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Local Rail - An Overview

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This is a guest post by DoDo, a railway professional in Hungary who front pages over at the European Tribune and posts here on TOD under the same name.

BruceMcF introduced us to various local transport modes as potential 'recruiters' for high-speed rail. Pursuing most of these is worth on its own, for local traffic. This diary expands on one of these: local rail. As the Recruiters diary indicated, local rail is just one alternative, but it should be the backbone of any decent public transport system.

Public transport near Budapest's *Keleti pályaudvar* (East Terminal): express and local rail (black), subway (thick red), light rail (thinner red), trolley bus (dashed red), bus (blue) all linked up. Blaha L. t. to the West is again a hub.

Below, I first want to chart distinct categories of local rail: describe their specialities, their differing best uses, and some newer developments. In the real world, however, the boundaries of those categories are rather blurred, what's more, different locales use a bewildering array of rail terminology. But there are also some ingenious ideas mixing the 'basic categories', some of them will be described below, too.

This diary can also be viewed as a general guide as to what kind of projects local initiatives could aim for, and tries to give examples around the world that can be used as model for supporters and argument against opponents.

Stopping train/local service

A 'normal' railway line runs between two transport hubs (or radiates from one), and has stations

in wayside towns. Running passenger transport on such a line is aimed for the outer commuter belt, it is the longest-distance (and potentially fastest) form of commuter service. It is typically also the most 'concentrated': it functions best if stations are transport hubs themselves (for buses etc.), it doesn't run too frequently, but can have high capacity.

In North America, an example could be the services around New York City still maintained by Metro-North.

'Normal' stopping trains often **share tracks with freight** trains. This can be both a blessing and a curse: a blessing if with passenger alone the line would make too high losses, a curse if passenger has no priority and has to face delays.

It is generally a good idea to strive for lines that don't **end** out in the nowhere, but **in another major hub**. This increases utility for passengers dramatically, and even if most passengers would almost always go to one of the hubs, the *possibility* of occasional trips into much more directions could draw new passengers overall: people who keep to cars for those occasional trips.

Systems centred on a city usually branch out. An old idea to rationalise such service is running '**wing-trains**': two trains run together until the junction station, and then continue separately. However, such attempts were often abandoned due to technical difficulties causing delays and extra costs. But lately, this idea finds increased application in Europe, with the spread of modern **multiple units** in place of locomotive-pulled trains: state-of-the-art electronics and automatic couplers make the option more viable.

Värmlandstrafik's X53-2 No. 3286, a wide-body electric multiple unit from Bombardier's Regina family, stops as local service in Arvika, May 2004. Photo by Jan Lindahl from SJK

Both prior paragraphs imply a need for a good timeplan, and traffic control able to keep trains on-time. In Switzerland, the latter aim led to a reversal of the normal order of things: instead of setting up a timeplan according to the characteristics of the line, some line upgrades are built where they help the timeplan best. That is, for example along the single-track line from the capital Berne to Langnau, a couple of **double-track sections** (e.g. over-long passing loops) have been built, so that a small delay of one train won't cascade to the trains in opposite direction.

A novelty that sounds simple but was difficult to implement, yet brought so positive results in

passenger numbers that it now spreads around the world, is the **regular interval timeplan** (or sometimes named by the German word *Taktfahrplan*): the idea to run trains at the same minute each hour (or two hours or half an hour). On one hand, this way passengers can remember times easily, on the other hand, introducing such a timeplan usually means a higher frequency, which again has a higher utility for passengers (e.g., even if some midday or late night trains run less profitably, new passengers drawn make the other trains even better earners).

On the rolling stock front, beyond multiple units, bi-level or double-deck trains also live a renaissance, also in North America. The lower floor of bi-level cars is also ideal for what has now became standard on European local trains: **bike transport**.

Modern **railbus**es gave new life to many European non-electrified branchlines. These are one- or two-car trains with compact engine packs, easier-to-board low floors, and a lighter chassis, in cases demanding special rules of traffic alongside/in normal trains. These kinds of trains don't spread fast in the USA, because AAR doesn't want to create a special category for them. Thus, either something similar but heavy (and expensive) has to be built (see Colorado Railcar's Aero DMU), or imported European trains are run as "light rail". An example is New Jersey Transit's River LINE, running GTW 2/6 railbuses of Swiss maker Stadler on a track also used by Conrail by night.

