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Department of Infrastructure, Transport, Regional Development and Communications

Bureau of Infrastructure, Transport and Regional Economics

Experimental analysis of networked service provision and hierarchies

At a glance:

- Understanding the role of a given place in the network of human activity is critical when considering regional policies or local strategies. This paper applies a network lens to the spatial pattern of service provision in Australia.

- Service provision is a network of relationships between places. Service points in larger cities and towns also provide services to the residents of smaller population centres.

- This paper defines these relationships by placing services in a hierarchy based on a population threshold for a service to be provided. This approach is based on the observation that the population threshold reflects the underlying relationship between the cost structure of the service and demand.

- At a high level, the results show that service centres in Australia form a fully interconnected network.

- In a narrower, day-to-day sense, there are geographic limits to service markets and this reduces the interconnectedness of service centres.

- These regional service networks illustrate the need to consider the different roles of different places. While service hubs are vital in providing services, other places have important roles providing specialist services, or being places where people live, work or play.

Introduction

The purpose of this paper is to explore the idea that services form a network. This paper describes a way to consider the role of a given place in the network of human activity.

There are four key steps taken to create a network of service provision:

1. Create a geographical system that uses both population and service points to assist in analysing the spatial distribution of people and services in regional Australia – creation of 2,450 cities, towns and villages (CTVs).
2. For each service type, create the population catchment of a CTV based on its service point.
3. Form a service hierarchy that takes into account all the different service types.
4. Ordering CTVs based on this service hierarchy, with higher order services creating higher order CTVs.

This paper builds on previous work completed by BITRE, such as the construction of the CTV geography and the creation of service hierarchies. Hence, these steps are provided in an overview format.

Step 1 Defining Cities, Towns and Villages through service locations

The concentration of both population and services in cities, towns and villages across Australia means that these features of human geography are integral to understanding service locations. To assist in understanding the spatial distribution of services, BITRE has developed the Cities, Towns and Villages (CTV) geographical classification. This is based on the intersection of where people live (population centres) and where services are located (service centres). A CTV is a place identified as both a population centre and a service centre.

The advantage of using both population and services to define locations is that we are able to include towns and villages with very small populations that are not usually identified in statistical geography. Using this method, we have identified 2,450 CTVs across Australia. The process of classifying CTVs begins with the identification of service centres, using the point location of various identified services. These include health, education, postal, retail and some Australian Government services, which reflect the service location data collected by BITRE. A complete list of service types can be found in Table 2 of this paper, but the underlying analysis and details of how CTVs have been defined can be found in BITRE Information Sheet 96: *An introduction to where Australians live* (BITRE 2019).

In short, these CTVs are estimated to include around 96.5 per cent of the Australian population and have a range of sizes. A feature of this definition is that only 3.5 per cent of the population lives outside an identified CTV. This is lower than the ABS Urban Centres and Localities (UCL), which has 8.1 per cent of the population not placed with a defined boundary. The number of CTVs within population size category is summarised below in Table 1.

Table 1: Cumulative proportion of the total population living in CTVs by size, 2016

CTV population	Proportion of total population living in CTV of a given size	Cumulative Proportion	Number of CTVs
1 million or more	63.4%	63.4%	5
250,000 to 999,999	8.7%	72.1%	5
100,000 to 249,999	4.5%	76.6%	7
50,000 to 99,999	3.1%	79.7%	10
20,000 to 49,999	4.8%	84.5%	36
10,000 to 19,999	2.8%	87.3%	45
5,000 to 9,999	2.4%	89.7%	84
1,000 to 4,999	4.6%	94.3%	525
500 to 999	1.1%	95.4%	376
200 to 499	0.8%	96.2%	594
Less than 200	0.3%	96.5%	763
Not in a CTV	3.5%	100.0%	

Source: BITRE analysis of the Australian Population Grid 2016 (ABS 2017)

Step 2 Create catchment areas for each service type

The process for allocating population to service centres begins by generating simple catchment areas for each identified service based on the following assumptions:

- Those services within a service type (i.e. government public schools) are homogenous.
- That all else being equal, the further a person lives from a service the more difficult it is to access that service.
  - Therefore, consumers will access the nearest service.

This creates a catchment area that corresponds to the area closest to a given service.

In practice, these assumptions do not necessarily hold: services at different locations provide different offerings and catchment areas can overlap, as people may not choose the closest service. However, given the available information, these assumptions make defining catchment areas possible using limited information. Using the nearest service, or 'as the crow flies' distance, removes considerations like access to transport, transport mode and time of day. Again for more information about how these have been defined can be found in BITRE Information Sheet 96: *An introduction to where Australians live* (BITRE 2019).

As an illustration, Maps 1 and 2 present the catchment areas of primary and secondary schools. The lines delineate the point at which an area is equally distant from two providers. The polygons enclosed by the lines are the area closest (as the crow flies) to a single education provider located in the polygon. This is a visual way of demonstrating that the distance between secondary education providers, and thus the area which they service, is larger than it is for primary level providers. This means that many students have to travel further to access secondary education than primary education, a pattern clearest in the more populated south west corner and the east coast of Australia. In the north and centre of Australia, this difference is less obvious because both levels of education are predominantly provided through combined schools.

