Transit Technology Alternatives

Fixed Guideway Systems

(see http://www.apta.com/research/info/define/index.cfm)

**Heavy rail - HR**

Heavy Rail is a system that is totally separated from its surroundings and operates in a tunnel (subway), on elevated tracks or on a separated right of way. It typically has elaborate stations, and operates in multiple car trains and has the highest capacity of any transit mode. It is electrically powered with power typically collected from a third rail. It is the dominant system of transit in very large urban areas such as New York, Washington, D.C., Chicago, the San Francisco Bay area in the U.S. and elsewhere in the world (London, Paris, Toronto, Mexico City, Tokyo, etc.)

There are two basic types of systems, those built over 100 years ago in major cities and new systems built since about 1960. Changes in existing systems can include: new equipment, spot improvements, quieter, lower weight vehicles and station improvements.

![Chicago Elevated (Heavy Rail system)](image_url)
New heavy rail systems or lines in the U.S have been built in the San Francisco Bay area, Los Angeles, Washington, DC, Miami, and Baltimore. These use automatic control systems, card based fare collection, elaborate stations, and are completely grade separated. Costs vary depending on the complexity of construction and can vary between $100 million to over one $1 billion per mile.

Figure 2: Bay Area Rapid Transit System, Fremont, California
Light Rail - LRT

Light rail can operate on existing streets and areas as well as on separated rights of way. It normally uses overhead wires to collect power and some view it as a modern version of the streetcar. There are many systems in Europe and Asia (typically called trams) and new systems and modernized systems in the U.S. such as in Shaker Heights (Cleveland) Ohio, Boston, San Francisco, San Diego, Sacramento, Portland, Salt Lake City, Dallas, New Jersey, St. Louis, Minneapolis, Denver, and Houston, with other systems under construction.

Figure 3: Portland Oregon Light Rail system
New Light Rail systems feature new vehicles and are electrically powered with overhead power. Vehicles operate in highway medians, on streets, with at grade intersections or on old railroad or totally new right-of-ways. Stations (stops) are simple. Light rail has a lower cost and capacity than heavy rail. Light Rail can be an evolutionary system which upgrades over time to heavy rail.

Figure 4 San Diego Light Rail at San Ysidro, California

Figure 5: Light Rail in downtown Minneapolis
Modern Streetcar

The modern streetcar is similar to light rail but uses smaller vehicles and operates almost exclusively on existing streets. It has been implemented primarily in central business districts or in special zones of high activity. Vehicles can be modern in appearance or built to look like historic street cars. In some cases historic vehicles are used. They provide circulation between buildings in concentrated areas or else may provide a connection between two nearby areas. Sometimes they also serve tourism markets. Some U.S. examples are in Portland, Ore. Little Rock, Ark., Memphis, etc. There are numerous examples outside the U.S.

In several U.S. cities streetcar lines continue in operation and serve wider markets with legacy systems. For example San Francisco has maintained a network of streetcar lines overlaid with their bus service and regional heavy rail transit services. New Orleans has kept or expanded their heritage street car service in parts of the city to serve local travel markets as well as tourists. Tampa has built a heritage system using old looking modern vehicles to connect a historic district to its downtown.

Figure 6: Portland Streetcar
Commuter Rail - CR

Commuter rail services operate as passenger trains over conventional railroad tracks. They can be electrically powered or operate in trains pulled by diesel locomotives. They are used in large cities such as in New York, Chicago, Philadelphia, Boston, San Francisco, Washington, D.C. as well as an emerging mode in other cities. The service is typically used by commuters traveling from suburbs to central city service over regular railroad tracks. It can use push-pull equipment which doesn't require turning at the end of the line and high capacity, double deck, cars.

Figure 7: Virginia Railway Express Commuter Train, Washington D. C. Union Station
Figure 8: Maryland Commuter Rail, Washington, D. C. Union Station

Figure 9: Coaster, San Diego, California
Bus rapid transit operates similar to a rail system but without the tracks. Bus rapid transit systems feature separated right-of-way or exclusive lanes, signal priority, off line fare collection, and express service between stops. Examples: Boston; Shirley Highway in Virginia; Pittsburgh, Bogotá, Columbia; Los Angeles Salem Oregon. BRT systems tend to have lower construction cost than light rail. Buses can do local collector routes on regular streets and then use busway for higher speeds.

