Introducing light rail transit

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Introduction

The last quarter of the twentieth century has seen a rise in interest in the use of light rail transit (LRT) in providing a sustainable yet attractive transport system and aiding urban regeneration. At the same time LRT has been considered for other applications whilst certain manufacturers have claimed to have systems that, whilst cheaper, are just as effective as conventional light rail.

In some instances, the Far East being a good case, installations labelled light rail or LRT are that in name only having expensive totally segregated alignments and carrying very heavy levels of traffic.

This publication is designed to show planners, politicians and the public just what light rail is and can be. The reader should bear in mind that there are many exceptions to the rules governing light rail and in this short publication we are unable to cover them all.

History

In its usual guise light rail consists of electrically powered passenger carrying vehicles using steel wheels on steel rails and being able to operate on a variety of alignments both segregated or shared with other vehicles and pedestrians. As such it has evolved in many cases from the electric tramway but not all tramways are light rail and not all LRT systems are tramways.

Whilst tramways and light railways have been associated for over one hundred years through legislation the term *light rail* seems to have been firstly applied to the development of the Gothenburg (Sweden) tramway in the 1960s when various segregated extensions were added. This was followed by some interesting traffic management based on that originally developed to preserve the historic city centre of Bremen which gave the backbone to a modern, efficient transport system.

In fact the first “new” light rail system is generally thought to be that of Edmonton (Canada) where a conventional railway right of way was linked to the city centre using a new tunnel in 1978.

This was quickly followed by a similar system in Calgary which saved considerable expense by using a cross-city dedicated transit street instead of a tunnel. Because of this cost saving Calgary’s LRT system has expanded much more rapidly than that of Edmonton.

However it was in San Diego, California, where the most radical step took place. Here a freight short-line was equipped with off-the-shelf rolling stock and connected with the city centre by the simple expedient of laying track in streets shared with other vehicular traffic. Since that event light rail has been installed in many guises in many cities worldwide.

What is it?

Light rail covers a range of operations from, but not including, the conventional street tramway to the full blooded metro. In most cases it uses electric vehicles running on two steel rails.

Light rail as an economic tool

A well planned and designed tramway or light rail system should, as part of an integrated transport system, be able to cover its operating costs and thus be a sustainable project.

The actual construction phase will inject a considerable amount of funds into the local economy and should also create employment. As some of these funds will pass through the local economy a number of times the local benefit can be much more than the original spend.

The provision of an attractive public transport system can be integrated into urban renewal projects as has been done in many French cities. This will attract further investment.

Application

Generally light rail is used as on major radial transport corridors either linking suburbs with a town or city centre or as part of a cross city or town network. It should serve major traffic generators such as hospitals, schools, universities, railway stations and airports, major recreational, exhibition and leisure centres as well as central business and retail districts and residential areas. Where LRT is implemented to serve new development it is important that it is in operation *before* the development opens so that use of light rail is taken as norm from day one.

Light rail can operate economically where there are traffic levels between 3,000 and 11,000 passengers per direction per hour
Easy access to such a system should be made from residential areas and also methods of providing feeder services be implemented from the start of the project. Provision for feeding the system should be made including;

Well lit, safe and planned walkways;
Park and ride facilities, and
Feeder bus services

LRT should be able to replace a number of bus services which can be either withdrawn or redesigned as feeders.

Light rail can also itself be a feeder mode, linking into metro or other heavy rail systems as at Alvik (Stockholm) or built linking various suburbs to each other and also heavy rail or metro stations *en route* as with line T3 in Paris.

Further specialist applications such as tram-train and heritage lines will be discussed later on.

Why light rail

Light rail is used by cities that;

Want to provide an attractive alternative to motor vehicle use when accessing the city centre or other traffic generators.
Be able to reduce the need for city centre car parking and use the space for something more useful.
Convince investors that the locality is investing in the infrastructure that will be available for the long term.

Vehicles

Most modern light rail vehicles are single deck and articulated in one or more places, have low floors and collect power from an overhead wire. They can, and often do, operate as a coupled set and if this is a permanent arrangement then the vehicles can be single ended; such a configuration can also be used where there are turning loops at all route termini.

