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Transform Traditional Trains to Linear Docking and Save Significant Time

J. Nordlander

Jo-Jo Tåg, Linköping
Sweden

Abstract

In an earlier paper the Jo-Jo train Concept is presented, a linear docking train and a railway "switch" without moving parts. There it is described as if it required a completely new railway to be built on pillars or land bridges along or above existing highways. However, one could consider a simplified version of the Jo-Jo Concept to be introduced on existing railways. The only prerequisite needed is at least one station located at a siding. In this paper is shown how for instance an LGV stepwise can get more stations without prolonged travel time for the TGV. Earlier bypassed cities are revitalised. In another application of the Jo-Jo Concept a less used line might be saved by linear docking on all its stations, a game changer.

Keywords: Jo-Jo train, TGV, siding, railcar, linear docking, traditional trains

1 Introduction

In an earlier paper [1] the Jo-Jo train Concept is presented, a linear docking train and a static railway switch. There described as if it required a completely new railway to be built on pillars or land bridges along or above existing highways. However, one could consider a simplified version of the Jo-Jo Concept to be introduced on existing railways. The only prerequisite needed is that at least one station is located at sidings. To convert a standard classical railway we could add a main track outside the urban area related to the station and the associated turn out and turn in

"switches" without moving parts. Now on the station locate a "railcar 1" with extra wheels that makes it work in the "switches". Approaching train has at its rear a "railcar 2", also with extra wheels, that is undocked and thus automatically turn out towards the station. Simultaneously the "railcar 1" leave the station, accelerates, passes the turn in and docks at the end of the passing train. Part of docking is to open a gangway and passengers can be exchanged.

2 Time saved for one station with the Jo-Jo Concept

How much time is saved by this linear docking Jo-Jo Concept approach? From [2] we have an estimate for a 320 km/h high speed train eight (8) minutes travel time are saved by having the main line passing outside the station urban area. The station located at a so called by-line or siding. For another example from the Ostlänken, in project a 250 km/h railway, to go with up to 400 m long trains from Järna (60 km south of Stockholm) to Linköping. Here is a by-line for Nyköping, see Figure 1.

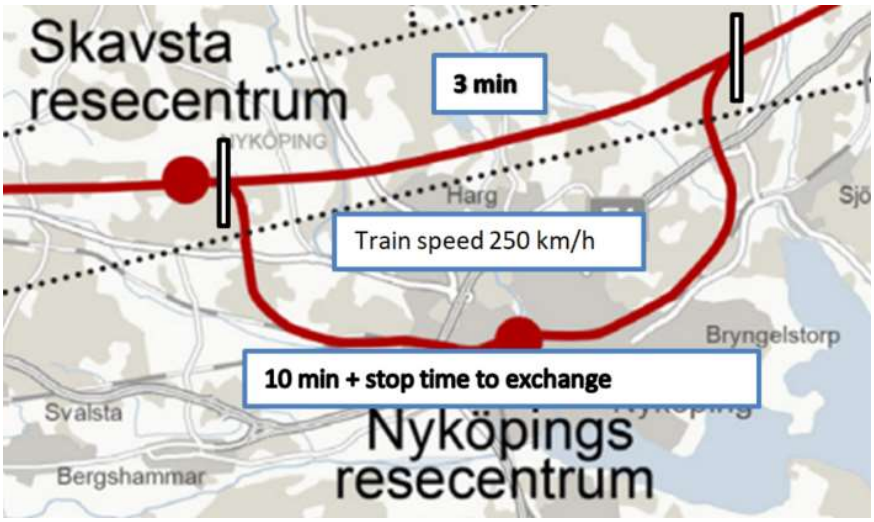

Figure 1: Cut out [3] from "Ostlänken" showing a by-line or siding at Nyköping. Going passed takes 3+ minutes, whereas the siding takes 10+ minutes. The actual stop to exchange passengers is estimated to take 2 minutes.

Hear we get 10 - 3 = 7 seven minutes saved running time, and for exchange of passengers two minutes [4]. However, two minutes for passenger exchange with a 400 m long train is optimistic I would rather assume 3 to 5 minutes. For smaller urban areas and for trains with lower speed the travel time saved is less. Using these estimates we can make the simple graphs in Figure 2.

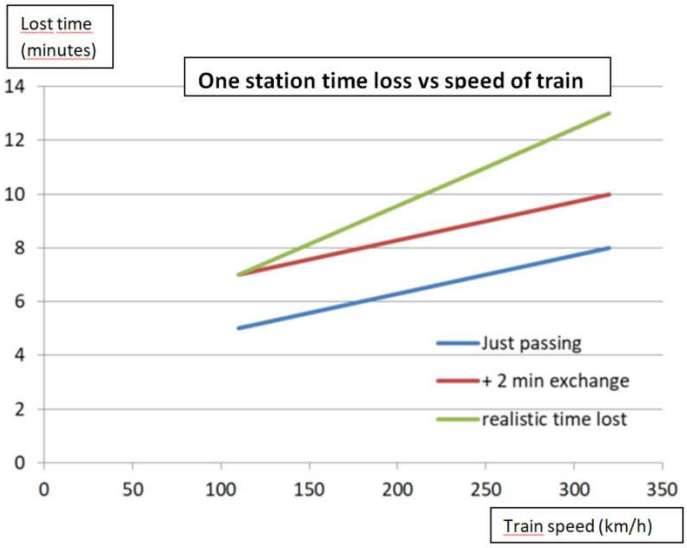

Figure 2: Time saved with the Jo-Jo Concept for one station as compared to a traditional train.

