

Office of Rail and Road

## **System Operation**

A consultation on making better use of the railway network

### **A submission by Jonathan Tyler Passenger Transport Networks, York**

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## **1 INTRODUCTION**

1.1 A consultation paper that addresses issues of 'system operation' is welcome and overdue. Since infrastructure and operations were institutionally separated the obvious and paramount fact that any railway is an integrated system has often been overlooked. This submission will argue that the separation model is based on flawed analogies with other modes, but if it is to continue to shape the organisational framework of Britain's railway it is essential that the best possible means of integration are researched, understood and implemented [see ¶8].

1.2 The recognition of the importance of a detailed understanding of the network and how different parts interact is significant, especially since system operation supported by those two factors can “maximise the level of plannable capacity ... in a way that separate parties could not” [¶45]. Similarly, it is noted that features of a rail network make coordination vital [¶49].

1.3 The paper is also right to focus on securing a proper balance between increasing use, improving punctuality and keeping costs down [Figure 2]. Equally timely is the discussion that, *inter alia*, emphasises the importance of ensuring that decisions to expand the network are well-informed and that costs are kept at an efficient level [¶13+14]. That is not necessarily happening now, not just in terms of Network Rail's difficulties but also because of evidence of poorly-specified schemes.

## 2 THE CHARACTERISTICS OF A RAILWAY

2.1 It is important to be clear about the distinctive characteristics of a railway.

- \* A railway must operate in a disciplined mode because of the mass and speed of a train.
- \* Trains are confined to tracks from which they cannot deviate.
- \* Trains can only overtake each other at dedicated locations where the layout of tracks permits such a move.
- \* Planning must avoid conflicts, and real-time control must prevent them.
- \* On a busy multi-user railway trains typically have a mix of
  - power-to-weight ratios
  - rates of acceleration and deceleration
  - running speeds
  - available power for managing gradients
  - permissible speeds where the condition of the infrastructure requires limits
  - calling patterns
  - dwell times
  - routes at junctions

which collectively create dynamic interactions that it is the task of timetable planners to minimise and the task of controllers to manage intelligently in real time (note that train drivers cannot make independent judgments).

2.2 These factors are both a weakness and a strength. On the one hand they render the railway system relatively inflexible in operation and very expensive to modify, but on the other they make possible a large potential capacity – and generally do so at low environmental cost and with a modest land-take per unit of traffic moved.

2.3 They also explain why analogies with ports, airports and roads are mistaken. Those modes afford dimensions of movement that trains do not possess. Ships and planes have almost limitless freedom, and even when their paths coincide at terminals their passages are largely homogeneous. (Failure to recognise this point is why the word 'slot' is inappropriate for railways: 'path' better expresses the complexity and spatial determinism of a railway system.) And unlike roads, where access is at random and interactions between vehicles are largely controlled by individual drivers,

railways require external control and constraints on access<sup>1</sup>.

2.4 It may be understandable that this analogy grew out of concern in the European Union about inefficiencies in the national railway systems, particularly with regard to international traffic, but that does not make it any less flawed. Moreover the further belief that the best means of making the railways more competitive against the huge challenge from other modes is to introduce competition *within* the railway does not take proper cognisance of its specific characteristics. One may concede that the concept may have had some legitimacy in the case of freight, but its transfer to the passenger business was essentially ideological.

### 3 CAPACITY AND ITS MEASUREMENT

3.1 The capacity of a port can be readily measured in terms of ship sizes and berth occupancy. The capacity of an airport runway – measured in slots – is defined by the rate of take-offs and landings that is operationally practicable and safe. The capacity of a road is more complex but is primarily a function of speed (and variations in speed in busy conditions); the mix of vehicles is taken into account by introducing the homogenising metric of passenger-car-units.

3.2 The capacity of a railway is more difficult to define. Influenced by the analogies with other modes and by the requirement to manage access to the track once operation of trains had been separated, regulators, infrastructure managers and academics have endeavoured to measure capacity as though it is somehow fixed and hence capable of subdivision into a bundle of paths. This may be true of an urban metro worked by identical trains that always stop at the same stations and that are not impeded by crossing moves<sup>2</sup> or of a dedicated heavy-freight mineral railway. It is not true of most of Britain's national railway.

3.3 There are two intertwined issues, one technical and one market-related. On the first

\* because most services run through a number of sections, combining and recombining with other services, calculating the capacity of any one section is not particularly helpful and the capacity of the network as a whole becomes an elusive concept<sup>3</sup>;

\* because the railway network is sparser than the road network its effective capacity is influenced or even determined by that of the more constrained sections (whereas in most road cases alternative routes are available); and

\* the factors listed earlier [in ¶2.1] profoundly influence outcomes.

