National, local and household media ecologies: The case of Australia’s National Broadband Network

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Abstract
This article draws from recent work by the authors on high-speed broadband and Australia’s National Broadband Network (NBN) to critically engage with and extend theories of media ecologies. The argument of this paper is that the media ecology approach is a valuable framework for making sense of such a large-scale infrastructure project as the NBN, but that, equally, due to its scaled nature, the NBN leads to a reconceptualised understanding of media ecologies as operating at three different levels: national, local (at the level of the suburb or town), and within the household.

Introduction
Media ecologies are dense networks of interconnecting and mutually constituting devices, performances and services that may be examined on any number of scales—from the micro, where individuals and the media act and interconnect, through to the global, where networks of networks bring billions of media interconnections together. In this paper we focus on Australia’s National Broadband Network (NBN) and its reconstitution of media ecologies at three levels: national, local, and within the household.

Engineering a media ecology
The metaphor of ecology was introduced into studies of media and communication by theorists Marshall McLuhan and Neil Postman in the 1960s and 1970s, who adapted it from already established ideas of ‘human ecology’ in urban sociology from the Chicago School, rather than directly from biological science (Heise 2002; Strate 2004). The metaphor of ecology shifted the attention on communication media from metaphors associated with conduits for transmission or languages of representation (Meyrowitz 1993), opening a perspective onto the interconnectedness of media technologies configuring and stabilising a cultural environment. Yet, in its metaphorical application, as Pickett and Cadenasso (2002, p. 6) note, the concept of an ecological system ‘can be used to stand for equilibrium, resistance or resilience, diversity, and adaptability’. It is the first of these senses—that of equilibrium—that tends to characterise established media ecology approaches. For instance, Neil Postman writes:

We put the word ‘media’ in the front of the word ‘ecology’ to suggest that we were not simply interested in media, but in the ways in which the interaction between

media and human beings gives a culture its character and, one might say, helps a culture to maintain symbolic balance.

(Postman, quoted in Strate 2004, p. 3)\textsuperscript{1}

While we share Postman’s focus on interaction, and his definition of media ecology as ‘the study of media as environments’ (Postman, quoted in Strate 2004, p. 4), our concern in this article is not so much with media ecologies in states of dynamic equilibrium. Rather, we turn to current efforts in Australia to geographically transform, or ‘terraform’, the national media infrastructure landscape, and thereby fundamentally reshape its media ecology, through a massive project aimed at encouraging the proliferation and then the domination of high-speed broadband as a communications mode. In order to do this we explore the dynamics of the media ecology in terms of appropriation and resistance, and strategic interposition across three levels: national, local and household. With this in mind, the second-generation strands of media ecology scholarship that inform this part of the investigation are David Altheide’s (1995) work on communicative ecology, and the treatment given by media anthropologist Jo Tacchi (2006). The contributions of each are sketched below.

Altheide draws out four crucial aspects of the term ‘ecology’ for the study of information and communication technologies (ICTs), which he summarises as follows: first, the word ‘implies relationships related through process and interaction’; second, it ‘implies a spatial and relational basis for a subject matter’, meaning that ‘the characteristics of a medium depend on a certain arrangement of elements’; third, ‘the relations are not haphazard or wholly arbitrary’; and, fourth, ‘there are developmental, contingent, and emergent features of ecology’ which suggests that ‘ecology does not exist as a thing, but is a fluid structure’ (Altheide 1995, pp. 10-11). This fourfold understanding of ecology informs his concept of ‘ecology of communication’. It is a framework that is productive for grasping ‘how social activities are joined interactively in a communication environment […] and with information technology’ (Altheide 1995, p. 2). The merit of this approach for our investigation of the interactions between the NBN and households, and the NBN and the suburb of Brunswick in Victoria, Australia, is that it situates these interactions within domestic environments and within the particular vagaries of local environments, a significant context in that the material and spatial aspects of domestic and local ecologies of communication have a direct influence on strategic interposition of the network (Shepherd, Arnold, Bellamy & Gibbs 2007).

