HOW CAN RAIL INFRASTRUCTURE BE MANAGED IN AN OPEN ACCESS MARKET? SOME REFLECTIONS ON EUROPEAN CASES

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INTRODUCTION

The liberalization of the Rail industry in the EU is still in progress, with various degrees of completion. After a first stage of separation between infrastructure and services, the reform has now been completed for freight services and is now beginning for passenger trains. The choice initially made is to facilitate the entry of newcomers in the market, following the principles of open access: any qualified competitor can apply for train paths, with no particular priority given to incumbent operators. The use of infrastructure requires the payment of track access charges whose levels vary considerably from one country to another.

The experience of freight market liberalization shows that newcomers have tried to run long-distance block trains. Some of them were already hauled by the national railways, but many of them correspond to traffic transferred from road or waterways. For instance, overall rail freight traffic has increased from 2000 to 2008 in the United Kingdom and in Germany. The entry of new operators has contributed to an overall growth of the market. In other countries such as France, we observe a severe decrease in traffic figures, despite the entry of nine new operators.

Among the barriers to entry that are put forward, the poor quality of train paths and the low residual capacity of the network are frequently mentioned. The responsibility of the infrastructure manager is denounced and, beyond its level, the responsibility of the public authorities who have launched the liberalization process without reshaping the network. However, adapting the network capacity to new forms of use is a long-term task.

This paper will try to explore the hypothesis of a gap between the layout of the network, shaped for the exclusive use of a national carrier with a large predominance of domestic

traffic, and the demand from new entrants exploring new markets on a continental scale. The routes are different, and the hierarchy of the network is called into question.

REFORMS OF THE RAILWAY SECTOR IN EUROPE: THE DELIBERATE CHOICE OF SEPARATION BETWEEN INFRASTRUCTURE AND SERVICES

In Europe, the basic principle of the deregulation of railways, initiated by Directive No. 91/440 in 1991, is that, from now on, a service operator (which was to be in competition with new entrants or companies operating in other countries) and an infrastructure manager must be separate. The latter must allocate train paths without favouritism, while receiving track access charges. In France, these two roles are respectively assigned to SNCF (the French national railway operator) and to RFF (the state-owned manager of the French national Railway Network), which was founded in 1997.

This decision to "disintegrate" railways was very criticized by the national railway operators. In a book published in 1993, two years after the start of the reform of European railways[1], the former Chairman of SNCF Jacques Fournier fought against this conception, which was considered very short-sighted. He argued that good use of the lines' capacity, which is necessarily limited, implies overall organisation, and that one cannot separate fixed installations from rolling stock, whose constituent parts must evolve in relation to each other. He also pointed out that the Swedish precedent produced mixed results, that the Japanese had not separated the infrastructure from the operator when privatising, and that the countries that wish to have high-speed railways look for integrated systems (including the economically very liberal U.S.A.).

This political choice is a response to the European conception of open access to the network. Furthermore, it is also found in other types of network such as electricity systems: every member country had to create a separation between an infrastructure manager (RTE in France) and distributors who can freely use the infrastructure to convey electricity between various producers and the end customer.

Chronological history of reforms

Although it was planned from the beginning by the Treaty of Rome (1957), the European Community's transport policy remained dormant for a long time. The awakening did not happen until 1985, when the European Parliament had the European Council sentenced by the Court of Justice of European Communities (CJEC) because of its failure to take action in transport.
The reforms started in 1986, with the adoption of the Single European Act. They were intoned to be gradual, in stages (corresponding to sets of legislation called "packages" in the

[1] Fournier, 1993.

EU's own specific language) whose content was the result of long negotiations between Member States and long debates in the European Parliament. The numerous ups and downs of the second railway package in the early 2000s or the public services directive that was finally adopted in 2007 reflect the long period of maturation of each stage of liberalization. In addition to reactions by certain Member States that wished to protect the strategic nature of certain public services there is more and more effective lobbying by major operators who all opened offices to represent them in Brussels.

The European Union defined a proactive railways policy from the very beginning of the 1990s. This aimed to improve the efficiency of railway systems by integrating them into a competitive market. This vision of things was very largely contested by the operators, led by SNCF, who pleaded for prior technical harmonisation of the railway systems developed on national bases, and therefore for increased cooperation between networks. The "master" directive is European Council Directive 91/440/CEE dated 29 July 1991 concerning the development of European railways. It laid the basis for the major European principles on this subject: separation between the management of the infrastructure and the activity of transport; establishment of charges for use of the infrastructure; financial reorganization of railway companies; and gradual provision of open access to the infrastructure in Member States. As of its transposition, international groupings of operators had the right to use the networks of third parties in other countries for through transit of their convoys, but this was very limited opening.

The first railway package, composed of Directives Nos. 2001/12, 2001/13 & 2001/14, introduced into national legislations the opening to competition of international freight traffic on the network Trans-European Railway Freight Network (TERFN) from 15 March 2003 then, on the entire European rail network from 15 March 2008; the establishment of non-discriminatory rules for access to the network, governing the operation of the entire railway system.

The draft second railway package, proposed by the European Commission on 23 January 2002, concerns the following:

- the opening of international goods traffic to competition on the entire European railway network on 1 January 2006 (or two years before the previously-specified deadline);
- the opening of domestic freight traffic on 1 January 2007;
- the creation of a European Rail Agency, which was opened in 2005. Located in Lille and Valenciennes [in northern France], it employs around one hundred people. Among other things, it is responsible for proposing measures for gradual harmonisation of safety rules and for drawing up Technical Specifications for Interoperability (TSI).

The proposals of the second railway package were adopted by the European Parliament and by the European Council on 30 April 2004 and they had to be transposed into national law for the beginning of 2006.

The third railway package initially included a series of proposals concerning the following:

- the opening to competition, by 1 January 2010 at the latest, of international passenger transport services. These services may take on board and drop off passengers who are making journeys within the States (the cabotage right);
- the establishment of joint rules for certification of drivers, in order to facilitate their interoperability and improve their management;
- compensations in cases of non-compliance with contractual quality requirements applicable to railway freight services,
- the rights and obligations of international railway travellers.

While an agreement was reached in the European Council on 5 December 2005 for three of these four proposals, the proposed regulation concerning the quality of railway freight transport services was thrown out by the European Parliament on 28 September 2005. Therefore the package was adopted in September 2007, but without the controversial regulation.

The railway sector is also concerned by the regulation finally adopted in May 2007, after seven years of discussions, on public service obligations. Indeed, it could have led to the opening of local and regional networks to competition: a change strongly opposed by railway companies, but also by States that had a large proportion of municipal companies such as Germany. The compromise reached at the European Council on 9 June 2006 avoids this threat to services provided by "internal operators" (national, regional or municipal companies, semi-public companies and of course public corporations), on the condition that they do not enter markets outside their territory. The adaptation period is long: organising authorities and "internal" operators have until 2020 to comply with the provisions of this regulation. As this is a regulation and not a directive, no transposition into national law is necessary: only the provisions that are contrary to the regulation must be eliminated.

