The University of Sydney

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Sustainable Transport for Sustainable Cities Satellite Forum

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"Coming to a city near you!

….sustainability step two"

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Introduction

From the 1960's to 1990's, the car has grown to be the dominant mode in most western cities. These cities have developed an urban sprawl structure. Residential and later employment, scattering away from the original trunk routes to the city CBD. The freedom of the car has seen cities develop with high accessibility by car. Apart from the original corridors along radial trunk routes to the CBD, these cities are short when it comes to accessibility by public transport.

In this type of car dependent city the historical trend is accessibility up, sustainability down. Recent research work, case studying Sydney has highlighted a large increase in person km traveled and vehicle kilometers traveled (VKT) by car in suburbs beyond 20 km from the CBD, in comparison to inner and middle suburbs of Sydney.

Suthanaya (2002)[i] observed that between 1961 and 1996, 62% of all job increases have happened in these outer ring suburbs of Sydney. Over the same period, 87 % of all residential worker increases were in this outer ring and the mean trip length by car was close to double the trip length of inner suburbs. Suthanaya (2002), comments that the present trend in distribution of jobs and homes points to a 30% increase in Sydney wide car VKT from 1996 to 2011 and worrying environment implications.

Before going further it is first necessary to ask ourselves, what is sustainability? There can be a variety of definitions. Sustainability in the context I am using here is about balancing livability for us now, with livability for our children in the future. Ingredients are stewardship of ecological capacity, energy, mobility, space, social value and financial capacity. Transport is a significant influencer of a city's sustainability.

Accessibility however is an equal goal for most of us now. Accessibility at its most underlying level is about relationship, whether directly through fellowship with other people, or indirectly through the out workings of connection to services, goods or employment. Transport is a significant provider of accessibility.

As a general rule, a city's transport system and spatial distribution of land use is not an optimum match. Car dependent cities are characterised by land use distribution that largely happened assuming that freely available car capacity would follow. A city's transport system more often than not has got to catch up to the landuse changes.

Catch up is typically through adding extensions to the road network, bus services and by adding extra capacity to trunk corridors as mobility demand increases. Accessibility is usually lagging behind the expectation of the communities as landuse changes take shape. As the city's transport system is adjusted, the accessibility increases.

However, with the increase in accessibility as the transport system changes, is a fall in sustainability of the city. Figure 1 illustrates this graphically for a transport system where a change in landuse has left the system needing to move from accessibility "A", to a new goal.

As the transport system in these heavily car dependent cities becomes congested, efficiency of the transport system falls, worsening emissions, noise and city liveability. Sustainability falls. At the same time, congestion brings about a shift in accessibility. The available capacity in the system is no longer available for the opportunity to make a new trip. Available capacity is firstly used and the existing trip times lengthen. Accessibility in this system can actually decrease.