The work of media anthropologist Tacchi complements the above approaches and extends them in one crucial respect: by drawing attention to the macro-level ‘environmental’ frames within which domestic and local communication ecologies operate. ‘It is a characteristic of anthropological media research’, she writes, ‘that it considers media in wider contexts’ (Tacchi 2006). Drawing on extensive fieldwork in the area of ICTs for development, Tacchi argues that the communicative ecology framework is useful insofar as it focuses attention not just on more immediate communication-related aspects of the contexts in which people operate but also on the ways that they are ‘in turn imbricated in other structural, social, economic and cultural contexts’ (Tacchi 2006).\textsuperscript{2}

The issues Tacchi raises resonate with arguments developed within human geography around the notion of ‘relational’ place. According to a relational way of
thinking, place is a process—something that is produced. A place can be understood as a bounded but open and contested site, a complex product of competing discourses, ever-shifting social relations, and internal (as well as external) events (Malpas 1999). In other words, any given ‘place’ is ‘dependent upon the interconnectedness of the elements within it—as it is also dependent on its interconnection with other places’ (Malpas 1999, p. 39). Place is imagined as ‘articulated moments in networks of social relations and understandings’, albeit which carry implications far beyond ‘what we happen to define for that moment as the place itself’ (Massey 1994, p. 154). Such a perspective emphasises the importance of thinking place through, and in relation to, what Doreen Massey terms a ‘politics of connectivity’. As Massey explains:

A relational politics of place, then, involves both the inevitable negotiations presented by throwntogetherness and a politics of the terms of openness and closure. But a global sense of places evokes another geography of politics too: their construction. It raises the question of a politics of connectivity.

(Massey 2005, p. 181)

While Massey refers to connectivity in a number of different senses here (see Massey 2005, p. 181ff), one of these senses includes networked information and communications technologies, the infrastructure that supports them, and the role that they play in the construction of a relational politics of the home, the suburb and the nation.

This approach has a long and rich history within media and communications scholarship (see Heise [2002] and Strate [2004]), and has also emerged from and been influential in studies of media histories and successive waves of technical innovation adopted into home life, including family television viewing (Spigel 1992), home-based computer adoption and use (Lally 2002), media rich ‘bedroom culture’ and multiple screen households (Livingstone 2009), shifts in wireless devices and living, and the ‘domestication of elsewhere’ through personalised electronic media (Morley 2003).

The approach also extends a rich tradition of media homes research, and empirical approaches that trace how the uses and experiences of innovations in technologies within the home are adopted and accommodated into routines and environments (for example, Silverstone & Hirsch 1992). Theories of ‘domestication’, for example, develop a more integrated perspective that is not limited to individual people or products, but accounts for the situated and dynamic processes of technology appropriation in the context of family life.

**Methods**

To understand the evolving wider and more immediate dynamics of this emerging media ecology from the national infrastructure down through the local geography and to the household, the study used mixed methods and a longitudinal approach. We recruited households in Brunswick—an inner Melbourne suburb in Victoria, Australia, and NBN early release site—including homes with an NBN connection and those without. There were 2600 homes contained within the Brunswick early release rollout area. Of these, the study initially surveyed 282 households in late 2011, followed by qualitative interviews with a smaller sample of 20 households in mid-2012. To capture something of the dynamics of the ecology through time, a second follow-up survey
was conducted in late 2012 with a subset of 102 households from the initial survey respondents (for a detailed explanation of the methods see Nansen, Arnold, Wilken & Gibbs 2013).

The NBN and the national media ecology

The idea for a national Australian broadband network emerged during the Howard Government era (1996–2007) through the work of the Government’s Broadband Advisory Group (BAG). In a 2003 report, BAG recommended that the Federal Government assemble industry and state governments to reshape Australia’s media environment through the construction of a high-speed broadband network (Broadband Advisory Group [BAG] 2003). At the time, Australia’s media environment was, as always, in dynamic flux. By 2005, Australians in their millions were reshaping the ecology from the ‘bottom-up’ by appropriating social networking, peer-to-peer file sharing and other bandwidth-intensive applications, with a flow-through effect to Telstra, the nation’s largest telecommunication provider, who announced a plan to meet increasing bandwidth demand by replacing its copper network with a fibre optic network (Maiden 2005). The dominant telco, fibre optic cable, and Web 2.0 users, were thus negotiating the conditions of an intermediated relationship in which the relative position of each within the media environment would be strengthened. The Australian Competition and Consumer Commission (ACCC) was prevailed upon to take the view that a Telstra owned fibre network would produce an ecological monoculture in which other media players could not compete, and would survive only on Telstra’s terms. The ACCC agreed with this view and as a consequence the plan was never enacted.

