for three research questions investigated

Research question 1. What is the status (supply) of broadband infrastructure in the WDR (rural Australia)?

Key findings from the first research phase indicate there is significant existing broadband infrastructure in the WDR in terms of wired and wireless technologies. The WDR is extensively covered by PSTN and ADSL/ASDL2+, 3G/4G mobile networks and, more recently, NBN Co Satellite broadband. This digital infrastructure potentially has the capability to deliver broadband internet services via ADSL/ADSL2+ and 3G and 4G mobile broadband and Satellite Broadband to the WDR. However, ADSL broadband is only available in 9 of the 20 towns in the WDR. 3G mobile broadband is available in 13 of the 20 towns; whereas 4G mobile broadband is available in only 11 of the 20 towns. Moreover, findings indicate that many of the smaller towns have only Telstra mobile network service available; and other mobile network service providers, specifically, Optus and Vodafone, limit their service to bigger towns. However, the study confirmed that much of the WDR suffers from inadequate provision of reliable broadband infrastructure, as evidenced by the detailed analysis of the supply of broadband infrastructure in the WDR provided in Chapter 4 (Section 4.4 Table 4-24). Mobile broadband is highly variable in terms of speed and reliability across the region and is much more restrictive in terms of data quotas than ADSL—which also makes it a much more expensive broadband service. Satellite broadband provides coverage of the entire region, but is only available to households and businesses in remote areas with no access to alternative broadband services. Furthermore, it is a costly option for households with limited upload and downloads and relatively expensive data quotas.

This study identified the limitations in the supply of broadband infrastructure in remote and outer regional locations in the WDR. Furthermore, and to a lesser extent given the reliance of remote and outer regional locations on mobile and satellite broadband, affordability of broadband is an issue for households in view of the lower socio-economic status of much of rural Australia, including the WDR. It was noted that data quotas for mobile broadband are more expensive than wired broadband, as evidenced by the detailed analysis of the household internet subscriptions by cost and data quota in the WDR (see Chapter 5 Section 5.7 Table 5-10). Hence, the findings of this study suggest there would also appear to be a digital divide, particularly between the remote and outer regional locations of the WDR and inner regional and urban locations in

Australia. Overall, the findings from the analysis of broadband infrastructure indicates that a lack of reliable and affordable broadband services due to rural Australia's reliance on wireless broadband could be a limiting factor for rural regions such as the WDR being able to successfully make the transition to the digital economy.

Research question 2. What is the extent of adoption and use of broadband Internet services by households in the WDR?

Key findings from the analysis of the data collected in the second and third research phases indicated that the majority of households in the WDR have adopted, and use, some kind of broadband Internet service since this service became readily available. The majority of users are using wireless broadband such as 3G and 4G and, to a lesser extent, wired broadband-ADSL/ADSL2+. Laptops and notebooks are the most common devices used by households to access the Internet, followed by smart mobile phones and desktop computers. In this study, the most common categories of digital services that were considered useful by households were: communication; information seeking; e-commerce activities; social media and social networking; entertainment activities; and e-organizational services.

In relation to broadband, the results of this study suggest that most households have moved beyond the adoption phase to the use phase. Technology adoption factors such as hedonic outcomes and self-efficacy also have a significant influence on actual broadband use, rather than influencing intention to adopt and use a broadband Internet. Furthermore, the findings from the quantitative data analysis (Chapter 6) indicate that the factors of utility outcomes, hedonic outcomes and self-efficacy do not influence the intention to adopt and use broadband because most households have moved onto the actual use phase. However, it has been noted that the effectiveness of the Internet (based on the results of analysis of the qualitative interviews in Chapter 5) does provide some motivation for households to use broadband Internet.

Another finding of this study suggests that cost is another important factor in determining broadband adoption and use in rural communities. The findings from the phase 3 survey indicate that a small but significant proportion of the sample population in this study felt that broadband services were expensive. This is most likely to be the case in outer regional and remote locations in the WDR where only mobile broadband services are available and are relatively expensive compared to wired broadband ADSL. Furthermore, in outer regional and remote locations mobile broadband is often patchy at best in terms of coverage and quality (speed and reliability).

Knowledge and experience of users is another important factor found to significantly influence household intention to adopt and use broadband Internet in rural communities. This study found that given the importance of having relevant knowledge and experience in order to effectively use broadband internet, many households in rural communities are willing to undertake some training on the use of computers and the Internet to increase their digital literacy and self-efficacy. The findings of this study also indicated that purchase complexity is not an issue for most of the outer regional and remote households because there are limited broadband internet services options to choose and access in these locations.

Research question 3. To what extent does broadband Internet use by households help to build and maintain social capital in the WDR?

The findings from the second and third research phases of this study indicated that broadband Internet helps to build and maintain social capital in rural communities in the WDR. The majority of interview participants in the second phase of this study indicated that their households are actively using broadband Internet to connect with family and friends by using social media such as Facebook and Twitter. However, in the third phase of this study the findings of the quantitative survey suggest that although households use broadband Internet to connect to family, friends and relatives, they may prefer to meet and talk face-to-face with family and close relatives rather than online. As family, friends and relatives already have strong existing bonding connections, they may think that broadband Internet connectivity will not change their bonding capital relationships, however, the findings of this study suggest that it helps to maintain their close relationships and ties (i.e. bonding social capital).

On the other hand, actual broadband use was found to have a positive influence on building bridging social capital in rural communities. Broadband Internet seems to be an inexpensive and convenient medium to connect household members with weak ties. A broadband internet connection not only contributes to building social capital through social connections facilitated by social media websites such as Facebook, but also through the general information and resources that it affords and can be shared with other users. The interviews in the second phase of this study indicate that many households in the WDR are using social media such as social networking sites (Facebook and LinkedIn) and other Internet applications such as E-mail, instant messages, blogs and micro-blogs (Twitter), photo-sharing (Instagram), forums and Skype to build their bridging social capital through contacts with outside communities. Some of the interview participants indicated they are using Facebook and Twitter for facilitating online business and for advertisement and to meet similar business people with whom they can share their thoughts and conduct business with.

8.3 CONTRIBUTION TO THEORY AND PRACTICE

The following subsections discuss the main contributions of this study to theory and practice.

8.3.1 Contribution to theory

This study makes several contributions to theory, as follows.

This study extended the overarching theoretical basis of the broadband ecosystem of the fundamental economic theory of supply and demand. This study included information systems success theory (system quality), technology adoption and use (TAM and MATH theory) and social capital theory to provide a deeper understanding of the main components of the broadband ecosystem. This helped to better understand and describe the important relationship between broadband supply and demands of broadband and its impacts of building and maintaining social capital in rural communities.

Much of previous IS research on technology adoption has placed an over-emphasis on the organization as the unit of analysis. Moreover, previous IS research has adopted a blinkered approach (Clarke 2015) and missed the opportunity to focus on the important and wider research problems, ignoring important societal, business and government policy problems. This study used two units of analysis: (1) Broadband Infrastructure in the WDR-evaluation of Broadband Infrastructure; and (2) WDR Households-perceptions of broadband adoption, use and its impact. Additionally, this study addressed important research problems in terms of society and government policy.

Most of the studies on broadband have previously focused only on the demand side of the broadband ecosystem, that is, adoption and use, whilst there is a dearth of studies and research focus in terms of supply, that is, broadband infrastructure in communities.

More importantly, there is a very limited number of empirical studies that have considered broadband infrastructure quality (Bauer, Schneider & Zenhäusern 2013; Bauer & Tsai 2014). Hence, this research addressed an under-researched and an important gap in information systems digital infrastructure research (Tilson, Lyytinen & Sørensen 2010)-the lack of empirical research on broadband infrastructure and its role in the broadband ecosystem.

Most of the theoretical and empirical studies on broadband have previously focused on only adoption and use of broadband from a macro policy perspective. There is an apparent lack of empirical studies that have considered the broadband ecosystem in terms of supply, adoption and use and impact of broadband at the micro level within rural communities. Hence, this research addressed an important gap in broadband research by examining and validating the relationship between broadband supply, adoption, use and impact in the broadband ecosystem model at the micro level in rural communities.

This study extended the broadband adoption and use components of the broadband ecosystem to include MATH and TAM theory through the second phase (primarily qualitative study) and the third phase (quantitative study) of this study in the context of rural communities. Factors such as utilitarian outcomes, hedonic outcomes and self-efficacy were found not to have a significant impact on broadband adoption and use. However, the factors hedonic outcomes, self-efficacy and number of years of using Internet were found to have a significant impact on broadband actual use. Hence, the findings of this study suggest that in relation to broadband most households have moved beyond the adoption phase to the use phase.

Lastly, another key theoretical contribution of this study was to empirically validate and test the impact of broadband use on building and maintaining social capital in rural communities. The findings of this research helps to understand the role of broadband in maintaining bonding social capital and building bridging social capital in rural communities. Furthermore, the findings of this study provide further support for the notion that bonding and bridging social capital are interrelated and part of social capital as a whole.

8.3.2 Contribution to practice

This study contributes to practice in the following ways.

This study informs government policy by identifying shortcomings of broadband infrastructure in outer regional and remote locations in terms of availability and reliability which, in turn, could negatively affect household adoption, use and impact for building and maintaining social capital in rural communities. This study identified poor network coverage and highly variable quality of service of mobile broadband networks in outer regional and remote rural Australia, suggesting that a digital divide still exists between much of rural and urban Australia. Future government policy needs to address the lack of government investment in the backbone broadband infrastructure in rural Australia needed to underpin high speed wireless broadband access in rural Australia. The researcher believes that the current situation in the WDR also exists in many other parts of rural Australia that also suffer from inadequate provision of reliable broadband infrastructure, as evidenced by the analysis of the supply of broadband infrastructure in phase 1 of this study. This situation could also detrimental to the short term and long term growth of economic, human and social capital in rural regions in Australia.

This study highlighted that government and policy-makers should consider including high speed broadband access as part of the Universal Service Obligations (USO) to ensure that rural and regional Australia is not disadvantaged in a digital future. This USO was previously the responsibility of Telstra, but in 2012 became the responsibility of the Telecommunications Universal Service Management Agency (TUSMA) (Eyers 2014). However, on 1 July 2015, TUSMA was abolished and its functions transferred to the Department of Communications and the Arts (Department) (ACMA 2016). Despite these changes in terms of how the USO is administered and financed, funding by USO remains basically the same regarding the availability of telephone service connections and there is no specific requirement to ensure availability of high speed broadband to all Australians.

