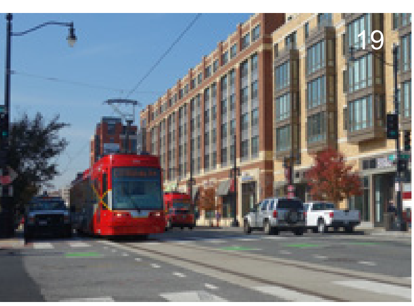
15: Light Rail substation with architectural treatment; Portland, OR

16: LRT substation factory-assembled; Denver, CO

17: Streetcar substation factory-assembled; Portland, OR

18: Light Rail catenary overhead power supply; Phoenix, AZ



19: Streetcar simple overhead power supply supported by span wire; Washington, DC

contrasts are illustrated by Photos 15 through 19. More recent streetcar projects, such as those in Dallas, Detroit, Milwaukee, Oklahoma City and Seattle, have been built with sections having no overhead wire whatsoever, using onboard energy storage systems to power the vehicles through these areas instead. Some systems in other countries use a form of in-ground power supply whereby a segmented contact rail embedded in the street is energized only when a vehicle is directly above it. In this instance, power is collected by contact 'shoes' underneath the vehicle, somewhat akin to the third rail on a rapid transit system.

Light Rail requires a ***signal system*** to maintain safe distance between trains and possibly control train speeds where it operates on separate right-of-way and usually at higher speeds and frequent intervals. In addition, traffic signals or crossing gates are required where light rail tracks cross streets. **Streetcars** operate with traffic on local streets and are subject to the same line-of-sight precautions, traffic signals, and rules of the road. In some cases, they may have some form of traffic signal priority or pre-emption at specific locations, such as turns at intersections. Some examples of these devices are included in Photos 20 through 23.

With long corridors, developed stations, and a higher capacity and frequency of service, **Light Rail** requires significantly more ***communications*** equipment. In addition to radio communication between the trains and a central control office, light rail stations employ passenger information signage, public address equipment, passenger emergency phones, closed-circuit television surveillance, and fare vending equipment. This equipment is linked by some form of communications line, such as a fiber optic cable, along the entire route. The station shown in Photo 22 has most of these features, although they are difficult to show. **Streetcars** also require a train radio system, but their stops are very simple, employing, at most, electronic 'next train arrival' signs and perhaps simple fare vending machines. Because the stops are essentially part of the sidewalk, they are highly visible and do not require dedicated communications and monitoring equipment. Again, think attractive bus stops. Photo 24 is an example of the extent of communication at a streetcar stop.

20: Light Rail grade crossing warning system; Charlotte, NC

21: Lght Rail wayside signals and pedestrian crossing warning lights; San Jose, CA

22: Light Rail station with full array of communications and security devices; Houston, TX

23: Lght Rail train warning sign for left turn lanes; Salt Lake City, UT

24: 'Next Train' arrival sign at streetcar stop; Cincinnati, OH

25: Unique traffic signals for streetcars; Seattle, WA

Fare Collection

Fare Collection on both light rail and streetcar systems is typically based on the 'proof of payment' approach whereby passengers are required to pay for their trips prior to boarding and are subject to spot checks by roving fare inspectors. Court-enforced fines are levied for those found to not have paid their fare. The difference in fare collection equipment between light rail and streetcar systems is the quantity, complexity, and location of the equipment. For **Light Rail**, as shown in Photo 26, ticket vending machines are usually full service devices, offering all forms of ticket types and means of fare payment. They are also geared to accommodate a high volume of transactions given the larger numbers and more intense concentration of light rail passengers. Stations are equipped with ticket vending machines near each access point, with at least two per station. **Streetcars**, however, cover shorter distances and have a simpler fare structure, such that ticket choices are fewer, and ticket vending machines are sized for fewer transactions. Typically, there is one ticket vending machine per stop. Some streetcar operators use sidewalk parking ticket vending machines for this purpose, similar to that shown in Photo 27, and have supplemented them with small ticket

26: Light Rail full-service ticket vending machine and smart card reader; Los Angeles, CA

27: Simple ticket vending machine at streetcar stop; Portland, OR

28: Streetcar simple ticket vending machine on-board streetcar; Seattle, WA vending machines on board the cars, as seen in Photo 28, although this practice is diminishing. Operators of vintage or vintage-look streetcars, which do not have enclosed driver's cabs, collect fares using a farebox, such as those on buses. Mobile ticketing apps, whereby one's cell phone acts as a 'purse', are also gaining popularity. Some streetcar operators provide free service and do not collect fares at all.

