

Regional Rail: Best Practice Versus New York Practice

Alon Levy

November 9, 2017

Table of Contents

Introduction

Frequency

Fare Collection

Local Service

Integrated Fares and Planning

Through-Running

Lessons for New York

What is Regional Rail?

Regional rail means public transportation that uses conventional rail tracks, serving cities and their suburbs.

Examples:

- ▶ New York: LIRR, Metro-North, NJ Transit
- ▶ Other US cities: Metra (Chicago), MBTA Commuter Rail (Boston), SEPTA Regional Rail (Philadelphia)
- ▶ German-speaking cities: S-Bahn
- ▶ Paris: RER, Transilien
- ▶ London: commuter rail, Overground, Thameslink, Crossrail
- ▶ Japanese cities: commuter rail

The goal of this talk is to explain why regional rail works better in Europe and Japan, and what New York could learn from their examples.

Why Regional Rail?

Regional rail has one key difference from the subway: it **runs on legacy rail track**. Legacy railroads usually go far out of the city, reaching other cities, serving suburbs on the way.

The subway only covers about 2/3 of New York and no suburbs. Transit use is high in the subway service area and low elsewhere.

Regional rail can also be **faster**. The RER A averages about 50 km/h end to end. Express trains in New York average at best 35-40 km/h, and only on short segments.

Commuter rail in New York gives people fast connections from the suburbs to Penn Station/Grand Central at rush hour, but isn't too useful for other trips.

Regional Rail Ridership Comparison

Regional trains get more ridership in Europe and Japan than in the United States.

City	Population	Metro	Regional rail	Light rail
New York	22.5	1,800	260	21
Paris	12	1,520	1,100	290
Berlin	5	535	417	175
Hamburg	3	218	221	
Munich	2.8	390	300	104
Madrid	6	570	264	20
Tokyo	35	3,151	10,372	39

All numbers are in millions; ridership is annual

Subway and PATH ridership in New York is respectable, but commuter rail ridership is weak, driving the difference in overall transit use with the other example cities.

What Makes for Good Regional Rail?

Regional rail in Paris, Berlin, and Tokyo aims to provide the same service levels as the subway. This means,

- ▶ High frequency all day, not just at rush hour
- ▶ Low-cost fare collection: faregates or proof-of-payment, not conductors
- ▶ Local service (a stop every 1-3 km), not just express trains
- ▶ Affordable fares, same as the subway, with free transfers
- ▶ Through-running: trains go from suburbs on one side of the city to suburbs on the other side

Frequency

Frequency is freedom —Jarrett Walker

There is a minimum frequency for transit to be useful. The shorter the trip, the more frequent service has to be. On subways, it's 5-10 minutes. On longer-range regional lines, lower frequency is acceptable, but the minimum is a train every 15-30 minutes.

RER and Berlin S-Bahn branches have a train every 10-20 minutes. They interline to trunks with a train every 4-5 minutes all day.

Tokyo commuter trains have 5-minute frequency until midnight, going 40+ km outside Central Tokyo.

New York commuter branches come every hour off-peak, occasionally twice an hour. Only a handful of stations get frequent service, such as Jamaica.

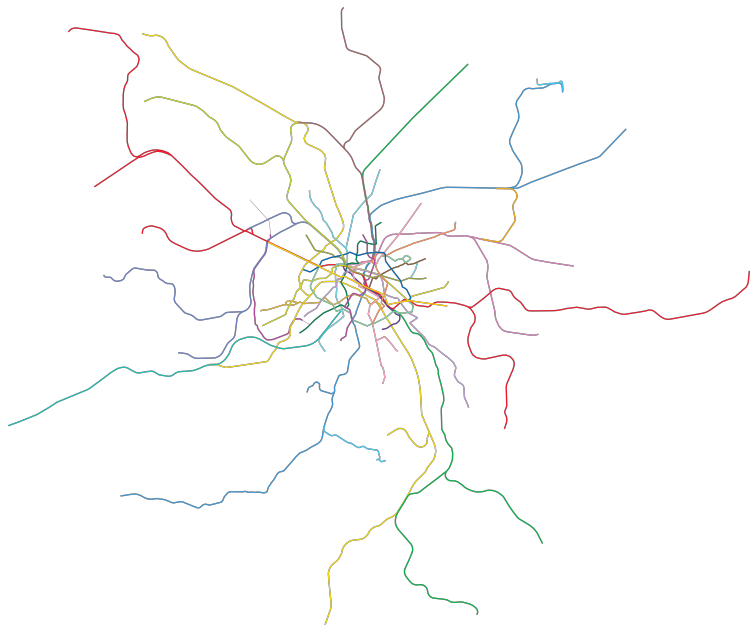
Maps: New York

Some same-scale maps of frequent rail transit networks by city.
Only lines with at worst 20-minute midday frequency are depicted:



Source: <http://alexander.co.tz>

Maps: Paris



Fare Collection

High frequency requires reducing variable operating costs.