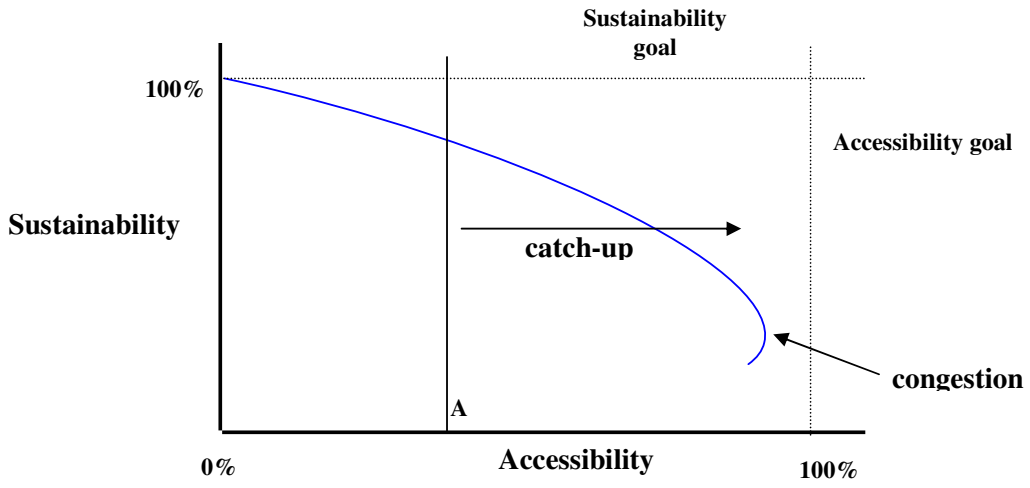


Figure 1

Is there sustainable accessibility?

Throughout the 1990's much work has been done on the beginnings of restructuring urban form.

- Providing local township identities within sprawling suburbs.
- Introducing mixed employment, residential and retail zones at a local level.
- Increasing densities around existing rail stations.
- Adding cycle ways, opportunities to walk and local public transport services.

In many cities these measures are beginning to provide good local accessibility with more people having local opportunities. As residents take up these opportunities, there is beginning to be a shift from high VKT car trips, to more localised non motorised or public transport based trips.

Good local accessibility with increased sustainability is achievable in this way. Good local accessibility reducing the need for mobility, with lower VKT car trips ……... Sustainability Step 1!

However, people also choose to work further away. Manning (1978)[ii] observes from the 1971 Census in Sydney that the expectation that resident workers would take up local jobs when they are provided near where they live, was not a definite outcome. Jobs close to home were often overlooked for better opportunities further away. Campbelltown take up rates were as low as 25% in 1971, while opportunities were available for 61%. Take up rates in Penrith were 32% in 1971, with opportunities for 95% to work locally. This effect is still a reality today. Factors influencing this include an attachment to a job when either the person shifts residence, or employment shifts location, or match of skills to a more distant job.

Is there sustainable accessibility city wide, not only locally?

City wide sustainable accessibility. If it is achievable, it will depend on sustainable local accessibility coupled with sustainable trunk transport.

Clues to sustainable trunk transport come from a seemingly unlikely place, the developing network of motorway corridors. In cities such as Sydney and Melbourne middle to outer suburb orbital ring roads are being added to radial motorways, providing city wide accessibility between local areas. In Melbourne, these corridors have induced industries to relocate into the middle suburb areas in close proximity the ring road.

This city wide web of trunk corridors is a structure that provides a city wide web of accessibility. The application of the corridors for road transport alone however, does not provide for a sustainable system or make the best use of the corridor's capacity.

Sustainability Step 2 is taking this city wide web structure, of trunk corridors and adjusting the web from multiroad, to multimode. On a sustainability / accessibility plot, the effect is to shift to a new characteristic curve that is closer to both goals. This is illustrated in figure 2.