Vehicles

Differentiating between light rail vehicles and streetcars can be difficult because they share several common features. They use the same thoroughly proven electric railway technology; they are clean and quiet; they draw electric power from overhead wire; they have the ability to operate in a variety of alignment types; and they have level or near-level boarding capability for accessibility. What sets them apart is capacity and performance. **Light Rail** vehicles are typically longer (80-95 feet or more) and wider (8.75 feet or more), and provide seats and standing space to reasonably accommodate up to about 150-180 passengers. They are also limited to curves no tighter than about 82 feet in radius. In addition, they are capable of being linked into trains of up to four cars and designed to operate at maximum speeds up to 55-65 miles per hour. Two basic variations are shown in Photos 29 (high-floor vehicle) and 30 (low-floor vehicle). Some of the newest systems have much longer multi-section vehicles such as seen in Photo 33.

29: High floor light rail vehicles in 3-car train; Los Angeles, CA   30: Low floor light rail vehicles in 2-car train; Houston, TX

By contrast, the **Streetcars** found in the US today include vintage/vintage-look and modern cars which are shorter (40-80 feet) and in some cases, narrower (8 feet), and, therefore, have lower capacity (roughly 70-120 seated and standing passengers). Typical examples can be seen in Photos 31 and 32. They also can negotiate tighter curves of as little as 60 feet in radius. However, the cars built for some legacy systems have to accommodate much tighter radius (36 feet) curves due to the geometry of their lines, which was set decades ago. In addition, streetcars are configured to operate as single units and designed to reach maximum speeds of about 35-40 miles per hour. Their smaller size and lower speed is largely dictated by the need to fit into city streets and run with urban traffic where higher speeds are not practical.

31: Modern low-floor streetcar; Detroit, MI 32: Restored vintage streetcar; El Paso, TX
33: Long, multi-section low floor light rail vehicle, Ottawa, ON

Now Comes the Fuzzy Part...

The foregoing descriptions illustrate that there are clear differences between light rail and streetcar applications. However, in looking at some of the light rail and streetcar systems that have been built recently, the boundaries between them are not crisp, but fuzzy. Here are a few examples:

Operating Environment

The operating environment is simply a function of the market, infrastructure, and vehicle configuration variations described above. So, **Light Rail**, which is focused on radial/regional trips, can be described as having partially exclusive right-of-way, running in multiple-car trains at reasonably high speeds, serving purpose-built stations spaced somewhat far apart. **Streetcars**, which provide local circulation in urban areas, can be described as operating smaller, single vehicles in mixed traffic on city streets at street speeds, serving sidewalk stops which are several blocks apart. Table 3 summarizes the comparisons we have highlighted here.

34: Light rail vehicle operating in mixed traffic on city street; Sacramento, CA

....when Light Rail does not look like or operate like Light Rail

In Sacramento, Regional Transit operates trains as long as four cars like streetcars in the downtown (Photo 34), where they run in mixed traffic at slower speeds (35 mph or less). But outside the downtown, they operate on largely dedicated rights-of-way at speeds reaching 55 mph and higher. Light rail or streetcar?

Other places where light rail systems act like streetcars, with some in-traffic street running, include a short segment in Salt Lake City and portions of varying lengths on legacy systems in Boston, Philadelphia, Pittsburgh, and San Francisco. Light rail or streetcar?

Table 3: Typical Characteristics of Light Rail Transit and Streetcar Systems

Characteristics	Light Rail	Streetcar
Location and Markets Served		
Route Orientation/Trip Type	Radial; connecting close-in suburbs with Central Business Districts	Local Circulation in urban neighborhoods
Trip Length	Up to ~20 miles (32km)	~1-2 miles (1.6-3.2km)
Infrastructure		
Right-of-Way	Mostly reserved right-of-way; some grade separation at major streets and arterials with tunnels and aerial structures; level crossings with street traffic	Operation in mixed traffic on urban streets
Track		
Maximum grades	7%	9%
Minimum curves	82ft (25m)	60ft (18m)
Composition	Rail on ties and ballast; embedded rail on dedicated trackway	Embedded rails in street surface
Utilities	Relocation usually required due to inability to easily shift the alignment, depth of trackway and conduit	Avoidance where possible; shallow trackway structure
Stations/Stops		
Size	Sufficient length for multi-car trains	Single-car length
Spacing	~0.5-1 mile (0.8-1.6km)	Several city blocks
Location	Separate, dedicated platform	Sidewalk extensions
Amenities	Park-and-ride, kiss-and-ride, feeder transit services, large shelters, seating, lighting	Pedestrian access, minimal shelter, minimal seating, nearby street lighting
Electric Power Supply		
Substations	Large substations (1-2MW) spaced about one mile apart, linked to utility medium voltage power grid Underground feeder/return cable typically required for length of line	Smaller substations (<1MW) spaced less than one mile apart, possibly able to draw from local commercial 480Vac Minimal underground feeder/return cable, typically between substation and nearest pole
Overhead Wire	Catenary structure with pole supports	Simple trolley wire with pole supports, span wire connected to poles on sidewalks or attached to adjacent buildings