Though ridership grew healthily, constantly (from 4,200/weekday in spring 2004 to 7,350/weekday in 2006) and beyond projections(5,900/weekday), economically, the River LINE is also a truly bad example of re-starting service on an existing line. I just can't explain what cost $1.1 billion on a mere upgrade of an existing single-track 34-mile line without any major superstructures. But, since opponents of public rail transport projects like to cite it as example, I give an example of how **restarting passenger service** is **done right**.

The *Schönbuchbahn* was a 17 km (11 mi) branchline near Stuttgart, Germany. With no maintenance and a busy main road built in parallel, daily ridership dropped to one or two hundred, so the national railways ended passenger service in 1966. Local initiatives kept demanding a re-start, but the national railways projected only 1,250 trips daily even with full renovation, which is too little.

Then the locals pursued the takeover of the line by a regional railway, which projected twice as many daily rides: 2,500. Ambitious, given that buses carried 2,000/weekday in a region of 24,000 inhabitants. But the concept they hatched was ambitious, too:

1. full renovation of the since disused track
2. stations should be built where passengers can be expected
3. new railbuses must be bought & locally maintained
4. 30-minute regular interval timeplan
5. bus companies should re-arrange their services from parallel to feeder routes
6. adjustment between the timeplans of this railway, the Stuttgart rapid transit it feeds into at one end, and buses that feed it
7. businesses and public institutions should adjust their work hours for the railway, above all schools
8. local communities should raise a reserve pool of €0.6 mio/year for operating costs

Schönbuchbahn before and after: track at kilometre point 7.4 in October 1994 (above) and August 1996 (below). Photos by Aschpalt from PROBAHN

After spending €14.6 million on construction and purchase, the line opened in December 1996. On the very first workday, 3740 were carried. By spring 2003, 6,800/weekday was achieved, over two thirds left their cars, and bus ridership doubled, too. About the same sum as the original investment was spent on enhancements for the unexpected traffic load.

Rapid transit/commuter rail/S-Bahn

The dense inner parts of a city's commuter belt can bring very heavy traffic, say 10-50,000 trips a day. To manage it, railways often added extra tracks, built more frequent stops, built elevated platforms to ease and accelerate boarding, and purchased rolling stock with high acceleration and many doors. Such service could even spin off as a separate network. Thus rapid transit formed, already in the steam era.

A North American example could be the Long Island Railroad.

Recognition as separate category was the clearest in late 19th century Germany, where it was called *Stadtschnellbahn* (= city fast rail). Today the short form *S-Bahn* is a household name. By the 21st century, all major German, Swiss and Austrian cities got *S-Bahn* networks as the backbone of their transport system, with other networks from subways down to buses tightly integrated at stations. Most *S-Bahn*s use electric multiple units (EMUs) with high acceleration or locomotive-pulled double-deck trains. As opposed to normal local service, the ideal is **not connecting two hubs, but** connecting two commuter lines: e.g., trains **crossing the city**, so less passengers have to transfer. Often, multiple lines share the same central section in the city,

which functions as an artery.

These *S-Bahn* networks carry the bulk of local rail passengers, and demand sustains a high level of further investments even if elected leaders aren't progressives, a level comparable to that spent on high-speed rail.

As an example, the Swiss canton and city of Zürich (the former has 1.27 million, the latter 370,000 inhabitants) voted in a referendum to build an *S-Bahn* network instead of further road construction. The plan included some new lines (mainly in tunnel under the city), new tracks and stations along existing lines, and 115 new purpose-built four-car double-deck EMUs, which should enable a timeplan that on some relations is *faster than for express trains*. The system started in 1990, and *evolved into a monster* since.

Currently, 26 lines along 380 line-kilometres serve 171 stations, carrying more than 320,000 daily passengers. Traffic growth called for several enhancements. A few years ago, a two-track line was 'doubled' by adding another two tracks for express trains in a 10-km tunnel. 120 new-generation double-deck EMUs are in delivery, while the old ones remain in service. The $1.2 billion project of adding a *second* central artery in a 6 km tunnel is underway. (Compare to the incredible $8.7 billion cost estimate for the 3 mile long North-South Rail Link tunnel for Boston.)