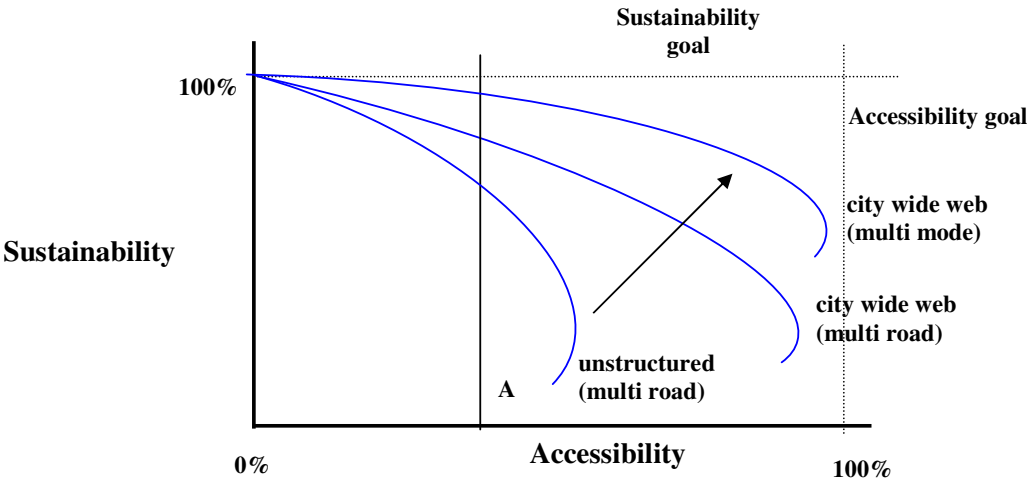


Figure2

Can there be city wide sustainable accessibility? If we couple to the Sustainability Step 1 directions, Sustainability Step 2, city wide sustainable accessibility is an achievable outcome.

The city wide web structure - a Sydney Case Study

Sydney land use and transport has been characteristic of a car dependent city. Its original trunk corridors centre on the CBD of Sydney, located at the harbour entrance to the city. Landuse was originally focussed around the CBD and radial trunk corridors. The advent of car in the late 1950's onwards has seen a spread of residential areas away from these corridors as accessibility by car became a possibility. This was followed by a slower shift of employment into the middle suburbs.

Even with the increasing effort on Sustainability Step 1 land use changes in the past 10 years, the city continues significant urban fringe residential development until this day. This mixed land use policy has been a significant driver to a large increase in person trips by car in the middle to outer ring suburbs.

The western half of Sydney's geographical space contains over 50% of Sydney's 4.1 million population. The bulk of the rapid increase in person trips by car, have taken place in the suburbs of this area.

At a number of forums in 2002 and 2003 local government and community groups alike have strongly canvassed the need for a realignment of Sydney's transport. Priorities to establish for more containment of trips and an increase in public transport share of the journey were top billing at a Western Sydney transport forum in June 2003.

Central to this, is a restructuring of the trunk corridors within the western sector. Current trunk corridors are largely radial. The major new trunk rail corridors planned or under construction are radial extensions from eastern Sydney.

The Western Sydney motorway orbital is one trunk corridor developing a reorientation for accessibility within the western half of Sydney. To increase accessibility and mobility by public transport, the corridor was modified in principle to multi mode. However, the construction commitment has only been provided for multiroad across the full length of the link at this time. Never the less, the spatial relationship to other trunk road corridors develops the type of web structure that provides a big step in accessibility for the population of Sydney's western half.

Sustainability Step 2 for Sydney, hinges on getting an effective multimodal trunk web structure in the western half of Sydney. The orbital motorway principle invites us to develop a multimodal trunk web structure by overlaying an orbital public transport corridor over the top of the network of radial motorways and rail lines. Conceptually, the structure is illustrated in figure 3.

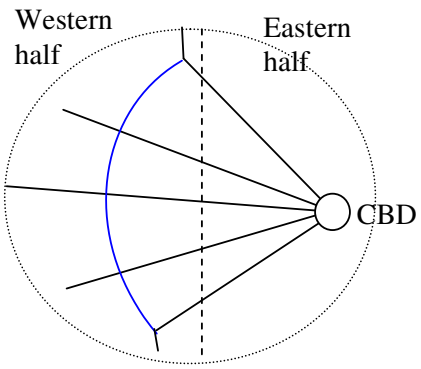


Figure3

By being intentional about this, it is possible to include within the Western Sydney orbital motorway, a trunk NW/W/SW arc of an orbital public transport system. To complete the city wide web structure, extensions of the orbital arc, together with additional radial capacity, will need to be added to the public transport within the system. Extensions of the orbital arc would be to the northern and southern areas of Sydney.

The key task for government in the first instance is to identify and reserve suitable corridor easements.

Sustainability Step 2, not only requires the correct web structure, it also requires the correct mix of system technology. The trip maker currently uses car for most trips involving trunk routes, even though as it is applied today it is the least sustainable technology.

The car trip is therefore the baseline to which other system technology has to compare and compete. The correct mix of system technology demands both the best technology for each link on the web, together with the best interchange locations.