The second phase qualitative findings of this study show that most of the households could more actively participate in online (digital) activities using the Internet if they acquired better digital literacy and skills. This would indicate that for effective participation in online activities and to use broadband Internet by rural communities, households need computer and Internet skills. Therefore, government and service providers could initiate and offer computer and Internet training programmes to rural households to enable them to gain and increase their confidence in using computers and the Internet and participate more effectively in the digital economy.

The findings of this study suggest that the variability in access and reliability and high cost of wireless (mobile, satellite) broadband data quotas compared to wired broadband in the WDR needs to be addressed. This situation is prohibitive to households actively using broadband services, particularly in outer regional and remote locations, compared to inner regional and urban locations in Australia. Rural communities simply need to spend more money on broadband Internet data quotas comparatively to urban Australia as they depend on mobile broadband, which is much more expensive compared to wired broadband. Furthermore, future thought and consideration needs to be given to correcting the current failure of telecommunication markets to address the shortcomings of wireless broadband networks in rural Australia, given its vital importance in providing high speed broadband services for rural communities. The researcher believes this market failure could be addressed in part through subsidies, including guaranteeing access to broadband as part of the USO which currently only considers access to a fixed line telephone service.

Another practical contribution of this study was to confirm that improved access and more effective use of broadband could help to build and maintain social capital in rural communities. As a result of such initiatives, rural communities would be able to access increased inclusive social opportunities and improved connectedness; thus creating opportunities to build new social capital and to facilitate the maintenance of existing social capital in rural communities.

8.4 LIMITATIONS OF THIS STUDY

Despite the key findings of this study providing a deeper understanding of the relationship between broadband infrastructure supply, household adoption and use of broadband services and its impact on building and maintaining social capital in rural communities, this research, similar to any research study, does have some limitations. These limitations are noted as follows:

- The scope of this research is limited to the extent that it was a single-case study of broadband supply, adoption, use and its impact on social capital in rural communities in the WDR. However, this limitation provided a unique opportunity not often available to researchers to conduct an in-depth evaluation of the broadband ecosystem within a specific rural region.

- The findings of this study represent an assessment and perceptions of households located in the WDR regarding broadband infrastructure, adoption and use and its impact of building and maintaining social capital in rural communities. It is acknowledged that these findings might not match with findings and perceptions in other rural communities.
- The measurement of social capital did not have any pre-defined items to measure building and maintaining social capital by using broadband Internet, thus, this study adapted the items from a study on building and maintaining social capital through online communications.
- The measurement of a household's length of Internet use is reliant on a single simplistic item. Future research could use a more comprehensive set of items for measuring Internet use over time.
- The data collection for the first phase (archival) of the study in terms of wired broadband coverage in the WDR relied on ADSL2 Exchanges, which is a social website where the data is largely contributed by end-users, hence, results may not be entirely accurate.
- The sample size for the semi-structured interviews conducted in the second phase of this study in large towns such as Dalby is relatively small in comparison to small towns such as Moonie.

8.5 DIRECTION FOR FUTURE STUDIES

There are a number of directions for future research and these are outlined as follows.

- With regard to adoption and use of broadband internet and its impact in building and maintaining social capital in rural communities, future research could examine whether the findings obtained from this study are specific to the WDR households, or whether the results are representative of other rural regions in Australia. This would require a larger sample that is representative of a number of rural regions in Australia in order to establish a more comprehensive understanding of the broadband ecosystem-supply, adoption, use and impact in Australian rural communities.

- The findings of this study could be further reinforced and confirmed in a longitudinal study over a period of 3-5 years duration. The data for this research has been collected over a short period of time and provides a snapshot. However, it could be expanded over a longer period of time to provide a longitudinal study which could help to further refine the components of the broadband ecosystem.
- Due to emergence and usage of many different kinds of social media to connect and communicate with family and friends, future research could benefit from a specific study on the impact of social media such as Facebook, LinkedIn and Twitter on building and maintaining social capital in rural communities, given this is a broad topic area.
- Furthermore, previous studies on the adoption of PCs in American households show that the household lifecycle has a significant impact on adoption of PCs. Therefore, future research needs to explore if there is any impact at different stages of the household lifecycle on broadband Internet adoption, use and its impact on rural communities.
- Finally, all the data collected in the second phase (primarily qualitative study) and third phase (quantitative study) were obtained from households who are already using the Internet. Further empirical work is required to ascertain why some households are not adopting and using the Internet in rural Australia, although non-users are a very small group in the population. Hence, comparing the results from Internet users and with non-users would provide a more complete picture to fully understand the key factors associated with broadband adoption, use and its impact in rural communities.

8.6 CLOSING REMARKS

In summary, this study adapted and evaluated the broadband ecosystem framework to investigate the relationship between broadband infrastructure supply, household adoption and use of broadband services and its impact on building and maintaining social capital in rural communities. Three research phases and a multiple methods approach was used to collect and analyse data to answer three research questions and test 13 hypotheses in this explanatory case study of the WDR using two units of analysis-the WDR (broadband infrastructure); and households (adoption, use, impact of broadband).

This research has made several important contributions to knowledge and theory. Firstly, this study evaluated and validated the broadband ecosystem framework – in terms of supply, demand/use and impact in a rural context. Secondly, this research addressed an important gap in information systems research, the lack of empirical research on digital infrastructure, in this study, broadband infrastructure. Thirdly, this research examined an extended and modified technology adoption and user theory (MATH and TAM) in rural context. Finally, this study empirically validated and tested the impact of broadband use on building and maintaining social capital in rural communities.

This research has made a number of significant practical contributions which can inform and raise government awareness about the availability, reliability and affordability shortcomings of broadband infrastructure in outer regional and remote locations in rural regions. This study argues that government and policy-makers should consider including high speed broadband access as part of the USO to ensure that rural and regional Australia is not left behind and can actively participate in the digital future of Australia. This study also suggests that government and policy-makers need to support rural communities by providing computer and Internet training programs so that rural communities can actively participate in the digital economy.

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Appendices

Appendix A ASGC remoteness areas

Adapted from AIHW (2014):

In 2001 the ABS added the Remoteness Area Structure (ASGC Remoteness Areas) to the Australian Standard Geographical Classification.

ARIA+ methodology

ASGC Remoteness Areas is based on ARIA+ methodology rather than ARIA methodology. The ARIA+ index value is calculated in much the same way as the ARIA index value (see http://www.aihw.gov.au/publication-detail/?id=6442467589). However, there are some differences:

- ARIA+ uses a different island weighting factor for Tasmania.
- Whereas the ARIA index value is based on distance to four categories of service centre, the ARIA+ index value is based on distance to five categories of service centre. ARIA+ measures distance to the nearest category E service centre (centres with populations of 1,000 to 4,999 persons) as well as to category A, B, C and D service centres. ARIA index values range from 0–12, whereas ARIA+ index values range from 0–15.

ASGC Remoteness Areas

ASGC Remoteness Areas and their ARIA+ index value ranges are shown in Table below.

Structure of ASGC Remoteness Areas

Class	Abbreviation	Index value range
Major Cities of Australia	MC	0–0.2[(a)]
Inner Regional Australia	IR	>0.2–2.4[(b)]
Outer Regional Australia	OR	>2.4–5.92[(c)]
Remote Australia	R	>5.92–10.53[(d)]
Very Remote Australia	VR	>10.53–15[(e)]
Migratory(f)		

(a) Equal to or greater than 0 but less than or equal to 0.2.
(b) Greater than 0.2 but less than or equal to 2.4.
(c) Greater than 2.4 but less than or equal to 5.92.
(d) Greater than 5.92 but less than or equal to 10.53.
(e) Greater than 10.53 but less than or equal to 15.
(f) Areas composed of off-shore, shipping and migratory CDs. In allocating an ASGC Remoteness Areas class to an area of land, only the first five classes are applicable.

Source: ABS 2001b.

Appendix B HFC available location and mobile virtual network operators in Australia

Table B2-1 Communities where HFC will available

State	Region Available by 2018
New South Wales	Ashfield, Balgowlah, Balmain, Bankstown, Baulkham Hills, Blacktown, Waverley, Botany, Burwood, Carlingford, Castle Hill, Chatswood, Como, Coogee, Cremorne, Carramar, City south, Dalley, Drummoyne, Dural, City east, Edgecliff, Engadine, Epping, Edensor Park, St Mary's, Glebe, Guildford, Harbord, Haymarket, Homebush, Hornsby, Hunters Hill, Hurstville, Minto, Killara, Kensington, Kogarah, Lakemba, Liverpool, Matraville, Menai, Miller, Miranda, Mona Vale, Mosman, Newtown, Orchard Hill, Peakhurst, Petersham, Pennant Hills, Pymble, Quakers Hill, Ramsgate, Eastwood, Redfern, Rockdale, Rose Bay, Rooty Hill, Ryde, Sefton, Seven Hills, Shalvey, Silverwater, Springwood, St Leonards, Undercliff, Wetherill Park, Northbridge and Wahroonga
Queensland	Acacia Ridge, Albany Creek, Albion, Ashgrove, Cleveland, Aspley, Arundel, Ashmore, Bundamba, Beenleigh, Bald Hills, Browns Plains, Brassal, Burleigh Heads, Chermside, Charlotte, Chapel Hills, Capalaba, Camp Hill, Currumbin, Darra, Eight Mile, Ferny Hills, Inala, Ipswich, Loganholme, Mount Gravatt, Gold Coast-Tweed Heads, Merrimac, Nudgee, Paradise Point, Redcliffe, Rothwell, Springfield, Slacks Creek, Southport, Stephens, Sherwood, Salisbury, Surfers Paradise, Tingalpa, Toowong, Woolloongabba, Warner and Waterford
South Australia	Brighton, Croydon Sa, Edwardston, Elizabeth, Flinders, Glenelg, Golden Grove, Gepps Cross, Glenunga, Henley Beach, Hampstead, Modbury, Norwood, Paradise, Reynella, Salisbury, and West Adelaide
Victoria	Altona, Bayswater, Bundoora, Broadmeadows, Brighton, Blackburn, Bentleigh, Box Hill, Burwood, Canterbury, Caulfield, Coburg, Clayton, Croydon, Chelsea, Cheltenham, Collingwood, Dandenong, Dandenong North, Doncaster East, Deepdene, Deer Park, Eltham, Endeavour Hills, Exhibition, Fawkner, Ferntree Gully, Frankston, Footscray, Flemington, Greensborough, Glen Iris, Hawthorn, Heidelberg, Highett, Kew, Keysborough, Kings Park, Kellor, Kellor East, Kooyong, Lilydale, Lonsdale, Laverton, Maidstone, Mordialloc, Mitcham, Moreland, Melton, Mount Eliza, Montrose, Narre Warren, North Balwyn, Northcote, North Essendon, North Melbourne, Newport, Oakleigh, Port Melbourne, Richmond, Reservoir, Ringwood, Scoresby, Seaford, South Oakleigh, Springvale, Sunshine, South Yarra, Thornbury, Tarneit, Thomastown, Tally Ho, Werribee, Wheelers Hill, and Windsor
Western Australia	Applecross, Cottesloe, Ellenbrook, Girrawheen, Hamersley, Joondalup, Jandakot South, Kingsley, Mullaloo, South Perth (Como), Subiaco, and Wembley