One of Zürich *S-Bahn*'s second-generation bi-level EMUs on a test run: RABe 514 004 on the Winterthur-Etzwilen line, March 22nd, 2006. Photo by Reinhard Reiss, from RailFanEurope.net

A rapid transit system doesn't need to be bound to a single large city. Near the source of the Danube, lines connecting half a dozen major towns form a circle. This circumstance inspired the *Ringzug* concept: the integration of all local services into an *S-Bahn*-type service, with lines 'bending around' the ring in horseshoe shape, platforms rebuilt, new stops and some extra track. A not yet complete ring is in service since 2003, and brought significant growth. For US conditions, I note that this system uses diesel railcars.

Heavy metro/subway/elevated

For traffic corridors *within* a major city, for acceptable speeds (and curve radii), you have to leave street level. There are two ways to go: up and down.

At the turn of the 19th and 20th centuries, both were tried. But elevated railways, while somewhat cheaper to build, still take away building space, emit noise all around, and are exposed to weather. So, while New York's system has a lot of elevated sections, the even more subway sections gave it its name, and Chicago's 'L' is rather unique in still being dominated by elevated sections. Of the few modern examples, I note Vancouver's SkyTrain, and the first lines of Taipei's system in Taiwan and Bangkok's in Thailand.

Urban rail in major cities (say half a million or more) also means corridors with the heaviest traffic (say upwards from 100,000 trips a day). You need something even more high-capacity than a normal rapid transit. Two possibilities remained for that: running trains more frequently, and providing more space to standing passengers. The first demands dedicated lines, both demand purpose-built trains. The dedicated lines can, however, extend out from the densest part, and run on the surface, much like a normal rapid transit service. New York, San Francisco has such lines, and Washington D.C.'s was built so very purposefully.

In North America, heavy-load urban rail service is commonly not even separated from 'rapid transit'. Elsewhere however, using the name of the fifth subway system in the world, Paris's, 'metro' is the generic name, and is considered a separate category, especially as many cities have both systems overlaid.

Impressions from the busiest and most beautiful subway in the world: Moscow's Metro, with its rich 'Stalin-baroque' interieur. By Andron3

I stressed the importance of connection with other modes of public transport at stations. This doesn't just mean location. It's already good to have with normal rapid transit, but essential for metros to have **common ticketing** with buses and light rail, so that travellers don't have to buy a separate ticket or monthly card for each leg of their journey/commute. In an American context, also worth to point out: such tickets take away the stigma of a bus ride ("I'm just hopping on to the train station" will be the initial excuse).

France is also the origin of a new development: VAL type metros. The steel-on-steel roll of classic railways has the problem of low adhesion relative to rubber-tyres-on-pretty-much-everything-else. On the other hand, rubber tyres on rail don't bear too high loads, and there is the issue of interoperability with existing lines. These problems matter least for metros, with their dedicated passenger-only lines, especially in cities still only about to build their first line.

Metro systems are still growing all around the world. I give some examples of recent fast growth.

The subway system of South Korean capital Seoul started only in 1971, the system was more than doubled in the nineties, and this year it will grow to the world's third longest (after London & NYC) with around 320 km (200 mi) line length.

The Chinese boom didn't just brought an explosion of cars. A dozen major cities, above all Beijing, Shanghai and Guangzhou, construct subway systems at breakneck speed for about a decade now. All but one are totally new, yet the aim for the three mentioned is systems the size of New York's or Seoul's in another decade.

In Europe, Spain was most wise in using EU Structural Funds, and that with support from both political sides. Only Madrid and Barcelona had subways before the Civil War, not much happened under Franco's dictatorship. But today, half a dozen cities are busy boring tunnels, and Madrid's system quadrupled. For a developed Western country, Madrid should be the example to follow in how to build subways.