What are the requirements to shift trip makers in a significant way, to use a Sustainability Step 2 Web Structure?

REQUIREMENTS?

- integration between all links in a multimodal transport web structure.
- when integrated provide door to door trip times for cross regional trips that are significantly (15% to 30%) better than the trip time by car only.
- passenger comfort and personal safety.

What are the matching characteristics of the trunk orbital public transport arc?

CHARACTERISTICS?

- integration with motorways/buses/rail and other feeders.
- interchanges 5 to 10 km apart
- rapid transit times ….. 2 to 4 minutes between stops
- stay within environmental noise capacity of corridor
- passenger comfort and personal safety onboard and within interchange areas.

System Technology- new meets old

At first, the most likely configuration of the orbital arc public transport system would be thought to be bus, suburban train or light rail. Each of these are capable of meeting stopping patterns from 5 to 10 km, staying within noise limits, and providing passenger comfort. However none are able to meet the rapid transit time of no more than 4 minutes between stops, necessary to better car trip times by 15% to 30%.

In the spring of 1998, Thyssen Transrapid Australia was in the midst of technical and commercial studies on application of maglev technology trains in Australia. It was observed during these studies, that the Transrapid technology was a good match for rapid, limited stop urban transport.

In particular, the TR08 maglev train has rapid acceleration, braking and high cruising speed capability.

In conventional higher speed trains, traction limits the acceleration rate. As speeds climb above 140kph, the acceleration rate and braking rate reduces. The TR08 is able to reach a speed of 300 kph in a third of the distance as illustrated in figure 4.

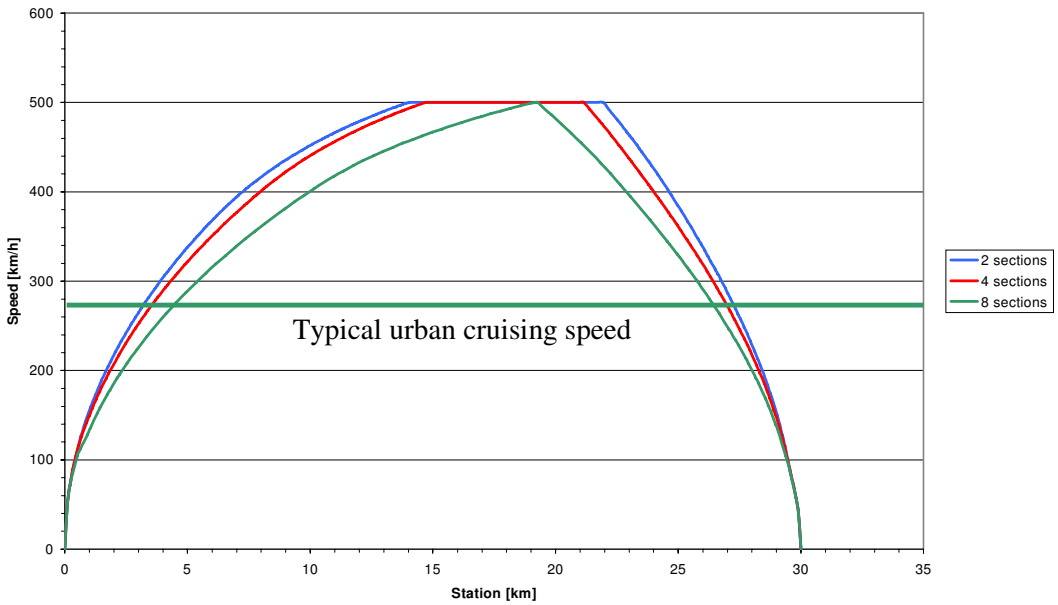
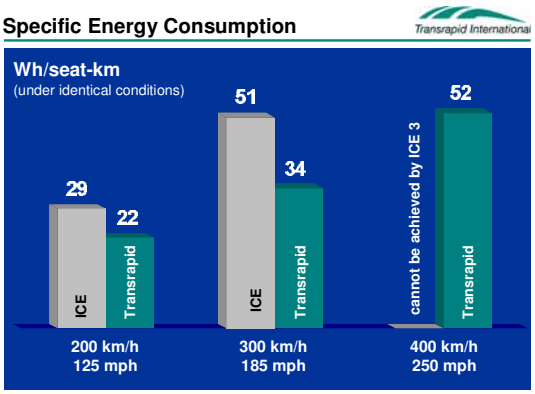