3.4 Consideration of the market reinforces this point. On a predominantly passenger railway paths need to be planned in such a way that

\* their characteristics vary to suit different markets (but not by more than is necessary);

\* their sequence minimises interactions and avoids gratuitous waste of capacity (by for example

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1 The first railways were conceived on the roads model of an infrastructure provider offering access to independent operators of vehicles, but it was quickly found that this was unmanageable and unsafe. A price paid for contemporary highway practice is of course the frequency of collisions and of vehicles leaving the road, and it is significant that technical advances may introduce more external controls (as traffic lights already do).

2 Contrast the simplicity of London Underground's Victoria Line or the central sections of the Central and Piccadilly Lines with the operational problems of the Circle or the Camden Town Junctions, the latter being once a marvel of the world and now an impediment to higher frequencies that may have to be removed.

3 Network Rail's analysis of timetabling on the East Coast Main Line [ECML] in response to multiple applications for paths breaks the route into five sections for this reason and thereby illustrates some significant constraints.

careful positioning of stopping trains and flighting of fast trains);

- \* market requirements are balanced against almost-immutable features of the infrastructure (for example, one train calling at a station may hold up the following train and thereby consume two nominal paths – this is why headways on open track have little meaning because what controls capacity are station layouts where a train cannot overtake another in the absence of a loop<sup>4</sup>);
- \* each is used to maximum effect in terms of its economic value, which will be some function of the nature of the traffic carried and the number of passengers or volume of goods (the preoccupation with 'paths' has misled regulators into underplaying this point, with the result that valuable capacity is being wasted by the running of trains of a smaller-than-norm size);
- \* overall they offer the most attractive feasible service, make the most efficient use of a national asset and secure through good inter-relationships the best possible connectivity for travellers;
- \* preferably they follow a consistent pattern hour-by-hour since this is both demonstrably what most passengers expect and respond to and widely accepted as the most efficient scheme (once again, because variation tends to have a disproportionately disruptive effect on capacity); and
- \* their daily operation achieves a high standard of reliability.

3.5 This means that the statements in Figure 6 [p.12] have limited value.

3.6 The ineluctable conclusion is that the real capacity of a mixed-traffic railway is a function of a mix of factors *and of the decisions taken about how to combine and balance them* rather than an abstract predetermined quantum<sup>5</sup>. It has in fact been suggested that railway timetables present one of the most intractable operational problems, and it is telling that no definitively-optimising algorithm has yet been found. Computer-aided human ingenuity and judgment remains the norm.

\* The phrase 'notional capacity' appears to mean signalling headway, but the qualification about rolling stock implies use by a single type of train, which is rarely the case on congested sections, and the word 'route' confuses the (not very interesting) situation on one section with the more complicated situation on a string of sections.

\* 'Plannable capacity' includes the same weakening qualification about stock and seems to assume an unrealistic homogeneity of trains and service requirements: it may have some relevance to suburban sub-networks (for example, on the Main Suburban Lines into London Waterloo or on Merseyrail), but it is of little value as a benchmark elsewhere.

\* 'Throughput' is a *post hoc* measure that may be useful for monitoring performance but is only relevant to discussions of capacity if systematic trends indicate that the network is operating significantly above or below its sustainable realisable capacity.

\* 'Capacity in use' comes closest to what we have outlined above, although it obscures the more fundamental features by framing them in institutional terms such as franchise specifications and

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4 A loop may allow a second train to overtake, but since this delays the first train and may introduce performance instability it is usually only justified in particular circumstances, such as interchange between two services that both call. Where two platforms enable a second train to arrive before the first has cleared, the effective capacity is closer to the open-track headway, but it is operationally difficult to equal it. This facility is built into the plans for HS2, but it is costly on the existing railway – witness what has been achieved at Reading.

5 Compare ¶36. This also explains why the idea of auctioning paths is unworkable [Figure 8, outcome 4, p.18]. That does not mean that relative value is not very important in guiding priorities in the timetabling process, although it is not always easy to measure.

track-access agreements that may be the prevailing determinants but are not a given fact<sup>6</sup>.

3.7 This tension between different interpretations of 'capacity' can be identified in the terminology used in the document – and was evident too at the Workshop on 2 October. The classic regulatory phrase is that capacity is to be “allocated between train operators” [an outcome stated in the Executive Summary, p.3] and, making a big assumption, “to competing users” [¶46]. It is assumed when discussing allocation by value (which is in itself an important criterion) that there is some fixed quantity to be apportioned [Figure 8, Outcome 4]. And a reference to Network Rail having only limited incentives to sell more paths seems again to imply that they are there for the asking, just like a plainly unused 'slot' at an airport [Fig. 9, Outcome 2].