Urban rail system of Madrid (click for full-size version). Pink is *Cercanías* (suburban rapid transit), red-bordered yellow is in-construction light rail, the rest subway. Dashed: built in the 2003-7 period (note that the rapid transit central artery is doubled, too -- includes a 7.5 km tunnel). Map from The Subway Page

Metro Madrid added more than 40 km (25 mi) in a four-year period to 2003, and another 56 km (35 mi) heavy metro this year -- to a total of 283 km (176 mi) -- note that Madrid is a city of just 3.2 million. The showcase project of the previous four years was Line 12 (yellowish green on the map), nicknamed MetroSur. This ring line doesn't circle the city, but serves a couple of suburban towns by distributing traffic from radial subway and rapid transit lines. Planning, tendering, boring, fitting out with concrete lining and tracks and electronics of this 40.5 km all-tunnel line;

station construction; and purchase, testing and commissioning of subway trains was all done *within four years* and on a budget of *only €1.1 billion*! **On time and budget** in the extreme! Compare that to the time and cost earmarked for New York's 8.5-mile Second Avenue Subway project.

Light rail/Tram/Trolley/Streetcar

In a city, one may also opt for street-level transport, gaining easier access at the price of lower speed: you have to wait at cross-streets. This idea was first tried in the USA: in New York in 1832. But it really took off in the last two decades of the 19th century, after Werner von Siemens invented electric trains: lack of air pollution and good acceleration were the decisive factors.

The new transport mode, variously called tram, streetcar, and trolley. had some specialities forced on it by streets: rolling gear and body made so that tight curves can be negotiated, cars are narrow, entrances are for practically rail-level boarding, not too high speeds allow catenary on the cheap, and special rails are sunk in the pavements. Also, with no need to be strong enough for long trains, cars could be built lighter, hence the modern name light rail.

Trams evolved for half a century (which I documented with examples from my hometown Budapest/Hungary), but then got stuck. In the USA, the PCC made the revolutionary switch from single axle rolling gear to bogies (which give a smoother ride) in the thirties, but still from the next decade, nothing held up the clearcutting of streetcar lines to make way for buses and cars. Funnily, starting from a PCC license, Czech maker ČKD became the world's biggest tram supplier during the time of the more public transport friendly East Bloc, Tatra tram parts were then even used in New Orleans. Western Europe got as far as articulated trams in the fifties, but then the big cull started there, too, and the surviving systems seemed struck in that age.

All-weather service: a type T5C5K at *Moszkva tér* in Budapest, a Tatra built in the eighties. February 13th, 2004. Photo by Ákos Varga from from RailFanEurope.net

That there is now an on-going **light rail revival** had reasons in technology. The following appeared in trams from the seventies, many of which later found their way into normal trains:

- AC motors: beyond being lighter and stronger than DC motors, they provide continuous acceleration (thus no jerks due to switching between speeds), and by using the as generators, they can function as brakes;
- disc brakes;
- rubber and air springs, dampers: smooth ride instead of the classic rumbling;
- air conditioning;
- new automated door mechanisms: you can make entrances that can adapt to platforms of different height.

All these technologies were successfully merged for the vehicles of the *Stadtbahn* systems in West Germany (covered in the next section), and also in Japan. There was an attempt in the Oil-Crises-era US too, but, unfortunately, the Boeing-Vetrol-developed US Standard Light Rail Vehicle was plagued by construction problems, so light rail systems now rely on imports.

The light rail revival really took off in the nineties, thanks to another innovation spurt in France:

- size reduction made low-floor trams possible, with most of the electric equipment on the roof;
- lightweight alloys could be used for lighter carbodies (though some manufacturers had big problems with these);
- departing from bland industrial designs, trams with more stylish and aerodynamic fronts made trams hip (for example Straßbourg's Tram from 1994).

Sometimes politicians treat light rail as if it were an alternative to subways or rapid transit, a cheaper alternative, but that is a bad idea to have. The busiest light rail line in the world, the one along the Grand Boulevard in my hometown Budapest, has a weekday ridership in excess of 200,000, but it is constantly crowded and relatively slow despite extra-long trams every 2-4 minutes.

