NETWORK PLANNING FOR MORE EFFECTIVE PUBLIC TRANSPORT IN NEW ZEALAND CITIES

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ABSTRACT

'Network planning' seeks to design cost-effective public transport services to provide a competitive alternative to the car and meet the growing demand for travel to multiple destinations across the city region. This approach has been successfully adopted in many cities around the world, across a range of sizes and degrees of dispersed suburban development. The key elements of the 'network planning' are: integration of all modes with easy transfers at locations across the city; a clear line structure that is easy for users to learn; direct route alignments with the fastest possible operating speeds and high frequencies where demand is greatest and coordinated timetables elsewhere. This paper reports on research to assess the potential for the network approach to improve the efficiency and effectiveness of public transport in NZ cities. This assessment was done through international benchmarking on a range of urban form and public transport service parameters, and through investigation of current institutions, policies and service patterns for the delivery of public transport in Auckland, Wellington and Christchurch.

Keywords: public transport, network planning, New Zealand, international comparisons

INTRODUCTION

This paper reports on recent research that investigated the potential for the 'network planning' approach to the design of public transport services to significantly improve both patronage and efficiency in the use of public subsidies in the urban regions of Auckland, Wellington and Christchurch.

The motivation for the research is emerging evidence from some European and North American cities on the application of a rigorous method of planning and delivery of public transport services known as the network approach (Mees 2010; Nielsen 2005). This approach appears to allow the delivery of public transport service levels that are sufficiently attractive to shift considerable numbers of trips away from the car, even with dispersed patterns of residential settlement, while maintaining levels of expenditure that are acceptable to operators and governments.

It has long been held that dispersed urban form, as is found in New Zealand cities, is a large, if not insuperable, barrier to significant improvement in public transport mode share (Bruegmann 2005; Newman and Kenworthy 1999). However, our research challenges this assumption through the careful use of benchmarking between the New Zealand cities and three international comparators on a range of urban form and public transport service parameters.

Having established that the dispersed urban form of the New Zealand cities should not be an insuperable barrier to growth in public transport patronage, the research then turned to the current public transport planning practice in the New Zealand cities. Current operations were assessed in relation to various criteria including the institutional arrangements for service planning and delivery, the level of competition between modes, the effectiveness of timetabling for intermodal transfers, the simplicity of route layouts particularly in the city centre, and the nature of ticketing systems.

Directions for improvement in public transport service planning and delivery in the New Zealand cities were identified in workshops held with local transport planners, and through comparisons between current practice and the network planning practice adopted in the benchmark cities and outlined in international 'best-practice' guides.

This research extends previous work on this subject by taking the theoretical concepts from Mees' *Transport for Suburbia* (2010) and the principles and strategies from Nielsen's best-practice guide (2005) and applying them to a very specific context. The project team engaged directly with the key planners, politicians and community leaders to influence both project design and the debate, in public and within local institutions, about the implementation of changes to public transport services.

EVIDENCE OF SUCCESS FOR THE NETWORK PLANNING APPROACH

Public transport is increasingly called on to serve diverse objectives – ranging from providing mobility to the disadvantaged through to alleviating traffic congestion – while making efficient use of financial resources. The challenge for public transport seems daunting. It must cater for travellers with very different needs, ranging from peak-period access to the CBD to all-day access to local shops and community centres. It also needs to provide attractive service frequencies and operating hours for multiple destinations, while maintaining high occupancy rates. Some observers have argued that these trade-offs present an insoluble problem (Roth and Wynne 1982), but there is evidence to counter this assertion.

The essence of public transport, reflected in its name, is carrying people with different trip origins and destinations in the same vehicle. These travellers can then be transported with lower economic and environmental costs than if they travelled separately. This is public transport's strength, but also its weakness, because people do not all have the same trip origins or destinations.

One approach to diverse travel patterns is to provide separate services for different markets: express buses and trains for peak commuters; regular buses for local trips along busy corridors; car-like paratransit for low-demand corridors and times. The problem with this approach is that the more public transport becomes tailor-made, the more it surrenders its environmental and economic advantages. A public transport system offering a direct service between every origin and destination would have low frequencies, low occupancies, high costs and high greenhouse emissions per passenger.

The alternative is networks. This approach enables 'anywhere-to-anywhere' travel while keeping occupancy rates high, by carrying different kinds of travellers on the same services. Transfers are integral to a public transport system that offers access to a large number of potential destinations at an affordable cost to the operator (Mees 2000; Nielsen 2005). Traditional public transport planning (in the English-speaking world, at least) has treated transfers as an inconvenience to be avoided at all costs (Balcombe et al. 2005; DfT 2006), but the network approach makes them the building blocks of a multidestinational system.

Two US researchers have commented on the importance of transfers:

> Surveys asking what passengers …dislike about transit find that transferring is at or near the top of the list …(So, traditionally), transfers are avoided, but at the cost of limiting opportunities for travel to non-CBD destinations. In contrast, the multidestinational approach uses transfers to open travel paths to … destinations that are reachable in radial systems only by lengthy and circuitous travel (Thompson and Matoff 2003, p. 298).

While transfers present many new travel opportunities, they also impose inconvenience. Creating effective transfer-based public transport systems requires careful planning to ensure that the inconvenience is reduced to the minimum possible.

Four key elements underpin the creation of high-quality, transfer-based networks:

1. *A simple line structure*: simplicity makes the network easier for passengers to understand, and minimises the resources that an operator must provide.

2. *Stable line and operating patterns*: as well as being simple, a network must also be stable. The idea is to provide a consistent, high-quality service across the network all day, rather than operating different service types in peak, off-peak, night and weekend time periods.

3. *Convenient transfers*: easy transferring requires attention to timetables and physical facilities. 'Random' transfers are possible when all lines serving an interchange point operate frequently, generally every 10 minutes (6 departures per hour) or better. 'Timed' transfers are needed when services are less frequent, and the timetables for connecting lines must be coordinated (Mees 2010, chapter 8; Nielsen 2005).

4. *Appropriate institutions and fare systems*: fare systems must allow free transfers. The pooling of fare revenues is essential for this; and to allow cross subsidies. Planning on a whole-of-system basis seems to require a single responsible regional agency. This is consistent with neo-liberal economic objectives of "healthy and fair competition for contracted public transport services" (NZMOT 2009, p. 10). A combination of regional planning by a public agency and competitive tendering for services has achieved positive results in London, Copenhagen and Swedish cities. It is also being introduced for buses in Singapore (Land Transport Authority of Singapore 2008, pp. 38-39). In Australia, these institutional arrangements are in place in Perth, where public transport patronage has grown steadily since the early 1990s (Stone 2009).

There is growing evidence that network planning delivers improved patronage and economic efficiency. The first comprehensive comparison made between network planning and the more traditional approaches was Mees' analysis of Melbourne and Toronto: two cities with similar populations, incomes and urban forms but very different public transport outcomes. Per capita public transport usage in Toronto was at least twice as high as in Melbourne, despite a much smaller rail system and significantly lower public subsidies. Toronto's performance was the result of network planning by a single public agency offering travellers frequent and direct bus services and easy transfers. Melbourne suffered from indirect, infrequent and poorly connected services that were the consequence of unproductive competition between multiple operators (Mees 2000).