3.8 Yet it was also necessary to introduce less precise concepts. The first of these phrases is followed by the words “in a fair, economic and effective way”, and the word 'fair' occurs again in “fair treatment of customers” [¶21] and “ensuring that capacity is allocated fairly” [¶46]. It is difficult to see how 'fair' can be defined between multiple applicants for access when accommodating their trains may ripple through the timetable plans with all manner of unintended consequences<sup>7</sup> – let alone how fairness to the many other stakeholders can be evaluated. In a congested network (which much of Britain's system is) most train movements will impact on other movements and affect the connectivity offered to travellers. What is 'fair' then becomes intangible and difficult to measure. Similarly the metrics used to judge fairness call for careful definition: for example, allocation of capacity between different operators on the basis of paths would not necessarily be 'fair' if the number of seats on their respective trains differed markedly.

3.9 Similarly, while 'economic' is susceptible to measurement, though often contentiously so, it is not clear whether 'effective' refers to some metric of capacity utilisation, to the supposed benefits of competition or to the satisfaction of wider policy goals. Finally, Consultation question 2 [¶71] asks respondents to consider whether a focus on system operation would ensure that the 'right services' are using the network: that is a fundamental political question, not a mere matter for regulation.

3.10 Further ambiguities emanate from references to characteristics of the timetable. The Executive Summary [p.3] refers to customers expecting 'minimal interchange' – which cannot be presumed to arise from an allocation process. This is elaborated later [¶51 and Box 1 at p. 16]: “The timetable would ... facilitate so-called [why is this pejorative adjective inserted ?] 'network benefits' so that individual services are coordinated in such a way that passengers can make timely connections to reach their destination”. That begs innumerable questions, since allocation of paths to operators with disparate objectives is most unlikely to yield that outcome and since the idea of a fixed quantum of allocable capacity will evanesce as paths are arranged to meet this essentially public-interest goal.

3.11 In sum, access rights cannot be sensibly granted in some abstract fashion without prior awareness of their consequences, nor can it be assumed that the aggregation of access proposals from a range of disparate operating companies will match the specification for optimal use of a congested network<sup>8</sup>. Moreover, it is unlikely that the activities of these companies will combine to

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6 The remark that “Some of these parameters ... are affected by market demand” is rather odd: surely they all are – or should be.

7 A timetable developed by Network Rail to illustrate how competitive services on the ECML between Edinburgh, Newcastle and London could be arranged contained a number of anomalies and contentious proposals, and when it was suggested that ORR's decision-process required fully worked-up timetables NR stated that the task would take many months.

8 Optimal use is not just a matter of mainline paths. For example, the more the service is fragmented the more there may be extra empty-stock moves and extended platform-occupation times at terminals because rosters for train-sets can no longer be optimised in a common pool.

yield the best overall public interest. They may individually succeed in serving the markets they have chosen to target, but given their specific (and typically profit-making) aims it is almost inevitable that the resulting timetable will contain gaps and anomalies.

3.12 It would be surprising if this confusion is not costing a great deal in management time, delayed benefits and possibly misguided investment. And because of questionable confidentiality conventions the public are excluded from understanding what a future timetable might offer – except for one draft that has been released that proposes withdrawal of London inter-city services from Berwick-upon-Tweed, Alnmouth and Stevenage (an irony since one of the open-access companies has built its business case on restoring London trains to neglected centres).

3.13 This conclusion is vividly illustrated by the case that relates to, namely applications by two open-access operators to compete head-on with the incumbent franchisee on the East Coast Main Line. The parties involved have markedly differing views on the available capacity of the various sections of route, and Network Rail is unable to undertake the full-scale timetabling exercise that is necessary in order for all the consequences to be understood because staggered franchising dates and other uncertainties mean that it does not have the requisite information from the other operators on the route – ScotRail, Northern, TransPennine Express and Thameslink.

## **4 THE TIMETABLE**

4.1 The timetable is the fundamental feature of the product offered to potential customers by any provider of public transport. As a catalogue it states the availability of a vehicle to convey people from A to B at set times. That truism should not need to be reiterated, but it is necessary because it has been neglected while the focus has been on secondary (though not trivial) issues such as staff attitudes and WiFi provision, while discounted fares have (obsessively ?) dominated marketing and while so much attention has been paid to governance, regulatory processes and institutional structures.

