A Concise Analysis of 30-30-30

By Alon Levy, Ph.D.

Fresh off the election, Connecticut Governor Ned Lamont has proposed an ambitious infrastructure plan, dubbed 30-30-30, in which train travel between New York and Stamford, Stamford and New Haven, and New Haven and Hartford would be cut to 30 minutes. With an average speed of about 68 mph, this is only about half the average speed typical of high-speed rail, but still slightly higher than that of the Northeast Regional between New York and Washington, which is competitive with cars and buses provided there is enough capacity.

For 30-30-30 to truly be cost-effective, the plan needs to speed up trains with relatively little infrastructure investment, at a cost measured in hundreds of millions of dollars. Is that feasible? The topline answer is yes. All three segments can be done in the specified amount of time. North of New Haven, there are generous margins, but 30-minute travel times will rely on electrifying the Shuttle and running high-quality electric trains. South of New Haven, each segment has just seconds to spare to achieve the governor's goal, and no big-ticket capital investment would be needed, but the plan will require a complete overhaul in Metro-North operations.

Some additional repairs are needed on tracks straight enough to allow trains to run at 100 mph, tracks that are today only maintained to allow 75 mph. The state may also need to procure lighter trains, able to accelerate faster than the current equipment. On a fast schedule, with few intermediate stops, the difference with the current M8 trains is small, but in practice north of Stamford where trains are likely to make many stops, the difference would be noticeable.

Most of all, reliability must improve enough that is possible to remove the extensive schedule padding in the timetable today. Metro-North is in a perpetual maintenance cycle. At any time there is a slow zone somewhere on the tracks, with generous schedule padding on top of it. Maintenance must be switched to the nighttime, as is practiced on high-speed lines in Japan and France and on subways everywhere in the world outside New York, in order to improve daytime reliability.

The simulation of train performance

In order to figure out the best possible trip times, I made a table of speed zones on the New Haven

Line, from Grand Central to New Haven. But instead of using current speed zones, which are very conservative, I looked for the maximum speed that is feasible within the current right-of-way.
The most important rule I followed is **no curve modifications**, even modifications that are likely to happen under any high-speed rail scenario. While some capital investment may still be required, it is entirely within existing rights-of-way.

In the simulation, I used code outputting slow penalties for trains based on prescribed performance characteristics. For this, I used two sets of characteristics. The first, is for the M8 trains used by Metro-North today. The second is an average of modern European regional trains, such as the Stadler FLIRT, the Alstom Coradia, the Bombardier Talent 2, the CAF Civity, and the Siemens Mireo. Because they are much lighter-weight, all have about 50% better acceleration than the M8 at any speed. Both sets of trains can reach the same top speed, 100 mph, but when the M8 slows down from top speed to make a station stop, the extra acceleration and deceleration time add another 69 seconds to the trip, compared with only 46 seconds on the European regional trains. That said, the proposed schedule has few intermediate stops, and even with frequent slowdowns due to curves, the total difference in time between the two sets of trains is about two minutes. So, while I would urge Connecticut to buy modern trains at its next procurement, based on the latest revision in FRA regulations permitting lightly-modified European trains, the present-day rolling stock is good enough, it's just much heavier than it needs to be.

While I did not assume any curve modifications, I did assume that trains could run faster on curves than they do today. The New Haven Line has conservative values for the permitted centrifugal force acting on trains. I explain more about this in a previous post about trains in Connecticut, but the relevant figures are about 8” of total equivalent cant on the New Haven Line today, whereas light trackwork increasing total cant and already-existing regulatory changes above the rails could raise this to 12” on existing trains (more on tilting trains like the Acela), which corresponds to a 22% increase in speed.

Moreover, in some areas the maximum speeds are even lower than one might assume based on curve radius and current permitted curve speeds. These include the movable bridges over the waterways, which have very low speed limits even when the tracks are mostly straight; if the bridges physically cannot accommodate faster trains then they should be replaced, a capital investment already on the state and the region's official wish list.