Source from Coyne (2015); and NBN (2016c)

Table B2-2 Mobile Virtual Network Operators in Australia

Virtual Operator	**Network Used**
Aldi Mobile	Telstra
Amaysim	Optus
Bendigo Bank Telco	Optus
Boost Mobile	Telstra
Club Telecom	Optus
Coles Mobile	Optus
Commander	Optus
ClubTelco	Optus
CMobile	Telstra
Dodo	Optus
Exetel	Optus
GoTalk	Vodafone
Hello Mobile	Vodafone
iinet	Optus
Internode	Optus
Jeenee Mobile	Optus
Just Mobile	Vodafone
Kogan Mobile	Vodafone
Lebara Mobile	Vodafone
Live Connected	Optus
Lebara Mobile	Vodafone
Lycamobile	Telstra
Ovo	Optus
iPrimus	Optus
Reward Mobile	Vodafone
Southern Phone	Optus/Telstra
Startel Communications	Optus
Telechoice	Telstra
Think Mobile	Vodafone / Telstra
TPG Mobile	Vodafone
Vaya	Optus
Virgin Mobile	Optus
Woolworths Connect	Telstra
Yomojo	Optus

Source from IDD (2016); and Mobile Network Guide (2016a)

Appendix C1 Interview protocol

Date: ………………………………………………
Location: ………………………………………………
Occupation: ……………………………………………..
Start Time of Interview: …… Finish Time of Interview: ………

Purpose of this research
This research will determine the key factors for adoption of broadband internet in rural and regional Australia.

Introduction
Thank you for agreeing to be interviewed. This university research would not be possible without your participation. Results from this study will help guide local, state and federal governments to developing new policies and programs. These will help rural and regional Australia maximise benefits from broadband connectivity in terms of industry, education and employment.

Status of this research
This research is conducted on behalf of the University of Southern Queensland. If confirmation is required you may contact Dr Michael Lane, Senior Lecturer, School of Management and Enterprise, Faculty of Business, Education, Law and Arts, on (07) 4631 1268.

Ethical Concerns regarding this research
- This interview is confidential. The confidentiality and anonymity of the participants of data collection in this research will be ensured.
- Incidental identification will not be possible as steps will be taken to de-identify all participants.
- Identifiable information about participants in this research will not be made public or given to a third party.

Note:
- We would like your permission to record this interview. If you agree, you are welcome at any time during the interview to ask me to cease recording the interview or to push the pause button yourself.
- Are there any further questions either about the interview procedure or the purpose of the research?
- If you wish we would be happy to provide you with a summary of the results from this research.

Appendix

1. Who (including you), in your household uses the Internet? (list all the members)

   How long (years) your household been using the Internet? (Distinguish between Narrowband/dialup and broadband) ....

   Are you familiar with the term Broadband and what is meant by broadband (if not provide a definition) (For the purpose of this research, broadband is defined as ***as high-speed, always on, internet connectivity, with a minimum download speed of 256 kbps and minimum upload speed of 64 kbps.***)

2. What has influenced your household's adoption of Internet (work, family, relatives, friend, news and advertisement)?

3. What does your household member use the Internet for?

❐ Information search	❐ Social networking	❐ News	❐ Pay bills	❐ Videos
❐ Education services	❐ Instant messaging	❐ Maps	❐ Auctions	❐ Gambling
❐ Government services	❐ Health services	❐ E-mail	❐ Music	❐ Banking
❐ Employment services	❐ Shopping	❐ Skype	❐ Games	❐

4. How do your household members connect to the Internet? There may be more than one kind connection. (Please tick all that apply)
   - ❐ ADSL/ADSL2+
   - ❐ Satellite wireless connection
   - ❐ 3G broadband
   - ❐ Dial-up
   - ❐ Others (Please specify)__________

5. Where do members of your household access the Internet? (Please tick all that apply and also provide percentage (%) of usages)

Household member 1	**Household member 2**	**Household Member3**	**Household member 4**	**Household member 5**
❐Home _____%	❐Home _____%	❐Home _____%	❐Home _____%	❐Home _____%
❐Work _____%	❐Work _____%	❐Work _____%	❐Work _____%	❐Work _____%
❐School_____%	❐School_____%	❐School_____%	❐School_____%	❐School_____%
❐Library_____%	❐Library_____%	❐Library_____%	❐Library_____%	❐Library_____%
❐Public places____%	❐Public places____%	❐Public places___%	❐Public places__-_%	❐Public places___%

6. Indicate which of these devices is used by members of your household to access the Internet (Please tick all that apply)

	Which year did you get it	**Are you planning to get this device in future (when and why)**
❐ Desktop computer	_____	_____
❐ Laptop/netbook	_____	_____
❐ Smart-phone (iPhone/Android / others)	_____	_____
❐ Tablet (iPad / Android / others)	_____	_____
❐ TV	_____	_____

7. Have you and your household built or maintain relationships and networks within your local community and /or with outside communities by using the Internet? (How and why?)

8. How comfortable are you and your household with using broadband Internet? Please rate between (1- Lowest to 7- Highest) for your skills for using broadband Internet.
   1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐

Please rate (1- Lowest to 7- Highest) your household members digitally literacy

Digital literacy is "The capability to use digital technology, communication tools or networks to locate, evaluate, use and create information and knowing when and how to use it."

	Digitally literate (1- Lowest to 7- Highest**)**
Household member 1	1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐
Household member 2	1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐
Household member 3	1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐
Household member 4	1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐
Household member 5	1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐

9. Do you think that some training would improve the digital literacy of you and your household and help you and your household to make better use of broadband Internet?

10. How difficult has it been or it would be to decide which broadband service or plan will meet the needs of your household? Please rate between (1-Lowestest to 7- Highest) difficulties to decide broadband and why it’s been difficult?
    1❐ 2❐ 3❐ 4❐ 5❐ 6❐ 7❐

11. How much does your household pay for broadband internet? Is the current subscription rate for your principal Internet access is reasonable for your household?
    Do you see the cost as a deterrent to broadband internet subscription? Why or why not?

12. Are you planning to subscribe to a high-speed broadband Internet (such as ADSL2+, NBN FTTN, Fixed Wireless, Satellite) service when it becomes available in your area?
    (For the purpose of this research, high-speed broadband is defined as ***as high-speed, always on, Internet connectivity, with a minimum of 1Mbps of data transfer permitting the transfer of large files.***)

    Are there any other issues or factors concerning you and your household’s adoption or use of the broadband you would like to discuss?

Appendix

Demographics information

What is your total household income per year? *(Please tick one box only)*

❒ under $19,999	❒ $80,000 - $99,999
❒ $20,000 - $39,999	❒ $100,000 - $120,000
❒ $40,000 - $59,999	❒ Over $120,000
❒ $60,000 - $79,999	

Which of the following best describe your household? *(Please tick one box only)*

- ❒ Single person living alone
- ❒ Single person living with others
- ❒ Single parent with children at home
- ❒ Couple/family with no children
- ❒ Couple/family with children at home
- ❒ Couple/family with children not living at home

Demographic of all household members

	Age (Years)	**Sex** (M or F)	**Education** (highest obtain) P- Primary, S-Secondary school, U-Undergraduate, PG-Post Graduate, D-Diploma, T- Training
Household member 1	______	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T
Household member 2	______	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T
Household member 3	______	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T
Household member 4	______	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T
Household member 5	______	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T

Your contribution to this research is greatly appreciated

Thank you

Interview Participant Information Sheet

University of Southern Queensland

USQ
AUSTRALIA

The University of Southern Queensland

Participant Information Sheet

HREC Approval Number: **H13REA159**

Full Project Title: Key factors determining adoption of high-speed broadband services in rural and regional Australia

Principal Researcher: Sanjib Tiwari, *Faculty of Business, Education, Law and Arts (BELA), University of Southern Queensland*

Other Researcher(s):

- Dr Michael Lane, *BELA, University of Southern Queensland*

I would like to invite you to take part in this research project.
The purpose of this project is to identify the key factors that determine the adoption of high speed broadband services by rural and regional households in Australia.
The research team request your assistance because you live in rural and regional part of Australia which eligible as a participant of this project.
This project is being undertaken as part of a PhD research for Sanjib Tiwari. This project is supported through the Australian Government's Collaborative Research Network (CRN) program. PhD student is funded by USQ CRN. This project is part of the USQ CRN project 2 collaboration with ANU, UniSA and WDRC.

1. <u>Procedures</u>

Participation in this project will involve

- ***The purpose and objectives of this research will be explained to each participant***
- ***The participant will be required to sign a consent form indicating that they have agreed to participate in this research.***
- ***Participation in an interview. The interview will capture your perspectives of factors that determine adoption of high-speed broadband services by households in rural and regional Australia.***
- ***It is expected that the interview will take no more that about 45 minutes.***
- ***Participants can benefit by receiving (if they chose to) a summary of the results. This will provide further insight into key factors determining the adoption of high-speed broadband services in rural and regional Australia***
- ***There are no identified risks for participants other than a limited time imposition (interview will take 45 minutes to complete)***

2. <u>Voluntary Participation</u>

Participation is entirely voluntary. **If you do not wish to take part you are not obliged to.** If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. Any information already obtained from you will be destroyed. Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with the University of Southern Queensland and WDRC.