Currently (July 2010), the European railway freight market is therefore completely open, on all scales. The passenger market is only open for international services, and one notes that new entrants are not in a hurry to create new lines to compete with existing services.

A certain diversity in implementation

The management and regulation provisions implemented in application of the successive packages were very different from one country to another. The status and scale of infrastructure managers resulted in a maximum number of diverse choices. The infrastructure manager's independence in relation to the national railway operator is particularly necessary to allow new entrants to be properly catered for.

This independence is measured in two ways:
- The number of employees who are directly employed by the infrastructure manager. A manager that is constituted *a minima*, such as *Réseau Ferré de France* (RFF), which has barely 800 employees and has no direct control over the network's maintenance (which is subcontracted to SNCF!) does not have the same powers as those who have taken on all the employees of the incumbent operator managing the infrastructure and traffic on the network,

such as ADIF in Spain (13,800 employees), Infrabel in Belgium (12,748 employees), RFI in Italy (32,000 employees), etc.
- Relationships with the incumbent operator: in several countries (Germany, Italy, etc.), the infrastructure manager is a subsidiary of the national operator, which creates some doubt as regards its real independence. In the case of Germany, DB Netz, the network manager is a sister company of operating subsidiaries (DB Fernverkehr, DB Regio, and Railion) within a single holding (DB AG). Staff members move from one company to the other and therefore there are numerous links. A first crisis happened in 2000 when small companies complained to the Cartels Office (the German competition regulator) of track access charges that they considered discriminatory. Subsequently, several new entrants complained of anti-competitive practices by DB Cargo and DB Regio, who were very well informed of applications for train paths and the traffic rates concerned.
In the French case, SNCF's Infrastructure Department, which is RFF's intermediary for processing of applications for train paths, is supposed to be separated from the rest of the company by a "Great Wall of China". However, those who request paths are surprised to see that their clients are approached a little later by sales staff from Fret SNCF (SNCF's freight division)... The situation is more healthy in the United Kingdom and in Sweden, countries where the infrastructure manager is directly dependent on the State and has no inherent links or links of dependence with the main operators.

Our hypothesis is that the degree of independence must have an impact on the ways and means of management of infrastructures and the investment priorities. There is a real risk of heavy dependence related to the incumbent operators' strategic choices of service. It may greatly hinder the development plans of the newcomers to the market, who would not be content with network configurations that give a competitive advantage to the incumbent operators.

The determination of track access charges also provides an opportunity for favouring a given market player or the degree of the market's opening. The track access charges that operators must pay to infrastructure managers have become a major stake in the strategies of players in deregulated railway systems. They represent a cost that they must pay in addition to the costs normally involved in operation, without receiving any additional service in return. The scales of charges adopted reflect the political objectives which are sometimes very different from one country to another, which does not necessarily facilitate the development of international traffic.

A study distributed by the European Conference of Transport Ministers (ECTM) at the end of 2005 (ECTM, 2006) shows the disparity of charges received by infrastructure managers. Thus, for all of Europe, there are three major categories of countries: those which advocate charges that just (sometimes barely) cover costs, with a 5% to 30% rate of coverage of costs, such as Sweden or the Netherlands; another group that applies charges covering 50 to 65% of infrastructure costs, such as Germany, the United Kingdom or France; and a third category of countries which recover virtually all their costs with an 80 to 100% rate of coverage, such as Poland and Hungary. Needless to say, from one country to another, carriers are far from being in the same boat. Considering the fact that track access charges

can represent up to 50% of the operating budget of a railway company, the question of harmonisation is significant.

Therefore there is no equality of treatment between operators, between different EU member countries or within each national network. Beyond these diverging configurations, the infrastructure management policy became crucial for the development of new operators on networks that were largely occupied by national companies. For the capacity reserves must be enough to allow the attribution of additional paths without overall loss of quality (congestion) or any *de facto* disqualification of applicants.

INFRASTRUCTURE: A CENTRAL ISSUE IN POST-REFORM DEBATES

Railway transport is a relatively complex matter because of the importance of the infrastructural factor and the diversity of services that may use railways, with all the risks of conflicts between uses involved in this diversity.

The technical characteristics of each section of the network are determinant for the speeds attained, the accepted tonnages, the possibility of absorbing additional traffic, etc. The capacity of railway junctions also plays an important role in design dimensioning of the general available system, and the capacity of stations (the number of platformed tracks) plays a role in determining the volume of the passenger services in particular.

In recent years, a new question has arisen: that of the level of maintenance of infrastructure. Their deterioration has been linked – often incorrectly – to liberalization processes, as in the case of the United Kingdom. The accidents in Southall (1997), Paddington (1999) and Hatfield (2000) were damning for Railtrack, the very recently privatised infrastructure manager, although the under-maintenance of British railway infrastructure dated from at least thirty years previously. In France, the report written in 2005 by Swiss experts at the École Polytechnique Fédérale in Lausanne[2] shows that the acknowledged under-investment in French infrastructures has existed for a long time and that the network manager's financial difficulties only aggravated the problem, although they had not created it.

However, the question of infrastructure is crucial for the success of the reforms undertaken, whatever their nature and their initial objectives. The infrastructure - rolling stock combined tandem must be continually optimised in order to ensure that the system's performance is satisfactory. The risk of split of this tandem due to diverging strategies between infrastructure managers and operators was evoked by national incumbent operators, who advocated prior technical harmonisation before any reform (Fournier, 1993).

[2] Rivier & Putallaz, 2005.

An obstacle to the development of international services

Before liberalization, Europe was not reputed for the average speed of international railway services. Freight trains could wait for a long time at borders. Nowadays, national borders are still difficult obstacles to cross, due to the very insufficient technical harmonisation and the difficult coordination of business policies of national operators. The emergence of newcomers operating on the scale of the continent is still too recent to identify interesting effects. However, the obstacle course faced by any newcomer on a national railway network may be dissuasive, because of the length of time taken by approval procedures and because of the necessity to own multi-standard rolling stock, which is particularly costly (Vogt & Ruby, 2008).

Therefore the approval of rolling stock takes place on each national network, subject to adaptation to ground-train radio systems, signalling systems, and compliance with the characteristics of the infrastructure (clearance or track gauge, electricity supply voltage, etc.). Therefore the cost of the "entrance ticket" for a newcomer who wishes to operate in several countries is high, which favours *de facto* the major pre-existing operators. The EU launched a new generation joint signalling programme (ERTMS) but, because of its high cost, it will take many years to produce its effects.

If we consider that minimum equipment for international traffic requires the purchase of locomotives with standard clearance and with continental track gauge, suitable for four different traction currents[3] and ten different signalling systems, a certain number of countries pose problems, as shown in Table I.