In addition to speed limits imposed by curves and bridges, there is a uniform speed limit of 90 mph on the New York segment of the line and 75 mph on the Connecticut segment. This is entirely a matter of poor maintenance: the right-of-way geometry could support higher speed today in some places, even without curve modifications.

Finally, trains today go at excruciatingly slow speed in the throat heading into the bumper tracks at Grand Central, 10 mph. This is bad practice: even with bumper tracks, German train throats with complex switches are capable of 40-45 mph. This change alone would save about 4 minutes. Overall, trains today are scheduled to take about 11-12 minutes between Grand Central and Harlem, and the proposed schedule cuts this down to 5-6.

The proposed schedule

I am attaching a file with exact speed zones, rounded down in 5 km/h increments. People who wish to see what's behind the timetable I'm proposing can go look there for intermediate times. These may be especially useful to people who want to see what happens if more stops on the Lower New Haven Line are included. For example, one might notice that all technical travel times are padded 7%, as is standard practice in Switzerland, and that trains dwell exactly 30 seconds at each station, which is observed on busy commuter lines in Zurich as well as Paris.

I am including two stopping patterns: regional and intercity. Regional trains make the same stops as the Upper New Haven Line trains do today, plus New Rochelle. Intercity trains only make a few stops beyond Stamford, with a stopping pattern close to that of Amtrak. In addition, I am including two different sets of rolling stock: the current M8, and lighter, faster-accelerating European trainsets. The difference in the regional train pattern is noticeable, while that in the intercity one is less so.

Finally, at stations, it's possible to state the scheduled the time the train arrives at the station or the one it departs. At all intermediate stations, the timetable below states the arrival time, unlike the attached spreadsheet, which uses departure times to permit calculating exact average speeds.

Stop	Regional, M8	Regional, euro	Intercity, M8	Intercity, euro
Grand Central	0:00	0:00	0:00	0:00
Harlem-125th	0:05	0:05	0:05	0:05
New Rochelle	0:17	0:16	0:17	0:16
Stamford	0:30	0:29	0:30	0:29
Noroton Heights	0:34	0:33		
Darien	0:37	0:35		
Rowayton	0:39	0:37		
South Norwalk	0:42	0:40	0:37	0:36
East Norwalk	0:45	0:42		
Westport	0:48	0:45		
Greens Farms	0:52	0:48		
Southport	0:55	0:51		
Fairfield	0:57	0:53		
Fairfield Metro	1:00	0:56		
Bridgeport	1:04	0:59	0:49	0:47
Stratford	1:09	1:03		
Milford	1:13	1:07		
West Haven	1:19	1:13		
New Haven	1:23	1:17	1:03	1:01

New Haven-Hartford-Springfield

In theory, achieving the governor's proposed timetable is easier north of New Haven. The Hartford Line is a straight route. Most of it has a top speed of 80 mph, and outside the approaches to New Haven and Hartford, the speed restrictions are caused by arbitrarily slowdowns for grade crossings rather than by constrained geometry.

However, in practice, the line is in a poor state of repair. Grade crossings are unprotected. The entire line is not electrified, and there are no plans to electrify it, for reasons that can only be explained as an allergy that North American railroaders have to electrification. The stations have low platforms, which are not accessible to people in wheelchairs without labor-intensive, time-consuming lift operations—and even if there are no riders with disabilities, it just takes longer for passengers to board from low platforms.

The above schedule assumes 7% padding and 30-second dwell times at stations, but such assumptions only work when the equipment is reliable, and when there are wide doors letting passengers on the train with level boarding or at worst short steps. Traditional commuter lines pulled by diesel locomotives, serving low-platform stations with narrow doors, have to be much slower. Clem Tillier's example timetable for Caltrain requires 15% padding and 45-second dwell times with today's diesel operations—and at rush hour some station dwells stretch over minutes due to the railroad's uniquely high number of passengers with bicycles.