Telstra’s withdrawal left a national broadband network vacuum, and, in 2009, after much negotiation, the Federal Labor Government (2007–2013) announced their intention to terraform the national media environment, thereby dramatically disrupting media ecologies at all levels (domestic, local, and national), and in all places. The Federal Government would use the power of the State (financial capacity, legislative power, national reach, and electoral legitimacy) to build a wholesale, open-access national broadband network to deliver high-speed broadband to all homes and businesses in Australia (Conroy 2009). The government decided to fund the construction of a fibre-to-the-premises (FttP) network that would deliver speeds of 100 Mbps downstream and 40 Mbps upstream (with the capacity to be upgraded to 1 Gbps/400 Mbps) to 93% of the population at a total projected cost of AU$44.1 billion (NBN Co Limited 2012). This plan was the largest engineering and public infrastructure project in Australia’s history, laying 200,000km of fibre optic cable to the doors of 93% of Australian premises. For the remaining 7% of Australians who live in remote rural areas, or in towns of fewer than 1000 households, wireless and satellite connections would deliver speeds of at least 25/12 Mbps (NBN Co Limited 2013). Together, these technologies would provide a common platform of universal and ubiquitous broadband across the whole of the Australian media environment, with significant implications for the media ecologies of households, schools, medical practices, government agencies, industries, and all other denizens of the digital environment.

Here is a classic case of confidence in the power of materiality. If, as Latour (1991) says, ‘technology is society made durable’, the Federal government’s intention was to
use the agency of fibre optic cable to make a particular kind of society, a socioeconomic and cultural environment, shaped by its new media ecology. This new society and its defining media ecology is at best only roughly sketched out, but is well enough known as the ‘knowledge based society’, the ‘network society’, the ‘information society’, the ‘digital economy’, and so forth.

The NBN Co, a government-owned company set up by the Federal Government in 2009, was thereby delegated the task of installing and operating the network as a wholesale monopoly, selling a tiered range of broadband products to retail service providers, who in turn would offer products to consumers (NBN Co Limited 2010a). The Australian Government negotiated an AU$11 billion deal with Telstra, itself once a government-owned telecommunications monopoly, to decommission the company’s extensive but ageing copper network. NBN Co would utilise its conduits for fibre, and Telstra would separate its retail and wholesale arms to allow it to transfer customers to the new NBN. This assemblage of a limited number of powerful elements, each with a clear relation to the others, was figured to provide the best chance of a successful interposition on a national scale. Once the interposition of fibre was completed (estimated to be June 2021), things could be permitted to get messy. The Government would sell its stake in NBN Co and privatisethe company. The monopoly would have served its purpose as a national terraforma, and fluidity of elements and interrelations in the new environment would be encouraged, eventually stabilising in a new ecological equilibrium.

As described above, and as others have noted (see Dias 2012), this plan for a national broadband network differed from the approach taken to infrastructure investment in many developed economies around the world. Australia’s national media ecology was to be actively and radically disrupted by the State, ready and willing to act to introduce and interconnect new and powerful elements, to realign relationships, and to create a state of dynamic fluidity, albeit without a clearly defined stable end point. This environmental and subsequent ecological transformation was almost entirely funded through public finances, and its reach was maximised in the provision of material elements (fibre, satellite, or wireless) as common goods, not differentially according to capacity to pay, but as a communications infrastructure, available at standard wholesale costs and guaranteed minimum performance rates to every household in every street in every town. In making this decision the Labor Government was leveraging the ‘network effect’, whereby the value of the network increases as the number of users increases. Anticipated productivity gains associated with the broadband capacity and data transfer speeds of the NBN clearly rely upon delivery and take-up by manufacturing and service industries, by people and organisations in rural and remote areas, and by public institutions such as hospitals and schools.

In April 2013, the then opposition party in Australia, the Liberal/National Coalition, announced their alternative policy to the Federal Labor Government’s plan to deliver FttP to most of the population by 2021. The Coalition’s plan—dubbed ‘Fast. Affordable. Sooner.’—also aimed to transform the environment by interposing a national broadband network similar in some respects to the Federal Labor Government’s. Key differences in the Coalition’s policy included providing a mainly fibre-to-the-node (FttN) network rather than an FttP network, with the last mile of the network utilising the existing copper network; and a projected completion date of
2019, sooner than the NBN’s previous projected completion date of June 2021. The Coalition’s arrangement was also projected to cost less, at AU$29.5 billion, although long-term costs of FttN have been argued to exceed the cost of FttP (Tucker 2013). The then Federal Opposition thus proposed to interpose an arrangement of elements (legislation, money, fibre, nodes, copper, users) that was different to the Labor Government’s elements (legislation, money, fibre, users), with a concomitant change in environmental and thus ecological impact. The Coalition was elected to govern in the 2013 federal election, and, at the time of writing this article, specific plans to proceed with the amended broadband policy were emerging. It is claimed this arrangement of elements will deliver speeds of between 25 and 100 Mbps for all users of the network by the end of 2016; and speeds of 50 to 100 Mbps for the 90% of homes connected to the mainly FttN network by 2019 (Liberal Party of Australia 2013).