Table I - Disparity of standards applicable to European networks.

Country	Clearance	Track gauge	Electrification	Observations
Germany, Austria, Switzerland, Sweden, Norway	continental	Standard (1.435 m)	15 kV 16 2/3 Hz	No constraints
Belgium, Italy, Poland, Slovenia	continental	standard	3 kV d.c.	No constraints
Slovakia, Serbia-Montenegro, Greece, Hungary, Romania, Bulgaria, Denmark	continental	standard	25 kV 50 Hz	No constraints
France, Croatia, Luxembourg, Czech Rep., Netherlands, Turkey	continental	standard	25 kV 50 Hz and d.c. at 1.5 or 3 kV	No constraints
Spain, Portugal	Iberian	Iberian (1,668 m)	3 kV d.c. and/or 25 kV 50 Hz	1 constraint: track gauge. Clearance is larger than continental clearance.
Ukraine, Russia, Belarus, Baltic countries and Finland	OSJD[4]	Russian (1,520 m)	3 kV d.c. and 25 kV 50 Hz	1 constraint: track gauge. Clearance is larger than continental clearance.

[3] 15 kV 16 2/3 Hz, 25 kv 50 Hz, 1.5 kV and 3 kV d.c.
[4] In 1957, the former Socialist bloc grouped around the USSR and China formed its own standardisation organisation, the OSJD, which still exists, with 27 member countries, some of which belong to the EU, such as the Czech Republic and the Baltic countries.

Great Britain (United Kingdom, not including Northern Ireland)	limited	standard	750 V d.c. (3rd rail) south of London, 25 kV 50 Hz elsewhere	2 constraints: clearance and 1 atypical electrification system
Ireland (including Northern Ireland)	continental	Specific (1,660 m)	1.5 kV d.c.	1 constraint: atypical track gauge

The recently developed high-speed lines can reduce constraints by adopting less atypical characteristics. Spain has decided to develop a standard track gauge AVE network which will soon be connected to French tracks at two places and will make it possible to avoid load-splitting, changeover or the use of costly hybrid technology. Similarly, the recent completion of the "high speed one" line in the United Kingdom makes it possible to bring trains of continental clearance to London Saint Pancras. However, apart from exceptions, these notable advances only concern a limited number of relations and are not to the advantage of cross-border goods, which the EU would so like to transfer from road to rail transport...

It is signalling that currently causes most problems. Locomotives that run on international routes must have safety equipment specific to every country and must have them approved individually[5]. The EU is pushing for the development of a continental standard, the ERTMS (European Railway Traffic Management System), in association with the operators and a consortium of industrialists. The ERTMS aims to replace the different national train control and command systems in Europe. The deployment of the ERTMS would enable the creation of a seamless European railway system and increase European railways' competitiveness. However, implementation of the ERTMS will take time, since infrastructure managers also have other types of investment to make urgently. In practice, new infrastructures are pre-fitted with the ERTMS or combine a national system and ERTMS. This is the case of the *Betuwelijn* between the port of Rotterdam and the Dutch-German border, and the new Spanish and Italian high-speed lines. Existing infrastructure will be equipped at different rates[6], which means that it will be necessary to have both national and ERTMS equipment. Therefore, during an initial stage, the announced simplification will be a source of extra costs, which will not be an incentive for new entrants to develop their activities...

Non-uniform equipment: a source of extra costs for new entrants

There can also be great disparities within each national network. While the track gauge and clearance of tracks are normally the same for the entire main network, the same cannot be said for electrification voltages (not forgetting that the entire network is not electrified) or for signalling systems. For goods, one could add the axle load, which is not necessarily uniform on a given route.

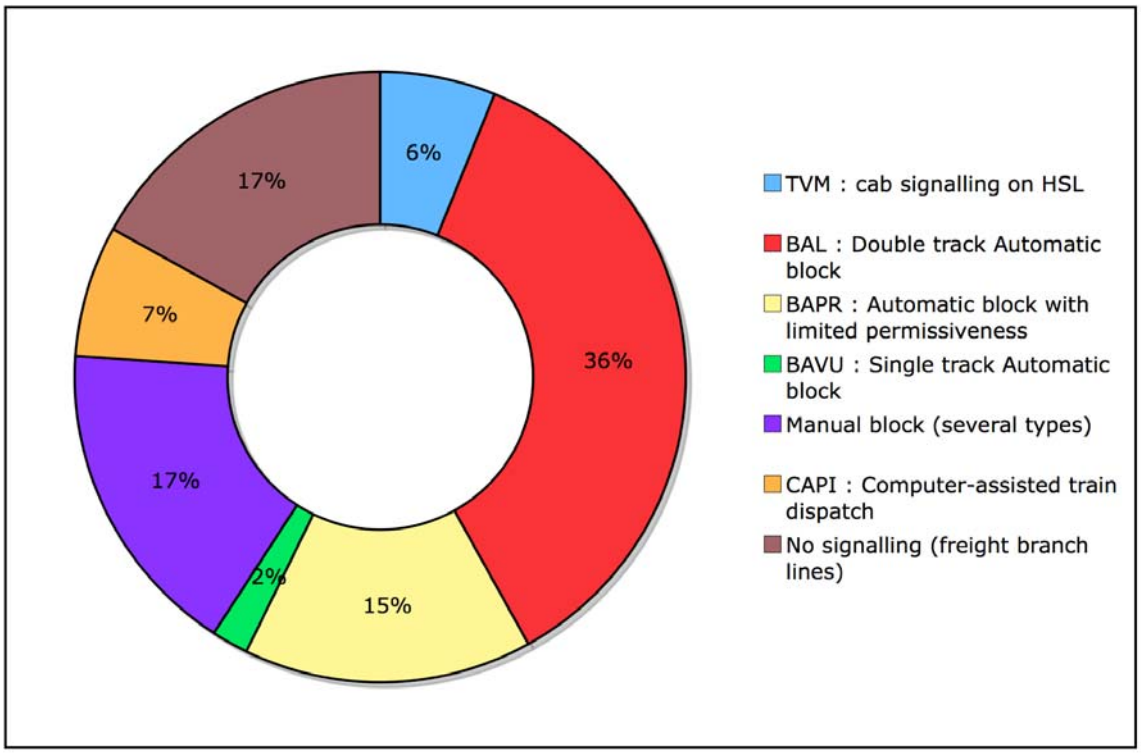
The case of the French railway system is very typical, with:
- two voltages of electrification (1.5 kV d.c. and 25 kV 50 Hz) which correspond to two distinct phases of equipment (i.e. before and after 1960),

[5] For instance, the *Thalys* trainsets running between Paris-Brussels-Cologne and Amsterdam have to be equipped with 7 different types of train control systems, which incurs considerable costs.
[6] In this respect, only Luxembourg and Sweden implement a systematic policy of deployment in their railway network. With only 45 km equipped, France is not extremely proactive.