Subsequent analysis of US cities has confirmed the benefits of network planning. Thompson and Matoff (2003) investigated changes in public transport service levels and patronage between 1983 and 1998 in nine urban regions. They found that cities that had adopted a network planning approach significantly outperformed those using the traditional approach: recording higher growth in patronage and lower rises in subsidies.

Zurich is often regarded as the 'benchmark' city for public transport in Europe. Residents use public transport at very high rates, and importantly, usage rates have been increasing at the expense of the car for at least two decades. The Canton of Zurich, covering the small Zurich City, its suburbs and surrounding rural areas, has a population of around 1.3 million. Canton Zurich's residents made 542 million public transport trips in 2007 (ZVV 2008). In the City of Zurich, 63% of travel to work was by public transport at the 2000 census, while 25% was by car; the Canton-wide shares were 41% and 47% respectively. In both cases, the public transport share has increased since the 1990 census (data from the Swiss census reported in Mees 2010, chapter 8).

While Zurich has a substantial inner-city tram system and an extensive suburban rail network, this infrastructure is not remarkable by European standards. Nielsen (2005, pp. 89-93) and other observers agree that the critical factor behind Zurich's superior performance is its detailed network planning across the canton.

Significantly, while Zurich City has typically European high-density residential development, the suburbs and rural areas are more spacious than the suburbs of many dispersed cities, with many residents living in small villages dispersed through farmland and forest. Zurich has found a way of extending network planning to areas with extremely low population densities. Zurich also employs restrictive policies for parking and road space allocation for cars that contribute to the comparative advantage of public transport for many trips. (For a general discussion of the need for a coordinated package of incentives for public transport and disincentives for car travel, see Vuchic 1999.) The relative importance of the quality of public transport service over other factors in shifting travel away from the car is reinforced in the example of Schaffhausen, described below. This small town has achieved significant public transport patronage without imposing major obstacles for car users, through the exceptional quality of its public transport network.

THE POTENTIAL FOR BETTER PUBLIC TRANSPORT PERFORMANCE IN NEW ZEALAND CITIES: BENCHMARKING URBAN FORM AND PUBLIC TRANSPORT SERVICE

In order to establish the potential for improvement in public transport in New Zealand's three largest cities, the performance of each city was benchmarked against an international comparator on a range of urban form and transit performance criteria.

Auckland, Wellington and Christchurch are very different urban regions, reflecting the influence of varying histories, topography and economic structures. Wellington, as the national capital, has a strong CBD underpinned by a large base of government jobs. Transport patterns in Auckland are affected significantly by the region's location on two harbours and a volcanic field. The management of public transport in Christchurch reflects the different approach taken by city and regional political leaders in response to the 1989 deregulation of bus services. For this reason, each city is benchmarked against an overseas comparator, rather than compared against one another.

Some basic similarities were required to ensure comparability. These include high incomes that enable near-universal car ownership and the absence of explicit demand-management policies like congestion pricing. Another important criterion was the availability of useful data on travel patterns and public transport operating conditions. Where possible, this data has been sourced from census authorities and public transport operators; in other cases we have employed the *Millennium Database for Sustainable Transport* (Kenworthy and Laube 2001). The Database contains information for 1995/6. (We have supplemented this for Auckland and Christchurch, which are not in the Database, with data prepared as part of the same project, and reported in Bachels et al. 1999.)

The benchmarking data is set out below in Table 1, but before moving on to discuss its important features, we include a brief note on sources and various issues in the collection and interpretation of the data.

Table 1: Urban form and public transport performance in the three New Zealand urban regions and their chosen international benchmarks

	Auckland	Vancouver	Wellington	Zurich	Christchurch	Schaffhausen
Total population (millions)	1.3	2.1	0.45	1.3	0.35	0.044
	18.9	17.1	22.0	37.6	17.0	36.7
Jobs in CBD (% of total jobs in the urban region)	13.5	12.6	22.0	12.2	16.6	n/a
Share of work trips by:						
- Public transport	7.0	16.5	17.1	40.7	5.2	40.7
- Walk, cycle	5.6	8.0	13.4	12.1	12.3	14.9
- Car	87.4	74.4	69.6	47.2	82.5	44.4
Public transport boardings (millions of 'unlinked' trips)	52	283	34	542	16	13
Boardings per capita	40	135	77	417	46	289
Public transport service-km (all modes – millions)	42.3	116.2	24.5	71.9	18.8	2.7
Service-km/capita	32	55	61	57	59	61
Subsidy per boarding[a]	2.54	1.10	1.70	0.45	1.62	1.05

a) Equivalent in $NZ at October 2009 exchange rates

Notes on sources and interpretation of benchmarking data

In each case, information was collated to provide a picture of the 'urbanised area' of each region. Population, density and journey-to-work modal split data for the international comparators comes from the 2000 Swiss census and the 2006 Canadian census. For New Zealand, population data comes from the 2006 census, but this source did not yield appropriate density figures because Statistics NZ does not release data for 'urbanised areas', which are defined as the contiguously built-up part of a region, excluding farm and other non-urban land. Instead, density figures for the three New Zealand urbanised areas are taken from Kenworthy and Laube's *Millennium Database*. Although these are for 1995-96, they are unlikely to have changed dramatically, as urban densities alter only slowly over time. Compared with the New Zealand and Canadian examples, the density figures from the Swiss census are somewhat overstated, due to methodological differences. The Swiss Federal Statistical Office draws urban boundaries more tightly than those used in the other countries. It excludes all open space and farmland, even when it is surrounded by urbanised land. Non-urban land of this kind is included in the figures for the other countries. It was not possible to obtain more precisely comparable data.

Employment shares for CBDs come from the *Millennium Database*. Because of variations in the definitions of CBD boundaries, these should be regarded as indicative only. Schaffhausen is too small to be included in the database, so the relevant figures could not be obtained.

Data for international public transport performance comes from Annual Reports for 2007 and 2008 supplemented by personal communications with staff in local agencies. These agencies, and the area for which they provide public transport services, are as follows: Zurich – Zürcher Verkehrsverbund (ZVV), covering an area slightly larger than the Canton; Schaffhausen – Verkehrsbetriebe Schaffhausen (VBSh), covering Schaffhausen and Neuhausen; Vancouver – Translink, approximately the same area as the Census Metropolitan Area. Auckland and Wellington public transport performance data comes from Annual Reports for the Auckland Regional Transport Authority (ARTA) and Greater Wellington Regional Council, which oversee public transport services across the respective urbanised areas and into some small regional centres beyond the urban boundaries. Christchurch figures are for the City of Christchurch, which since amalgamations in 2006 covers the entire urban area. The regional authority, Environment Canterbury, covers a much larger area, including significant, but separate, settlements such as Timaru.

Public transport trip-making data in New Zealand, unusually in the international context, use 'unlinked' trips (that is, each leg of a single journey that uses a different mode counts as a separate trip). For sensible comparisons, therefore, the international trip-making data is also reported as 'unlinked' trips. Care is needed when comparing these figures with other published trip-making data. For example, Vancouver authorities typically report 'linked' trips, in which a single journey counts as one trip no matter how many transfers are made. Therefore, some accounts of transport performance in Vancouver quote a lower figure than is used here (Kenworthy and Laube 2001).