An implication of the interposition of the new Government’s elements is that the environment will, for the short term at least, be patchier or more diverse than would be the case as a consequence of the Labor Party’s plan. Under the new Government’s arrangements the FttP component of the NBN will be scaled back to the 22% of premises in areas already being serviced by NBN Co, to new housing premises, and to areas where the copper is too degraded to deliver 25Mbps speeds. Therefore, 71% of homes and business will be connected to FttN by upgrading the already existing copper network, while the fixed wireless and satellite components of the NBN for the last 7% of premises will remain the same as in the previous policy. In addition, homes on the FttN network that can already access speeds of at least 25Mbps on the Coalition’s planned network will be able to upgrade to a complete fibre connection (or FttP) if they are willing to pay for the cost themselves (Liberal Party of Australia 2013). A patchy media environment that varies materially from house to house, from suburb to suburb, from city to country, will no doubt give rise to differentiated media ecologies, some of which will be richer, more productive and more robust than others.

In this period of broadband policy transition, much is uncertain about just what new elements will be introduced and what interactions and relations will be encouraged or discouraged. Also rendered uncertain (and necessarily so), are the specific goals of this massive media ecology intervention.

Quite understandably, the NBN’s projected impact on public and private services, economic productivity and social life in Australia remains unclear in the public mind and is still subject to debate (Burns & McGrail 2012; Dias 2012). While there has been much rhetoric using the sweeping terms of transformation of the economic and social landscape of Australia at the ‘macro’ scale, less attention has been paid to its impact on the ‘micro’ level, in relation to the individuals and families who will appropriate and assemble their own arrangements of interacting media elements in their own domestic media ecologies.

The NBN and the Brunswick media ecology

Brunswick was selected as one of the five mainland first-release sites. First-release sites were selected so as to test and bed down a number of physical and consumer design and installation factors in different geographic locations prior to the network rolling out nationally. These factors included terrain, housing type and density, demographics, climate, and existing infrastructure. Brunswick was regarded as a
representative location for testing design and construction techniques in an inner suburban area, where much older communications infrastructure must be negotiated (NBN Co 2010b). The heritage Telstra conduits were decades old, were often hostile to the introduction of fibre optic cable, and many needed to be re-bored and replaced. Like most Victorian era suburbs, the footpaths and roads are crisscrossed with pipes and cables of all kinds, many decommissioned, some not, and many not accurately surveyed. The challenges posed by the material environment in Brunswick were therefore formidable.

The rollout in Brunswick took place in stages: installation of the fibre optic cable through the streets; connecting the fibre optic cable to the outside of private properties using a Premises Connection Device (PCD); fitting a Network Termination Device (NTD) on the inside of the house; and, finally, activating a retail plan with an internet service provider (ISP) and/or retail media provider on the fibre network. Preparation for the rollout in Brunswick began in 2010, and work laying cable and connecting homes proceeded through 2011, with retail services from ISPs slowly made available to households in late 2011 and early 2012.

As a first-release site, the Brunswick rollout was predominantly a technical trial of installation processes and protocols that might be deployed by the NBN Co to alter the physical environment inhabited by the materiality of media. However, in the context of the political debate on demand for high-speed broadband, and rates of uptake, the first-release site rollouts were interpreted more broadly in the media as a trial of demand for, and thus expected success of, the NBN itself. In the terms used in this paper, it was suggested that a change in the environment did not necessarily result in a change in the ecology; that the presence of fibre in the environment did not and would not result in significant change in the dynamics of media consumption and production. Conditions clearly differ from neighbourhood to neighbourhood. In some environments, the NBN created conditions that disturbed the ecology to a point where it shifted to a new equilibrium—a new norm in which use of fibre was central, for example in Willunga, South Australia (Gregg & Wilson 2011). In others, Brunswick being one, the newly introduced element was met with resistance, and the existing media ecosystem by and large maintained its stability.

Brunswick is a culturally and linguistically diverse community, where university students, young professionals and young families gradually replace post-war migrant households, due to amenities such as proximity to the Melbourne CBD and ease of access to employment and education. Brunswick is populated by a higher proportion of residents born overseas (39%) and residents from non-English speaking backgrounds (36%) compared with the Victorian average (Australian Bureau of Statistics [ABS] 2012). Brunswick also has a significantly larger proportion of group or shared households (14%) compared to family households, and a larger proportion of residents who rent their homes (46%) rather than own their homes. The Victorian average is 4% and 27% respectively (ABS 2012).