- a low proportion of electrified routes: 15,424 km out of a total of 29,473 km in operation, i.e. 52.3 % (source: RFF). But these routes carry most of the traffic, as well shall see later,
- at least six different signalling systems, some of which date from the railway companies that were replaced by SNCF in 1938 (see figure 1).

Due to these disparities, it is necessary to limit the validity of newcomers' safety certificates to the lines which will be actually used, and to provide particularly complex training of drivers, which also incurs costs.

Figure 1 - The disparity of signalling systems in France
(source: RFF, 2009 report, in percentage of the total length of the network in operation)



Even if proposals for centralised control of railway traffic and the development of a GSM-R (Global System for Mobile communications - Railways) network would reduce the degree of disparity, there is still a lot of work to be done.

Unforeseen needs for public investment

All this work for bringing obsolescent equipment up to date and standardising operating systems requires financial efforts that the infrastructure managers are not always able to make on the sole basis of their income from track access charges. To this must be added the creation of additional capacities to absorb the extra traffic that the success of the policy for opening the market was supposed to generate. This work is necessary to ensure the success of the reforms. It was not anticipated, apart from some exceptions, which were mainly in those Member States that had understood that liberalization could enable them to

develop their ports and attract traffic which previously went via other seaboards. This is particularly the case of Belgium and the Netherlands, which both made major investments to develop their projects for a corridor reserved for freight traffic between their principal port (respectively Antwerp and Rotterdam) and the German hinterland. Thus, the Dutch *Betuwelijn* (160 km between the port of Rotterdam and the Dutch-German border) cost a final € 4.7 billion. The *Steel Rhine* is a project for reactivating a direct line created in 1873, connecting Antwerp to Munchengladbach (Germany). But its completion was delayed by several ecologist oppositions, and by the fact that the line crossed a portion of Dutch territory.
In the case of France, the creation of corridors dedicated to freight traffic was debated in the 1990s before being postponed, and this question has been recently raised again with the publication of a "national freight commitment" in 2009 (figure 2) which foresaw the development of a "freight-oriented" network, mainly involving ports and interfaces with neighbouring trade partners (Zembri, 2007).

The cost of completing all these projects has been estimated at €7 billion. This mainly consists in increasing the railways' market share of major international traffic. This plan does not call into question the long-term trend towards centralisation of the network on Paris and its surrounding area.

It is a matter of creating the capacity where the present traffic flow is difficult as well as recreating efficient routes that avoid the most congested junctions. But this type of plan is late, several years after the effective opening of the market, and one may ask whether the residual capacities on the national railroads network were deliberately limited in order to protect the national operator. For its organisation corresponds entirely to the present hierarchy of lines and junctions, and any questioning of this architecture would be a welcome breath of fresh air for more inventive competition.

Figure 2 - The official map of the 2009 French *Engagement National Fret* / National Freight Commitment (source: RFF web site)

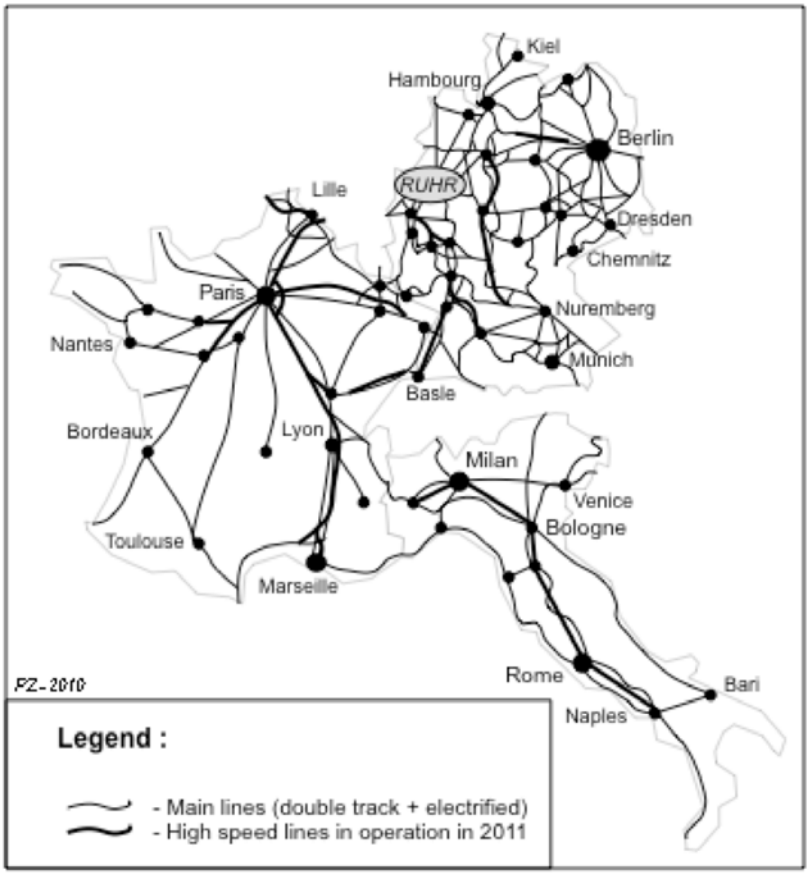
TWO ILLUSTRATIONS OF "MALADJUSTMENT" IN FRANCE

Therefore we put forward the idea that there is a gap between the network structure that was wanted and designed by the incumbent operator, and a more "universal" conception that allows other operators to enter the market on a significant scale, by attracting point-to-point traffic which has previously avoided rail or which was not particularly desired by the national operator. By network structure, we mean not the layout or alignment of all the lines of which it is composed, but the layout of those lines that are given priority in terms of equipment and use. The larger the gap between the portion of network that is "useful" for the operator in place and its theoretically usable entirely, the more it is probable that the arrival of newcomers on the market will be difficult. On the other hand, a high rate of use reflects a more varied conception as regards alternative routes and connectivity, and which is therefore normally more favourable to the development of alternative operators.

If we compare the French network with other European networks, we find that it is characterised by:
- a relatively low proportion of well-equipped routes (electrified with high-performance signalling),
- a large quantity of under-used lines, with an average number of trains per day less than 25,
- very marked centralisation, with a major network junction at the Paris conurbation, and a smaller-scale junction at Lyon.

Figure 3 shows, in schematic form, the differences in structure in relation to networks in neighbouring countries. Only the Italian network may be considered comparable, with a major junction in Bologna, and an alternative North-South route that is much less efficient via La Spezia and Pisa. The German network is very dense with many alternative routes.