Figure 4

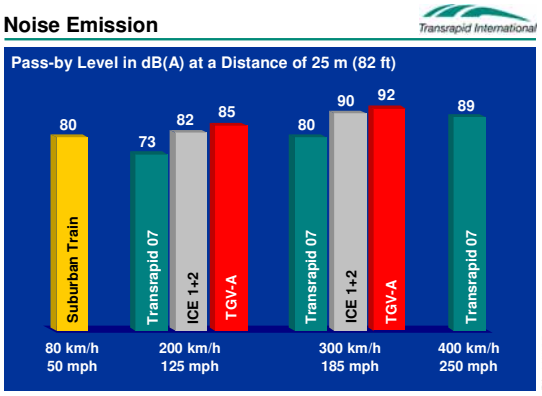
The favourable aerodynamic properties and the non-contact technology make the Transrapid extraordinarily economical. At the same output the system consumes 20 to 30 percent less energy than the already very “modest“ railway. This is illustrated in figure 5.

Figure 5



In urban areas, noise legislation limits most conventional trains to 160kph, beyond which compensating measures such as noise barriers are required. The experience with TR08 is that this same noise limit is able to accommodate a speed of 270kph, without any compensating measures, giving an additional sustainability improvement over other technology. Comparison with other technology is illustrated in figure 6.

Figure 6



High acceleration/ braking and high cruising speed within a noise budget acceptable to the community, provides a significant advantage in transit time for terminals spaced closer than 15 km apart.

A selection of origin destination pairs are listed in Table 1 showing typical transit times between each pair, for a service with stops at intermediate stations averaging 10 km apart.

Holsworthy to Eastern Creek	10 min
Hornsby to Blacktown	12 min
Hornsby to Campbelltown	28 min

Table 1

This technology provides a good match for the Characteristics of the orbital arc.

Transrapid took the initiative to propose the orbital arc in the summer of 1998, progressively refining the options into August 2002. Numerous discussions were held with the NSW Government and its agencies over that time.

Part of the proposal put to government was a first link in a high speed orbital public transport system to compliment the trunk radial services provided by CityRail and the planned rapid bus only transit ways.

Integration is a key objective of the Transrapid proposed routes and terminal locations. The aim is to provide the users of public transport with the ability to transfer from one mode to another with minimum delay and inconvenience.

A number of hub terminals are proposed for this orbital network, from which local bus, light rail and rail feeder services could operate, utilising both peak and counter peak capacity. Opportunities exist for new connector technology, such as Bishop Austrans, to extend the feeder service to a new level.

A properly integrated system, combining the high speed capabilities of Transrapid, with local distribution capabilities and seamless interchange would present an attractive alternative to travel by car.

Figure 7 illustrates how this multimodal arc, builds a web structure for the western half of Sydney.