Cultural and linguistic diversity, lower home ownership rates and varied composition types of households in Brunswick would not seem to constitute an environment in which the NBN might flourish and in which an NBN-based ecology might stabilise as the norm. We discuss why this might be so in the following section. But first, it might be noted that it is no simple matter to determine whether or not any given household and the NBN are in fact connected. Of those who were not receiving
NBN-enabled services 13% had the NBN PCD equipment installed on the outside of the house, but had not activated the NBN with a high-speed broadband service. A further 15% had the NBN PCD equipment installed, had the NTD installed on the inside of the house, but had no connection between the NTD and the modem because cable had not been laid inside the house or they were in the process of organising a high-speed broadband service with an ISP. Another 5% had the NBN PCD equipment installed, but were unable to get NBN-enabled high-speed broadband services with their ISP because they were either locked into a contract or their provider did not offer NBN-enabled high-speed broadband plans. A further 6% said they had not been contacted by NBN Co (see Figure 1).

So, if we take PCD connection to mean connection to the NBN, only around 50% of our Brunswick respondents were connected, which is considerably lower than other first-release sites with PCD connection rates between 80% and 90%. It is necessary, however, to assert the complicated interrelation of elements that make up ‘an NBN connection’. What is evident here is that it is not a simple binary in which two elements (household, NBN) are in two possible states (connected, not connected). The elements that need to be assembled in relation to each other include the cable in the street, the PCD, the household and the ISP plan. High-speed broadband functionality—the performance of the new domestic media ecology—requires these four (and more) to be conjoined and to work harmoniously, and in Brunswick this occurred less frequently than in other environments. We suggest that this can be explained by three ecological factors.

The first factor is time; the installation of the NBN and the instigation of a whole new set of material and immaterial interrelationships that hang off the NBN, form a
process, not an event. To begin this process, communication must occur between the NBN and the household. The NBN Co addressed this through a letterbox drop of forms, some of which were mislaid or misunderstood, though most residents did get the form, and many did complete it, which began a process that extended in some cases for months. At the time of our first observations, some households were ‘connected’ to the NBN through agreements and contracts but were ‘unconnected’ through the PCD while waiting for technicians to make the material changes required. Others were connected materially to the cable through the PCD, but were waiting for their current ISP to release NBN pricing plans, or were waiting for their current internet contract to expire. These time- and process-related issues were exacerbated by installation arrangements that involved more than an arrangement between two elements (the household and the NBN Co). Households needed to engage and negotiate with multiple contractors and companies over a period of weeks and sometimes months, in a process that included signing a consent form from NBN Co, making arrangements with subcontractors to install external and internal NBN equipment, and negotiating with an ISP to establish a retail plan and connect to the NBN equipment.

The second factor, or group of factors, stems from the constitution of the households to which the NBN was to connect. At the time of our research, the NBN PCD installation process required the owner of the property, not the residents of the property, to sign a consent form granting access rights to their property, and agreement to install the external PCD and then the internal NTD. As 46% of Brunswick households rent their premises, a policy that blocked direct interaction between residents and the NBN and interposed the landlord as a third element whose active cooperation was required was clearly troublesome. Unsurprisingly, this reverse-salient (Hughes 1987) was recognised and taken up by the NBN Co, who prevailed upon the Government to use the power of the State to eliminate the landlord from the process. So far as this aspect of the functioning ecology is concerned, the landlord is now extinct.

However, the high proportion of rental households still has live implications for the functioning of the Brunswick ecosystem. Comparisons between internet connection type and home ownership show that households that take up the NBN are much more likely to own their home (63%), and rental properties less so. An important reason for this is no doubt related to income; home ownership is related to higher income and higher income is related to NBN uptake. However, another factor is that rental households are more likely to be shared households (as compared to single family households). While single-family home-ownership households provide a convivial social environment for the NBN, shared households have a preference for wireless connectivity using smartphones and laptops equipped with broadband dongles (each of which facilitates independent billing). So, the social environment that exists within the household shapes a domestic media ecology, which interfaces with the ecosystem that lies outside the house, and different household arrangements are associated with assembling different elements in different ways to satisfy different motivations and avoid different obstacles.

The third factor, or group of factors, relates to our informants’ grasp of just what the NBN is all about. Motivation is required if one element in an ecosystem is to actively seek out another, or if one element is to allow another to approach, and still more
motivation is required if they are to interrelate in an ongoing way. For this to occur, meaning and value must be grasped. In contrast to seeing a value proposition in connecting to the NBN, our respondents frequently reported that they were not interested because they didn’t really know what it was. In particular, there was considerable confusion about the NBN Co as a wholesale infrastructure provider, as compared to a retail ISP, and people would express disinterest in the NBN because they were ‘quite happy with their current ISP’.