Figure 3 - Schematic structures of French, German and Italian networks



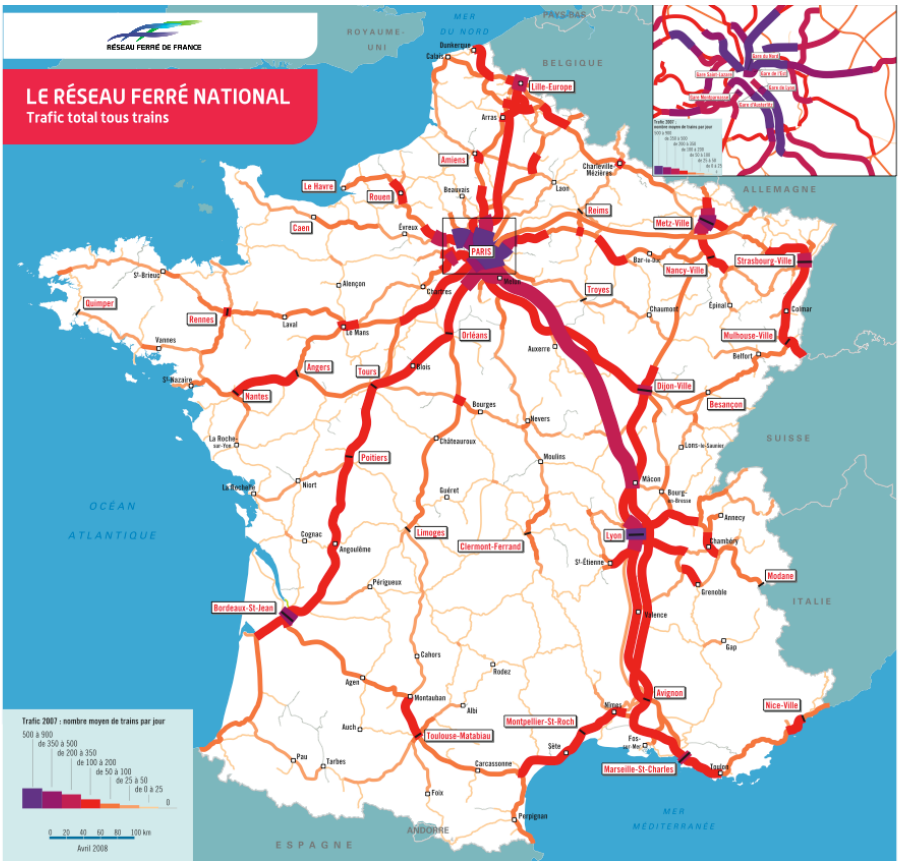
A small number of main routes, complying with the SNCF strategy

In 1938, SNCF took over the assets of five networks which were developed from Paris railway stations on geographical bases. As a result, there is a large number of terminus stations, which, for the moment, prevents Paris acting as a railway “hub” for passenger

traffic. Circular railway lines were created between 1852 and 1883 to reduce this handicap, particularly for freight transit. A high-speed partial circular line, serving Disneyland Paris and Charles de Gaulle airport, provides access to interregional TGV high-speed trains, mainly in the North - South direction. Most of the shunting yards were installed in the Greater Paris area (in Villeneuve-Saint-Georges, Achères, Vaires, Trappes, Juvisy, etc.). Lastly, the radial routes (from Paris to the exterior) have always been better equipped than other lines, and they allowed the highest speeds.

The chart of average daily traffic per line for all train categories in 2007, published by RFF (figure 4) shows very great disparities in the use of the French railways network. It is easy to see the importance of the radial routes, particularly in the predominant North-South direction. There are only a few rare lines that do not touch the capital but which have a good level of traffic: Dunkirk - Lille - Metz in the North of the country, Metz - Dijon in the East, and Bordeaux - Toulouse - Narbonne in the South.

Figure 4 - Average total daily traffic for all categories of trains, in 2007 (source: RFF)



Radial routes were often doubled with high-speed variants and/or with priority freight. The most complex case is that of the South-East sub-network, with one line for all types of traffic via Dijon (the oldest), one more direct high-speed line (opened between 1981 and 1983) and duplication of lines for carrying freight traffic between Paris and Montereau, then between Dijon and the Lyon junction (via Bourg-en-Bresse) and finally between Lyon and Marseille (two routes which cross at Avignon then at Miramas). In the Rhone Valley, the left bank route

is the only one that carries all types of traffic, while the right bank route has been reserved for freight trains since 1976.

On other routes, the long-term trend has been rather towards the concentration of traffic on a single route, which is given priority in terms of the level of equipment. On Paris - Bordeaux, two existing routes were managed by two competing companies (Paris-Orléans and Ouest): the first (Paris-Orléans or PO) via Orleans and Tours, and the second (Ouest) via Chartres, Saumur, Niort and Saintes. SNCF gave priority to the route that had been electrified (PO); the second route disappeared almost completely, and its surviving sections only carry local traffic. As a result of the increasing saturation of the PO route – which takes 220 km/h TGV trains as well as 100 km/h freight trains – a separate high-speed line will be built by 2016.

This highly centralised configuration with a minimum number of large routes is a considerable factor of fragility. If the routes are interrupted, there are virtually no alternative routes. Bottlenecks such as Bordeaux and Toulouse determine the scale of the service to an enormous part of the country. The service to the port of Le Havre depends on the saturation of the Paris - Rouen route and on the very limited capacity of the Rouen Rive Droite station[7]. More generally, the Paris railway complex, which is largely saturated by regularly boosted regional services, does not guarantee any regularity of traffic flow. Projects for reopening the circular outer line around Paris to passengers, which was previously reserved for freight, may further jeopardize the overall quality of services, even if investments in capacity are made hand-in-hand with these operations.