Map 1 Primary level estimated proximity based catchment areas
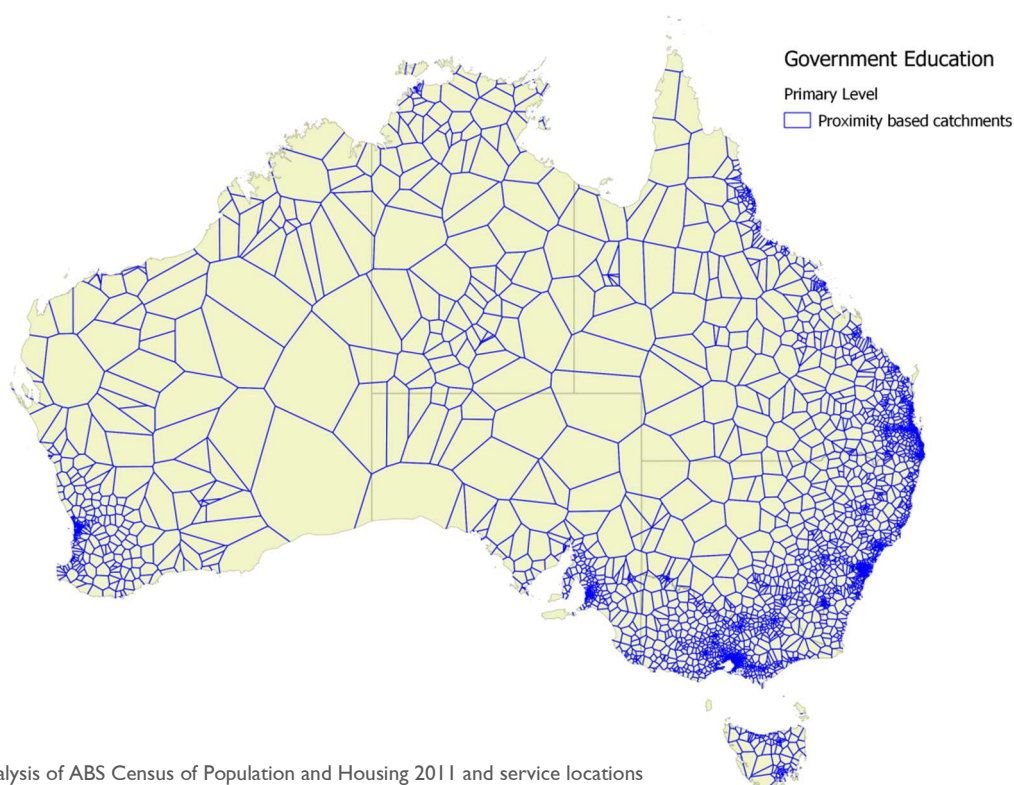
BITRE analysis of ABS Census of Population and Housing 2011 and service locations

Map 2: Secondary level estimated proximity based catchment areas
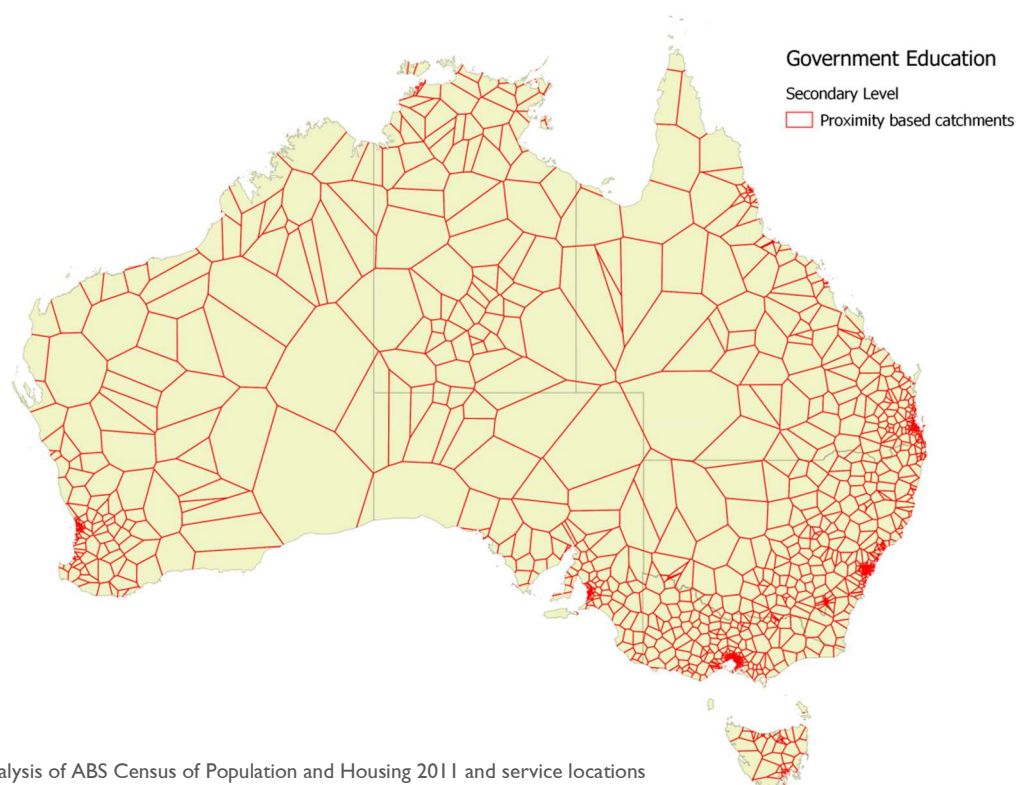
BITRE analysis of ABS Census of Population and Housing 2011 and service locations

Step 3 Hierarchies in service types

One of the most prevalent strategies for providing services to populations of different sizes is to change the bundle of services offered by each location supplying the service. This is the result of the relationship between cost and demand. On the cost side, in the presence of economies of scale at some level of production, services with higher total costs require a larger population to be viable. On the demand side, services for which we are willing to pay more or which have higher demand per head of population (i.e. are the least specialised), require lower populations to be viable (Thomson et al. 2019).

As a result of the tension between cost and demand, services offered tend to vary with the market's population (both size and characteristics). Higher cost or more specialised services require larger populations to support them, while lower cost or less specialised services are viable in locations with smaller populations. As a result, a common strategy to cope with varying populations is to vary the services available from a given location or service point. Two very good examples of this strategy are public hospitals and Australian Government services provided through Centrelink. Each of these service types provides a bundle of services that in part depends on the size of population of the market in which they operate.