In the context of these difficulties it is important to bear in mind that the NBN Co is not working with a blank canvas. Household internet connection in Brunswick prior to the NBN did not seem to face significant local barriers, and non-NBN internet access in Brunswick maps closely to Victorian averages. Of all Victorian households 79% have internet access, and 91% of these connections are via broadband; of Brunswick households, 82% have internet access, and 90% of these connections are via broadband (ABS 2012). Brunswick was thus a vibrant, fully mature media ecology in a state of dynamic equilibrium. It takes a major interposition to knock such a system off its balance and to establish a new equilibrium around a different point of circulation. In the context of a take-up rate of around 50%, the NBN Co might regard its intervention as successful.

We turn now from the ecology of the Brunswick neighbourhood to the ecologies we find within Brunswick households.

The NBN and the household media ecology

The media ecologies of Australian homes are complex and continually evolving. The trend towards the accumulation of devices, screens and media access in Australian homes is well documented (ABS 2012; Australian Communications and Media Authority [ACMA] 2007, 2011). According to Australian ISP iiNet, Australian household downloads have increased by 19,000% in the last 10 years, and iiNet anticipates uploads per household to increase by 600% from 2010 to 2015 (iiNet 2012, p. 13). The media ecologies of Australian households are thus well connected to the global media ecology. Unsurprisingly, ACMA describe the household media ecology as technology rich, yet the interposition of NBN will severely disrupt this ecology, endangering some household elements and practices (for example, DVDs, wired telephone calls), and significantly benefitting others (for example, user-created content, video conferencing). Contemporary homes, then, are already media-saturated environments, as is Brunswick, and as is the nation. As these are sites of continual technological change, a study of their media ecology requires an approach that examines the domestic technological environment as a whole, and in relation to local and national ecologies. Everything is, of course, connected to everything else.

This ecological metaphor shifts the focus away from studies focusing on discrete, individual devices, applications and performances, to encompass systems of media and communications interaction. Radically faster connectivity available through high-speed broadband will undoubtedly have a significant impact on this ecology, and on the household’s use of telephones, television, video, gaming, social networking, government services, commercial consumption, media production, work practices, education, health services, and all manner of other performances and devices that are arranged in meaningful relations within and between households.
It is a banal but important truth that money is required in order to assemble elements (such as modems, tablets and video services), in order to express agency with and through these elements, and, thus, in order to shape an environment of devices and an ecology of performances and interrelations. It therefore comes as no surprise that comparisons between internet connection type and household income in Brunswick show that households that initially took up the NBN tended to earn more money than those who had ADSL broadband connections, with 52% of NBN adopters having an annual household income greater than AUD$100,000 per annum, compared to 33% of ADSL and 39% of wireless connected households.

So, the more money available to the household to populate its media environment and build its ecology, the more likely the NBN is to be part of that ecology, and when the NBN is part of that ecology, the more money the ecology is likely to cost the household. But even so, the quantitative data suggests that appropriating the NBN does not necessarily increase the total cost of running the household media ecology. Instead, for half of the households in this study, the NBN had no real impact on costs. The key factor here was the elimination of the landline telephone and its associated service charges, the elimination of the copper landline itself and its associated line rental charges, and the substitution of a bundled Voice over Internet Protocol (VoIP) service in which the cost of voice calls are bundled up with internet services in a single plan. A domestic media environment in which landline telephones are eliminated is a cost-effective reconfiguration, and the dynamics of this are establishing a new domestic equilibrium.

Overall, our survey data of the hardware environments of households showed that there are more mobile phones than landline phones per household, and more laptops per household than desktop computers. This pattern of household device appropriation remains fairly consistent regardless of broadband modes, with laptop computers and mobile phones much more popular than other media and communication devices (see Figure 2). Such ‘household device’ data supports previous research showing that overall, the number of household desktop computers are declining, while the number of alternative devices to access the internet in the home—notebooks and laptops, tablets, smart phones—are proliferating (ACMA 2011). Similarly, the data supports evidence that fixed-line phones are steadily being replaced or substituted for alternative kinds of telephony—mobile or VoIP. This change in the material environment will no doubt be associated with a change in the performed ecology. Households today are less likely to arrange devices in fixed locations (the computer in the study, the telephone in the hall) and household members are much more likely to roam through the house taking a media device with them as needed. This change in the domestic media ecology in turn has implications for changes in the dynamics of other domestic performances. An ecology that facilitates roaming enables a media device to interpose itself as a presence at the dinner table for example, or in the bedroom, thus disrupting performances in those spaces, and establishing new social and cultural equilibriums.