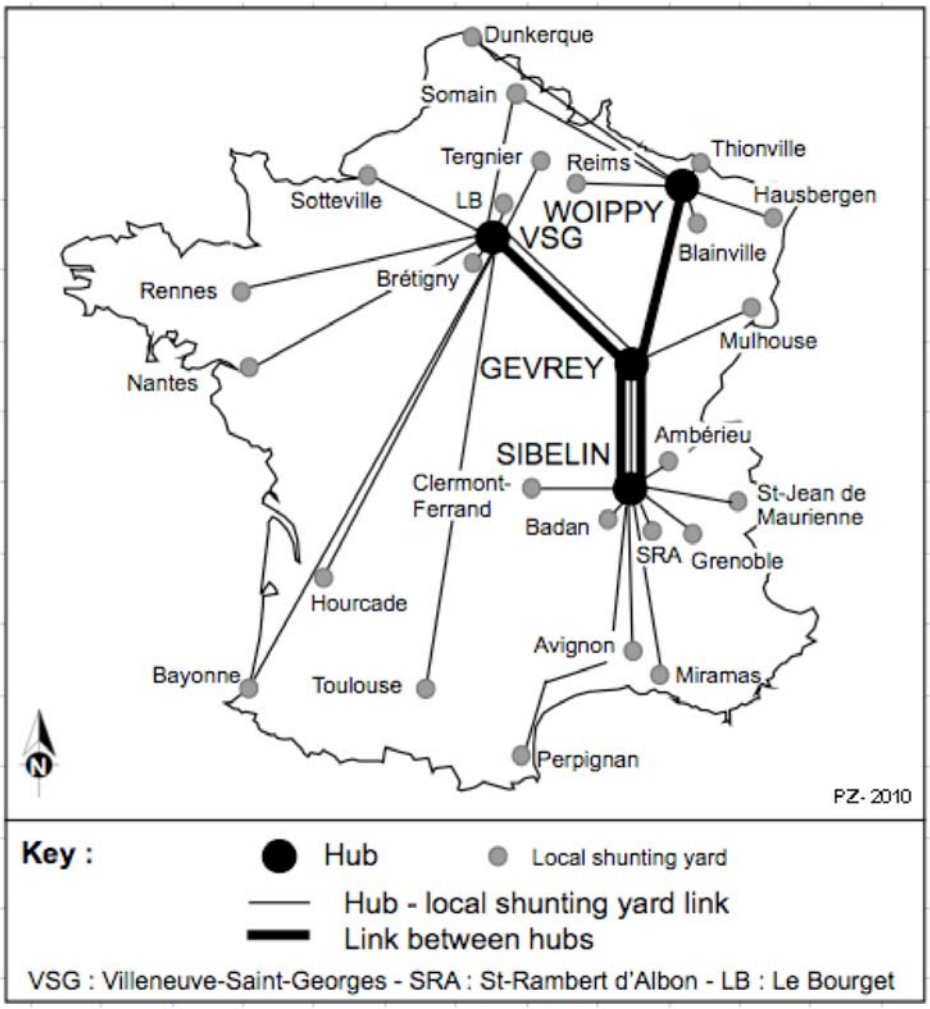
The development of the high-speed network was itself copied directly from the network's radial structure, currently with four main directions from Paris, including three (North, East and South-East) linked together by the above-mentioned junction line. A proposal for a South junction in the West and South-West directions via Orly airport is currently being drawn up, but it will probably not be completed before 2017. The TGV interregional market now represents 10% of SNCF's services and 14% of its income. It is a very buoyant market. However, most of the traffic is conveyed via the Greater Paris area, even if there is a major detour in terms of kilometres, such as Lille - Strasbourg (+120 km, i.e., + 22.6%), Nantes - Lyon (+110 km, i.e., + 16.8%) or Bordeaux - Lyon (+200 km, i.e., + 31.3%). On the other hand, the long-distance services of direct "as the crow flies" lines have been considerably reduced: only one train takes the Nantes - Tours - Lyon route from one end to the other every day (and two trains on weekly peak days), compared to five to seven trains at the end of the 1980s.

The single wagon freight services are also strongly oriented on the best-equipped major routes. The number of marshallings and switchings is continually decreasing with service reorganization plans. As a result, there is an increasing number of shuttle trains between a

[7] An extremely costly project is currently being studied for a new underground line through Rouen with a new station located on the left bank, but it will be difficult to finance. A junction line to avoid passing through Rouen was re-established in 2008, going towards Amiens and the North of France, but these are not the priority directions of traffic flow to and from the Port of Le Havre. This line carries less than 25 trains every day, as opposed to 300 via Rouen.

limited number of sites. The most recent plan (SWING) – which has been suspended for the moment, because of a change in SNCF's internal policy – proposed to keep only three "hubs" linked together by frequent shuttles, redistributing the wagons to regional hubs that are often very far apart, but making maximum use of radial routes (figure 5).

Figure 5 - Diagram of the SWING plan's service published by SNCF in 2008, but finally not applied (according to official SNCF documents)



As a result, the network of SNCF services is even more radial, also involving block trains, and this has repercussions for the following:

- transport times: increased distances, passage through saturated junctions;
- rotation of trainsets: more wagons are necessary for the same volume of traffic,
- reliability and robustness of transport plans.

Neglected transverse routes, difficult to access by new entrants

New entrants answered invitations to bid for block train services between sites that are often very far apart. One of them (Seco Rail) operates trains of construction materials for itself

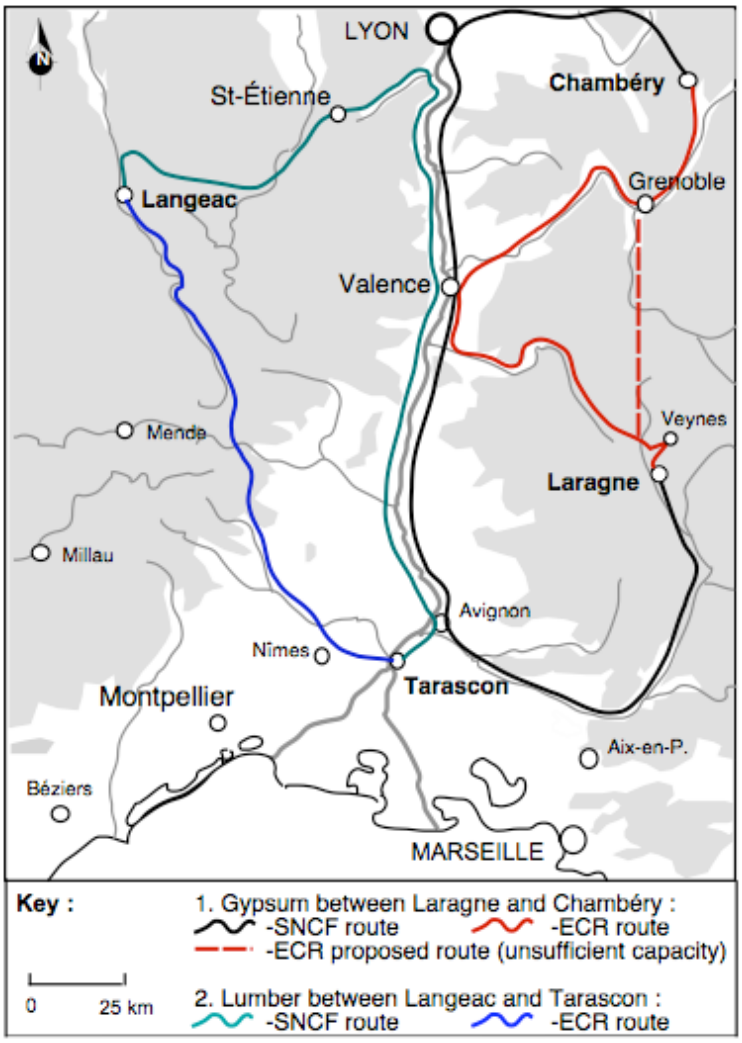
from its quarries to construction sites of motorways or other infrastructures which are mobile, by definition. More recently, long-distance international trains have appeared, such as those that transport automobile parts between Spain and the United Kingdom. While the network's radial structure may suit certain markets, it can be a handicap for developing others. The success of new entrants depends on the reliability of transport plans (an area where SNCF's services posed a problem) and in productivity gains in terms of rotation of trainsets.