Centrelink is part of the Department of Human Services and provides a range of government benefits, payments, pensions and support services. There are three levels of service:

- **Centrelink Customer Service Centres** are staffed by Australian Government public servants. They have the ability to review, assess or vary payments and ultimately make decisions about payments and services. These locations provide the highest level of service.

- **Centrelink Agents** are contracted by Centrelink to assist customers to access payments and services through online, phone or other channels. An agent is contracted to assist by certifying photocopies of identity documents, however the agent does not lodge documents on behalf of customers. They are also unable to make any payments or decisions about payments or review, assess or vary payments. These locations provide the second highest level of service.

- **Centrelink Access points** make available equipment to access Centrelink's online self-service options and display information about Centrelink payments and services. These locations provide the lowest level of service.

Public hospitals are grouped into peer groups assigned by the Australian Institute of Health and Welfare. In this paper, we use the 2012-13 peer group classification to order hospitals into a hierarchy of six categories, as shown below:

- **Principal Referral Hospitals** provide a very broad range of services, including very sophisticated services, and have very large patient volumes. Most include an intensive care unit, a cardiac surgery unit, a neurosurgery unit, an infectious diseases unit and a 24-hour emergency department.
- **Large Acute Hospitals** provide a wide range of services to a large number of patients. Most have an intensive care unit and a 24-hour emergency department. They are among the largest hospitals, but provide a narrower range of services than the Principal Referral group. They have a range of specialist units, potentially including bone marrow transplant, coronary care and oncology units.
- **Medium Acute Hospitals** usually have a 24-hour emergency department and perform elective surgery. They provide a narrower range of services than the Principal Referral and Large Acute groups. They have a range of specialist units, potentially including obstetrics, paediatrics, psychiatric and oncology units.
- **Small Hospitals with Surgery and/or Obstetrics** usually provide an obstetric unit, surgical services and some form of emergency facility. Generally smaller than the Medium Acute hospitals.
- **Small Hospitals** offer a smaller range of services than other public acute hospital groups. Hospitals in this group tend to have a greater proportion of non-acute patients compared with the larger acute public hospitals.
- **Very Small Hospitals** generally service fewer than 200 admitted patients each year.

Both of these services also have mobile service providers that do not have fixed catchment areas. In the case of Centrelink, mobile buses are also used, especially in response to disasters. The hospital system is integrated with the ambulance systems and flying doctor service, to bring care to patients and patients to care facilities.

As noted above, varying the level of service provided is a common strategy for adapting a service to changing populations, or in effect, changing levels of demand. This can be seen by comparing the explicit hierarchy of these two services through estimates of catchment populations. The population estimates shown below have been drawn from the BITRE Staff Paper *Population and access to local services* (Thomson et al. 2019).

Table 2 summarises all services of a given type across Australia and their corresponding catchment populations and overall order. The bottom 10th percentile of the market population provides an approximation of the population threshold without being influenced by extreme outliers. This is used to represent the population threshold of the minimum population required for a service to be present.[1] The Market Area Limit represents the geographic size of a market for a given service type, and is defined as the distance at which the resident population is no longer a statistically significant predictor of the number of services in a city, town or village.

In summary, the method is to define the geographical market of services of a given type, calculate the population in the market and divide this between the number of services in that market. The distribution of market populations per service point can then be examined to find the minimum, median or at the extreme population at which we observe a given service type.

For Centrelink services, the most comprehensive service, the Customer Service Centre, has the largest population threshold at 6,300 persons at the 10th percentile. Agents, which provide a lower level of service, have a threshold of 400, followed by Centrelink Access Points, which provide the lowest level of service, with a threshold of 300. In public hospitals, the 10th percentile population threshold is largest for Principal Referral hospitals, at 197,000 persons, and decreases as the level of services provided decrease to Very Small Public hospitals, at 1,300 persons.

The hierarchy in Centrelink and public hospitals is explicit, with each tier generally providing the services of the tier below as well as some higher order services. Other services also manifest different population

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[1] While this represents a simple descriptive statistic, the results correspond with other entry thresholds for the first firm derived through ordered probit regression in the manner of Dranove et al. 2003. For the sake of providing results for services with too few service points to estimate a catchment (and given the very similar results where this can be calculated) descriptive statistics have been used rather than modelled estimates.

thresholds, again depending on the relationship between cost and demand for each service. This does not form a hierarchy, as they are not overlapping service levels of the same service type and instead are entirely different types of services. However, while different, the population threshold is still able to rank the services in order of the relationship between costs and demand for the service. This ranking is described as the *order* of the service. For the services included in this study the order of the service, as manifest in the population threshold, is shown in Table 2.

It should be noted that these descriptive statistics are based on the observed distribution of services and population as it exists now, not an analysis of the fairness or efficiency of each service. As such, the statistics represent what is and should not be assumed to represent an outcome that is either necessarily equitable or efficient. For some services, this outcome is the result of market forces and firm strategy, while for many others it represents the complex decision making and trade-offs of government and not-for-profit providers.

Table 2 Experimental order of service

Service type	Estimated Entry Threshold, persons (10th Percentile of Market population per organisation)	Median Population	Market Area Limit (km)	Order
Centrelink - Access Point	300	3,800	63	1
Australia Post	300	3,300	52	2
Centrelink - Agent	400	8,300	49	3
Schools - Government Primary	400	3,600	26	4
Employment Services	1,000	7,400	82	5
Schools - Government Secondary	1,100	13,100	65	6
Public Hospitals - Very small	1,300	6,500	79	7
Aged Care - Home Care (Low)	1,400	13,200	57	8
Aged Care - Residential Care (Low)	2,300	8,800	32	9
Public Hospitals - Small	2,400	12,200	72	10
Aged Care - Residential Care (High)	2,700	9,700	67	11
Schools - Catholic Primary	3,600	15,400	42	12
Major Grocery Retailers	3,700	10,800	86	13
Schools - Independent Primary	4,200	16,800	87	14
Schools - Independent Secondary	5,000	21,900	86	15
Private Hospitals	5,300	31,600	61	16
Aged Care - Home Care (High)	6,200	27,000	31	17
Centrelink - Customer Service Centre	6,300	57,500	51	18
Public Hospitals - Small (with Surgery/Obstetrics)	8,300	36,700	58	19
Schools - Catholic Secondary	8,500	42,000	20	20
Schools - Government Special	17,000	52,800	35	21
Aged Care - Transition Care	23,100	158,300	44	22
Medicare	26,800	78,500	88	23
Schools - Independent Special	27,200	103,500	74	24
Schools - Catholic Special	29,400	291,100	69	25
Public Hospitals - Medium	47,600	157,900	72	26
Public Hospitals - Large	81,300	225,800	70	27
Public Hospitals - Principal Referral	197,000	589,200	61	28