Trains should run with a 1-person crew, a driver, without conductors as in New York.

There are two ways to collect fares on rapid transit: faregates and proof-of-payment (POP).

Faregates



Passengers need to tap, swipe, or insert a farecard to enter and exit. Examples: Tokyo, RER in Paris, New York subway.

This is best used on systems with **high traffic per station**.

POP

Roving inspectors (**not cops**) do spot checks for tickets and fine passengers caught without a valid fare. Examples: Germany, Switzerland, RER in suburbs, American light rail.

This is best used on systems with **low traffic per station**, since costs scale with ridership, not system size.

It's also better for systems that share tracks with intercity rail, such as at Penn Station—it's hard to gate intercity trains.

It's probably better for American regional rail than faregates.

No Conductors!



Photo: conductor on New York Central, 1934

NY commuter trains still have conductors punching tickets. The LIRR pays about \$1.40/car-km for conductors (LIRR opex: \$11), plus benefits. This should be replaced with faregates or POP.

Commuter Rail Stop Distribution

PW Branch	km	RER to MLV	km
Woodside	7.8	Gare de Lyon	2.8
Flushing	15.2	Nation	5.1
Murray Hill	16.6	Vincennes	7.8
Broadway	17.8	Val de Fontenay	12.3
Auburndale	18.7	Neuilly-Plaisance	14.5
Bayside	20.3	Bry-sur-Marne	15.8
Douglaston	22.4	Noisy-le-Grand	17.6
Little Neck	23.3	Noisy-Champs	19.9
Great Neck	25.3	Noisiel	22.6
Manhasset	27.7	Lognes	24
Plandome	29.5	Torcy	26.6
Port Washington	32	Bussy-Saint-Georges	30
		Val d'Europe	35
		Marne-la-Vallee	37

Observe: 2:1 ratio at the third stop, nearly 1:1 at the last.

Infill Stops

Inside the city and inner suburbs, best industry practice is a local stop every 1-3 km, like an express subway.

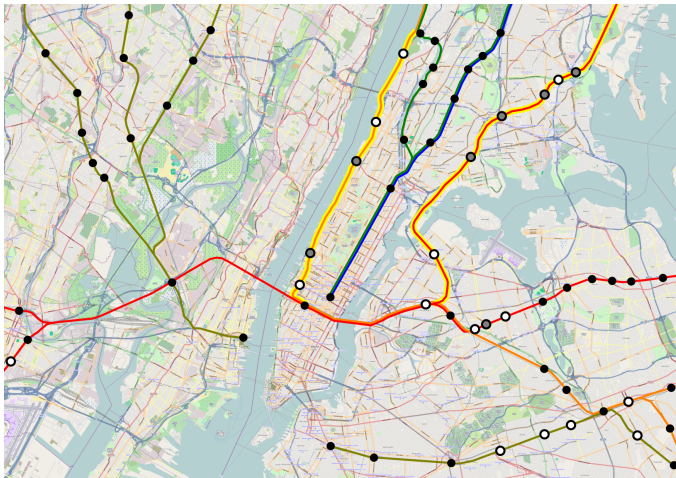
Stop locations should maximize transfers to the subway and buses.

Potential infill in New York:

- ▶ Penn Station Access, with extra stops at Astoria and Pelham Parkway
- ▶ Metro-North service on the Empire Connection
- ▶ PW Branch: Corona, Elmhurst, Queens Boulevard
- ▶ LIRR Atlantic Branch: Cypress Hills, Woodhaven, Richmond Hill
- ▶ NJ Transit: Newark South Street
- ▶ Gateway Tunnel: Bergenline Avenue

Map: Infill

Black circles represent existing stations, gray ones planned stations, white ones additional potential infill. Highlights indicate new lines.