Interpretation of the service supply data also requires some caution. For the four cities with trains, rail service is measured in units of train-km. Within and between these cities, the capacity of these trains varies considerably.

The information on subsidy levels for the international cities comes from operators' Annual reports for 2007 and 2008. New Zealand data is for the 2007/08 financial year and was supplied by Alex Campbell from Greater Wellington Regional Council based on information supplied to him from other agencies. It includes bus, rail and ferry contract payments; concessionary fare payments; and kick-start funding for new services. Care is needed in interpreting these comparisons because of the volatile exchange rate movements of the past year or more, which have seen a significant decline in the value of the New Zealand dollar against most major currencies, and a substantial appreciation of the Swiss Franc.

Assessing the benchmarking data

Public transport mode share and tripmaking rates are increasing in all six cities. A range of factors including rising petrol prices has driven the increases in New Zealand cities, but the increases began at the 1996 census, well before petrol prices began to rise. Although a revival of employment growth in the CBDs of all three cities' is doubtless an influence, the improvements to public transport services initiated by the three regional councils and by the Auckland Regional Transport Authority (ARTA), which was set up in 2004 as a statutory organisation accountable to the Auckland Regional Council, have also played a part.

Public transport's share of work trips and per capita tripmaking rates are much higher in the international comparator cities, as is to be expected. However, it is noteworthy that the difference in per capita tripmaking is greater than the difference in mode share for work trips: for example, mode share for work trips is 2.5 times as high in Zurich as in Wellington, but tripmaking is more than 5 times as high. This reflects the greater ability of networked public transport to serve dispersed non-work trips. It is good news, because it suggests that potential patronage increases may be greatest in the off-peak, local and cross-city markets, which can be served without substantially increasing capacity costs.

Auckland – Vancouver

Vancouver is a large urban region and, like Auckland, spreads at relatively low densities across a visually spectacular landscape. Both cities have relatively weak CBDs in terms of employment, reflecting the fact that neither is a capital. In each case, the CBD is remote from the demographic centre of the region and water crossings are required to connect it to other parts of the city. One other important similarity is that buses have dominated public transport in both cities, until recently. Vancouver's first elevated light-rail line, the Skytrain, opened in 1986, and although the network is being extended, most passengers are still transported by bus. There is some spectacular high-rise housing in and near the Vancouver CBD, which features prominently in many aerial photos of the city. However, this accounts for only 5% of the regional population (GVRD 2002) and has little influence on regional density figures.

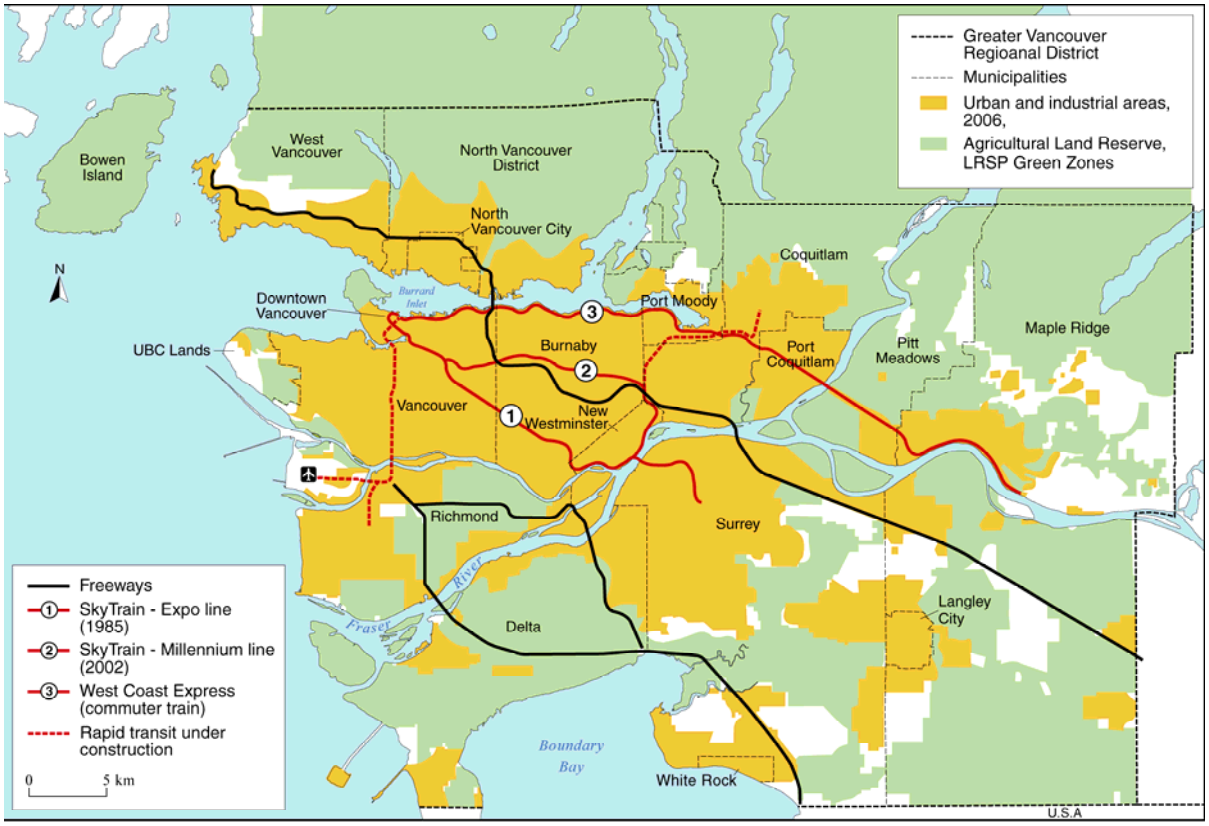

Figure 1: Auckland urban region and major transport infrastructure

One critical difference is that Vancouver has no radial freeways: its freeway system is confined to two outer-suburban links near the US border to the south, and the Trans-Canada Highway, which crosses the suburbs to the north. By contrast, Auckland has three major radial freeways that converge in a large ‘spaghetti junction’.