It may be advantageous, if not necessary, to travel via lines that are as direct as possible, thereby saving precious kilometres and avoiding problematic bottlenecks. To provide for such choice, most new railway companies have equipped themselves with diesel locomotives, so that they can use the 47% of non-electrified lines. However, the capacity of these lines is often very limited because of the savings made in the infrastructure, and they sometimes have difficult longitudinal sections that require powerful traction equipment. Lastly, speed and axle load restrictions – which were imposed on 1,500 km of France's national network of railway lines from 2006 because of the obsolescent state of the infrastructure – necessarily have an impact on freight services.

Three examples illustrate the stakes involved in making better use of the network's capacities (see figure 6):

- Traffic of mineral water from Volvic and Evian to the United Kingdom: the operator Euro Cargo Rail (ECR, a subsidiary of the DB AG Group) hauls two half-trainsets from the two production sites to Bourg-en-Bresse, where they are merged before being hauled to the Channel Tunnel. The half-trainset from Volvic (near Clermont-Ferrand) travels on little-used transverse lines to Bourg-en-Bresse (but it does not avoid the Lyon crossroads).
- Traffic of gypsum from Laragne (between Sisteron and Gap in S.E. France) to Chambery (in the Savoie area): this traffic, taken over from SNCF by ECR, goes via Veynes, then via the Valence - Briançon line, before heading towards Grenoble and then Chambery. The first part of the run (to Valence) has a difficult longitudinal section, and the infrastructure is restrictive (with a single track and few stations where trains can pass each other). SNCF trains went down to Avignon before going back up the Rhone Valley (a major radial route) to Lyon and then branching off to Chambery. This saves 237 km (323 km instead of 560 km). ECR would have liked to use the direct "*Alpes*" line between Veynes and Grenoble (i.e., an additional saving of 119 km) but there no train paths available.
- Traffic of pulpwood between Langeac (in the Auvergne) and Tarascon (between Marseille and Nimes): here too, ECR won the invitation to bid by choosing a direct route via the "*Cevennes*" line (from Clermont-Ferrand to Nimes), which is very steep, with a fragile infrastructure (it is restricted by speed reduction measures since 2009, following rock falls in some tunnels). SNCF went via Clermont-Ferrand, Lyon then the Rhone Valley to Tarascon, with a considerable risk of irregularity, and a detour of 360 km in relation to the direct line (228 km).

Figure 6 - Compared routes of ECR and SNCF trains for two services in the South-East of France



The new entrants' applications to use the original routes are developing regularly. This suits RFF, which aims to develop the use of a maximum number of lines in its network. A sales department was even installed recently to sell a maximum number of paths, if possible outside the saturated areas. But the infrastructure must also be upgraded, and this will have to happen very gradually, considering the very limited investment resources outside of major emblematic development projects.

The "capillary" network, in great danger, hinders the development of local freight operators and disturbs the development of regional trains

Since 2005, we have witnessed the beginning of the collapse of the part of the network that carries the least traffic, due to a lack of renovation work. This shows the limitations or, rather, the end result of the choice of maximum concentration of traffic made by SNCF's directors at the time when it was still an integrated company, managing the infrastructure according to its business strategy.

The crisis started with the enforcement of several speed reductions on the lines that were considered most fragile, which had major impacts on run times and on connections. There is still a risk of decisions to close lines for safety reasons, especially as more than three derailings related to the bad condition of some tracks happened between 2003 and 2006. As a result, temporary closures affected some very deteriorated lines from 2007, obliging RFF to carry out urgent work.

An audit of the network conducted by the École Polytechnique Fédérale de Lausanne (EPFL), directed by Robert Rivier (Rivier & Puttalaz, 2005), showed that the problem was not just a matter of the amount of credits allocated to the network's maintenance (which was considered poor), but was also related to the breakdown of these credits between ordinary upkeep maintenance (70% of the total) and renovation (30%). In most other European networks, the proportion is inverse. This amounts to maintaining an existing asset in its current state at a loss, without renovating it. Therefore all the component parts of the network (the track, switch towers, control/monitoring systems, etc.) inevitably age. This situation reflects a lack of clear strategy. Action is always taken urgently, without any aim to have long-term control of maintenance costs. The audit found that low-traffic lines were not the only ones affected by the crisis, since the rate of renewal of the network's largest lines (groups UIC 1 to 4) implied that the average service lifetime a track of this category was around 60 to 70 years!

Having said this, it was the 13,600 km of the least used and least regularly maintained lines that were running the greatest risk. To avoid this risk, it was necessary to greatly increase the renovation credits without reducing credits for ordinary maintenance, since all lines could not be concerned. An agreement was reached between the French government, RFF and SNCF in May 2006 to gradually increase the amount of annual credits between 2006 (+ €110 million) and 2010 (+ €600 million), but, as we will see, this is still not enough.

IMPLICATIONS FOR PUBLIC POLICIES

We base ourselves on the principle that the public powers, which are interested in developing free competition on their railways, are concerned about removing a maximum amount of physical and technical obstacles that may possibly limit the new entrants' market share, in a context where the track access charges of already established operators cannot be called into question, apart from their profit margin. Therefore it is important that they should assist the infrastructure managers in "reformatting" their installations so that they can absorb new traffic developed by the various market players, as part of long-term management of their asset which does not jeopardize its future use, on the basis of a strategic vision of the uses of networks.

Two time scales must be taken into consideration:

- the short term, a crucial period for the establishment of new entrants, when it is clearly difficult to successfully make heavy investments: therefore, as a priority, one will take

operation or regulation measures that can reduce any difficulties that arise, while awaiting more for substantial action to be taken on the infrastructure;
- the longer term, where, according to the new uses of the network that are gradually revealed (and which can only partly cover those of incumbent operators), it is necessary to determine the investments to be made in order to allow all the traffic increase that will normally result from the opening of the market.

Moreover, two objectives must be pursued in parallel: prevention of saturation related to the excessive concentration of traffic, and rehabilitation of secondary lines that have been neglected for a long time.

Prevention of saturation: a necessity for creating capacities and facilitating competition

At a time when freight traffic and regionalisation are being re-boosted, the shortage of paths is patently obvious in many links, in time slots of increasing importance. The allocation of these traffic possibilities is all the more difficult because railway infrastructure must cater for services of different performance (such as acceleration and maximum speed): it is difficult for freight trains, regional services and long-distance trains (which are more and more often high-speed trainsets) to co-exist on the same tracks. The prospect of a certain liberalization of freight on the European scale makes it necessary to provide capacity reserves on the routes concerned that can result in the real operation of a more open market.