Characteristics	Light Rail	Streetcar
Infrastructure (continued)		
Signals		
Safe Train Separation	Wayside or onboard signals on reserved right-of-way	Line of sight
Traffic Priority/Pre-emption	Grade crossing warning systems and traffic signals	Traffic signals where needed to protect conflicts with street traffic
Central Control	Train location, train routing, monitoring and control of equipment in the field (e.g., substations), station CCTV monitoring	Streetcar location display from external systems (e.g., NextBus); limited monitoring and control of critical elements like power supply
Communications		
Operator/Dispatch	Radio system with consoles in Control Center	Radio channel on existing system, or cell phones
Passenger Information	Active signage, public address	Active signage
Passenger Security	CCTV, passenger emergency phones	Sidewalk line of sight
Networking	Communications trunk lines	Little or no trunk lines
Fare Collection		
Fare Media Sales	Full-feature ticket vending machines; sales outlets	Simple ticket machines at stops and/or onboard; onboard fareboxes
Fare Collection/Payment Enforcements	Barrier-free, proof-of-payment w/ inspection	Free fare; or operator-monitored; or barrier-free, proof-of-payment w/inspection
Modern Vehicles		
Length	80-95ft (24-29m)	66-80ft (20-24m)
Width	8.6ft (2.65m)	8-8.6ft (2.46-2.65m)
Maximum Speed	55-65mph (100-110kph)	44mph (70kph)
Trainability	Yes (couplers)	No (Towbars)
Vehicle Capacity (Seated/ Standees)	70/130	30/90
Operating Environment		
Average Schedule Speed	20-25mph (32-70kph)	8-12mph (13-19kph)
Train Length	Up to 4 cars	Single cars

35: Streetcar operating in dedicated right of way; New Orleans, LA

36: Streetcar operating in mixed traffic; New Orleans, LA

.... when a Streetcar does not look like or operate like a Streetcar

A major portion of the New Orleans Streetcar network, the oldest continuously operating system in the US, runs in dedicated right-of-way rather than in mixed traffic for much of its distance. See Photos 35 and 36. Streetcar or light rail?

In late 2013, the Utah Transit Authority (UTA) opened its Sugar House Streetcar line (now called the S-Line) using vehicles nearly identical to those that operate on its extensive light rail network. The streetcars run on what was once a freight branch line situated behind homes and businesses, both commercial and industrial. Running on dedicated right-of-way with no mixed traffic, as shown in Photo 37, is it streetcar or light rail?

The City of Atlanta acquired some of these same vehicles, through UTA, that run on its new streetcar line in the downtown. The system is planned to be extended to a corridor dubbed the BeltLine, a collection of former railroad freight lines which, when joined, will form a ring around the city close to the downtown. While still in the planning stages, if the streetcars leave mixed traffic and turn onto the BeltLine right-of-way, do they lose their identity as streetcars and become light rail vehicles?

Similarly, the Charlotte Area Transit System (CATS), which operates a light rail line, is completing a modern streetcar circulator in its downtown. The two are physically connected such that the new vehicles being purchased are designed to safely carry passengers on both the higher speed dedicated right-of-way of the light rail line and the low speed streetcar line mixed with roadway traffic.

The City of Portland is well known for its regional light rail system operated by TriMet and its own downtown streetcar system. Light rail runs down its own lane on city streets, but at slow speeds and subject to the traffic signals that control roadway vehicles. The streetcars run in mixed traffic at similar slow speeds and are also subject to traffic signals. In 2015, light rail was extended to the southeast part of the region crossing over the Willamette River on the new transit-bike-and-pedestrian-only Tilikum Bridge (Photo 38) … the same bridge and on the same rail that the streetcars use to complete a loop of the downtown. Train signals are in place to control access across the bridge to avoid mixing the two rail modes in the same track.

37: Streetcar operating on dedicated right of way; Salt Lake City, UT

38: Tilikum Crossing bridge that carries light rail, streetcars, buses, bikes and pedestrians; Portland, OR

Conclusion

There are many examples that clearly illustrate how we have described light rail and streetcars, as well as the fuzzy middle. Hopefully, this brochure has been an aid in better understanding these two modes of rail transit and a recognition of their common features.

Perhaps the best conclusion from this information is that it is less important what you call a rail transit project than it is to understand what flexibility you have in making it work best for you in your community.

Credits

The primary authors of this document were Thomas B. Furmaniak, P.E., and John W. Schumann of LTK Engineering Services. The graphic design and layout was done by Alexis O'Rourke and Daniel Muck, also of LTK. Valuable critique and edits were provided by members of APTA's Light Rail Technical Forum and Streetcar Subcommittee.

The majority of the photographs in this publication were supplied by staff of LTK Engineering Services. By exception, others include:

Photo 1, Page 3: Seashore Trolley Museum
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