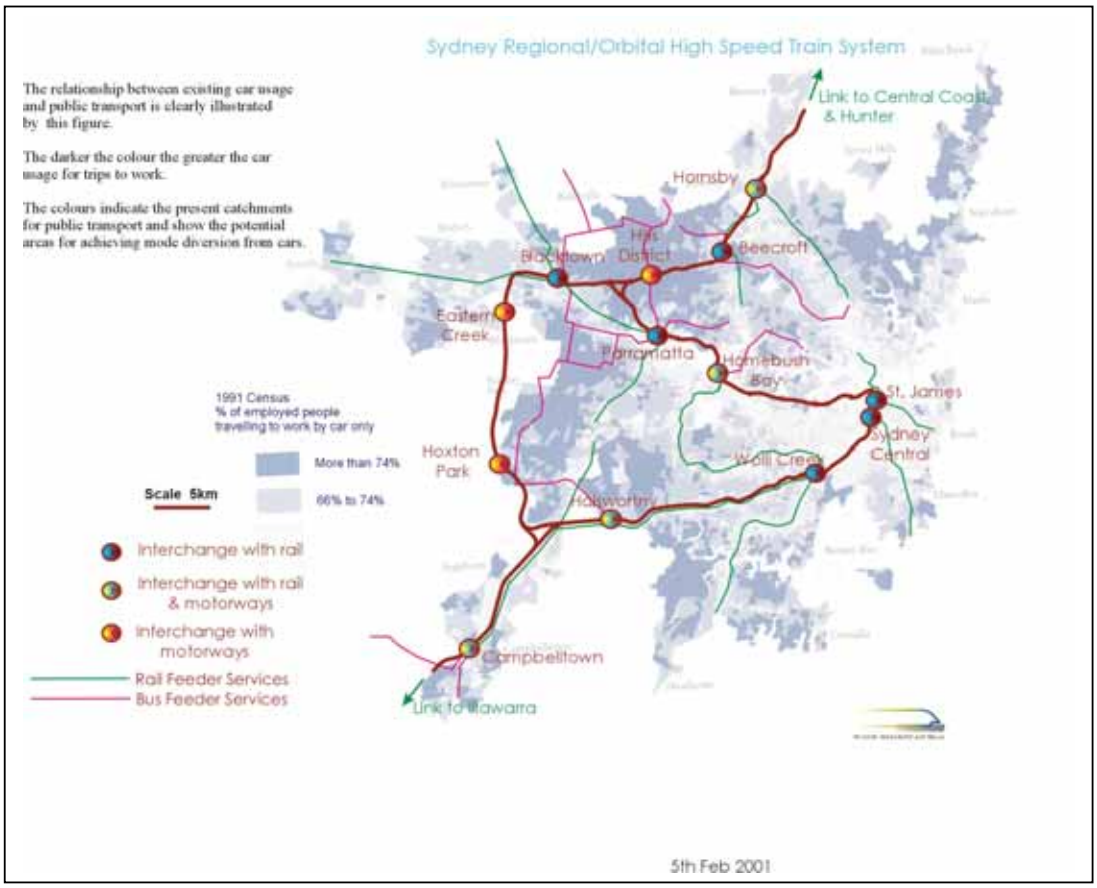


Figure 7

The locations for the orbital network terminals maximise the potential for integration with other modes. They are placed at major intersections of rail services, the motorways, major arterial roads and proposed rapid bus only transit ways. Park and ride facilities would be an integral component of the proposed hub terminals, to encourage diversion from cars to public transport. Outer perimeter intercepts at Campbelltown, Holsworthy, Hoxton Park, Eastern Creek, Hills District and Hornsby are intended to encourage a shift from car usage for trips across, or to within, the inner area of Sydney. Incentives schemes for park and ride, could provide a useful tool to change driver habits.

The operational concept for the services, is to commence with a 20 min frequency service in both directions on twin guideway, using a mix of 4 to 6 car (section) trains. The system has equivalent passenger capacity to the current City Rail City Met trains, when running in 8 car configuration and can run headways better than 5 minutes if required.

Corridor space is much less a footprint than road or even rail, given the flexibility of the system. The system can be banked to enable speeds to be maintained through tighter curves than railways, has gradient climbing ability of up to 10%, can be elevated or at grade and requires as little as 10metres for twin guideway in tight corridor areas. A typical guideway layout and power supply configuration is illustrated in figure 8[iii].