Source: BITRE analysis (see Thomson et al. 2019).

Step 4 A hierarchy of Cities, Towns and Villages

From the order of service types, we can translate that to ordering the cities, towns and villages (CTVs) classification, due to the order of the services that are located in each service centre. The highest order service located in a CTV can be used to assign an order to the CTV. Unlike the order of service types, this is a hierarchy, because service centres with higher order services tend to provide all of the lower order services as well.

The population size (based on a catchment area) of a CTV is a good predictor of the level of service provision in that CTV. The exceptions are isolated or remote locations, which have a higher service level than expected based on population size. One of the most valuable insights we gain by defining the order of CTVs in a hierarchy is to observe the relationship with other CTVs.

In essence higher order CTVs supply services to their own populations and to the populations of the surrounding areas. This results in a network of service provision, where the network is directed by one CTV providing services to the population of another. Where more than one higher order CTV provides services to the population of a lower order CTV, the CTV providing the greater share of the population is deemed to have a higher order in the network.

These networks are then built for all CTVs in Australia, based on the 28 services included in this research. This network is shown in Figure 1, using the Fruchterman-Reingold force directed layout graph. This is a representation of the service provision network in Australia unconstrained by the geographic location of CTVs or the distance between where people live and their closest service.

Figure 1 draws the relationships between Australia's cities, towns and villages in a way, which is very different from the way that we see them on a geographic map. Each circle represents a CTV, with the size of the circle relating to population. The colour of the CTVs ranges from bright yellow for CTVs providing the highest services in the hierarchy, to dark red for locations providing only the lowest level of services in the hierarchy (see Table 2, which is ordered from lowest to highest order services). CTVs with the highest order services (Public Principal Referral hospitals) have been identified using the largest labels.

Selected smaller connecting CTVs have been identified using smaller labels. Each line represents an occasion where, for any service, the closest service point to the population of one CTV is located in another CTV. Because CTVs can be quite large it is possible for a CTV to have multiple relationships to other CTVs for any given service, as there may be multiple CTVs, which are closest to at least some of the population of that CTV.

No distance limit has been placed on the relationships shown in Figure 1, causing all CTVs to be interconnected. For services at the top of the hierarchy, there are situations like specialist medical treatment, where it seems appropriate not to impose any limits on how far people would travel.

Figure 1: Service network diagram
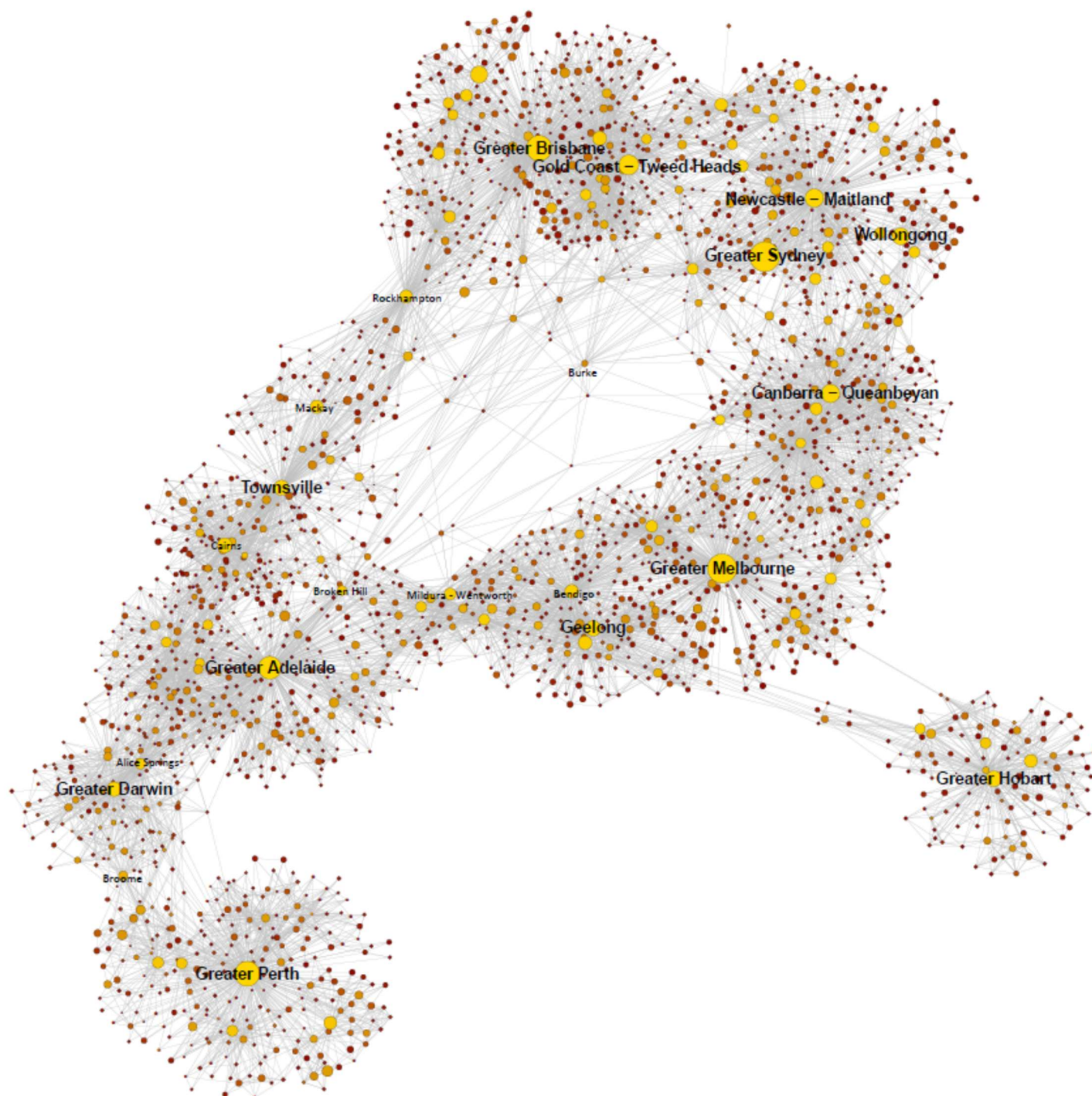
Source: BITRE analysis.