Light rail is the right choice for ten to hundred thousand daily trips, not higher (or lower). With that, it could serve as the backbone of public transport in cities between 100,000 and 3-500,000 inhabitants. Above that, it's best used as **feeder/distributor** for heavier rail systems. For example, should the METRORail in multi-million city Houston expand into a real city-wide system and induce a large proportion of inhabitants to switch to public transport, I'm certain the addition of a proper subway or express railway would become unavoidable.

In major cities, light rail can be especially useful as further-from-the-centre **orbital service**: traffic volume is usually much less than on radial lines, but most people would need to travel that way at least sometimes. London, Paris, Madrid have/are building such lines. One has been proposed for the US capital too, the Purple Line, to alleviate the one big problem of the fine DC Metro.

I close this with another technology innovation from France: light rail without catenary (overhead wire). Bordeaux's new light rail line has a segmented third rail in the middle, whose segments are put on voltage with a radio signal only when a tram is above. Attempts at ground-level power supply have a 120-year history, but after heavy teething problems, this one seems to work.

High-tech, style, low-floor comfort in one: a Bordeaux tram (an Alstom type Citadis302) on a catenary-free section at Quai Richelieu, August 16th, 2004. Photo by P.Chapar from RailFanEurope.net

Light metro/Stadtbahn

Adding tunnel sections, grade-separated inner-city and perhaps out-of-city high-platform stations, light rail gains the characteristics of metros and suburban rapid transit. This is often referred to as 'light metro'. A good North American example is what became of most of San Francisco's streetcars in 1978: the Muni Metro.

As often is the case, the idea is not new, only its application as a concept. The pioneer may be the streetcar line banished into a tunnel 110 years ago in Boston, which became the core of the Green Line [so-called altough it's not a single line].

An impetus for light metro development was the reconstruction and development of bombed-out West German cities after WWII, when people saw an opportunity for reinvention rather than just reinstalment, and that relatively cheaply. Also the well-developed *S-Bahn* systems reduced the need for the high capacity and rapidity of heavy metro. From the sixties, a dozen medium-sized cities converted some classic tram routes into light metro networks, for example Frankfurt (see a very good map of its overlaid *S-Bahn* and (light) metro [*U-Bahn*] systems at JohoMaps). Systems with little or no subway got yet another new name, *Stadtbahn*.

With light metro, I shall again emphasize that notwithstanding some policymakers' claims, it is no substitute for heavy metro. The same capacity limits apply as for normal light rail.

The Karlsruhe Model (tram-train)

Meeting in the freshly renovated Forbach-Gausbach station on May 18th, 2002: left a push-pull stopping train in limited-stops service, right dual-system tram No. 824 of Karlsruhe's *Stadtbahn*.
Photo by Der Eisenbahnfotograf

This isn't an entirely new idea either. There used to be a category of railways that ran tram-like vehicles, but on lines that go out in the countryside and then enter other towns: the overland tramway or **interurban** (see for example the Electroliner). Most were torn up, or converted into normal local rail, or normal light rail (if sprawl ate up the area).

Karlsruhe is a city of 286,000 in Southwestern Germany. While the city had urban trams, one private narrow-gauge overland tram led to a nearby town. Then in 1957, it came that the city got control of the overland tram. They decided to re-gauge and connect it to the system of the city proper. This took nine years, but then proved a success, and another nine years later, an expansion into a *Stadtbahn* network began, also absorbing former normal rail lines.

Once they wanted to get an electrified line. Then they got a bright idea: instead of buying and converting it, why not just build a connection, and buy two-system trams? Sounds simple, but a lot of technical and regulatory stumbling bocks had to be cleared, from collision prevention to train controls. But, in 1992, traffic started.

Thus the Karlsruhe model was born: trams leaving cities on normal rail lines, and leaving normal rail lines in cities. Yes, plural: once you have a bi-modal tram, nothing stops you from building tramway branches for downtown access in smaller cities of the agglomeration!

By today, Karlsruhe's *Stadtbahn* expanded into a 423 km (263 mi) network spawning as far as 80 km (50 mi) away from the core city, with tramway sections in half a dozen other towns, while traffic grew heavily (1960: 6 million, 1990: 19 million, 2005: 63 million rides).

So far the model was copied in a number of other German cities and in the Netherlands. Two East German cities applied the idea in reverse: in Zwickau and Chemnitz, the railbuses of normal rail lines enter town on tramway tracks.