Local Frequency

New York commuter lines do make a bunch of urban stops, but most trains skip them off-peak. Examples:

- ▶ Melrose and Tremont: 1 train per hour (tph) stops, 6 skip.
- ▶ Morris Heights and Uni. Heights: 1 tph stops, 2 skip.
- ▶ Forest Hills and Kew Gardens: 1 tph stops, ~5 skip.
- ▶ Hollis, Queens Village: 1 tph stops, 3 skip.
- ▶ New Hyde Park, etc.: 1 tph stops, 2 skip.

High frequency is the most important at short range. The RER runs some express service, but all trains make all stops in the city, and the local frequency in inner suburbs is 4-6 tph.

New York Practice: Premium Fares

The LIRR and Metro-North charge premium fares:

Station	Fare	Alternative	Fare
Forest Hills	\$ 6.25	Subway	\$ 2.75
Jamaica	\$ 7.50	Subway	\$ 2.75
Fordham	\$ 6.75	Bus + subway	\$ 2.75
Yonkers	\$ 8.25	Bee-Line + subway	\$ 2.75
Great Neck	\$ 8.75	NICE + subway	\$ 2.75

At the peak, commuter rail fares are even higher.

This is separate and unequal. *Transit apartheid* —Stephen Smith.

It's also inefficient: some vehicles (NICE, Bee-Line) are only for the poor, some (commuter rail) for the rich. This splits frequency. At the peak, the LIRR is full inbound and empty outbound and NICE is the opposite.

Best Practice: Fare Integration

In German-speaking cities, tickets are valid inside a zone (e.g. the entire city), on all trains and buses. In Switzerland it even applies to high-speed trains if they make multiple stops in one region (e.g. Zurich Hbf and the airport).

In Paris, monthly tickets cost €73 regionwide. Single-ride tickets have fares based on distance; the RER costs the same as the Metro in the city, with free transfers, but in the suburbs, fares may vary.

In Tokyo, there are no free transfers between different railroads. But commuter rail fares are still comparable to subway fares over the same distance.

Planning Around Free Transfers

Operating costs on trains per km are lower than on buses with the same capacity, so encouraging more rail ridership saves money.

With free transfers, it's useful to encourage people to only take the bus as far as the commuter rail station, and transfer.

In Switzerland, it's common for transfers to be timed, even across different operating companies.

In Japan, private railroads run their own connecting buses.

Integrated Planning

In Switzerland, planning involves integration of three aspects: infrastructure, rolling stock, schedule.

The schedule is designed around timed transfers at regular intervals (e.g. every half hour in Zurich). There are also timed overtakes, when faster and slower trains run on the same tracks.

Investments in infrastructure and rolling stock are designed around a concrete timetable, e.g. a short tunnel to allow a more frequent schedule and speed trains up so that they can make the next transfer point.

New York practice: LIRR Third Track and East Side Access aren't based on any public schedule.

Better practice: coordinate Amtrak and commuter rail schedules, look for good locations for timed overtakes.

Through-Running: the Subway

Subway lines don't stub-end in Midtown—they through-run from the Bronx or Queens to Brooklyn.



New Tunnels: New York Practice

Regional rail tunnels in New York (East Side Access, future Gateway) are built without regard for through-running:

- ▶ ESA is a stub-end tunnel, ending in a large cavern under Grand Central, with no integration with Metro-North, even though Grand Central already has more than enough tracks.
- ▶ Gateway is planned to stub-end at Penn Station. The old ARC plans had a cavern, too.
- ▶ Gateway involves condemning an entire block south of Penn Station to build Penn Station South for \$7 billion. Penn has enough tracks, it just needs better vertical circulation.
- ▶ There are no plans for systemwide integration, so each railroad wants to carve its own territory.

There are better models from peer cities.

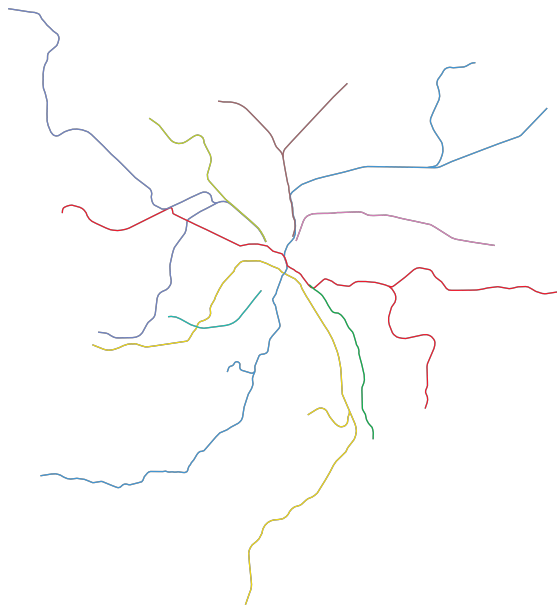
Through-Running: the RER, Before

Paris had six main train terminals and three smaller stations for commuter rail. Service across the city was provided by the Metro, with NYC local subway spacing and no express trains.