Please notify the researcher if you decide to withdraw from this project.

Should you have any queries regarding the progress or conduct of this research, you can contact the principal researcher:

Sanjib Tiwari
Faculty of Business, Education, Law and Justice and Arts
Toowoomba
Sanjib.Tiwari@usq.edu.au

If you have any ethical concerns with how the research is being conducted or any queries about your rights as a participant please feel free to contact the University of Southern Queensland Ethics Officer on the following details.

Appendix

Ethics and Research Integrity Officer
Office of Research and Higher Degrees
University of Southern Queensland
West Street, Toowoomba 4350
Ph: +61 7 4631 2690
Email: ***ethics@usq.edu.au***

Interview participant consent form

University of Southern Queensland

The University of Southern Queensland

Participant Information Sheet

HREC Approval Number: H13REA159

TO:

Full Project Title: Key factors determining adoption of broadband internet in rural and regional Australia

Principal Researcher: Sanjib Tiwari, *Faculty of Business, Education, Law and Arts (BELA), University of Southern Queensland*

Other Researcher(s):

- Dr Michael Lane, *BELA, University of Southern Queensland*

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I confirm that I am over 18 years of age. *Omit if participants are under age of 18.*
- I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential. *If other arrangements have been agreed in relation to identification of research participants this point will require amendment to accurately reflect those arrangements.*
- I understand that the tape will be *(if tape is to be retained, insert details of how and where the tape will be stored, who will have access to it and what limits will be placed on that access)*
- I understand that I will be audio taped / videotaped / photographed during the study. *Omit this point if not.*
- I understand the statement in the information sheet concerning payment to me for taking part in the study. Omit this point if no payment will be made.

Participants under the age of 18 normally require parental or guardian consent to be involved in research. The consent form should allow for those under the age of 18 to agree to their involvement and for a parent to give consent. Copy and paste another signature field if necessary.

Name of participant…………………………………………………………………......

Signed…………………………………………………….**Date**……………………….

If you have any ethical concerns with how the research is being conducted or any queries about your rights as a participant please feel free to contact the University of Southern Queensland Ethics Officer on the following details.

Ethics and Research Integrity Officer
Office of Research and Higher Degrees
University of Southern Queensland
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Ph: +61 7 4631 2690
Email: ***ethics@usq.edu.au***

Appendix C2 Survey questionnaire

Key factors determining adoption, use and impact of broadband Internet by households in rural and regional Australia: A case study of Western Downs Shire

Sanjib Tiwari
University of Southern Queensland

The Researcher

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The University Research Ethics Officer

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Email: ethics@usq.edu.au

QR Code for accessing an online version of the survey questionnaire

Sponsored By

University of Southern Queensland

Western Downs Regional Council

ADFI Australian Digital Futures Institute

Australian Government
Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education

For the purpose of this research, broadband internet is defined *as* ***high-speed, always on, internet connectivity, with a minimum download speed of 256 kbps and minimum upload speed of 64 kbps.*** Broadband Internet allows multiple tasks to be performed at same time for example user can download and upload data same time without any delay.

For the purpose of this study, a household is defined as where one or more people live in the same dwelling and share living accommodation, and may consist of single family or some other grouping of people.

Does your household have access to the Internet (this can be fixed line ADSL modem or dialup modem, 3G/4G Wireless Broadband – Mobile phone or Wireless Modem or Satellite Broadband)

- ❒ YES
- ❒ NO

B1. What kind of Internet connections are used in your household? *(Tick all apply to your household)*

- ❒ ADSL/ADSL2+ (Wired Broadband)
- ❒ Satellite wireless broadband
- ❒ 3G/4G Wireless broadband
- ❒ Dial-up
- ❒ Others *(Please specify)*___________

B2. My household has been using Internet for *(Please tick one box only)*

- ❒ Less than One year
- ❒ 1-2 years
- ❒ 3-5 years
- ❒ 6-10 years
- ❒ 11-15 years
- ❒ 16-20 years
- ❒ More than 20 years

B3. How often does your household use broadband services each week? *(Please tick one box only)*

- ❒ Less than once a week
- ❒ About once a week
- ❒ 2 or 3 times a week
- ❒ 4 to 6 times a week
- ❒ About once a day
- ❒ Several times each day
- ❒ Constantly during each day

B4. How many hours per week does your household use broadband services? *(Please tick one box only)*

- ❒ <1 hour
- ❒ 1-5 hour
- ❒ 6-10 hour
- ❒ 11-15 hour
- ❒ 16-20 hour
- ❒ 21-25 hour
- ❒ >25 hour

B5. Overall, how often does your household use broadband services during each week? *(Please tick one box only)*

- ❒ Extremely infrequently
- ❒ Quite infrequently
- ❒ Slightly infrequently
- ❒ Neither
- ❒ Slightly frequently
- ❒ Quite frequently
- ❒ Extremely frequently

B6. Where do members of your household access the Internet? *(Tick all apply to your household)*

- ❒ Home

- ❒ Work
- ❒ School or TAFE or University
- ❒ Library
- ❒ Public places (Cyber café, free hotspots)
- ❒ When you are on the move (such as travel)

B7. Indicate which of these devices are used by your household to access the Internet
(Tick all apply to your household)

- ❒ Desktop computer
- ❒ Laptop/netbook
- ❒ Smart-phone (iPhone/Android / others)
- ❒ Tablet (iPad / Android / others)
- ❒ Internet TV
- ❒ Gaming console (such as X-box, play Station)

B8. What activities does your household use the Internet for? (*Tick all apply to your household)*

❒ Information search	❒ Videos
❒ News	❒ Gambling
❒ Maps	❒ Banking
❒ Pay bills	❒ Skype
❒ Shopping	❒ Music
❒ Auctions	❒ Games
❒ E-mail	❒ Employment services
❒ Instant messaging	❒ Government services
❒ Health services	❒ Education services
❒ Facebook	❒ Instagram
❒ Twitter	❒ Blogs
❒ Linkedin	❒ Forums

The following statements are to capture your perceptions regarding Broadband Internet.
Please indicate the degree to which you agree or disagree with each of the following statements by ticking the appropriate checkbox *(For each statement, tick one box only)***.**
1= Strongly Disagree, 2= Disagree, 3 = Somewhat Disagree, 4= Neither agree nor disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

C1. Broadband internet is useful for your household	1	2	3	4	5	6	7
(1) Broadband internet can improve activities that my household undertake such as working from home.	❒	❒	❒	❒	❒	❒	❒
(2) Having broadband internet supports my household activities e.g. online shopping.	❒	❒	❒	❒	❒	❒	❒
(3) Broadband internet is useful for my household (such as bill payment, information search).	❒	❒	❒	❒	❒	❒	❒
(4) Broadband internet is useful for educational purposes in my household.	❒	❒	❒	❒	❒	❒	❒

Please indicate the degree to which your household uses each of the following entertainment services delivered by broadband internet ticking the appropriate checkbox *(For each statement, tick one box only)***.**
1= Never, 2=Very Rarely, 3 =Rarely, 4=Occasionally, 5 =Frequently, 6 =Very Frequently, 7 =Always

C2. Broadband internet delivers entertainment services for your household	1	2	3	4	5	6	7
(1) My household enjoys using broadband internet to listen to music and download music.	❒	❒	❒	❒	❒	❒	❒
(2) My household enjoys using broadband internet to watch movies and download movies.	❒	❒	❒	❒	❒	❒	❒

(3) My household enjoys using broadband internet to watch news and current affairs.	❒	❒	❒	❒	❒	❒	❒
(4) My household enjoys using broadband internet to play online games and other entertainment.	❒	❒	❒	❒	❒	❒	❒
(5) My household enjoys using broadband internet to play online gambling.	❒	❒	❒	❒	❒	❒	❒

Please indicate the degree to which you agree or disagree with each of the following statements by ticking the appropriate checkbox *(For each statement, tick one box only)***.**

1= Strongly Disagree, 2= Disagree, 3 = Somewhat Disagree, 4= Neither agree nor disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

C3. Broadband internet is affordable for your household.	1	2	3	4	5	6	7
(1) My annual household income is enough to afford subscribing to broadband internet.	❒	❒	❒	❒	❒	❒	❒
(2) It is not too costly for my household to subscribe to broadband internet.	❒	❒	❒	❒	❒	❒	❒
(3) My household is able to subscribe to broadband internet.	❒	❒	❒	❒	❒	❒	❒
(4) Broadband internet is not a priority in my household budget.	❒	❒	❒	❒	❒	❒	❒
(5) For my household, subscribing to broadband internet is quite expensive.	❒	❒	❒	❒	❒	❒	❒

C4. Using broadband internet would not require a lot of effort.	1	2	3	4	5	6	7
(1) My household feels comfortable using broadband internet without assistance.	❒	❒	❒	❒	❒	❒	❒
(2) Learning to operate broadband internet is easy for my household.	❒	❒	❒	❒	❒	❒	❒
(3) My household clearly understands how to use broadband internet.	❒	❒	❒	❒	❒	❒	❒

C5. Prior knowledge and experience in using broadband internet.	1	2	3	4	5	6	7
(1) My household does not have difficulty in justifying why using broadband internet may be beneficial.	❒	❒	❒	❒	❒	❒	❒
(2) My household knows the difference between broadband internet and dial up/narrow-band Internet.	❒	❒	❒	❒	❒	❒	❒
(3) My household knows the benefits that broadband internet offers that cannot be obtained by dial-up/narrow-band.	❒	❒	❒	❒	❒	❒	❒
(d) My household has the skills (or people who can help us) to use broadband internet for education/other opportunities.	❒	❒	❒	❒	❒	❒	❒

C6. Purchase difficulties with broadband internet.	1	2	3	4	5	6	7
(1) My household is confused with the process of selecting a suitable broadband internet plan.	❒	❒	❒	❒	❒	❒	❒
(2) Just thinking about shopping for a broadband internet service and having to decide on a particular plan is stressful.	❒	❒	❒	❒	❒	❒	❒