Figure 10: Bogotá, Columbia Bus Rapid Transit system
General background: The Federal Transit Administration has extensive information on Bus Rapid Transit in their Characteristics of Bus Rapid Transit for Decision Makers report. See:


Case Study: The Bottineau Boulevard Busway in Minnesota provides a case study of a project being considered see:

http://www.metrotransit.org/improvingTransit/bottineauBRT/index.asp
Transit Malls, exclusive lanes

In a number of cities, transit systems have priority usage on existing local streets with special features to facilitate transit service. These could be for transit only such as a transit mall, specific lanes for transit or regulations that favor transit service over other modes. These can be used by buses or by light rail systems. Very often they use extensive street furniture and amenities that favor pedestrian and bicycle users, especially when done in an urban central business district. They also often used for special events such as art fairs and may have street vendors as well.

Figure 9: Transit Mall on Nicollet Avenue, Minneapolis, Minnesota, USA
Figure 10: Light rail station in downtown Minneapolis, right of way shared with highway traffic
Bus/Bus and Bus/Rail and Rail/Rail Connectivity

An important part of any system is to create good local connections between collector systems such as a local bus and the fixed guideway systems. This is often done at outlying stations which combine park and ride facilities and a bus terminal or at a central city terminal. In some cases the facility also can include retail activity and services.

Figure 11: Minneapolis Light rail/bus transfer at 46<sup>th</sup> Street station

Figure 12: Portland Light rail/bus transfer station
Figure 13: San Diego Bus/Light Rail transfer at Old Town Station

Figure 14: Commuter rail/Light rail transfer station, San Diego
People Movers, AGT Automatic Guideway Transit, PRT--Personal Rapid Transit

A small automated vehicle, with no operator, that provides service on separated guideway (“horizontal elevator”). These systems have been used in airports (Seattle, Atlanta, Tampa, Dallas, Newark) and also in Miami, Detroit, and Jacksonville downtowns.

Figure 15: Dallas Airport People mover

Dual Mode

Vehicle operates on fixed guideway and also on regular streets, its own feeder. (PRT with on-board power source, or PRT pallets.) There are limited actual applications of these systems.
Monorail

Monorail is a fixed guideway transit system similar to Heavy rail which uses only one rail rather than two. Two types: suspended and supported. New systems of supported monorail are being built in Japan, then use less space than heavy rail, and perhaps lower construction costs. They have limited application elsewhere.

Figure 16: Supported Monorail, Seattle Washington

Figure 17: Suspended monorail, Wuppertal Germany
Guided Bus

A variation that combines light rail and bus rapid transit has been used in some cities outside of the U.S. These use vehicles similar to light rail but with different ways to guide the vehicle that substitute for standard trackage. For example the Trans Lohr rubber tired tram in Padua, Italy uses a single rail for vehicle guidance and rubber tires for vehicle support. It operates primarily on existing streets. It also has the feature that it can operate by battery for portions of the line where overhead wires are undesirable.

Figure 18: Guided rubber tire tram in Padua, Italy

Figure 19: Close up of vehicle and guide rail
Paratransit

Paratransit are a family of transit like services which normally do not operate on a fixed rout or fixed schedule. These include the following:

Dial-a-Ride (telephone contact), Manual dispatched--or computer dispatched. It is often used to provide alternative transport for people with disabilities. It may be more expensive than conventional bus because of overhead, lower productivity. But it may be better for outlying areas, small towns. Normally uses a smaller vehicle and can operate in a variety of patterns:

- many to many
- many to one (gather)
- one to many (scatter)
- subscription
- fixed route, fixed schedule
- package carrier

![Dial-a-Ride, Haddonfield, New Jersey](image)

Figure 18: Dial a Ride, Haddonfield, New Jersey

Shared ride taxicab is a dial-a-ride service which is open to all persons. It uses a zone fare system and can accommodate persons with disabilities as well as regular users. Rental cars, car sharing, Jitney, Subscription bus, Van pool, Car pool have all been classified as Paratransit.