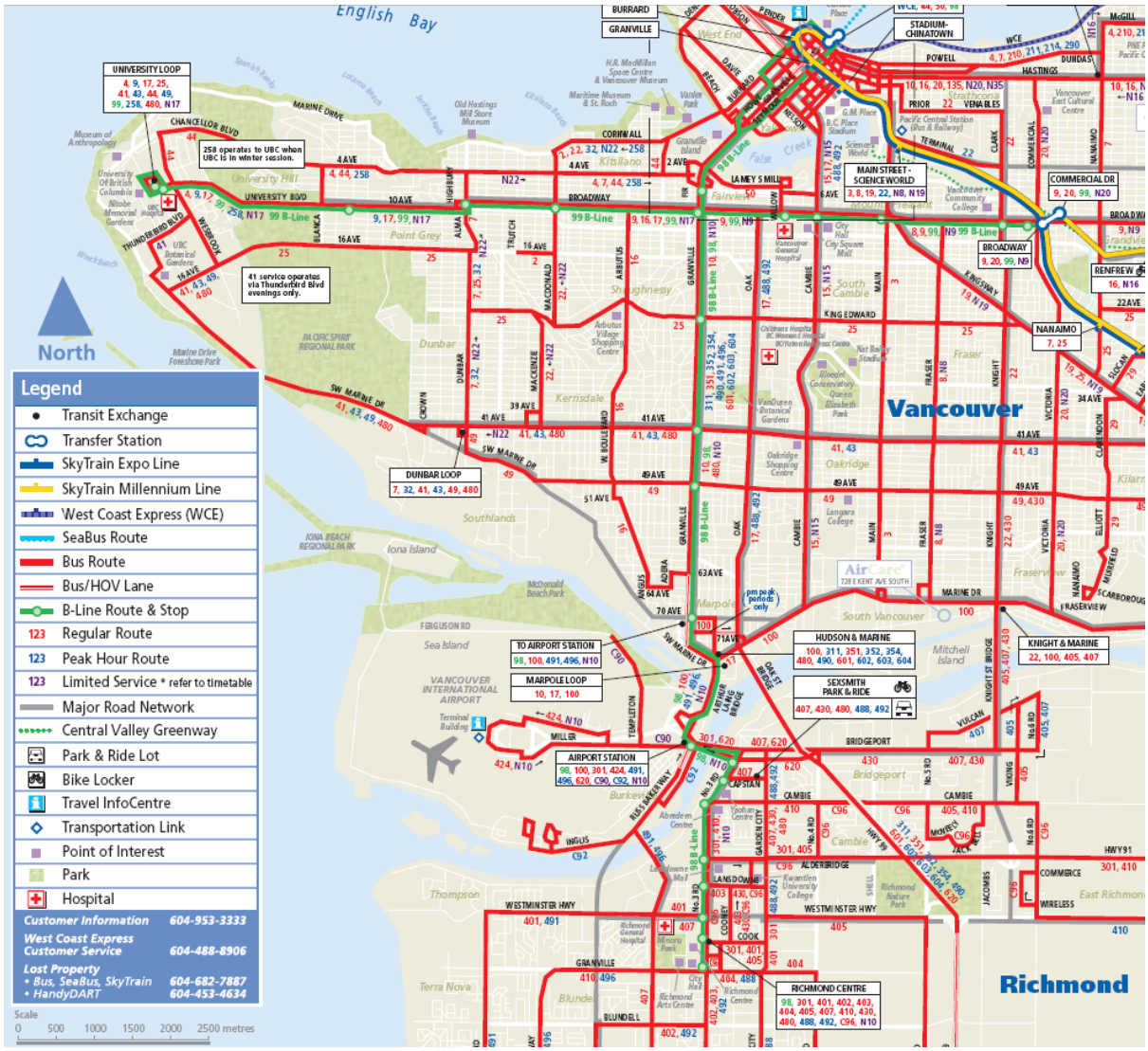

Figure 2: Detail of layout of bus lines in suburban Vancouver (Translink)

Vancouver outperforms Auckland in public transport's share of work trips, and by a greater margin for per capita tripmaking. Interestingly, Vancouver's much larger patronage is carried on a network that consists of fewer bus and rail lines than are provided in Auckland. Vancouver has a relatively 'sparse' network made up of heavily-trafficked lines; Auckland has a very dense and complex network comprised of many, mainly low-volume lines. For example, Vancouver's #98 B-Line express bus route carried over 20,000 passengers a day in 2004 (Translink 2005), while Auckland's 'Northern Express' busway service carries about the same number per week (ARTA).

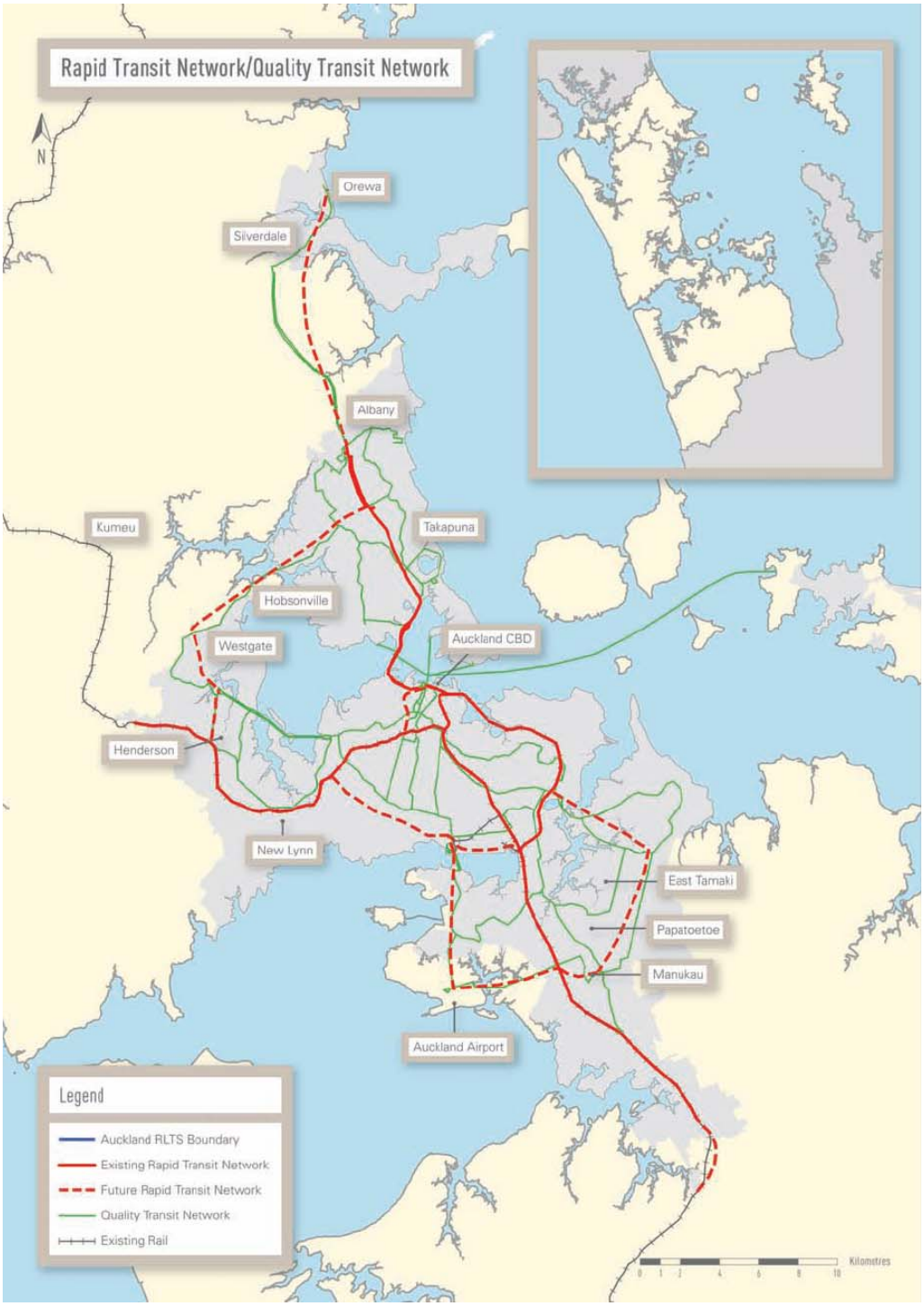

Figure 3: Auckland urban region and major transport infrastructure (Auckland Regional Council)

Wellington – Zurich

Zurich, like Wellington, has a strong CBD, although one that is less dominant than that of New Zealand's capital. Zurich also contains a relatively high-density city centre, linked to peripheral settlements by an extensive regional rail system. The mountainous terrain strongly influences the settlement and movement patterns of both regions, with major transport

corridors following valleys. The City of Zurich has a population of around 360,000, about 10% less than the entire Wellington region; the Canton of Zurich, which includes suburban and rural areas, has 1.3 million residents. This means that Zurich's population density is significantly higher than that of Wellington. However, the two cities remain sufficiently similar for worthwhile comparisons to be made, especially since Wellington appears to have a stronger CBD.