(3) Searching for accurate and relevant information about service/plans of broadband internet is a frustrating process.	❒	❒	❒	❒	❒	❒	❒
C7. My household intends to continue using broadband internet.	1	2	3	4	5	6	7
(1) My household intends to continue using broadband internet in the future.	❒	❒	❒	❒	❒	❒	❒
(2) My household intends to continue using broadband internet for work, household and entertainment related activities.	❒	❒	❒	❒	❒	❒	❒
(3) My household is satisfied with our current broadband internet service and plan.	❒	❒	❒	❒	❒	❒	❒
(4) My household will upgrade or subscribe to high speed broadband internet (such as NBN) when it's available.	❒	❒	❒	❒	❒	❒	❒
(5) My household will not continue using broadband internet in future.	❒	❒	❒	❒	❒	❒	❒

Please indicate the degree to which you agree or disagree with each of the following statements by ticking the appropriate checkbox *(For each statement, tick one box only)***.**
1= Strongly Disagree, 2= Disagree, 3 = Somewhat Disagree, 4= Neither agree nor disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

C8. Using broadband internet helps my household to maintain ties with family and friends, local community and the outside world.	1	2	3	4	5	6	7
(1) There are several people online my household trust to help solve our problems.	❒	❒	❒	❒	❒	❒	❒
(2) There is someone online my household can turn to for advice about making very important decisions.	❒	❒	❒	❒	❒	❒	❒
(3) There is no one online that my household would feel comfortable talking to about intimate personal problems.	❒	❒	❒	❒	❒	❒	❒
(4) When someone in my household feels lonely, there are several people online we can talk to.	❒	❒	❒	❒	❒	❒	❒
(5) If my household needed an emergency loan of $500, we know someone online we can turn to.	❒	❒	❒	❒	❒	❒	❒
(6) The people, my household interact with online would put their reputation on the line for my household.	❒	❒	❒	❒	❒	❒	❒
(7) The people my household interact with online would be good job references for my household.	❒	❒	❒	❒	❒	❒	❒
(8) The people my household interact with online would share their last dollar with my household.	❒	❒	❒	❒	❒	❒	❒
(9) My household does not know any people online well enough to get them to do anything important.	❒	❒	❒	❒	❒	❒	❒
(10) The people my household interact with online would help my household fight an injustice.	❒	❒	❒	❒	❒	❒	❒
C9. Using broadband internet my household can connect with outside social networks (communities).	1	2	3	4	5	6	7

(1) Interacting with people online makes my household interested in things that happen outside of our town.	❒	❒	❒	❒	❒	❒	❒
(2) Interacting with people online makes my household want to try new things.	❒	❒	❒	❒	❒	❒	❒
(3) Interacting with people online makes my household interested in what people unlike my household are thinking.	❒	❒	❒	❒	❒	❒	❒
(4) Talking with people online makes my household curious about other places in the world.	❒	❒	❒	❒	❒	❒	❒
(5) Interacting with people online makes my household feels like part of a larger community.	❒	❒	❒	❒	❒	❒	❒
(6) Interacting with people online makes my household feels connected to the bigger picture.	❒	❒	❒	❒	❒	❒	❒
(7) Interacting with people online reminds my household that everyone in the world is connected.	❒	❒	❒	❒	❒	❒	❒
(8) My household is willing to spend time to support general online community activities.	❒	❒	❒	❒	❒	❒	❒
(9) Interacting with people online gives my household new people to talk to.	❒	❒	❒	❒	❒	❒	❒
(10) Online, my household comes in contact with new people all the time.	❒	❒	❒	❒	❒	❒	❒

Section D – Demographics

D1. Please indicate your marital status *(Please tick one box only)*

❒ Single/Never Married
❒ Married
❒ Separated
❒ Divorced
❒ Widowed

D2. Please select that best describes your current employment status. *(Please tick one box only)*

❒ Full-time employed
❒ Part-time employed
❒ Student and not employed
❒ Student and employed
❒ Retired
❒ Self- employed or employer
❒ Not currently employed
❒ Others (Please specify)_______________

D3. Please select the occupation that best describes your current work? *(Please tick one box only)*

❒ Manager
❒ Professional
❒ Technician /Trade worker
❒ Community and personal service worker
❒ Clerical and administrative worker
❒ Sales worker
❒ Machinery operator and driver
❒ Labourer
❒ Other, please specify: _____________________

D4. Which of the following best describes your household? *(Please tick one box only)*

❒ Single person living alone
❒ Single person living with others
❒ Single parent with children at home
❒ Couple/family with no children
❒ Couple/family with children at home
❒ Couple/family with children not living at home

Section E– Household Demographics

E1. Do you currently rent or own your house?
(Please tick one box only)

- ❒ Rent
- ❒ Own
- ❒ Other (Please specify) ________________

E2. What is your total household income per year? *(Please tick one box only)*

❒	under $19,999	❒	$80,000 - $99,999
❒	$20,000 - $39,999	❒	$100,000 - $120,000
❒	$40,000 - $59,999	❒	Over $120,000
❒	$60,000 - $79,999		

E3. Number of household members using broadband Internet? *(Please tick one box only)*

❒ 1 ❒ 2 ❒ 3 ❒ 4 ❒ 5
❒ 6 ❒ 7 ❒ 8 ❒ more than 8

E4. Demographics of respondent

."

Age (Years)	**Sex** (M or F)	**Education** (highest obtained) P- Primary, S-Secondary school, D- Diploma, U- Undergraduate, PG- Post Graduate, T- Training
_____	❒M ❒F	❒P ❒S ❒D ❒U ❒PG ❒T

E5. Select your closest Geographic location

❒	Live in Dalby	❒	Nearest to Dalby
❒	Live in Chinchilla	❒	Nearest to Chinchilla
❒	Live in Wandoan	❒	Nearest to Wandoan
❒	Live in Tara	❒	Nearest to Tara
❒	Live in Miles	❒	Nearest to Miles
❒	Live in Jandowae	❒	Nearest to Jandowae
❒	Other place *(please specify)* …………………...		

E6. Would you like a copy of the research findings when they become available?

- ❒ Yes (Please complete E8)
- ❒ No (Please disregard E8)

E7. If you have completed the entire survey, would you like to be included in the random draw for an iPhone 5S smart phone or a Samsung Galaxy 4 smart phone?

- ❒ Yes (Please complete E8)
- ❒ No (Please disregard E8)

E8. Please provide your name and e-mail address or phone number or postal address:

____
____
____
____

QR Code for accessing an online version of the survey questionnaire

If you have any comments regarding this survey questionnaire or the research project, you may write them in the space provided below:

In case the return envelope provided has been mislaid, please forward your completed questionnaire to the postal address below.

Dr Michael Lane
Faculty of Business, Education, Law and Arts
University of Southern Queensland
West Street
TOOWOOMBA QLD 4350
Phone: (07) 4631 1268
Email: Michael.Lane@usq.edu.au

A copy of the report compiled from this survey will be sent to participating households upon request.

UNIVERSITY OF SOUTHERN QUEENSLAND

Appendix D: Survey Participant Invitation Letter

The University of
Southern Queensland (USQ)
Toowoomba, Queensland, 4350
AUSTRALIA
http://www.usq.edu.au
School of Management and Enterprise Department/

Dear Sir/Madame,
I am conducting a research project supported by the Australian Government's Collaborative Research Networks (CRN) program and sponsored by the University of Southern Queensland on the “Key factors determining adoption of high-speed broadband services in rural and regional Australia.” We would like to gain a better understanding of the factors that determine to adoption of high-speed broadband in rural and regional households. Results from this study will help guide local, state and federal governments to developing better policies and programs that will help rural and regional Australia maximise benefits from broadband connectivity in terms of industry, education and employment.

As you are the major decision maker in your household, we ask for your help in conducting this research project by completing the accompanying survey. This survey has been approved by the USQ Ethics Committee of University of Southern Queensland. There are no risks associated with participating in this study other the time constraint of 20-30 minutes to complete this survey. The survey collects no identifying information of any respondent unless they choose to provide this information. All of the responses to the survey will be recorded anonymously.

We would be grateful if you could complete this short survey which will take around 20-30 minutes to fill in. You can complete this survey online via the following URL link http://usqbusiness.co1.qualtrics.com/SE/?SID=SV_9F9fHqrP6Mqz2Qd or by scanning QR Code at the bottom of this page you complete this survey online with your mobile device or forward the URL link to the online survey in an email to your laptop or desktop (note: you can download a QR Code Scanner app from Apple Apps Store or Google Play Store).

As a thank you for your time if you complete all of the survey, you can indicate if you want to be entered into a draw with the chance to win a mobile smart phone (iPhone 5s or Samsung Galaxy 4 depending on the winner’s preference). This would require you to provide some contact details (Full Name, Email Address or Phone Number) so that we can contact the winner.

You may be assured of complete anonymity. Your postal address, email address or phone number will only be used to contact you about this research project and its results if you have indicated that you wish to receive a summary of report of the key findings and/or want to be entered into the draw for a smart mobile phone. At no time will this information be used for any other purpose. The results of this project will be published in aggregate form, so you will never be personally identified as part of the results of this study that are publish in the thesis or research articles.

I would like to thank you in advance for participating in this study, and I would be happy to answer any questions you may have via email phone or postal mail.

Sincerely,
Dr Michael Lane, PhD
University of Southern Queensland
Email: Michael.Lane@usq.edu.au
Phone: +61 07 4631 1268
Mobile: +61 0407 316 391

QR Code for accessing an online version of the survey questionnaire

Survey Participant Information Sheet

USQ
AUSTRALIA

University of Southern Queensland

The University of Southern Queensland

Participant Information Sheet

HREC Approval Number: H13REA159

Full Project Title: Key factors determining adoption of high-speed broadband services in rural and regional Australia

Principal Researcher: Sanjib Tiwari, *Faculty of Business, Education, Law and Justice and Arts (BELA), University of Southern Queensland*

Other Researcher(s):

- Dr Michael Lane, (BELA)*, University of Southern Queensland*

I would like to invite you to take part in this research project.