Drawing the relationships between CTVs as a network very clearly shows how CTVs with higher order services form the hub of clusters of other CTVs. The less connected clusters provide the clearest examples: Tasmania, which is centred on Greater Hobart; Western Australia, which is centred around Greater Perth; the Northern Territory, which is centred around Greater Darwin; and South Australia, which is centred around Greater Adelaide. The density of the population of the east coast makes it more difficult to see this pattern; however it is possible to make out hubs around Melbourne and Canberra-Queanbeyan. Brisbane and the Gold Coast-Tweed Heads are highly interconnected, as are Greater Sydney, Wollongong and Newcastle-Maitland.

Figure 1 also highlights the interconnections between population centres in Australia and provides some evidence for central place theory, an overview of which is provided in Box 1. Smaller centres are linked to larger centres for higher order services. The service links between rural and regional areas and regional cities, as well as regional cities and major cities are clearly shown. Also shown is the often forgotten direct link between small regional and rural centres and major cities for the highest tier services. Figure 2 below shows a simple example of these relationships using two hierarchical orders. Higher order levels of services are provided by the larger centre – as they are not present in small locations. Lower level service relationships are services provided by second tier locations to their surrounding catchment areas.

Figure 2: Stylised hubs in clusters
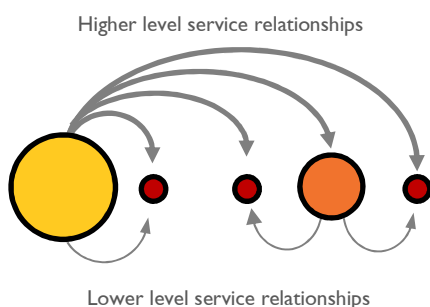
The hubs of each cluster are also connected to each other. These connections are due to relationships at lower orders of the hierarchy, as shown in Figure 3 below.

Figure 3: Stylised connections between hubs of different clusters
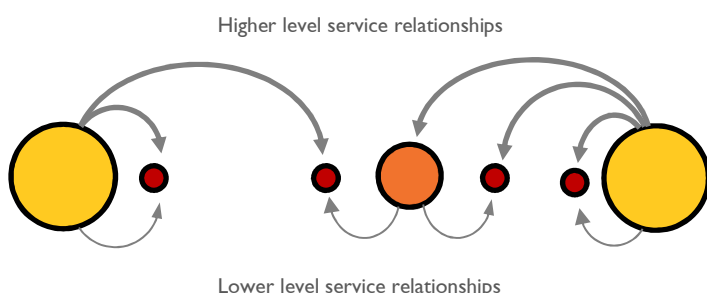
Box 1: Central place theory

Central place theory is one of the most developed theories of the spatial pattern of commercial activities (Eppli and Benjamin 1994). The theory originated in the geographer Walter Christaller's (1933) work, which attempted to determine 'the number, sizes and distribution' of *central places* (Christaller 1933 trans. Baskin 1966).

Central place theory provides a simple framework for describing how towns and cities of different sizes are spatially distributed, and correspondingly, where higher order goods and services are available. Higher order goods and services require a higher level of demand before they become available for sale, and are therefore found in larger centres (Brown 1993). For instance, new cars are higher order goods, while groceries are lower order goods, and so while the former are found only in more populous centres, the latter are more widely distributed.

The premise of central place theory is that each good or service has a 'range'; that is, the maximum distance consumers will travel to buy the item. People are willing to travel further to buy higher order goods or services, so these have greater ranges. However, the demand for a good or service within its range is not consistent; consumption lessens with increasing distance, reflecting transport costs.

Christaller reasoned that if a person has a certain budget for a good or service, then the more money they use to travel to the item, the less is left for the purchase, and the less frequently they can buy it. This concept of 'distance decay' has implications for service delivery, due to a reduction in use with increasing distance from the service (Pugh and Cheers 2010). In addition to having larger populations and higher order goods and services, central places also service surrounding areas.

There are several variations of the model: a marketing principle (focused on goods and services access, where the central place serves two other lower-order places), a transportation model (minimising network length, where three lower-order places are served) and an administrative model (where six lower-order places are served) (Agarwal 2001). A visual representation of the marketing principle model, which is the most relevant to service provision, is provided below in Figure 4. In this figure each central place has six, equally spaced central places of the next smallest order surrounding it.

Figure 4: Central place theory (marketing principle)
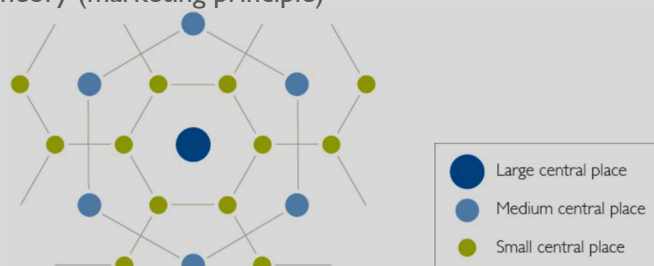
Source: Adapted from Christaller (1933).