Over the last two decades there have been a number of mergers of manufacturers with the result that there is a considerable amount of standardisation so that a Alstolm Citadis can be found in Eire, France, the Netherlands, Italy, Spain, North Africa and Australia whilst Bombardier trams as delivered to Blackpool are have also been chosen for a LRT system on Australia's Gold Coast. These cars can be supplied in various lengths and widths.

Historically tramways had floor levels *circa* 900 mm and, following the requirement for level access, these required long or short high level platforms, lifts or ramps. Whilst some of the newer LRT systems were built with such features because low floor vehicle design had not developed very far most new projects use light rail vehicles (LRVs) with a floor level of about 350 mm.

Power supply

Electric tramways have normally collected direct current electricity from an overhead wire and this is still true today. However there were some exceptions to this rule and some of these have recently been re-addressed using modern technology. For example;

Use of batteries. Historically this was normally found to be uneconomic. Karlsruhe considered the idea *circa* 1990 as a cheap way of electrifying some state railway lines for tramway operation but after trials decided conventional electrification was more economical. Nice used trams carrying batteries that would enable the city to avoid installing overhead wires in two city squares but has again decided that this is uneconomical.

Surface contact systems. These (and sub-surface contact systems) were tried in a number of cities and the conduit system lasted until the mid 1960s in Washington DC. Bordeaux requested a surface contact system when its new tramway was built. There were initial problems with this installation but it is now working well and has been installed in other cities. However there is a cost penalty in choosing this method of supply. Not only is the initial capital cost higher but the operator will probably be tied to one supplier.

Internal combustion. There were some tramways that used for all or part of their operations internal combustion engines but they were not common and normally restricted to rural areas. However it is possible to get trams with diesel engines and some dual mode (electric/diesel) trams were introduced into Kassel in 2006. These are used on an unelectrified railway branch line which would have been expensive to electrify because of a tunnel with limited clearance.

There can be complaints about the intrusion of overhead power supply systems but these ignore the fact that whilst there may be some visual intrusion at the same time the reduction in internal combustion emissions actually improves the environment. Best practice would combine traction poles and street lighting or, where possible, use span wiring supported by adjacent buildings.

Stations and stops

Stations and stops can vary from a simple platform through to an interchange with cross-platform with other transport modes, above, at ground level or sub-surface. These latter may have sundry retail features. At least a simple shelter and passenger information should be provided. For security purposes adequate lighting and, if necessary, CCTV are important considerations, not only at the station itself but also in providing secure access to the stop.

Park and ride facilities should be provided at suitable points, not just for motor vehicles but also for cycles.

Fare systems

In the UK four LRT installations use conductors but these are not typical of operation throughout the world. Systems with constant high ridership may have ticket barriers but generally access is based on an honour system backed up by high fines collected through the used of revenue protection squads.

The UK uses premium fares in an attempt to captivate the perceived added value of travelling on an improved system. Generally these features are not found elsewhere and not only are journey prices the same for bus, tram or metros but a ticket is for a journey not a specific vehicle ride, thus encouraging ridership of the whole transport system.

A wide range of tickets are available from single to daily, weekly, monthly and annual validity whilst other tickets allow more than one person to ride and can be obtained from a number of sources, including by mobile telephone. The Netherlands has introduced the *Chipkaart*, a national ticket that can be used on most buses, trams and trains throughout the country.

Alignments

Light rail can operate on a variety of different alignments. One of the factors that differentiate LRT from a pure tramway is the amount of segregation used. Segregation generally speeds up services but can make access take longer and this should be borne in mind when planning the system.

On street operation.

The performance of LRVs means that they are capable of running in streets shared with pedestrians and delivery traffic. Operation is obviously much slower than where there is a segregated alignment so such features should be kept to a minimum. One good example exists in Zürich where the high quality shopping street *Bahnhofstrasse* is served by a number of tram routes. Obviously facilities have to be provided to enable deliveries to buildings but these can be limited to off peak hours.

Streets shared with other traffic.