The purpose of this project is to identify the key factors that determine the adoption of high speed broadband services by rural and regional households in Australia.
The research team requests your assistance because you live in a rural and regional part of Australia which makes you eligible as a participant in this project.
This project is being undertaken as part of a PhD project for Sanjib Tiwari. This project is supported through the Australian Government's Collaborative Research Network (CRN) program. The PhD student Sanjib Tiwari is funded by USQ CRN which is part of USQ CRN project 2. This project is part of the USQ CRN with ANU, UniSA and WDRC.

3. Procedures

Participation in this project will involve

- ***The completion of an anonymous survey. The survey will determine the key factors for adoption of high-speed broadband services by households in rural and regional Australia.***
- ***It is expected that the survey will take no more that about 20-30 minutes to complete.***
- ***Participants can benefit by receiving (if they chose to) a summary of the results. This will provide the participants with further insight into key factors determining the adoption of high-speed broadband services in rural and regional Australia***
- ***There are no identified risks for participants other than a limited time imposition (survey will take 20 - 30 minutes to complete)***
- ***At the end of the survey this project thanks you for your time if you complete the questionnaire by inviting you to indicate if you would like to be entered into a draw to win a smart mobile phone.***

4. Voluntary Participation

Participation is entirely voluntary. **If you do not wish to take part you are not obliged to.** If you decide to take part and later change your mind, you are free to withdraw from the project at any stage. Any information already obtained from you will be destroyed. However, results obtained via the survey are anonymous and therefore cannot be identified to be deleted. Your decision whether to take part or not to take part, or to take part and then withdraw, will not affect your relationship with the University of Southern Queensland and WDRC.

Please notify the researcher if you decide to withdraw from this project.

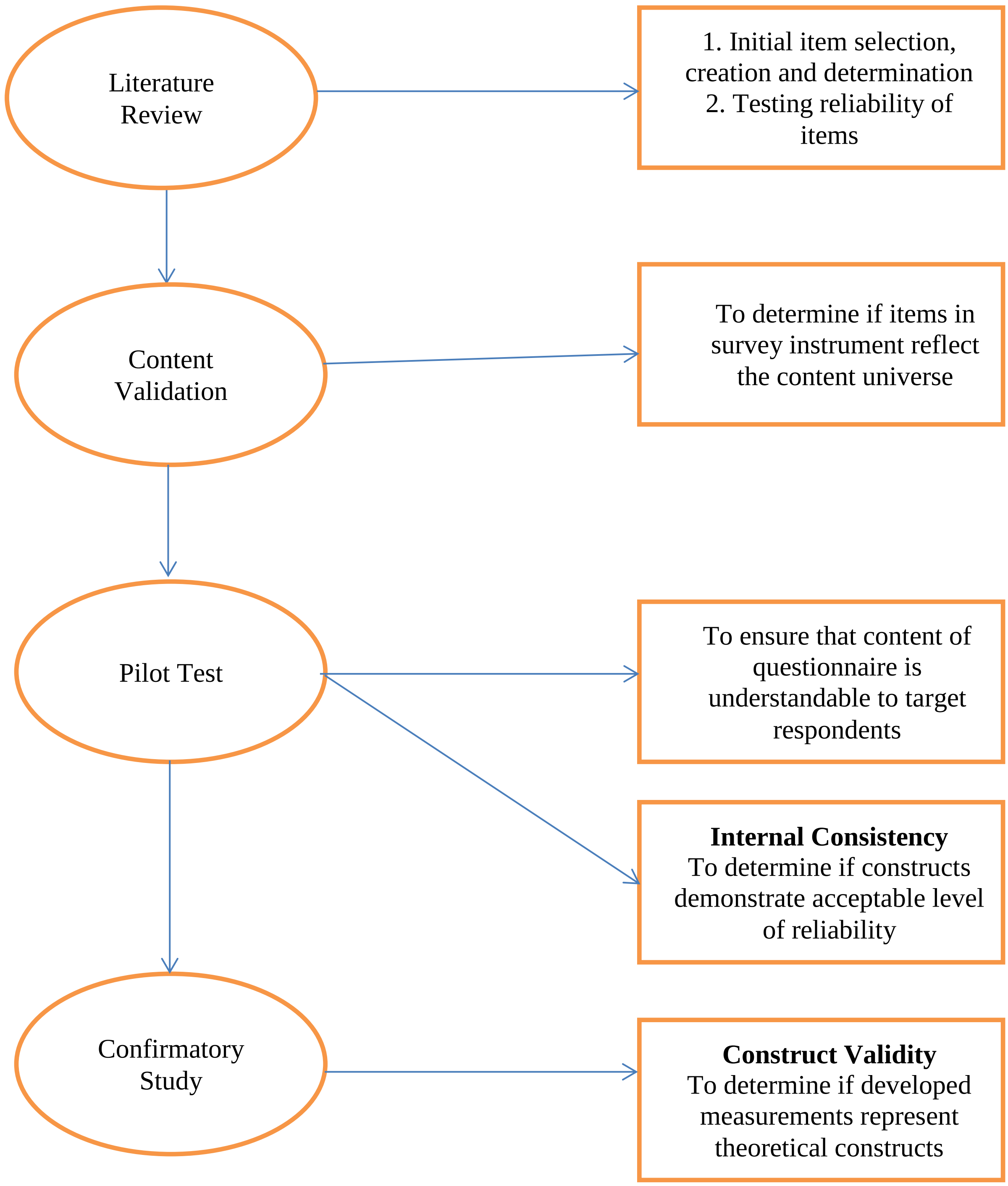
Should you have any queries regarding the progress or conduct of this research, you can contact the principal researcher:

Sanjib Tiwari
Faculty of Business, Education, Law and Justice and Arts
Toowoomba
Sanjib.Tiwari@usq.edu.au

If you have any ethical concerns with how the research is being conducted or any queries about your rights as a participant please feel free to contact the University of Southern Queensland Ethics Officer on the following details.

Ethics and Research Integrity Officer
Office of Research and Higher Degrees
University of Southern Queensland
West Street, Toowoomba 4350
Ph: +61 7 4631 2690
Email: ***ethics@usq.edu.au***

Appendix C3 Developing and validating the quantitative survey instrument of this research



Adapted from Dwivedi, Choudrie & Brinkman (2006a)

Appendix C4 Ethical clearance

USQ
AUSTRALIA

University of Southern Queensland

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CRICOS: QLD 00244B NSW 02225M

www.usq.edu.au

OFFICE OF RESEARCH AND HIGHER DEGREES
Ethics Committee Support Officer
PHONE (07) 4631 2690 | FAX (07) 4631 1995
EMAIL ethics@usq.edu.au

6 September 2013

Mr Sanjib Tiwari
School of Information Systems
Business, Education, Law and Arts
University of Southern Queensland

Dear Sanjib

The Chair of the USQ Fast Track Human Research Ethics Committee (FTHREC) recently reviewed your responses to the FTHREC's conditions placed upon the ethical approval for the below project. Your proposal now meets the requirements of the *National Statement on Ethical Conduct in Human Research (2007)* and full ethics approval has been granted.

Approval No.	**H13REA159**
Project Title	Key factors determining adoption of high-spped broadband services in rural and regional Australia
Approval date	6 September 2013
Expiry date	6 September 2014
FTHREC Decision	**Approved**

The standard conditions of this approval are:

(a) conduct the project strictly in accordance with the proposal submitted and granted ethics approval, including any amendments made to the proposal required by the HREC
(b) advise (email: ethics@usq.edu.au) immediately of any complaints or other issues in relation to the project which may warrant review of the ethical approval of the project
(c) make submission for approval of amendments to the approved project before implementing such changes
(d) provide a 'progress report' for every year of approval
(e) provide a 'final report' when the project is complete
(f) advise in writing if the project has been discontinued.

For (c) to (e) forms are available on the USQ ethics website: http://www.usq.edu.au/research/ethicsbio/human

Please note that failure to comply with the conditions of approval and the *National Statement (2007)* may result in withdrawal of approval for the project.

You may now commence your project. I wish you all the best for the conduct of the project.

Ethics Committee Support Officer

Copies to: sanjib.tiwari@usq.edu.au
michael.lane@usq.edu.au

Toowoomba • Springfield • Fraser Coast usq.edu.au

Appendix D1 RFNSA electromagnetic energy (EME) site safety documents

AMTA

COMPLIANCE CERTIFICATE - SITE

RFNSA Site No: 4405003

Site Address: 130 Cunningham St DALBY QLD 4405

Issued in accordance with the Radiocommunications Licence Conditions (Apparatus Licence) Determination 2015.

RF Human Exposure Limits

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) has produced a standard for exposure to Radio Frequency (RF) transmissions – ARPANSA Radiation Protection Standard 2002 Maximum Exposure Levels to Radio Frequency Fields – 3 kHz to 300 GHz (RPS3).

The Australian Communications and Media Authority (ACMA) has made the Radiocommunications Licence Conditions (Apparatus Licence) Determination 2015 that requires that the general public is not exposed to RF transmission levels exceeding the general public limits specified in the ARPANSA Standard (RPS3).

State and Commonwealth Occupational Health & Safety laws require compliance with the limits and obligations set out in the ARPANSA standard (RPS3).

Compliance Statement

This site has been assessed and found to comply with the RF Human Exposure Limits as specified by the ACMA Licence Condition Determination and requirements of the ARPANSA Standard RPS3.

Mobile Telecommunications Equipment

The mobile telecommunications equipment installed at this site and its configuration as a mobile base station, has been assessed in accordance with the ARPANSA RPS3 reference limits, and has been deemed to comply with the ACMA Licence Conditions (Apparatus Licence) Determination 2015.

Other Radio Frequency Transmitting Equipment

All identified radio communications services are included in the related compliance documents listed below.

Access Controls, RF Warning Signs and Safe Work Procedures

Access Control, RF warning signs (if required) and Safe Working Procedures are in place as detailed in the Related Documents listed below.

Compliance Certificate No: 22

NATA

Accreditation No

15500

Approved Signatory

Name: Anan Singh

Signature:

Designation: Compliance Services Manager

Company: RADHAZ Consulting Pty Ltd

Date: 01/04/2016

Related Documents:	Site Compliance Report	Ref No: 22
	EME Guide for Site Safety	Ref No: 4405003 -22

EME Compliance Certificate – Site (Issue 22 - 01/04/2016) #40325

Source from RFNSA (2016)

Environmental EME Report
130 Cunningham St, DALBY QLD 4405

This report provides a summary of Calculated RF EME Levels around the wireless base station

Date 2/12/2015 **RFNSA Site No. 4405003**

Introduction

The purpose of this report is to provide calculations of EME levels from the existing facilities at the site and any proposed additional facilities.