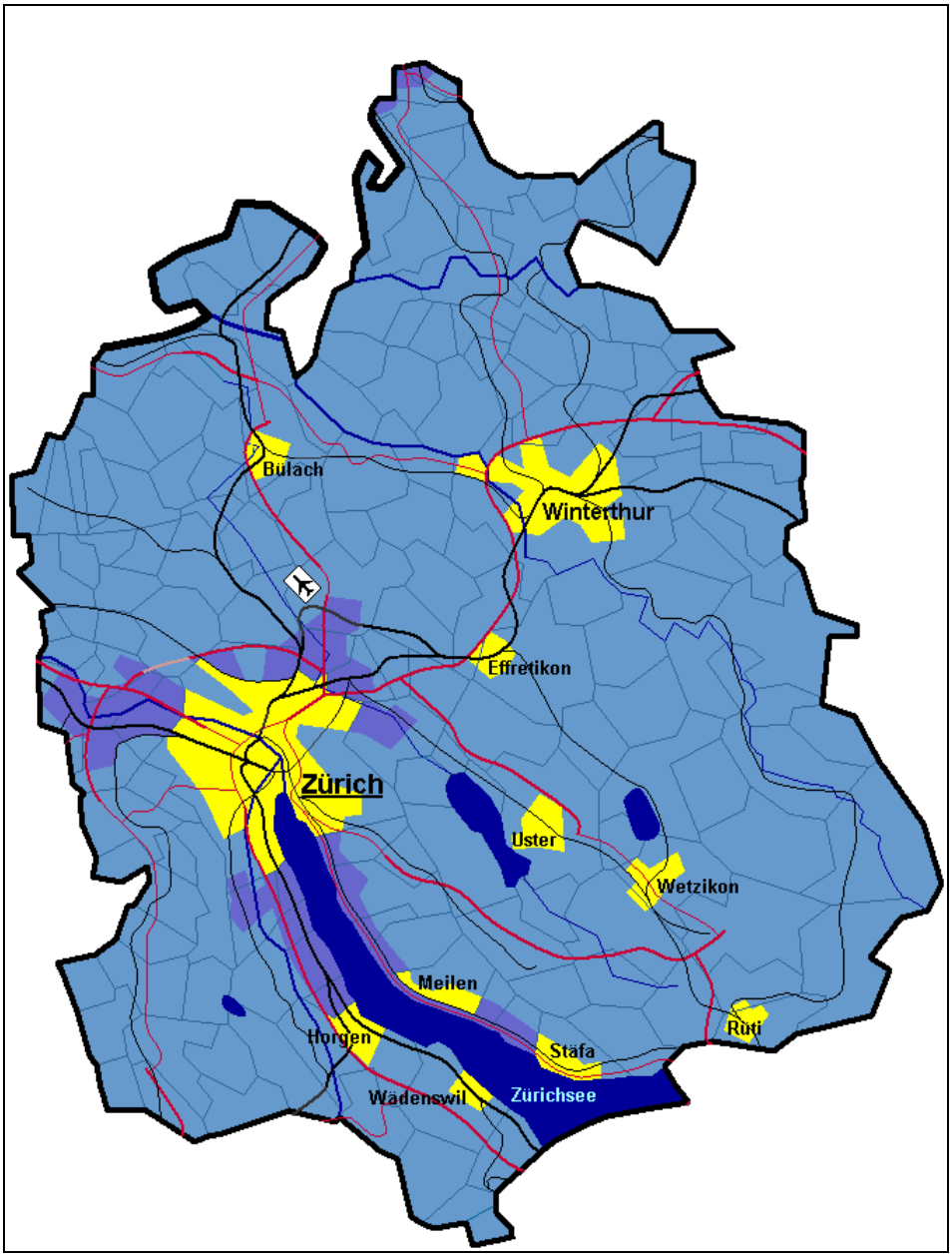

Figure 4: Urban (yellow) and suburban (purple) development in the Canton Zurich (scale 1 cm = 5 km approx.)