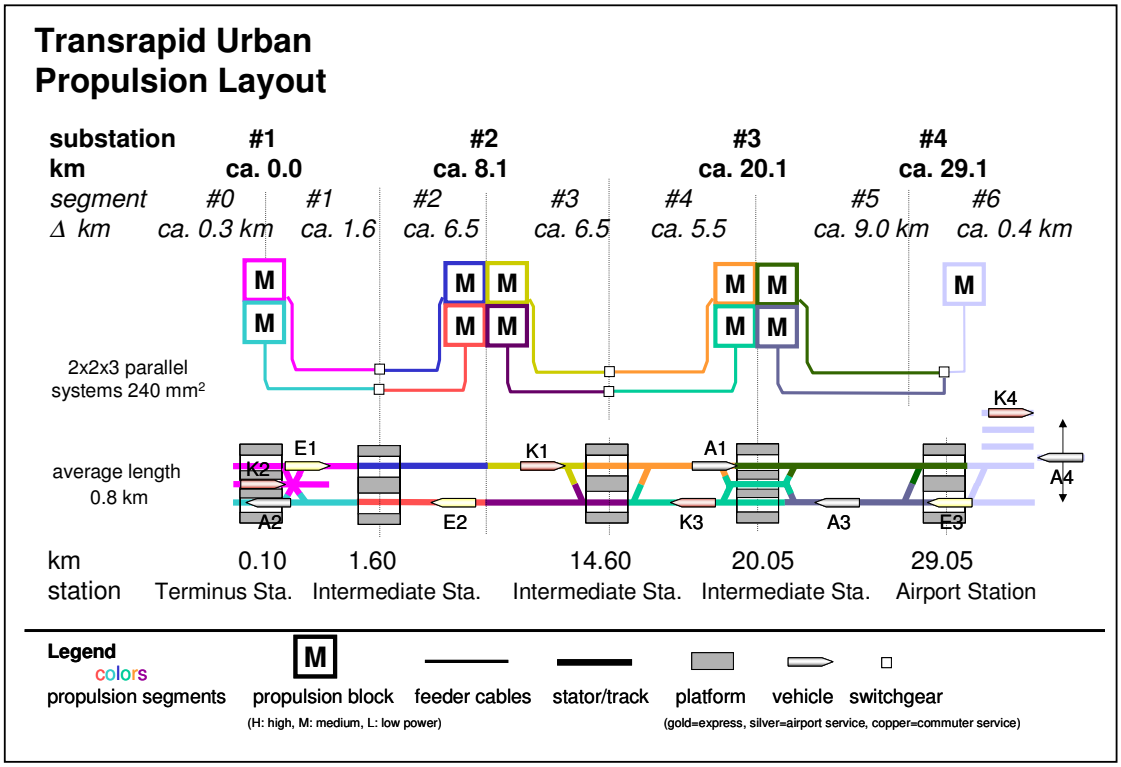


Figure 8

Ultimately the concept is for this web structure to draw together cities of the Sydney region, with an express transit time, from Wollongong to Newcastle, of just over 1 hour. Significant social and economic benefits would result from such a massive reduction in travel times.

The Transrapid technology and the system has been ready for service for some time having been in development since the 1980's, and certified for operation since the mid 1990's. The first fully commercial operation has been in operation in Shanghai, China since December 2003 and has recently carried its millionth passenger.

With the coming of age of this new trunk technology, the technological mix now exists for a web structure that can provide city wide sustainable accessibility. So keep a look out for sustainability step two…..Coming to a city near you !

[i] Suthanaya,P.(2002) Sustainable transportation indicators with reference to urban form and journey to work travel in the Sydney metropolitan region. Doctoral Thesis, School of Civil and Environmental Engineering, The University of NSW, July 2002

[ii] Manning I., (1978) The Journey to Work; Urban Research Unit , Australian National University.

[iii] Thyssen Transrapid Australia, various technical and proposal data, from 1998 to 2004

[iv] Windana Research Pty Ltd : a centre of sustainable transport: windana.com