This report provides a summary of levels of radiofrequency (RF) electromagnetic energy (EME) around the wireless base station at 130 Cunningham St DALBY QLD 4405 . These levels have been calculated by Telstra using methodology developed by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

The maximum EME level calculated for the existing systems at this site is 0.31% of the public exposure limit.

The ARPANSA Standard

ARPANSA, an Australian Government agency in the Health and Ageing portfolio, has established a Radiation Protection Standard specifying limits for general public exposure to RF transmissions at frequencies used by wireless base stations. The Australian Communications and Media Authority (ACMA) mandates the exposure limits of the ARPANSA Standard.

How the EME is calculated in this report

The procedure used for these calculations is documented in the ARPANSA Technical Report "Radio Frequency EME Exposure Levels - Prediction Methodologies" which is available at http://www.arpansa.gov.au.

RF EME values are calculated at 1.5m above ground at various distances from the base station, assuming level ground.

The estimate is based on worst-case scenario, including:
- wireless base station transmitters for mobile and broadband data operating at maximum power
- simultaneous telephone calls and data transmission
- an unobstructed line of sight view to the antennas.

In practice, exposures are usually lower because:
- the presence of buildings, trees and other features of the environment reduces signal strength
- the base station automatically adjusts transmit power to the minimum required.

Maximum EME levels are estimated in 360° circular bands out to 500m from the base station.

These levels are cumulative and take into account emissions from all mobile phone antennas at this site.
The EME levels are presented in three different units:

- volts per metre (V/m) – the electric field component of the RF wave
- milliwatts per square metre (mW/m²) – the power density (or rate of flow of RF energy per unit area)
- percentage (%) of the ARPANSA Standard public exposure limit (the public exposure limit = 100%).

Results

The maximum EME level calculated for the existing systems at this site is 2.44 V/m; equivalent to 15.73 mW/m² or 0.31% of the public exposure limit.

Environmental EME report (v11.3, Feb 2014) Produced with RF-Map 2.0 (Build 1.18) NAD (v1.0.60389.26337)

Source from RFNSA (2016)

Appendix D2 Wired and wireless broadband availability assessment - Selected rural regions in Australia

Queensland

Southern Downs Regional Council

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Warwick	16,000	Y	Y	Y	N	Y (All)	Y (All)	Inner Regional
Stanthorpe	5,500	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Allora	1,276	Y	Y	Y	N	Y(T)	Y(T)	Inner Regional
Killarney	911	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
The Falls	197	Y	N (±T)	Proposed (T)	N	N	N	Outer Regional

Goondiwindi Regional Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Goondiwindi	6,397	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Inglewood	1,069	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Texas	1,159	Y	Y	Y	N	Y(TO)	Y(TO)	Remote
Yelarbon	493	Y	Y	Proposed (T)	N	Y(TO)	Proposed (TO)	Outer Regional
Toobeah	218	Y	N (±T)	Proposed (T)	N	Proposed (T)	Proposed (T)	Remote
Bungunya	189	Y	N	N	N	N	N	Remote

Tasmania

Southern Midlands Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Bagdad	1,266	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Mangalore	521	Y	N	N	N	Y (T)	Y (T)	Outer Regional
Kempton	353	Y	Y	Y	N	Y(T)	Proposed (T)	Outer Regional

West Coast Council (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Queenstown	1975	Y	Y	Y	N	Y (TO)	Y (O)	Remote
Strahan	824	Y	Y	Y	N	Y (T)	Y (T)	Remote
Rosebery	922	Y	Y	Y	N	Y (TO)	Y (O)	Remote

New South Wales

Gilgandra Shire (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Gilgandra	2,700	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Tooraweenah	371	Y	Y	N	N	Y (TV)	Y(V)	Outer Regional
Armatree	284	Y	N (±T)	Proposed (T)	N	Y (T)	N	Outer Regional

Narrabri Shire (source: (ADSL2-Exchanges 2016; RFNSA 2016))

	Pop	PSTN	ADSL	ADSL2+	Fibre optic backbone	3G	4G	ASGC
Narrabri	7,392	Y	Y	Y	N	Y (All)	Y (All)	Outer Regional
Wee Waa	2,089	Y	Y	Y	N	Y(TO)	Y(T)	Outer Regional
Baan Baa	525	Y	N (±T)	Proposed (T)	N	Y(TO)	Y(T)	Outer Regional

Legend Y = Available; N = Not Available; T= Telstra; O= Optus; V=Vodafone Y (All) = Telstra, Optus & Vodafone; TO= Telstra & Optus; ±T = Telstra no ports

[Note: this figures were captured during the study which may be different other time]

Source from ADSL2-Exchanges (2016); and RFNSA (2016)

Appendix E1

Table E1-1 – Results for mean, median, standard deviation, variance, skewness and Kurtosis of all online survey questionnaire items

Constructs items	Mean	Median	Std. Deviation	Variance	Skewness	Std. Error of Skewness	Kurtosis	Std. Error of Kurtosis
HLUI1	4.18	4.00	1.302	1.694	-.168	.137	.235	.274
FOU1	5.73	6.00	1.251	1.566	-1.467	.137	2.144	.274
FOU2	4.53	5.00	1.984	3.938	-.098	.137	-1.394	.274
FOU3	5.75	6.00	1.458	2.125	-1.519	.137	1.763	.274
UO1	5.70	6.00	1.641	2.694	-1.387	.137	1.080	.274
UO2	5.58	6.00	1.714	2.938	-1.250	.137	.580	.274
UO3	6.23	7.00	1.283	1.646	-2.276	.137	5.405	.274
UO4	5.72	6.00	1.505	2.266	-1.281	.137	1.156	.274
HO1	4.19	4.00	2.092	4.378	-.156	.137	-1.232	.274
HO2	3.26	3.00	2.127	4.523	.510	.137	-1.123	.274
HO3	3.52	4.00	1.806	3.263	.219	.137	-.981	.274
HO4	3.18	3.00	2.114	4.467	.453	.137	-1.209	.274
HO5	1.34	1.00	1.042	1.086	3.372	.137	11.045	.274
PerC1	5.20	6.00	1.556	2.420	-.934	.137	.281	.274
PerC2	4.40	5.00	1.753	3.075	-.250	.137	-.896	.274
PerC3	5.46	6.00	1.491	2.224	-1.257	.137	1.307	.274
PerC4_Rev	4.90	5.00	1.808	3.270	-.518	.137	-.864	.274
PerC5_Rev	3.66	3.00	1.780	3.168	.331	.137	-.924	.274
SE1	5.79	6.00	1.344	1.808	-1.415	.137	1.781	.274
SE2	5.65	6.00	1.425	2.031	-1.208	.137	.874	.274
SE3	5.63	6.00	1.471	2.163	-1.285	.137	1.250	.274
PKE1	5.74	6.00	1.339	1.792	-1.319	.137	1.616	.274

PKE2	5.53	6.00	1.616	2.613	-1.205	.137	.608	.274
PKE3	5.69	6.00	1.493	2.229	-1.352	.137	1.331	.274
PKE4	5.70	6.00	1.415	2.001	-1.282	.137	1.243	.274
PurC1	3.69	4.00	1.844	3.399	-.019	.137	-1.192	.274
PurC2	4.08	4.00	1.874	3.513	-.206	.137	-1.075	.274
PurC3	4.62	5.00	1.834	3.363	-.563	.137	-.665	.274
ITUB1	6.33	7.00	.954	.911	-2.126	.137	6.860	.274
ITUB2	6.23	7.00	1.054	1.111	-1.987	.137	5.330	.274
ITUB3	4.36	5.00	1.952	3.811	-.341	.137	-1.071	.274
ITUB4	5.97	6.00	1.224	1.499	-1.422	.137	2.107	.274
ITUB5_Rev	6.09	6.00	1.128	1.272	-1.878	.137	4.908	.274
BOSC1	4.04	4.00	1.794	3.218	-.079	.137	-1.049	.274
BOSC2	3.89	4.00	1.802	3.248	.073	.137	-.962	.274
BOSC3_Rev	3.69	4.00	1.985	3.940	.246	.137	-1.156	.274
BOSC4	3.95	4.00	1.896	3.596	-.155	.137	-1.125	.274
BOSC5	3.11	2.00	1.996	3.984	.475	.137	-1.102	.274
BOSC6	3.43	4.00	1.788	3.196	.247	.137	-.794	.274
BOSC7	3.76	4.00	1.791	3.209	-.028	.137	-.933	.274
BOSC8	3.32	4.00	1.769	3.130	.240	.137	-.854	.274
BOSC9_Rev	3.93	4.00	2.005	4.021	-.008	.137	-1.285	.274
BOSC10	4.00	4.00	1.801	3.245	-.150	.137	-.796	.274
BRSC1	4.87	5.00	1.711	2.929	-.767	.137	-.339	.274
BRSC2	4.65	5.00	1.689	2.851	-.655	.137	-.330	.274
BRSC3	4.47	5.00	1.669	2.785	-.463	.137	-.499	.274
BRSC4	4.77	5.00	1.711	2.928	-.742	.137	-.256	.274

BRSC5	4.70	5.00	1.709	2.922	-.634	.137	-.395	.274
BRSC6	4.79	5.00	1.683	2.833	-.748	.137	-.162	.274
BRSC7	4.99	5.00	1.548	2.395	-.856	.137	.283	.274
BRSC8	4.34	5.00	1.573	2.473	-.480	.137	-.497	.274
BRSC9	4.39	5.00	1.673	2.799	-.469	.137	-.629	.274
BRSC10	3.74	4.00	1.711	2.927	-.053	.137	-.923	.274

Legend:

UO	Utilitarian outcome	HLUI	Length of Internet use
HO	Hedonic outcome	SE	Self-efficacy
PerC	Perceived cost	BOSCI	Bonding social capital
PKE	Prior knowledge and experience	BRSC	Bridging social capital
ABU	Actual broadband use	Rev	Reverse
ITUB	Intention to adopt and use of broadband Internet		