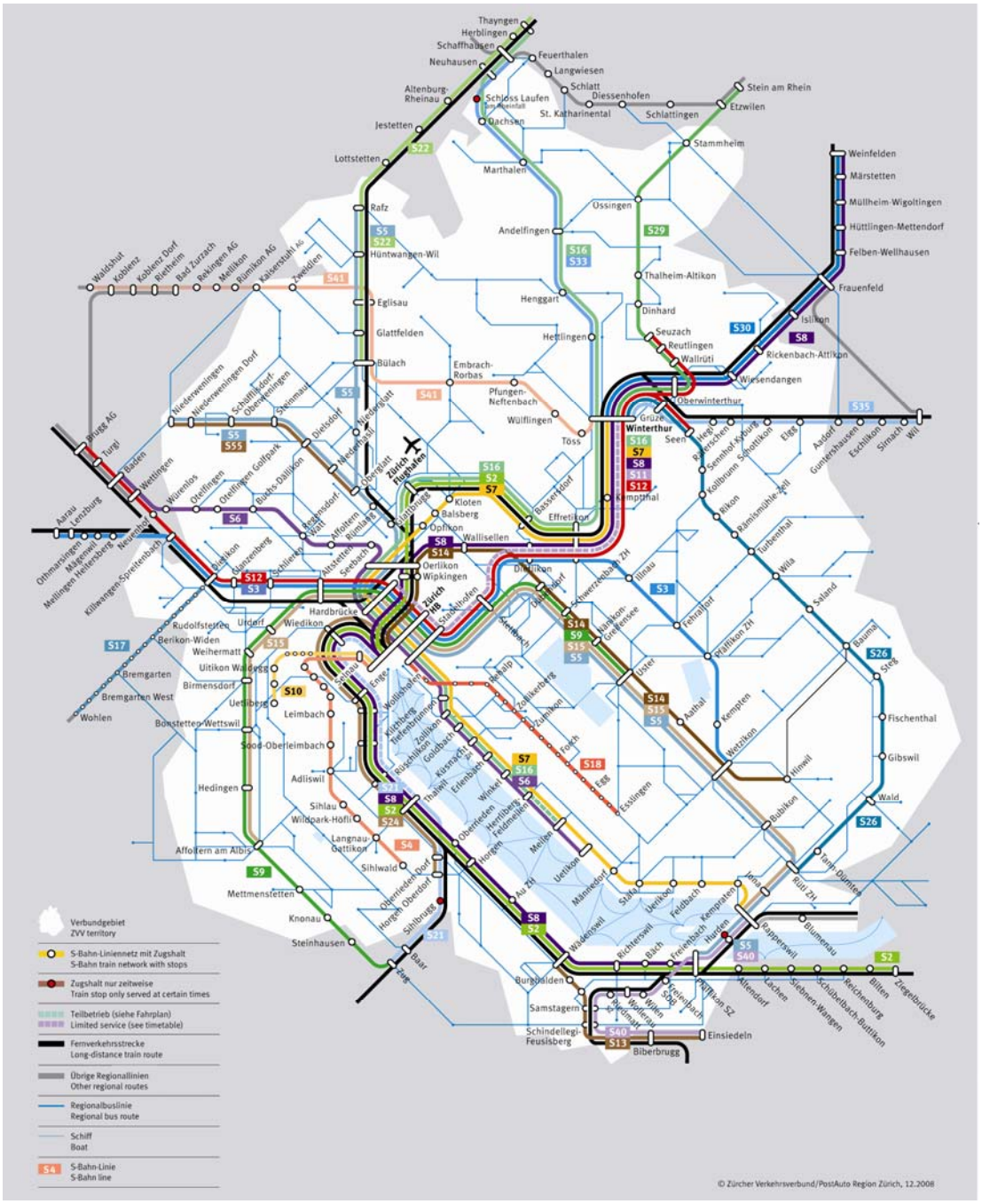

Figure 5: Integrated rail and bus network in Canton Zurich (ZVV)

Public transport's share of work trips in Canton Zurich is 2.5 times as high as in Wellington, and per capita tripmaking rates are more than 5 times as high, suggesting very strong use of public transport for non-work trips in Zurich. As in Auckland, this difference is encouraging, because it suggests that increases in patronage may occur primarily at times and on services with spare capacity.

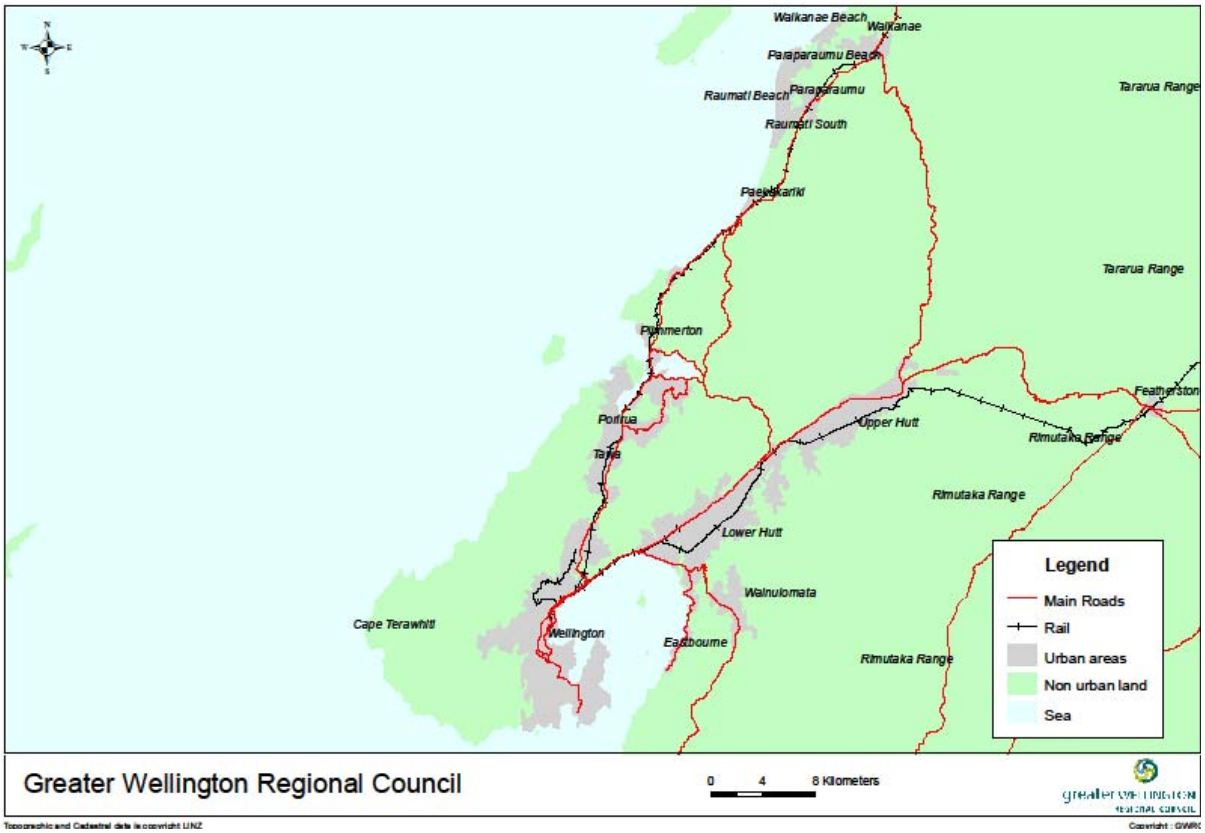

Figure 6: Wellington urban region and transport infrastructure

As in Vancouver, Zurich's central street-based public transport is very intensively used, with high patronage levels on inner-city tram lines (which correspond to trolley-buses in Wellington City). Suburban and regional rail services in Zurich are less intensively used. The superiority over Wellington is due as much to the larger number of rail corridors – two dozen to Wellington's three – as to density of traffic. Zurich has met the challenge of economically operating its large number of rail lines in areas with very low densities and populations by integrating them with feeder and cross-suburban bus services. Wellington's rail system is also very successful by Australasian standards, given the relatively low population it serves, but comparison with Zurich suggests a significant capacity for further improvement.

Christchurch – Schaffhausen

A close comparator could not be found for Christchurch. Although there are cities of comparable size with successful public transport, such as Freiburg in Germany, these have well developed heavy and light rail systems, while Christchurch operates an all-bus system. We originally considered using the Canadian capital Ottawa, but that city is renowned for its extensive segregated busway network (Al-Dubikhi and Mees 2010; Hoffman 2008), which functions like a rail system and so comparison with Christchurch would be difficult.

Figure 7: Schaffhausen bus network (VBSh)

In the absence of a direct comparator, we have used possibly the most successful all-bus urban transport system in Western Europe, that of the Swiss town of Schaffhausen. Located some 53 kilometres north of Zurich, Schaffhausen has been served by buses since trams were removed in the 1960s (the busiest line is served by electric trolley-buses). Schaffhausen is much smaller than Christchurch – its entire Canton has 75,000 residents of whom around 43,500 live in the capital (including the adjoining municipality of Neuhausen, which has the same public transport operator) – but its urban public transport system carries a similar volume of passengers. Although the two cities are not closely comparable, it should still be possible to learn lessons from Schaffhausen's success, particularly because Schaffhausen is a small city without a medieval core: roads and parking are relatively plentiful and there are few explicit demand management policies in place.