While this provides a theory of how goods and services are provided from service centres, it stops short of explaining how the populations and distribution of cities, towns and villages arose in the first place. This issue is explored in depth in BITRE research report 136: *The evolution of Australian towns* (BITRE 2014).

Constrained network

At the broadest level, Australia is a fully interconnected network. However, in the narrower, day-to-day sense there are geographic limits to service markets. Large sections of Australia are still connected by overlapping service markets, particularly the east coast. However, when geographic constraints are imposed, we see many isolated clusters and lone service centres. Figure 5 shows the service relationships after a geographic limit has been imposed. The limit used is the Market Area Limit (in kilometres as the crow flies) for each service type, as shown in Table 2. As described earlier, the Market Area Limit is an econometric estimate of the distance from which a population is not a significant predictor of the number of service providers in a service centre (Thomson et al. 2019). The CTVs are plotted according to their geographic location (using their service point weighted centroid).

There is a continuous network (of the kind described in Figure 3) running from the Western Australia - South Australia border along the southeast of Australia and up the east coast to Port Douglas in Northern Queensland. There are also some large isolated clusters, including southwest Western Australia (including Greater Perth), Tasmania and the Northern Territory around Greater Darwin. The centre and north of Australia are characterised by very small isolated clusters and isolated service centres.

A major change caused by imposing distance limits is the reduction in the number of direct links between the major cities and smaller rural and regional towns. Although there are important direct relationships for the highest order services, on a day-to-day basis we can see that smaller rural and regional towns are much more connected to regional service hubs.

Conceptually, the services provided by service centres form an interconnected network of service provision. Smaller towns are clustered around larger cities, which provide higher tier services. If we impose a distance limit we still see an interlinked network, however there are isolated clusters and service points. The network is built of overlapping markets rather than a 'hub and spoke' model.

Figure 5: Service network within market area limit
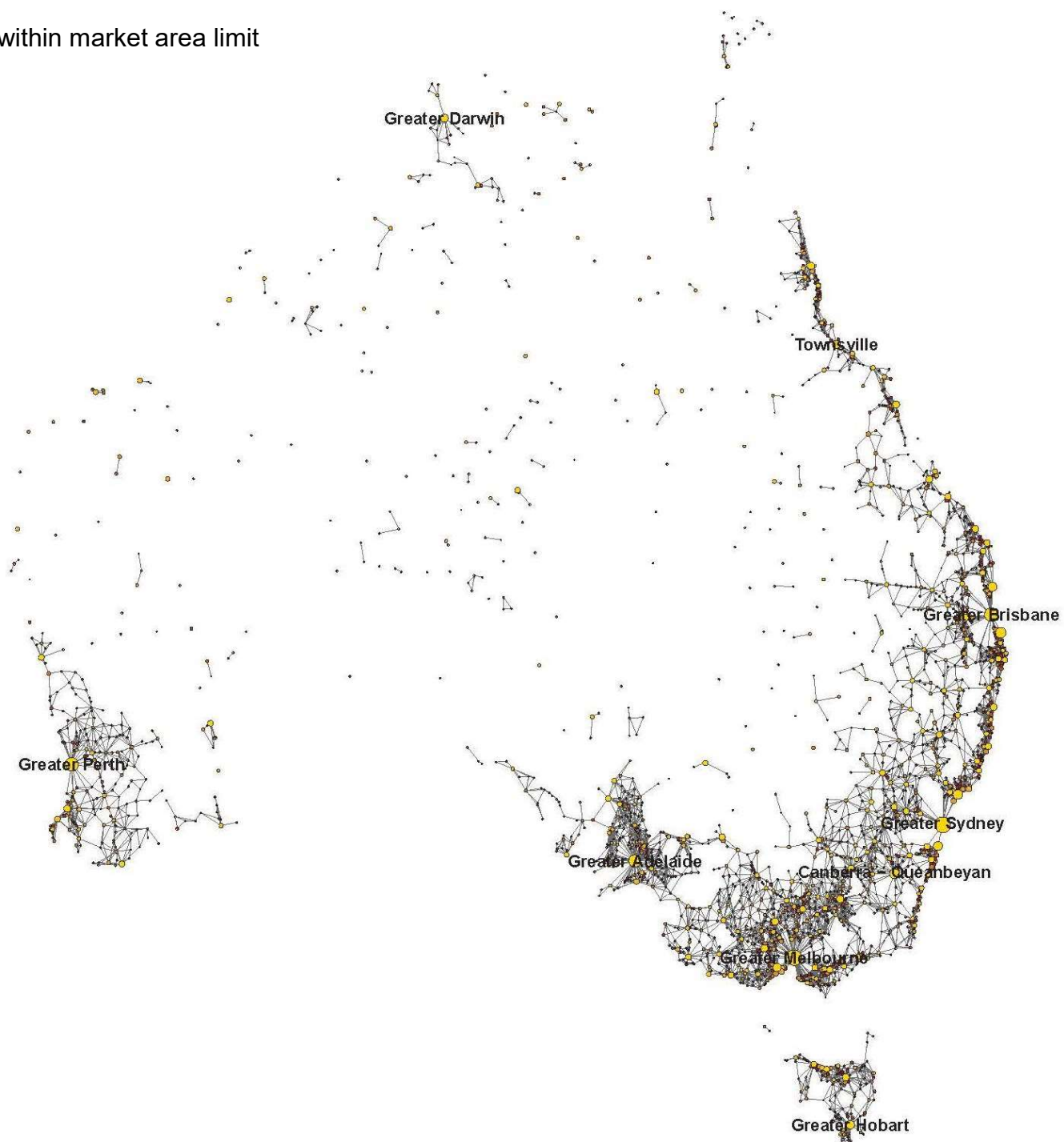
Source: BITRE analysis.