Table E1-2 Tests of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
UO1	0.28	315	0	0.77	315	0
UO2	0.269	315	0	0.788	315	0
UO3	0.311	315	0	0.644	315	0
UO4	0.256	315	0	0.798	315	0
HO1	0.127	315	0	0.9	315	0
HO2	0.196	315	0	0.861	315	0
HO3	0.162	315	0	0.925	315	0
HO4	0.201	315	0	0.854	315	0
HO5	0.499	315	0	0.375	315	0
PerC1	0.234	315	0	0.879	315	0
PerC2	0.146	315	0	0.936	315	0
PerC3	0.247	315	0	0.839	315	0
PerC4_Rev	0.205	315	0	0.896	315	0
PerC5_Rev	0.168	315	0	0.924	315	0
SE1	0.275	315	0	0.802	315	0
SE2	0.279	315	0	0.824	315	0
SE3	0.253	315	0	0.821	315	0
PKE4	0.261	315	0	0.82	315	0
PKE1	0.272	315	0	0.819	315	0
PKE2	0.28	315	0	0.814	315	0
PKE3	0.272	315	0	0.803	315	0
PurC1	0.164	315	0	0.919	315	0
PurC2	0.152	315	0	0.925	315	0
PurC3	0.175	315	0	0.906	315	0
ITUB1	0.31	315	0	0.696	315	0

ITUB2	0.277	315	0	0.72	315	0
ITUB3	0.164	315	0	0.911	315	0
ITUB4	0.246	315	0	0.791	315	0
ITUB5_Rev	0.253	315	0	0.75	315	0
BOSC1	0.132	315	0	0.932	315	0
BOSC2	0.129	315	0	0.937	315	0
BOSC3_Rev	0.178	315	0	0.907	315	0
BOSC4	0.152	315	0	0.919	315	0
BOSC5	0.222	315	0	0.863	315	0
BOSC6	0.195	315	0	0.904	315	0
BOSC7	0.195	315	0	0.92	315	0
BOSC8	0.201	315	0	0.901	315	0
BOSC9_Rev	0.162	315	0	0.909	315	0
BOSC10	0.215	315	0	0.915	315	0
BRSC1	0.206	315	0	0.887	315	0
BRSC2	0.181	315	0	0.909	315	0
BRSC3	0.171	315	0	0.925	315	0
BRSC4	0.188	315	0	0.895	315	0
BRSC5	0.163	315	0	0.906	315	0
BRSC6	0.174	315	0	0.896	315	0
BRSC7	0.187	315	0	0.894	315	0
BRSC8	0.168	315	0	0.931	315	0
BRSC9	0.173	315	0	0.919	315	0
BRSC10	0.158	315	0	0.936	315	0

Table E1-3 Variance inflation factor (VIF) for all Independent variables

Independent variable	Variance inflation factor
ABU -> BOSC	1.082
ABU -> BRSC	1.000
BRSC -> BOSC	1.082
HLUI -> ABU	1.070
HO -> ABU	1.455
ITUB -> ABU	2.131
PERC -> ITUB	1.253
PKE -> ITUB	2.197
PURC -> ITUB	1.253
SE -> ABU	1.975
UO -> ITUB	2.362

Legend:

UO	Utilitarian outcome	HLUI	Length of Internet use
HO	Hedonic outcome	SE	Self-efficacy
PerC	Perceived cost	BOSCI	Bonding social capital

PKE Prior knowledge and experience
ABU Actual broadband use
ITUB Intention to adopt and use of broadband Internet
BRSC Bridging social capital

Table E1-4 Harman's single factor test for common methods bias

Total Variance Explained						
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.670	30.562	30.562	14.670	30.562	30.562
2	7.353	15.318	45.880			
3	2.710	5.647	51.527			
4	2.143	4.465	55.991			
5	1.996	4.159	60.150			
6	1.562	3.255	63.406			
7	1.370	2.855	66.260			
8	1.200	2.501	68.761			
9	1.126	2.346	71.107			
10	1.102	2.296	73.404			
11	.873	1.818	75.222			
12	.819	1.706	76.928			
13	.753	1.570	78.498			
14	.679	1.414	79.912			
15	.645	1.343	81.254			
16	.631	1.315	82.570			
17	.566	1.180	83.749			
18	.533	1.110	84.859			
19	.507	1.056	85.915			
20	.489	1.019	86.934			
21	.437	.910	87.844			
22	.394	.821	88.665			
23	.382	.795	89.460			
24	.362	.755	90.215			
25	.353	.736	90.951			
26	.334	.695	91.647			
27	.316	.659	92.305			
28	.296	.617	92.922			
29	.288	.600	93.522			
30	.282	.587	94.109			
31	.266	.554	94.663			
32	.259	.539	95.201			
33	.251	.523	95.725			

34	.233	.484	96.209			
35	.214	.446	96.655			
36	.200	.417	97.072			
37	.175	.365	97.436			
38	.169	.352	97.788			
39	.164	.342	98.130			
40	.149	.310	98.440			
41	.135	.281	98.721			
42	.121	.252	98.972			
43	.112	.234	99.206			
44	.107	.222	99.428			
45	.086	.180	99.608			
46	.075	.156	99.764			
47	.062	.128	99.892			
48	.052	.108	100.000			
Extraction Method: Principal Component Analysis.						

Appendix E2

Table F2-1 Factor loadings of initial measurement model

	ABU	BOSC	BRSC	HLUI	HO	ITUB	PERC	PKE	PURC	SE	UO
BOSC1		0.753									
BOSC10		0.722									
BOSC2		0.740									
BOSC3_Rev		0.305									
BOSC4		0.887									
BOSC5		0.632									
BOSC6		0.638									
BOSC7		0.745									
BOSC8		0.673									
BOSC9_Rev		0.672									
BRSC1			0.907								
BRSC10			0.636								
BRSC2			0.862								
BRSC3			0.888								
BRSC4			0.862								
BRSC5			0.876								
BRSC6			0.857								
BRSC7			0.826								
BRSC8			0.882								
BRSC9			0.826								
FOU1	0.851										
FOU2	0.764										
FOU3	0.809										
HLUI1				1.000							
HO1					0.755						
HO2					0.769						
HO3					0.711						
HO4					0.660						
HO5					0.237						
ITUB1						0.865					
ITUB2						0.924					
ITUB4						0.600					
ITUB5_Rev						0.734					
PKE1								0.848			
PKE2								0.728			
PKE3								0.750			

PKE4								0.914			
PerC1							0.691				
PerC2_Rev							-0.371				
PerC3							0.701				
PerC4_Rev							0.660				
PerC5_Rev							0.123				
PurC1									0.985		
PurC2									0.779		
PurC3									0.477		
SE1										0.954	
SE2										0.953	
SE3										0.967	
UO1											0.811
UO2											0.861
UO3											0.746
UO4											0.682

Table E2-2: AVE, CR and Cronbach's alpha of the initial measurement model

Construct	AVE	CR	Cronbach's Alpha
ABU	0.65	0.85	0.85
BOSC	0.52	0.90	0.91
BRSC	0.71	0.96	0.96
HLUI	1.00	1.00	1.00
HO	0.52	0.81	0.81
ITUB	0.62	0.87	0.85
PerC	0.35	0.61	0.61
PKE	0.66	0.89	0.89
SE	0.92	0.97	0.97
UO	0.61	0.86	0.86

UO	Utilitarian outcome	HLUI	Length of Internet use
HO	Hedonic outcome	SE	Self-efficacy
PerC	Perceived cost	BOSCI	Bonding social capital
PKE	Prior knowledge and experience	BRSC	Bridging social capital
ABU	Actual broadband use		
ITUB	Intention to adopt and use of broadband Internet		

Table E2-3 Heterotrait-Monotrait Ratio (HTMT) for Discriminant validity of the initial measurement model for the broadband adoption and building social capital

	ABU	BOSC	BRSC	HLUI	HO	ITUB	PERC	PKE	SE	UO
ABU										
BOSC	0.213									

BRSC	0.273	0.653								
HLUI	0.380	0.035	0.037							
HO	0.691	0.379	0.424	0.116						
ITUB	0.605	0.145	0.274	0.251	0.542					
PERC	0.672	0.296	0.326	0.320	0.581	0.736				
PKE	0.551	0.250	0.247	0.260	0.499	0.767	0.618			
SE	0.572	0.246	0.255	0.201	0.491	0.696	0.568	0.910		
UO	0.598	0.184	0.314	0.247	0.632	0.651	0.701	0.663	0.620	

UO Utilitarian outcome
HO Hedonic outcome
PerC Perceived cost
PKE Prior knowledge and experience
ABU Actual broadband use
ITUB Intention to adopt and use of broadband Internet
HLUI Length of Internet use
SE Self-efficacy
BOSCI Bonding social capital
BRSC Bridging social capital

Table E2-4: Path Coefficient of the initial Structural model for the broadband adoption use and building and maintaining social capital

Relationships	**Original Sample (O)**	**Sample Mean (5000)**	**Strength**	**T Statistics (|O/STERR|)**	**P Values**
ABU -> BOSC	0.04	0.04	Weak	0.65	0.50
ABU -> BRSC	0.28	0.27	Moderate	4.64***	0.00
BRSC -> BOSC	0.65	0.65	Strong	14.87***	0.00
HLUI -> ABU	0.25	0.24	Moderate	4.21***	0.00
HO -> ITUB	0.06	0.06	Weak	0.752	0.45
ITUB -> ABU	0.54	0.54	Strong	8.77***	0.00
PERC -> ITUB	0.38	0.40	Moderate	2.55***	0.01
PKE -> ITUB	0.57	0.58	Moderate	2.35***	0.00
PURC-> ITUB	0.01	0.01	Weak	0.19	0.85
SE -> ITUB	-0.08	-0.10	Weak	0.40	0.69
UO -> ITUB	0.00	-0.00	Weak	0.01	0.99

* 90% significance level; ** 95% significance level; *** 99% significance level

UO Utilitarian outcome
HO Hedonic outcome
PerC Perceived cost
PKE Prior knowledge and experience
ABU Actual broadband use
ITUB Intention to adopt and use of broadband Internet
HLUI Length of Internet use
SE Self-efficacy
BOSCI Bonding social capital
BRSC Bridging social capital