A key function of a domestic internet connection, whether NBN, ADSL or wireless, is to integrate the domestic media ecology and the local, national and global media ecologies, resulting in a mutual reshaping of all media ecologies. One effect that may be expected in the domestic media environment featuring the NBN is a change in the media elements that inhabit that environment. A total of 30% of Brunswick
households that had taken up NBN plans reported that this mode of broader or faster integration had either increased the number of devices connected to the national and global ecosystem either “somewhat” or “a lot”, compared to 21% of households that had appropriated ADSL. The difference made by this single new element is significant to the domestic ecology in enabling the roaming described above and opening the entire architecture of the home to be populated by the household’s media ecology.

![Figure 2: Average number of media and communication devices per household by broadband type](image)

The increasing dominance of media ecologies characterised by roaming was reinforced by the device most often used to access the internet from home—it was clear that laptop computers were the most common way to access the internet, regardless of household broadband connection. Nevertheless, there were some comparative differences between wired and wireless ecologies. For example, desktop computers were the second most common device used to access the internet in NBN and ADSL households, but in wireless homes desktop internet access was much less pronounced in 2011 (7%) and, by 2012 (0%), had been supplanted by the proportion of households using mobile phones (18%) or tablets (14%) as the primary device to access the internet from home (see Figure 3). There is no technical problem that prevents a desktop computer from functioning well in a wireless environment, but the desktop has not been able to survive, apparently because it not able to roam the environment.

Trends in the types of devices people use to access the internet, the move to mobile roaming, and the steady expansion of the media ecology to occupy more of the home’s architecture were clear in our research. Yet, our observations on the manner in which the domestic media ecology colonised the architecture of the home differed from others. Ewing and Thomas (2012) found that nearly half of those accessing the internet
at home were doing so in a room designated as a study, suggesting, they argue, a strong relationship between household computers, internet use and the home office. They did find, however, signs that internet access is beginning to move more towards entertainment and related uses with a slight decrease in study access and a small increase in bedroom, living room, and lounge room access. Our research, however, suggests that this trend is now well underway.

Figure 3: Comparison between Internet type and most common device for accessing the Internet in 2011 and 2012

We found that the living room was by far the most popular place from which to access the internet. After the living room follows the study, the bedroom, and then the kitchen, and the dining room. This diversity of domestic places colonised by internet media signals a decline in specialised, dedicated, internet-friendly environments, and suggests a mutual adaptation of the domestic environment and the domestic media ecology such that each is convivally appropriated by the other. So, the living room comfortably accommodates the internet as a mode of ‘living’, and the internet occupies the living room as a place for browsing, watching YouTube and so forth. The environment and the ecology are thus mutually adaptive as the shift occurs from media that are singular, wired and fixed, to media that are multiple, wireless and mobile.

As one might expect, wireless environments were found to be leading the way in colonising the home’s architecture. Ecologies in wireless environments were comparatively less likely to occupy the study or office, and more likely to occupy the bedroom to access the internet. This pattern became clearer over time, with only 14% of wireless homes reporting the office or study as the key point of contact with the internet, and 32% reporting the bedroom. Interestingly, bedroom internet access rose among all types of broadband households across the period of the research, perhaps reflecting a cultural move from communal use of media communications in shared, common spaces within the household, to distributed and individualised use in private spaces—indicated by the existence of multiple screens and devices in multiple rooms (see Figure 4).

The steady encroachment of the internet from its beachhead in the study, to living room, and then on to the bedroom, may be associated with changes in media content.
As time goes by, as music and video shift to internet delivery, it becomes more and more likely that the internet is mediating a form of entertainment, rather than a form of work, and the place in the domestic environment for this media consumption shifts accordingly. It may also be that the aforementioned trend to use wireless affordances and to roam through the space of the house with internet-connected devices breaks down any preconception that ‘work is for the study’ not for the lounge or the bedroom, particularly in shared households where bedrooms are often multifunctional spaces.

![Figure 4: Comparison between Internet type and most common room for accessing the Internet in 2011 and 2012.](image)

The relatively high number of non-family, shared households in Brunswick is another factor providing a convivial environment for the expansion of a wireless, roaming media ecology. Shared households are more likely than single family households to individualise rather than aggregate media consumption and production, and members are more likely to roam to private spaces to do this, rather than restricting themselves to special-purpose or communal places. Their substitution of desktop computers with laptops is more pronounced than is the case in single-family homes, as is their substitution of landline phones with mobile phones, and their use of bedrooms for internet access. The reader will of course be aware that all of these environmental and ecological elements (share houses, mobile devices, entertainment content, wireless modems, individualised places) are entangled in ways that circulate causality, rather than stretch out in a linear chain. An ecology is a web of interconnected flows, a rhizome, not a sequence of causes and effects.