Rail bus VT 42 of regional railway Vogtlandbahn next to a normal tram at Zwickau Zentrum on February 10, 2002. The tram is narrow-gauge, so joint sections are 3-rail, but stations are separate. Photo by Marco van Uden from RailFanEurope.net

RER

Réseau Express Régional (=Regional Express Network) is essentially nothing but rapid transit resp. *S-Bahn* in another language, French. Indeed one system called so, that of the Belgian (and EU) capital Brussels, is indistinguishable. (As I mentioned above the fold, local rail terminology is totally chaotic.)

But the reason for a separate treatment based on the first RER, that of Paris, has to do with long city tunnels.

This again is not entirely new. There is the through line formed by the tunnels into New York's Penn Station (1910). There is the North-South central artery of Berlin's *S-Bahn*, which has six stations along a 5.9 km (3.7 mi) tunnel (1936/1939). The latter is an example of cities with (multiple) terminal stations pursuing underground connection of commuter lines. Younger examples are the rapid transit central arteries of Madrid, Frankfurt, Munich, Zurich; and Seoul's metro line 1 is co-used by suburban trains.

In Paris, the connection of the suburban lines going into the eight (now six) terminals was pursued from 1969 as a *network* concept. While suburbanites 'see' commuter rails bundled together into five rapid transit line families, for city-dwellers, the inner sections function as an express subway: today RER trains traverse four long tunnels (altogether 60 km/ mi underground). The in-the-city part of RER line A is the busiest non-Japanese heavy rail in the world (273 million trips a year).

Extreme capacity: lots of wide doors and two levels of an SNCF MI2N (series Z 22500) EMU at Haussmann-St-Lazare station, on the underground part of line E, January 1st, 2000. On line A, two five-car units form a train. Photo by Jörg Kuntz from RailFanEurope.net

What I described is something for the largest cities. Similar systems are planned in London (Crossrail) and Shanghai.

Conclusion

I emphasize again that the presented good examples from around the world are meant for use as argument of how well things could be done, and named bad examples from the US to stress that it doesn't have to be that bad. Of course, all is not well elsewhere too, there are plenty of projects over budget due to corruption and/or incompetence, and existing systems not in the best shape.

Subtitled trailer of genre-mixing movie Kontroll, whose anti-heroes are loser ticket controllers on a nameless ex-East-Bloc subway (filmed in its entirety on lines 2, 3 of the Budapest subway).

But the good news is that today, if you achieve a halfway decent ridership gain on an urban rail project, even on a scandal-ridden one, you gain a supportive subpopulation. People who may complain and growl, but will put enough pressure on local leaders to maintain the line, what's more, will demand extensions.

One thing is sure: even without overpriced projects, fitting all the car-dependent US cities with local rail systems would cost a helluva' lot of money. But so what. If you get the ball rolling, you can get the critical mass to support it. As the Zürich example shows, people may even vote in a referendum for rather expensive projects calling for their tax money.

Don't go for flashy futuristic projects, or follow those claiming a super-cheap alternative. Look at what best suits local conditions, focus above all on potential ridership.

Always think in networks, even if a line built will be part of one only in decades. And coordination with other modes of transport, or even work hour schedules, is essential. This involves road traffic: say, you need new traffic lights and information campaigns for car drivers who lack life experience that a even a streetcar can't brake for them, but is so much stronger it can crush your signal-ignoring car -- to avoid frequent incidents like on Houston's METRORail. But just in public transport, you can have several levels, all for differing kinds of travel, superimposed and linked up, say these seven levels:

1. high-speed rail (to get to major cities up to 800 km/500 miles away under three hours),
2. express rail (to get fast to smaller cities in a few hundred km/miles, or from those to the next two major cities),
3. normal stopping trains (to get to towns and exurbs around a major city, or from those to the next two cities),
4. rapid transit (for rapid commute in the dense inner parts),
5. metro (for travel in the city unhindered by street traffic),
6. light rail (for travel on major streets to get to your neighbourhood/near your workplace/shop),
7. buses (for travel within a neighbourhood to within a minute or two of your destination).