Public transport's share of work trips is very high in Schaffhausen, at some eight times the level in Christchurch. However, it is important to note that around a quarter of workers who travelled by public transport did so by train to destinations outside the Canton – mainly to the suburbs and city of Zurich. The difference for bus-only travel is around 6:1, similar to the difference in per capita tripmaking rates.

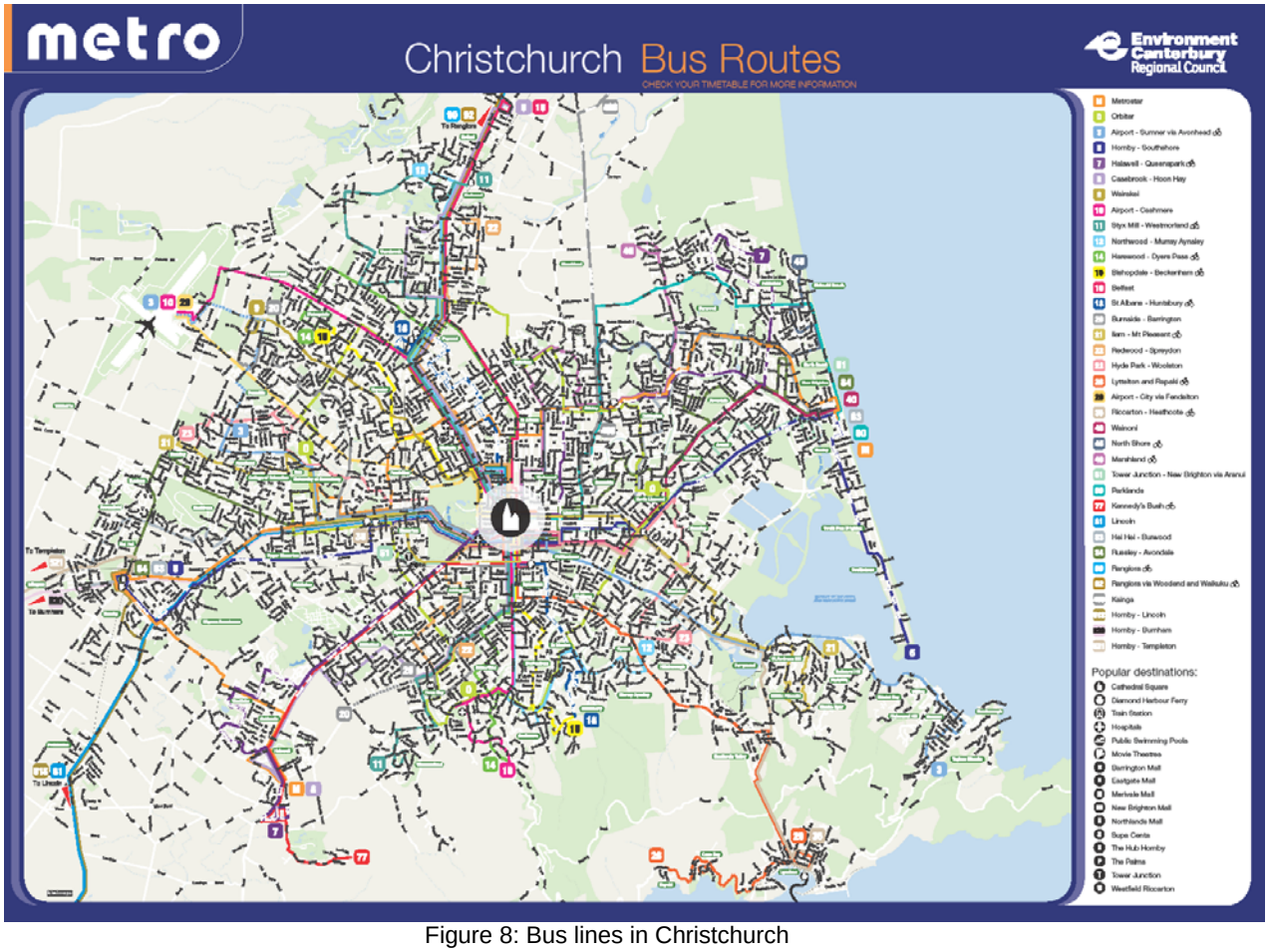

Figure 8: Bus lines in Christchurch

This points to one feature that distinguishes public transport in Christchurch from that in Auckland and Wellington, namely a more even spread of patronage between work and non-work trips. So, while the share of work trips by public transport is considerably lower in Christchurch than in Auckland, per capita tripmaking rates are somewhat higher, reflecting the fact that Christchurch already employs some features of network planning, such as multi-modal fares and the successful Orbiter bus line. However, comparison with Schaffhausen suggests the potential for further improvement. It is noteworthy that Schaffhausen's 13 million annual public transport passengers are carried on only six bus lines, reflecting a similar pattern to that found in Vancouver and the City of Zurich.

Institutions and policies for public transport

Regional public agencies plan, fund and manage public transport in the three international comparators. Vancouver's Translink is responsible for roads and public transport, Zurich's ZVV for public transport only, and Schaffhausen's VBSh for buses only (Canton

Schaffhausen also has an equivalent to the ZVV, serving rural areas and integrating urban services with rural buses and inter-cantonal rail lines). The Zurich and Vancouver agencies sub-contract some or all of their service offerings, to public and private sector bodies, but the overall network appears to the passenger as if it was directly operated by the regional agency, as is the case in Schaffhausen. Fares and timetables are integrated, and the system is marketed as a whole.

The situation in New Zealand cities is different, as a result of the deregulation of bus services in 1989. Since then, regional authorities could exercise planning functions in relation to 'contracted' services, but had little ability to influence 'commercial' services provided by private bus firms, even though those services receive government subsidies in the form of 'concession recoupment'. In Auckland, in particular, this has frustrated the development of a multi-modal fare system, and prevented the recasting of bus services in rail corridors to act as feeders rather than competitors. In Christchurch, a more cooperative relationship between planning agencies and bus operators, and the smaller role of commercial services, has enabled a greater degree of public planning and control. This has enabled the introduction of a multi-modal fare system allowing free transfers. Wellington lies somewhere between Auckland and Christchurch – a significant share of its services are commercially provided.

Another important difference has been the much higher degree of prominence given to public transport by regional and higher-level governments in the comparator cities. The upgrades to public transport in Vancouver, Zurich and Schaffhausen came as the result of region-wide debates about transport policy beginning in the 1970s. In these cities, public transport is seen as the priority mode for urban travel rather than just a supplement to the automobile. The objective of public transport being the preferred mode for urban travel generally reinforces the network approach, which is designed to provide convenient service for the full range of trip types. In New Zealand, until recently public transport has been treated as a 'back-up' mode to the automobile, for the disadvantaged and city centre commuters. There are signs of a shift in philosophy in the largest New Zealand cities, beginning in Christchurch, but now extending to the North Island. However, public transport infrastructure and operating patterns in all three cities still shows the influence of the long period of relative neglect.

Service supply and public subsidies

By using resources more productively to create a network that delivers higher average boardings per vehicle, the international comparator cities require significantly lower public subsidies per boarding.