For the highest speeds and longest train we might gain 13 minutes by the Jo-Jo Concept as compared to the traditional way to exchange passengers at the station. Off course depending on geometry for the siding there will be a station specific time saved if the Jo-Jo Concept is used. Data from Figure 3 must be looked upon only as a simple guide.

3 Application

It is the aim of the Jo-Jo Concept to solve the conflict between

- short “end station” travel time and
- the number of in between stations to be served

Its application is of course most important for lines with many travellers. However, a new concept might on the other hand best be qualified on a smaller scale. So now we have two approaches, to work with; a railway line with many passengers or one with few passengers.

3.1 Stepwise

In the case of many passengers, take for instance a TGV line 508. It goes from Paris to Montpellier 600 km and there is only one stop, at Lyon, see Figure 3 [5]. This is of course in order to get a short travel time, 2h 15 min.

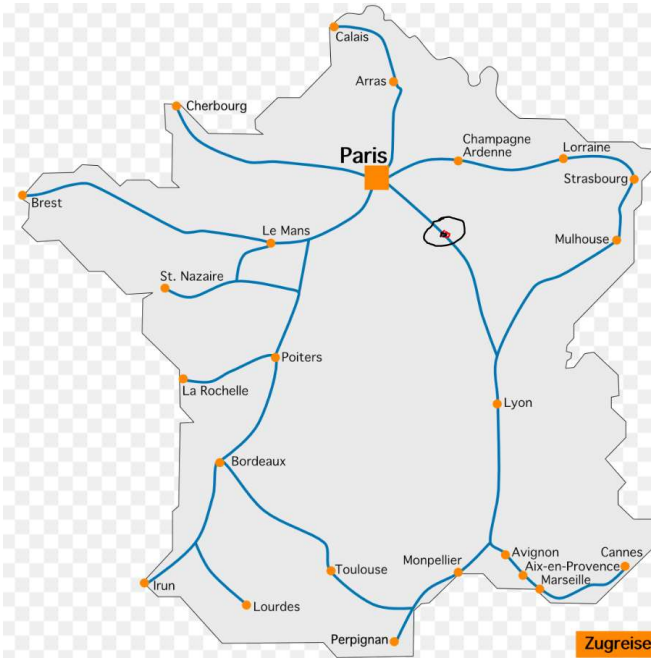

Figure 3: Map of TGV in France [5]. Marked area is for Auxerre, an urban area that could get train connection.

As a consequence many possible stations are left without train connection. On the map is marked where Auxerre is located, a region with 111 000 inhabitants [6]. At Gare De Lyon in Paris the TGV could have an extra railcar at its end connected with an open gangway. As the TGV approaches Auxerre the gangway is closed and the railcar is undocked. The railcar has extra wheels such that it takes the siding towards Auxerre. The extra wheel axle location is fixed and the turn out to Auxerre is compulsory. Simultaneously a railcar starts from Auxerre and catch up with the TGV. Gradually all TGV on line 508 from start in Paris will be equipped with a gangway and an undockable railcar at its end. Thus all these train service Auxerre.

This approach can now be adopted for other cities at or close to the line. Finally also Lyon is placed on a siding and the travel time from Paris to Montpellier is cut to perhaps two hours and still maybe 10 stations are served during the trip.

3.2 Game changer

Assume a railway line with too few travellers, maybe just about to be closed down. How to make it more attractive, to make it worth to save? One new option could be to invest in the Jo-Jo Concept. It would change end point travel time dramatically and still serve all stations. Here one example where it could be applied: Tjust railway with ca 200 thousand travellers per year (deduced from data in [7]) between Linköping and Västervik, 116 km not electrified, single track, radio controlled railway, and passenger exchange at four to six stations (formerly 22 stations), see Figure 4 [8] .

Figure 4: Map Linköping – Västervik. Blue sketched line is Tjust railroad and red cross line mark stations.

Travel time 1 h 42 min between end stations. Eight connections in both directions every day. Elegant time table: same departure time of trains from each end station, every two hours, and the trains meet at half the distance. Two sets of trains, IC3 trains, are used, see Figure 5.