France's railway network has been developed with high-speed lines which, until present, have been specialised in passenger traffic. Although TGV trains have the advantage of no longer cluttering some conventional lines, they still use the same saturated junctions and routes as other categories of trains (Bordeaux, Lyon, Nimes - Montpellier, etc.). The high-speed railway is so successful that two portions of line – on the South-East and North TGV routes – must be considered to have reached their saturation limit. However, RFF considers that there are still capacity reserves, as long as the trains spacing system is changed (with the adoption of the ERTMS).

As soon as it was set up in 1997, RFF tried to find solutions for this gradual jamming of the network. They included the reactivation of old neglected routes that are still continuous, for freight of, but, in some cases, major investments will definitely have to be made in capacity at the junctions or on jointly-used sections that reach their saturation limit. Among other places, Lille, Lyon and Bordeaux are part of sectors that may be concerned. But RFF has limited financial resources, which will limit the scope its action in the next decade. Only the Bordeaux bottleneck will disappear in the short term. In Lyon, the solution will entail diverting freight traffic via the East of the urban area, which is not yet planned.

Reallocation of traffic to under-used routes (such as transverse conventional lines) can now provide considerable improvement. But this implies revising highly-centralising transportation plans that neglect many routes and entail diversions, which are sometimes large-scale. The regulating State will have a difficult task in organising an indisputable system of paths

allocation and encouraging network users who can do so to avoid “black spots”. This action is necessary to provide the end users (shippers and passengers) with sufficient service quality to maintain or even develop the network’s attractiveness and to encourage them to switch their mode of transport from road or air transport.

In addition, operational measures can make it possible to gain precious paths while waiting for more substantial investments.

RFF launched a major plan for time-phasing of services in the Rhone-Alps region, which was first applied for the 2008 annual service. Considering its importance on the national scale, almost a third of the French network was in fact affected by this reorganisation. This plan is inspired by the Swiss experience of Rail 2000, which was started in 1987 and is still being developed, since its complete implementation depends on the creation of new sections of line aimed at establishing uniform travel times between stations where there are connections every hour or every half-hour. The idea is to maximise the number of regular paths for every hourly period, to be able to absorb the extra services related to the implementation of the REAL (Greater Lyon transport system), but also to allow the regular passage of more freight trains. The regional trains service has been increased by 15% in two stages. The trains are placed in groups which always provide the same service: the same routes, the same travel times in both directions, and the same stations served.

Without going as far as complete time-phasing in all cases, RFF also proposes to establish uniform speeds of convoys on the busiest routes of its network. The differences in speeds between convoys travelling on one same track reduces the possibilities of tracing train paths in a given lapse of time, to ensure that fast trains do not catch up on slower ones. Applying similar speeds of travel makes the trains’ progress plots more parallel on the traffic chart, and therefore makes it possible to create new paths. This goes largely against the practices of incumbent operators, for whom the peak speeds of passenger trains must be as high as possible. But it may also be possible to increase the speeds applicable to freight trains, as is possible with current traction equipment.

Upgrade the least used infrastructure so that it can be boosted

The question is more acute for infrastructure where only freight trains travel. Freight-dedicated lines of category UIC 7 to 9 represent 3,861 km divided between 186 sections. While it is true that SNCF no longer wishes to serve these lines for low levels of traffic, one must also realise that their future no longer depends only on the goodwill of the incumbent operator, and that a new dynamic is establishing itself around this network. Indeed, a new movement seems to be starting on the small lines thanks to local freight players, who may be local government authorities or associations of shippers (Dablanc & al., 2009). Projects by local freight operators, equivalents of the North American or Swedish Shortlines, are being developed with the launching of two local companies in 2010. New entrants such as Seco Rail, Euro Cargo Rail, VFLI and Veolia Cargo can use this freight capillary network for regular traffic of sufficiently large volume. It is not in SNCF’s interest to continue insufficiently large and/or insufficiently profitable traffic on lines that are sometimes long, slow and far from

the main maintained freight stations. Therefore some traffic has been abandoned, but most of the block train traffic has been maintained. The current maintenance policy takes this approach into consideration, and Fret SNCF only requests interventions if the traffic appears to justify them. From a reverse approach, Fret SNCF can use the infrastructure's excessive state of deterioration as a reason to justify discontinuing traffic that is considered too unprofitable.

Within a rationale of opening of the market, the maintenance policy cannot depend exclusively on the wishes of the present operator. Since the SNCF is the appointed infrastructure manager, RFF has little information on the real condition of the infrastructure or on the rationale concerning the maintenance carried out by track maintenance gangs on the ground. To resume control of matters, the infrastructure manager must have better knowledge of the state of the network infrastructure, its potential capacity for use and the real use that is made of it, in order to determine the lines that are in danger and those that have prospects for the future. Indeed, the state of the infrastructure may limit the feasibility of some over-deteriorated lines being taken over by local operators, as the cost of the work to be done may be excessive in relation to the foreseeable sales figure. It is not in interests of the infrastructure manager itself to make this expenditure, considering the low level of track access charges for freight trains in the French network. If traffic is doubled on several routes, this would only gain a few tens of thousands of euros, whereas the funding needs for all rehabilitation and repair works are measured in hundreds of thousands of euros per kilometre!

Mixed passenger / goods lines with low traffic are not treated any better, and the withdrawal of Fret SNCF is accelerating their decline. This situation, which is considered dramatic, has motivated some regions to launch Rail Plans to fund urgent upgrading and renovation work that the infrastructure's national manager could not start in the immediate future. The Midi-Pyrenees region, of which 70% of the network was obsolete, borrowed the necessary funds (€400 millions) to finance the rehabilitation of all the threatened lines (500 km) in six years (2008 - 2013). The Auvergne region followed, with a €213 million Rail Plan which it funds jointly with the State and RFF: 787 km of lines will be saved, including 536 km in the long term. Lastly, the Limousin region mobilised €118 million to invest in its network. It is not impossible that other regions will take action after them, taking the place of the State *de facto*, while considering that they pay twice for the same thing. Indeed, the track access charges paid to RFF for regional trains (TER) are high, and they are not reinvested in the regional network.

CONCLUSIONS

If they really want the opening of markets to be successful, public authorities have a heavy responsibility in terms of redefining investment and maintenance policies while considering the real potential of the markets served, but also the environmental obligation which makes it necessary to prefer modes that use less energy and emit less pollutants and greenhouse gases. It is edifying to note that SNCF bases itself on figures provided by ADEME (the French Environment and Energy Management Agency) to justify its withdrawal from areas

where the density of single wagon traffic is too low: a locomotive that hauls a handful of wagons on a final distribution or collection run emits more than the number of lorries that would have been necessary to carry the same volume of traffic. But there is no mention of the assessment of the overall run which consists of segments with very heavy traffic for several hundred kilometres. However, the stakes are high: all areas of Western and Southern France are not served since the end of 2007.

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