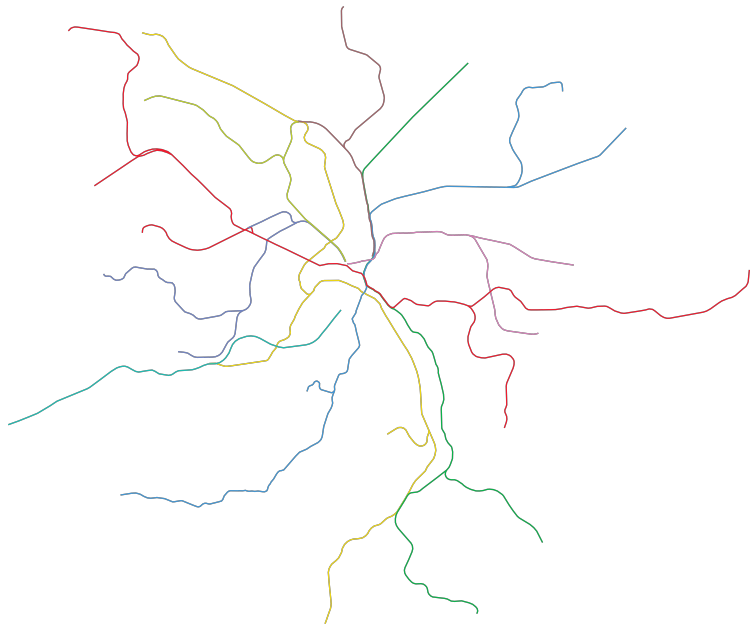


Paris regional rail, 1970

Through-Running: the RER, 1985



Through-Running: the RER, Today



Through-Running: Berlin



Through-Running: Tokyo

Tokyo has two layers of through-running.

- ▶ In the early 20th century, the national railway built through-lines radiating in all directions from Central Tokyo, like the S-Bahn and RER. Today, its privatized successor JR East keeps building through-lines.
- ▶ Since 1960, new subway lines have opened with the same technology as commuter rail, with connections allowing private railways to run through from their city terminals to Central Tokyo.

Even without fare integration, trains run through from one company's commuter lines (e.g. Tobu in the north) through the subway and then to another company's lines (e.g. Tokyu in the southwest).

Through-Running: London

Starting in the 1830s, London built many rail terminals, just outside Central London. This is why it built the Underground in the first place: to connect terminals like King's Cross and Paddington to city center. But cross-city connections were a lower priority.

London built the north-south Thameslink project out of existing tunnels, opening in 1988.

Next year London will open the east-west Crossrail project, with 21 km of new tunnels.

London is also planning another north-south tunnel, called Crossrail 2, with 35 km of new tunnel.

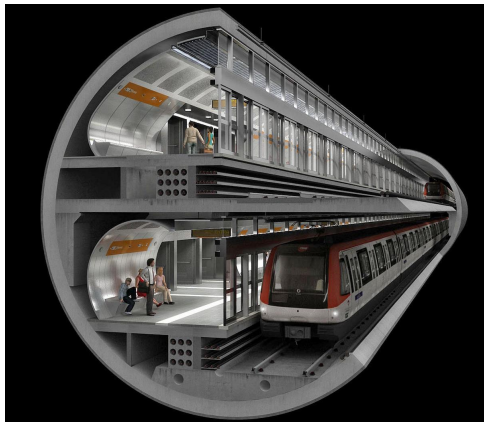
New Tunnels: Some Best Practices

Building new tunnels for through-running (or for extra capacity) is difficult, and the biggest networks in the world have the following principles and tradeoffs:

- ▶ Tunnels should have multiple city stations if possible, with transfers to most intersecting subway lines.
- ▶ To limit costs, stations should have just 1-2 platform tracks per tunnel track. Trains should be designed to allow passengers to clear fast.
- ▶ Long tunnels (e.g. RER A, Crossrail) offer better service, short ones (e.g. RER C, Thameslink) are cheaper. Crossrail cost: \$1b/km (highest outside US), RER A: \$750m/km (highest outside Anglosphere).