Again light rail vehicles are able to operate on streets shared with other vehicular traffic. To ensure that the service is not unduly hindered by traffic congestion traffic management methods are normally used to ensure that LRVs are not blocked by, say, traffic turning right, held up by delivery or waste collection vehicles. Where the street or road is wide enough then a simple reservation can be created by using white lines or a slightly raised surface. If necessary, emergency vehicles can use these alignments.

Subway operation.

In the late 1960s and 1970s there was great interest in putting tramways underground. Whilst this happened in West Germany on quite a large scale the pedestrianisation of many town and city centres led to a rethink of this idea.

However in some cases subways are necessary. They can be used for short sections to avoid major roads or road junctions and tunnels under railways can include interchange stations.

Where there are long routes, high traffic levels and/or a large city centre then subways may be necessary.

Roadside or central reservation.

Where there is enough space then roadside or central reservations can be used. At stops on such sections light controlled crossings for pedestrians are good practice.

Totally segregated alignments

On outer sections of route totally segregated alignments can be used. In some cases former railway alignments are available. Where new developments take place the alignments through or adjacent to these may be available.

Tram-train

During the 1980s the Karlsruhe transport authority started looking at the possible operation of light rail vehicles over railways that already had conventional rail services. Through its associated company, AVG, standard gauge trams already operated over a former narrow gauge railway and a state railway now reduced to freight only.

The new plan was to have dual voltage vehicles that could run over both the local tramway and state railway systems using both 750 volts DC and 15 kV AC power supplies. Quite a large network has now been developed but although many services are operated using LRVs not all of these run on to the city tramways or odd sections of tramway built to provide better city penetration as at Heilbronn.

Many tram-train projects were considered but few have actually been implemented. Saarbrücken built a totally new city tramway which links to the state railway and through services are operated. Kassel runs some tram-train services which intersperse with conventional workings that operate a more limited stop service. The tram-trains, whilst stopping more often, provide just as quick a journey time to the city centre as there is no need to change vehicles.

The implementation of tram-train projects is not as simple as one might expect considering that they are both electrically powered and run on steel rails. Technical differences exist with wheel profiles between the two modes and signalling meanings are also at variance.

In the UK joint operation of LRVs and conventional rail services does take place between Pelaw and Sunderland on the Tyne & Wear metro. When the system first opened freight trains operated over part of the metro and this feature is occasionally found of some new light rail systems especially in the United States. This form of joint operation can be simpler as freight services can be segregated from light rail passenger services by operating them at different time periods.

Heritage lines

Whilst many countries have operating tramway museums in certain instances first generation tramways have been retained and are part of the history of the local area. Examples of this are New Orleans, Soller (Mallorca) and Hong Kong.

Other cities, whilst retaining and modernising their tramways have retained some heritage operation on a regular basis as in San Francisco, Melbourne and Blackpool. In other cases heritage fleets have been retained and limited operation in conjunction with a tram museum takes place, e.g. Bruxelles and Gothenburg.

As part of the redevelopment of some city centres, especially in the United States, “fake” historic lines have been built. These use either restored vehicles not necessarily from the city in which they are now running or replica vehicles. The design of the latter can include provision for access for those with mobility impairments, something rarely catered for in designing the original systems!

In Stockholm a tourist line was built during the 1980s following the closure of the city trams. This line has been used more recently to give the local population a chance to ride modern tramcars and is now being incorporated into a new city system.

Ultra light rail

Ultra light rail is the use of light rail technology on special occasions where the traffic levels involved would normally be economically handled by a bus. Small vehicles are used, often similar to those used at such sites as airports where a totally segregated alignment enables automatic train operation to be used. As yet there is only one application of ultra light rail in the UK in general passenger service, that linking Stourbridge Junction railway station with Stourbridge town centre. It makes use of an existing railway branch that was for many years worked uneconomically by a standard diesel railcar.

Further information on modern tramways and light trail transit can be obtained from the Light Rail Transit Association. See www.lrta.org. *To contact the Light Rail Transit Association email office@lrta.org. Alternatively telephone 0117 951 7785.*