The good news is that electrification and high platforms are, in the grand scheme of things, cheap. Amtrak electrified the Northeast Corridor between New Haven and Boston at $3.5 million per kilometer in the 1990s, adjusted for inflation; at that cost, wiring the entire New Haven-Springfield shuttle would run up to $350 million. Moreover, Boston has been equipping a number of commuter rail stations with high platforms in order to provide wheelchair accessibility, and in ordinary circumstances, the costs have been on the order of $6-10 million per station. This entire package on the Hartford Line would be cheaper than replacing any of the movable bridges on the New Haven Line.

Moreover, upgrading grade crossings with four-quadrant gates, which make it impossible for cars to drive around the gates while they are closed, is affordable as well—and would permit the towns along the route to institute quiet zones, eliminating the loud train horns. In Boulder, the same installation costs about $500,000 per grade crossing for quad gates and another $300,000 for an alternative to horns; in federal regulations, quad gates are good up to 110 mph. There are 23 level crossings between New Haven and Hartford and another 11 between Hartford and Springfield; $30 million would upgrade them all.

The importance of a good maintenance regime

In Switzerland, schedules are padded by 7% over the technical travel time, to permit trains to recover from delays. By American standards, this is a low figure. The LIRR's schedules are padded by 20-30%, and I have personally seen an express New Haven Line train travel from Stamford t0 Grand Central in about 15% less than the scheduled trip time.

Switzerland achieves high punctuality with relatively tight scheduling by making sure delays do not propagate. Railroad junctions are grade-separated when possible, and if not then they are equipped with pocket tracks to allow trains to wait without delaying crossing traffic. To achieve comparable reliability, Metro-North should grade-separate its most important junctions: Shell, where the line joins with the Northeast Corridor tracks carrying Amtrak (and soon Penn Station Access); and Stam, where the New Canaan Branch joins. It could potentially also grade-separate Berk, where the Danbury Branch joins, and Devon, where the Waterbury Branch joins, but the traffic at these junctions is lighter and delayed branch trains can wait without disturbing mainline trains.

Moreover, like the rest of Europe as well as Japan, Switzerland conducts maintenance at night. The daytime maintenance with work zones that are a common sight on American passenger railroads are unknown on most European railroads. Only mixed lines running high-speed passenger trains in the day and freight at night have to schedule trains next to active work zones, and those are indeed much harder to maintain.

The laws of physics are the same on both sides of the Atlantic. If it's possible to maintain tracks adequately during four-hour nighttime windows in Europe, it's possible to do the same in the United States. Freight traffic on the Northeast Corridor is lighter than on many Swiss mainlines, and while passenger traffic at rush hour is very heavy, in the off-peak it is considerably lighter than on the urban commuter rail line trunks of Zurich. While four Metro-North trains run between New York and Stamford every off-peak hour, as does a single Amtrak train, ten Zurich S-Bahn trains run per hour between Zurich and Winterthur, as do six interregional and intercity trains.

The importance of maintenance was underscored in a recent article describing an independent plan to drastically cut travel times through better track standards, spearheaded by Joe McGee of the Business Council of Fairfield County and authored by San Francisco consultant Ty Lin and former Metro-North president (and next CTDOT Commissioner) Joseph Giulietti. In response to their plan, CTDOT said it was not possible—and to emphasize this fact, the article notes that an upcoming schedule revision will slow down the trains by 6 to 10 minutes due to trackwork delays.

The one thing that the state must avoid is funneling any money into State of Good Repair (SOGR) programs. SOGR is a black hole permitting incompetent officials to spend capital money without anything to show for it: agencies around the country have SOGR programs decade after decade and somehow their stated maintenance backlogs never shrink.

It's not yet clear what CDOT and Metro-North's reaction to 30-30-30 will be. Is the governor's goal achievable? Absolutely, give or take a few minutes. Is it achievable on a reasonable budget? Definitely. Are the managers who have let train schedules slip over the years, as their counterparts in New York have, capable of running the trains punctually enough in order to meet the timetable? That is the big question.

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