Large-Diameter Tunnels

To reduce station costs, some use large-diameter tunnel-boring machines (TBMs), which allow the platform to be built inside the tunnel.



Barcelona Metro Line 9/10 cross-section

Lessons for New York

New York should begin with full systemwide integration, before and in conjunction with investing more money in new tunnels:

- ▶ Integrate fares and service planning regionwide.
- ▶ Increase off-peak frequency: in-city stations should get a minimum of 6 tph off-peak.
- ▶ Build infill stations in Queens and Newark.
- ▶ Design Penn Station Access on Metro-North with infill stops at Pelham Parkway (Bx12) and Astoria (N/W).
- ▶ Run trains through from NJ Transit to Penn Station Access and some LIRR lines; this requires small investments (low 9 figures) into high platforms and reelectrification in New Jersey.

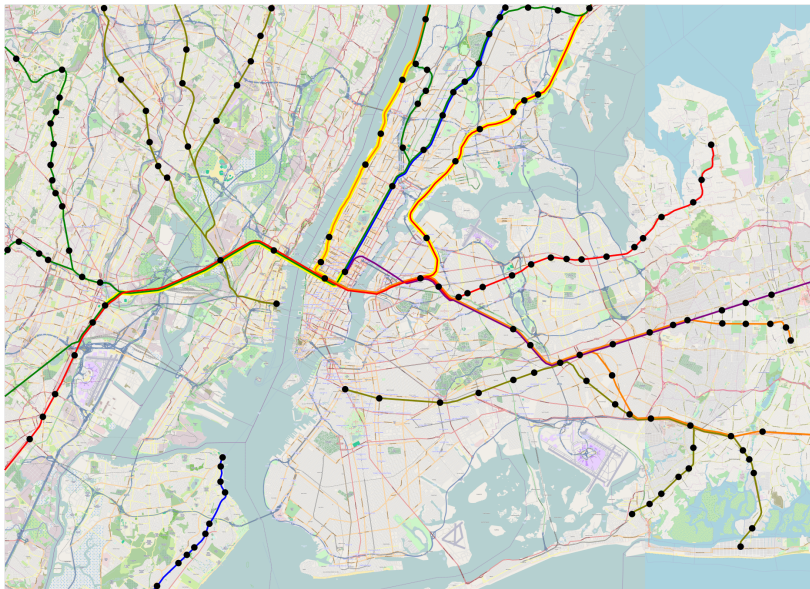
A Better Gateway Project

Gateway should be built around through-running:

The most important things: eliminate Penn South, and plan to go east to connect to Grand Central (“Alt G”).

- ▶ Realign Empire Connection tracks to allow easy through-service to the LIRR, and electrify accordingly.
- ▶ Infill station: Bergenline Avenue inside the Gateway tunnel.
- ▶ Sunnyside Junction infill with cross-platform transfers between the LIRR/ESA and Penn Station Access.
- ▶ Electrify the Raritan Valley Line, and rebuild the junction to avoid at-grade conflicts with the Northeast Corridor.
- ▶ No loop at Secaucus! There’s too much traffic from other lines, it’s not possible to connect the NJ Transit Erie lines (Main, Bergen County, Pascack Valley) to Penn Station frequently.

Better Gateway: Map



Future Regional Rail Lines

The above system only serves Midtown and doesn't incorporate all lines. Even before Gateway is done, the region should plan on building more.

- ▶ North-south tunnel, connecting the Harlem Line with Staten Island with stops at Union Square and Lower Manhattan.
- ▶ Northwest-southeast tunnel, connecting the NJ Transit Erie lines with the LIRR Atlantic Branch with stops at Pavonia/Newport, Lower Manhattan, and Brooklyn Borough Hall.
- ▶ The Erie's Northern Branch should be folded into this system, connecting to Manhattan.
- ▶ Paris: 12 million people, 4 independent RER lines. Berlin: 6 million, 3 S-Bahn lines. New York has 22 million people—it can't hope to satisfy all regional rail needs via just Gateway!

Future Regional Rail: Map



Thank you!