Sub-networks

One of the interesting consequences of removing relationships that are too distant to be realistic in a day-to-day sense is that it highlights the sub-networks around regional service hubs. Figure 6 (below) shows the local distance limited network around Townsville, based on geographic location. The arrows indicate that one service centre provides services to the population of another.

Figure 6: Townsville's local service network, geographic location
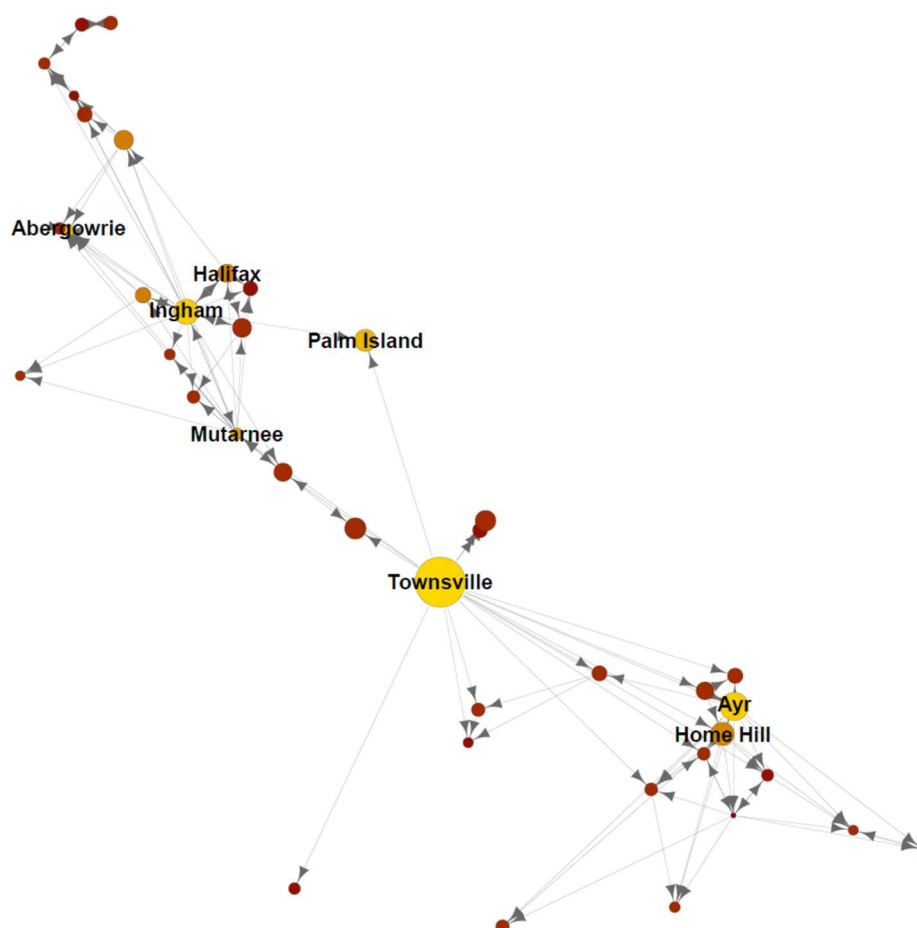
Source: BITRE analysis.

Figure 6 illustrates some of the complexity that exists in overlapping service markets, even at a local level. Townsville is clearly the central hub of this network; however, there are also other smaller regional service centres such as Ingham and Ayr. These relationships can be seen more clearly in Figure 7, which plots the service centres in terms of the highest order service located in each service centre.

Figure 7: Townsville's local service network, service order
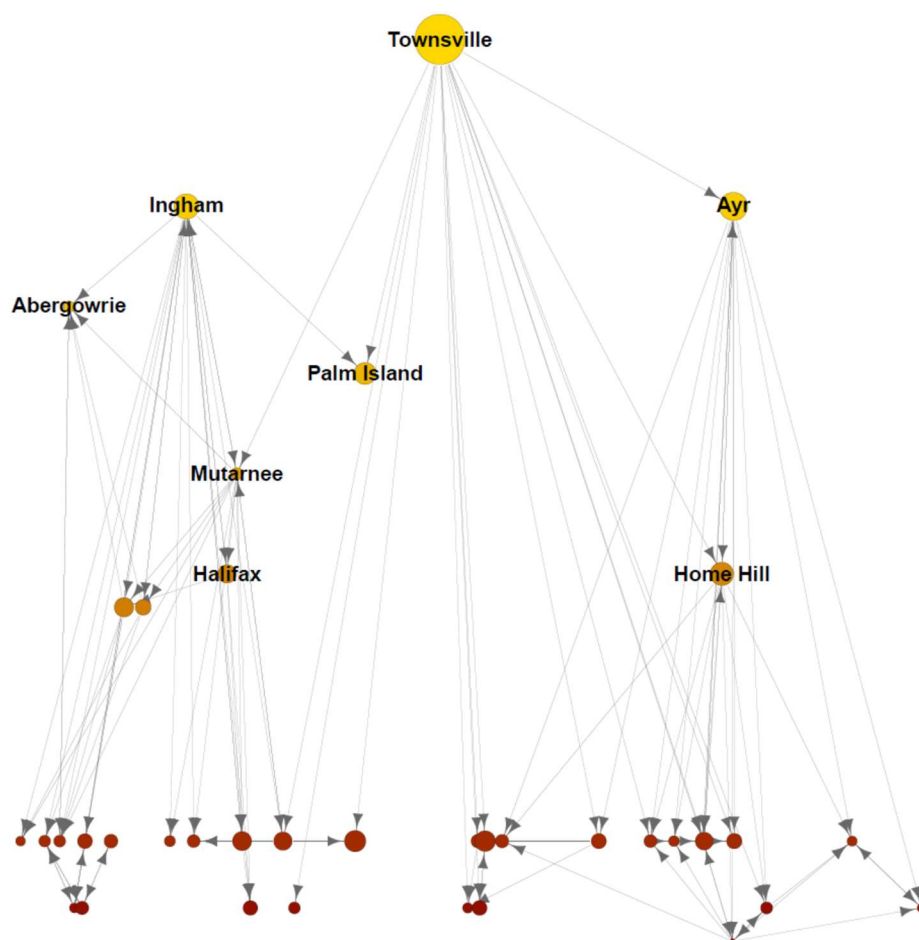
Source: BITRE analysis.