As the data in Table 1 shows, the much higher rates of public transport trip-making in the benchmarking cities are achieved without the need for proportionately larger 'quantities' of service supply. Although the figures are not directly comparable because of differences in vehicle sizes and modes used, it is evident that the New Zealand cities and their international comparators provide a similar order of per capita public transport service supply. The big difference is in how this supply is assembled. The attention to network planning in the benchmarked cities is the key to the higher levels of use.

ASSESSING CURRENT PUBLIC TRANSPORT PLANNING PRACTICE IN THE NEW ZEALAND CITES

A review of current public transport operating practices in the New Zealand cities shows that, because of decisions made over many decades, planning falls short of the ideals of network approach, though some important elements are in place, particularly in Christchurch.[1] This can be seen in the following summary of some key areas.

Institutions

The New Zealand government's 1989 deregulation of public transport had the greatest impact in the Auckland region, with several private bus companies operating services that directly compete with each other and with the rail services.

Rail services and some bus services are planned and subsidised by the Auckland Regional Transport Authority and are delivered by private contractors. Outside this framework, many bus routes are delivered as 'commercial' services, for which operators receive fare revenues and a payment from ARTA to offset concession fares. The MAXX brand is used as a coordinating mechanism but many services operate outside this, using the liveries of the private operators.

Like Auckland, 'commercial' contracts supply of a significant share (around 20%) of public transport services in Wellington. This includes commercial services 'peppered' among contracted services on regular routes. For example, some peak services (and associated fares) are commercial, while the public agency delivers the less profitable off-peak services, and even some for which the commercial operation comprises only selected services during the morning peak.

In Christchurch, commercial operators have less influence. The primary organisation for planning public transport services is the regional council. Since 1998, directions for planning have been set by a Public Transport Strategy prepared jointly by EC and the Christchurch City Council with input from an advisory committee comprising bus operators, user representatives and other interest groups. The Metro unifying brand and bus livery was introduced in 2000. The regional council contracts services from three bus operators. Of these, by far the largest is Red Bus Ltd, which evolved from the Christchurch Transport Board and remains under the ownership of the City Council. The only 'commercial' services are the two lines that operate to the airport. These are made viable by charging higher cash fares.

[1] Timetables used in this analysis were those in operation during the last quarter of 2008.

Service standards

Despite some positive changes associated with the establishment of the Northern Busway, public transport in Auckland does not have a clearly defined network structure.

The train system provides the skeleton of trunk service in the southern and western corridors that, even with current diesel operations, offers competitive travel times when compared with buses which offer direct competition. Services are chiefly oriented around city-bound commuter markets, with low frequencies during off-peak periods and in counterpeak travel directions. Bus services are generally designed to avoid transfers: a multiplicity of indirect lines are used to link likely origins and destinations. At some locations, timetables refer to transfers and interchanges but connections with trains are seldom well designed or encouraged. A new busway offers a trunk service to northern suburbs with relatively high daytime frequencies. The design of interchanges at busway stops is conducive to easy transfers and the routes of some local bus lines have been altered to take advantage of the improved travel times. However, other bus lines still run in competition, taking passengers all the way to the CBD, but at slower speeds.

As in Auckland, bus services in Wellington compete with rail on the trunk routes. Wellington's public transport system shows some sound elements of network planning: trunk routes in the main travel corridors with feeder services and ten identified suburban interchanges. However, interpeak and evening service coverage is poor; rail-bus connections commonly involve unacceptably long waiting times of ten minutes or more; and many routes are unnecessarily circuitous.

In Christchurch, core services provide the skeleton of an effective network: nine radial corridors have relatively direct bus services operating at 15-minute headways for most of the day. There are two cross-town lines operating at 10-minute headways until early evening, but only sparsely after that. Since the full circle route began operation in 2000, planners report a level of transfers exceeding their initial expectations. Alongside this core system, there is also a multiplicity of infrequent and indirect 'community' services.

CBD circulation

The concentration of many bus lines in the CBDs of all three New Zealand cities is major source of delays, as buses compete for street space with private cars and have little effective signal priority. The problems caused by this congestion for efficient operations and for public understanding of the system are well-understood by local planners, but current institutional arrangements limit the potential for the introduction of measures, such as the use of 'pendulum' lines and suburban transfers, that are available to alleviate these problems.

Ticketing

In Auckland, a bewildering array of tickets is available for travel on public transport. One set of tickets is issued for train travel, and there are nine separate sets of bus fare 'products'

associated with the various private operators. Free transfers between services are generally limited to those run by a single operator. In Wellington, a similar situation exists although there are fewer private operators. Any transfers require an additional ticket. Day trip tickets that allow multiple journeys and transfers are available separately for bus and train travel. A combined ticket is also available, but the price is the same as that for bus and train day-passes purchased singly. In Christchurch, most trips can be made using tickets that include free transfers.

CONCLUSION

Although further research is needed to quantify the specific benefits, it is clear that considerable potential exists to improve public transport in the three New Zealand cities at an affordable cost and in ways that can contribute significantly to the national government's strong economic growth agenda.

The current institutions that coordinate public transport services in Auckland, Wellington and Christchurch are chiefly part of regional governments. These institutions have the skills and structures necessary to plan networked public transport services. However, in Auckland and Wellington, a new relationship would be required between the regional transport planning agency and the private operators based on recognition of the mutual benefits that would flow from the increased patronage that could be achieved through a planned network.

New public processes will be required to build community support for reorganisation of existing public transport services into a functional network. In both Wellington and Auckland, current upgrades to rail systems provide a useful context in which to present operational changes to the community. The composition of Christchurch's strategic advisory committee provides a good model for a framework in which these public consultations could be organised.

In the re-negotiation of the relationships between public and private institutions, it is essential in both Auckland and Wellington to create a fare system that provides a mechanism for cross-subsidies for lower-patronage services that supply important network connectivity, and removes the financial penalty for making transfers between lines and modes.

Public transport in New Zealand cities, particularly Auckland and Wellington, is built around changing patterns of services for different users at different times of the day, in direct contrast to the prescriptions of the network approach, which recommend a stable pattern of services throughout the day.

To begin the introduction of 'networked' service planning, decisions must be made about the location of key suburban interchanges for a public transport network. These decisions largely follow from regional land-use plans, although it is necessary to take an iterative approach, which recognises that decisions about the location of high-quality public transport routes and interchanges will drive locational choices for property developers. Once decisions are made

about the basic structure for the network, the details of the operations of each component line must be considered in a way that allows stable and reliable performance.

It is beyond the scope of this paper to give specific details of how operational practices might be changed in the New Zealand context. (Some proposals are discussed in Mees, Stone et al. (2010).) However, the major political and institutional success of the project has been to build support among senior managers and other key players in local public transport planning policy networks for significant changes in service design and delivery. In Wellington, for example, planners have developed options for network improvement based on concepts generated during the project. These have had positive reception, in part due to learning achieved during project seminars. These options will be tested through modelling and community consultations in late 2010.

it is clear that international 'best-practice' in public transport planning, operations and marketing offer a variety of tools that can be used to remove or minimise the significant existing operational inefficiencies and improve public transport patronage even within the constraints of current public transport budgets and the limitations of the existing dispersed urban form.

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