This being the case, it is not surprising that many of our householders struggled with the complexity of terraforming their own domestic media environments in order to accommodate the NBN and nurture a new media ecology. The qualitative data reveals the challenges associated with device accumulation, functionality, interoperability and management. Points of difficulty in the domestic terraforming process included the needs to

- integrate new devices or services (for example, internet TV) into an established media environment (for example, DVD based)
• upgrade legacy equipment (such as the laptop) to support the enhanced capacities of new elements in the environment

• relocate the wireless modem to optimise its new interconnection to the NTD and at the same time maintain its interconnection to the many devices dependent upon the modem

• wire the NTD to the modem, often requiring internal architectural modifications—the most common being holes drilled in walls

• manage new and different accounts (most particularly, an NBN service plan) and service providers for NBN-enabled communications services.

All elements required maintenance to ensure they were interconnected and cooperating with one another, and that the domestic ecology as a whole was in a convivial relationship with the wider global media ecology.

Conclusions

The project to materially terraform the national media environment and thus establish significantly different conditions for the formation of media ecologies has been powered by the replacement of copper with fibre optics, however, nobody expects that this alone will be transformative. Australia’s domestic, local and national media ecologies will certainly be shaped by fibre in the environment, but also by the experience of the installation process, how the technology is understood, the perceived benefits of high-speed broadband, the quality of the internet service delivered by retail service providers, the costs and affordability of broadband internet service plans, how households use or anticipate using internet applications, and how broadband fits with—and affects—the existing household communications environment. Thus, the consumer experience of high-speed broadband is, in this sense, an experience of living in changing media ecologies, not simply an experience of high-speed broadband. The rollout of the NBN and the possibilities afforded by high-speed broadband are contextualised by the increasingly busy arrangements of electronic media and communications devices, providers, services and applications in the home.

In this article, we have argued that media ecologies, broadly understood, provide a productive framework for making sense of these complicated, intertwined factors. As media theorist Matthew Fuller (2007, p. 2) writes, the term ‘ecology’ is useful in that ‘it is one of the most expressive [that] language currently has to indicate the massive and dynamic interrelation of processes and objects, beings and things, patterns and matter’. Emphasising the dynamic nature of these ecological interactions, Fuller (2007, p. 1) argues that ‘complex objects such as media systems’ should be understood as involving ‘processes embodied as objects, as elements in a composition’ which settle temporarily into what passes for a stable state’ before reforming and resettling, and so on, in a process that is ongoing. Finnish media theorist Jussi Parikka develops a similar line of argument to Fuller. Drawing on the work of Bruno Latour (2002), Parikka (2011) suggests that media and communications technologies ought to be understood as part of ‘an environment of relations in which time, space and agency emerge’. Thus, he argues, ICTs are ‘less a matter of mediation and communication between humans, than a milieu of engagement, or relationality for the objects, vectors, agencies and
processes that enter into its sphere’ (Parikka 2011). These insights into the dynamism and relationality of human and non-human actors within communicative ecological systems are helpful for making sense of the variety of factors and forces that have impacted on and shaped the rollout of the NBN in Australia, in the suburb of Brunswick, and in its households.

The specifically domestic appropriation of the NBN will undoubtedly have implications for the routines, practices and meanings of home life, just as the telephone, television, and computing technologies have in the past (Lally 2002; Marvin 1988; Spigel 1992). Yet, the take-up of high-speed broadband does not operate in isolation, but in these existing and wider contexts of current communications technology use, as well as anticipated futures of internet applications. Investigating this ecological moment in the history of broadband developments is critical if scholars, policymakers and industries are to understand the emerging, evolving and shifting economic and cultural implications of communications infrastructure, services and uses. The ecologies of broadband appropriation in first-release suburbs such as Brunswick thus form a key site for mapping the present and possible future of innovation in broadband technology, and its social, geographic, economic, and other impacts.

Notes
1 To give a further example, Lance Strate (2004, p. 10) describes communications scholar James Carey’s interest in media ecology as motivated by a concern for ‘the preservation of community, which requires greater balance between time and space’.
2 This is a point that has also been made by earlier media ecology scholars. For instance, Lance Strate (2004, p. 9) notes how Harold Innis ‘points to the interrelationships between a variety of factors, including communication, language and culture, knowledge and education, transportation, time-keeping, political economy’, and so on, which all ‘interact to produce both unique historical circumstances and discernible historical patterns’.
3 NBN Co circumvented the necessity to get approval under an opt-in process by using powers available in the Telecommunications Act for telecommunications providers to enter residential properties to install equipment.

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