Ingham is too far from Townsville to be a significant population for the services located in Townsville; however, they are connected to the same network through relationships with intervening towns, such as Palm Island and Mutarnee. The relationship between Townsville and Ingham highlights the type of connection between hubs of different clusters that are caused by both towns having a relationship to a lower order service centre (Figure 3).

The view of the service network given by Figure 7 also shows evidence of the different service functions of different service centres. A clear indicator of a place having a specialised function are service relationships that go in both directions. For example, looking at the far left of the graph, Abergowrie is a very small town in which a Catholic secondary boy's school is located, along with a government primary school. Mutarnee is another very small town in which a government combined school and a community post office are located. Mutarnee offers services typical of a very small town, while Abergowrie in fact offers fewer services, but is home to a relatively high order education service. Although the range of services is extremely small, the role of Abergowrie in the network of service provision is as a place of education, due to it being the only provider of single sex Catholic education in the local region.

Cities, towns and villages have many functions, including places of work and production, places of residence, places of education and places of leisure. Visualising the network of services provided by different cities, towns and villages adds another layer of information on their role, illustrating the way in which they are places from which to access specific services or services of a given order.

One of the principal benefits of considering services from the perspective of an interconnected network is being able to see the differing roles of the cities, towns and villages in that network. Not every population centre needs to provide all services to all people. As with other specialised functions of place, some cities or towns are major regional service centres, like Townsville, or secondary regional centres, like Ingham and Ayr. Other locations provide fewer services, but are important in the network of human activity as places where

people live, work or play. This highlights the importance of considering regional connections, both in services and in other human activities. This network could be further extended by including services beyond the 28 included in this study, incorporating the road network and public transport, and testing whether the change in the mix of services changes the hierarchy, to name a few.

Conclusion

This paper considers the role of given locations in the network of human activity. As we have seen using the examples of Centrelink and public hospitals, some service providers change the range of services that each location offers in a hierarchical manner. Services or service points higher in the hierarchy provide all of the services of those lower in the hierarchy. The estimated population entry thresholds can be used as a proxy for the relative order of each service type.

The hierarchy among service types indicates that there is also a hierarchy among cities, towns and villages based on the range of services available at these locations. At a high level, service centres in Australia form a fully interconnected network where CTVs with higher order services form the hub of clusters of other CTVs that provide lower order services. In a narrower day-to-day sense, there are geographic limits to service markets and this reduces the interconnectedness of service centres. A major change caused by imposing a distance limit is to reduce the number of direct links between the major cities and smaller rural and regional towns, highlighting the role of regional centres.

A closer look at these regional networks reinforces the need to consider the different roles of different places. Not every city, town or village can or should be a regional service centre. While regional service centres are vital in providing services, other places have important roles as places for people to live, work or play. Understanding the role of a given place in the network of human activity is critically important when considering regional policies or local strategies.

References

Agarwal, P 2001, Walter Christaller: Hierarchical patterns of urbanization, *CSISS Classics, UC Santa Barbara Centre for Spatially Integrated Social Science,* https://escholarship.org/uc/item/6188p69v <Accessed 15 July 2019>.

Australian Institute of Health and Welfare (AIHW), 2013. *Australian hospital statistics 2012–13*, AIHW, Canberra.

Brown, S 1993, 'Retail location theory: evolution and evaluation', *International Review of Retail, Distribution and Consumer Research*, vol.3, no.2, pp.185-229.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2014, *The evolution of Australian towns*, Report 136, BITRE, Canberra.

Bureau of Infrastructure, Transport and Regional Economics (BITRE) 2019, *An introduction to where Australians live,* Information Sheet 96, BITRE, Canberra.

Christaller, W 1933, *Central places in Southern Germany*, translation into English by Carlisle W. Baskin in 1966.

Department of Human Services (DHS) 2018a, Agent Services, *Agent and Access Point Programme Schedule 1 to the 2018/19 Agent and Access Point Programme General Terms and Conditions*. https://www.humanservices.gov.au/sites/default/files/2018/05/18-19-schedule-1-agent1.pdf <Accessed 21 September 2018>.

Department of Human Services (DHS) 2018b, Access Point Services, *Agent and Access Point Programme Schedule 2 to the 2018/19 Agent and Access Point Programme General Terms and Conditions*. https://www.humanservices.gov.au/sites/default/files/2018/05/18-19-schedule-2-access-points2.pdf <Accessed 21 September 2018>.

Department of Human Services (DHS) 2018c, Agents and Access Points. https://www.humanservices.gov.au/individuals/services/centrelink/agents-and-access-points <Accessed 21 September 2018>.

Dranove, D, Gron, A and Mazzeo, M 2003, 'Differentiation and Competition in HMO Markets'. *The Journal of Industrial Economics.* LI(4): 433–454, December 2003.

Eppli, M and Benjamin, J 1994, 'The evolution of shopping center research: a review and analysis', *Journal of Real Estate Research*, vol.9, no.1, pp.5-32.

Pugh, R and Cheers, B 2010, *Rural social work: An international perspective*, Policy Press, Bristol, UK.

Thomson, K, Malam, K and Williams, L 2019, *Population and access to local services*, Bureau of Infrastructure, Transport and Regional Economics (BITRE) Staff Paper, BITRE, Canberra.

Information sheet

Acknowledgement

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