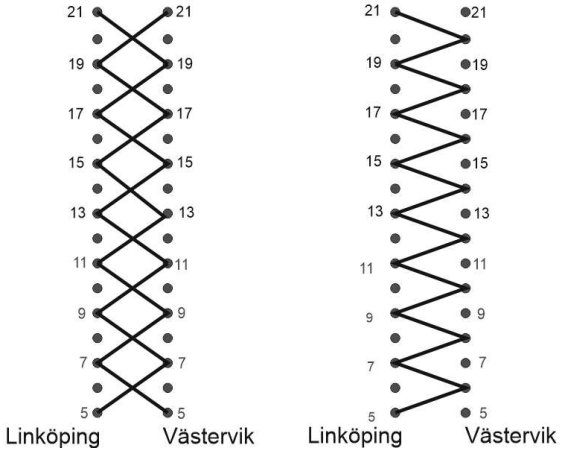

Figure 5: Illustration of time table. Today at left with two trains. At right after introduction of Jo-Jo concept same frequency of departures, half travel time and just one train.

Successively as stations are converted to be on sidings and linear docking is applied there is a time saving for end point travellers of seven minutes per station, from Figure 2. For six in between stations that would in theory yield a net saved time of 6 x 7 = 42 minutes. Remaining time for travel would be 1h42min - 42 min = 60 minutes. With an end point distance of 116 km then the train average speed

needed would be 116 km/h. With the by-passes built and some improvements on road crossings, animal fencing and alike it would be possible to reach less than an hour. That could give same train departure frequency, half transport time and only one train, but totally eight railcars, see Figure 5. In Figure 6 is illustrated the movements of these railcars. Note specifically that a railcar is "stationed" to serve only the two adjacent stations and thus used only for a short while. One selected railcar runs with constant speed as a train without stop, back and forth between end stations. If there is a demand for more transport capacity, then it is easy to add one or more railcars.

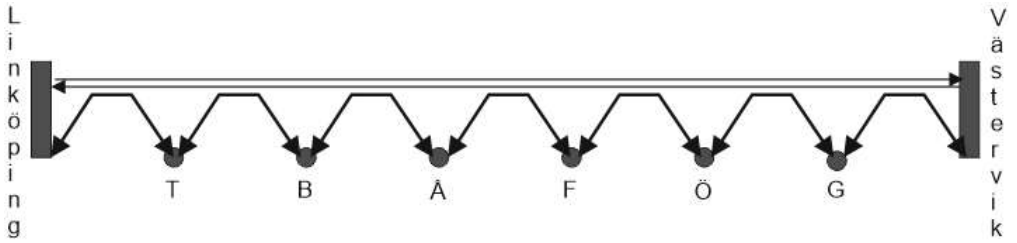

Figure 6: Illustrating how the eight railcars involved traffic the Tjust railway after introduction of the Jo-Jo Concept. One railcar runs back and forth between end stations. Remaining seven railcars swap between adjacent stations.

The distance between stations in Figure 6 is depicted as if equal. However, as can be seen in Figure 4 that is not the real case. Station T is close to Linköping and stations B and Å are close to one another. Starting from Linköping there is no problem. Those bound for T reside from start in the back most railcar, the one that compulsory will turn out to station T. Going the other direction from T towards Linköping is not either a problem, and those travellers can calmly reside in the railcar that they left in from T. For stations B and Å which are less than two kilometres apart, we must analyse how close adjacent stations can be, and still be part of the Jo-Jo Concept. It of course depends on the speed of the train and the assigned time to exchange position for travellers, perhaps 2 minutes. Travel distance for the train would be 120 km/h*2 min/60= 4 km. In this case one would probably position the new main line completely outside this urban area and from Jo-Jo point of view, regard B and Å as one station, see Figure 7.

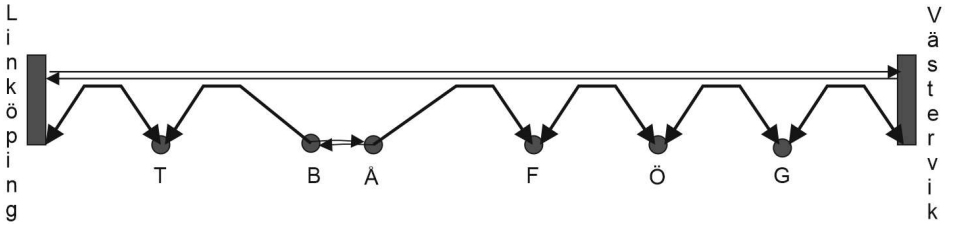

Figure 7: Illustrating how the close distance between stations B and Å can be handled within the Jo-Jo Concept.

A reason to why the simplified version of the Jo-Jo concept works so easy is the function of the railway "switch" in combination with the idea that the last railcar has extra wheels which compulsory makes the railcar turn out at the "switch". No moving parts, just free rolling wheels through the switch.

4 Conclusions

In this paper is shown how “abandoned” cities can be given TGV connection. An example where a whole railway is transformed: all stations positioned on sidings and travel time between end stations is significantly shorter. High average speed and constant speed gives a most convenient and environmentally friendly transport.

In an upcoming paper will be shown how the Jo-Jo concept also can handle transport of goods.

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