4.2 By reference to that statement of its importance Britain's national railway timetable is presently lacking. It does of course contain many excellent individual services and what follows is not to impugn the improvements that have been made. However

- \* there is no sense of a national network<sup>9</sup>;
- \* train operating companies are preoccupied with their own sub-networks<sup>10</sup>;
- \* journeys involving more than one operator are barely marketed and may be made difficult by poor management of interchanging<sup>11</sup>;
- \* the timetable book is unprepossessing and impenetrable (and too often wrong)<sup>12</sup>;
- \* other printed literature rarely gives any help to travellers requiring information about connections;

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9 The phrase “Britain's train operating companies working together” is an empty slogan in this respect, and it is hard to find maps of the complete system..

10 Many of their maps and route diagrams show inadequate or even no information about related routes.

11 Surveys that show a reluctance to change trains probably reflect perceptions of long waits, broken connections and poor information as much as more fundamental attitudes – interchanging appears to be better managed, commonplace and more acceptable in mainland Europe. ORR has a duty “to promote measures designed to facilitate the making by passengers of journeys which involve use of the services of more than one passenger service operator” [Railways Act 1993, 4(1)(e)] but rarely mentions it or shows any interest in the problem.

12 The industry has failed to redesign it throughout the 20 years since privatisation.

- \* gaps in the network render access uneven or make journeys by rail too roundabout to be attractive;
  - \* the quality of service varies to an extent that probably damages perceptions;
  - \* on-line journey-planners have become invaluable, but they present a one-dimensional view of the service-offer, are inadequate as a marketing tool and cannot substitute for print material;
  - \* some lines whose condition enjoins a thorough review of the service-offer seem held in aspic as a result of the reluctance to close redundant stations, the rigidities of the franchising system and the absence of innovative thinking by franchisees; and
  - \* connections with other public modes are neglected altogether or disorganised in practice;
- while the timetable itself is disfigured by
- \* erratic patterns, with both bunching and extended intervals between trains;
  - \* anomalies in service qualities;
  - \* poor (and sometimes bizarrely incompetent) organisation of connections;
  - \* excessive use of pathing margins and padding as a lazy response to solving problems; and
  - \* a tendency to favour the larger flows over the sum total of many smaller flows.

4.3 We know very little about how all this affects decisions on whether to travel by rail. Demand-modelling tools are mostly used for tactical purposes rather than for strategic exercises. Network Rail does good work in its long-term forecasting, but this tends to be constrained by use of existing flows as a base – and NR is not necessarily the most appropriate organisation to be undertaking the task. Transport Focus produces excellent research into customers' experience and opinions every six months, but the surveys are of existing travellers and hence tell us nothing about those who do not choose rail.

4.4 Moreover data on rail's modal share is sparse. The National Travel Survey provides a national aggregate figure and some clues about regional differences. From this it can be concluded (it is of course obvious) that rail has high market penetration in London and to a lesser extent across South East England, but statistically that must imply low shares everywhere else and in some areas and for some types of journey extremely low shares.

4.5 Yet, despite the avowed aim of Government policy being to raise rail's modal share, and specifically to encourage a transfer from private cars to trains (and public transport generally), trends in this measure receive almost no attention. Instead both the Department for Transport and the rail industry focus exclusively on the absolute increase in rail journeys, regardless of the fact that a trip created by marketing cheap fares may not have the same economic value as a trip that would otherwise have been made by car.

4.6 These circumstances are undesirable and probably unsustainable. A choice exists. One route would be to continue with and deepen a policy under which fragmented territorial franchisees sell rail travel as a consumer item no different from baked beans, with a heavy emphasis on bargain prices and perhaps extended levels of on-track competition – but no pretence that Britain has any need of a national railway operated in the collective interest.

4.7 The alternative would be a nationwide system of communal transport with rail as its long-distance and high-volume core whose purpose would be to afford every citizen a reasonably equal quality of access to places of work, education, goods, services, leisure and personal affairs and

thereby to underpin everyday life with an excellent, extensive and reliable offer<sup>13</sup>.

4.8 This model is broadly what is found in much of mainland Europe (however much the European Commission challenges it) and may well be the unspoken and unformulated feeling behind the popular call for renationalisation (and many local campaigns to protect bus services). Above all it will become imperative as the pressures of carbon reduction to avoid catastrophic climate change grow (along with other ecological constraints), since the vital and substantial uplift in rail's modal share is unlikely to be achieved by following the present course.

4.9 In this context the reference to “More transparency around what taxpayer and user money is buying” [Box 1, p.16] is particularly welcome. At present the process of franchising and even more the process by which ORR judges open-access applications are so arcane that few people beyond those directly involved understand what the choices and the long-run implications are. This is probably a factor influencing the widespread sense that the railway is serving narrow interests rather than the public interest. A thorough debate, grounded in good data, is needed [as is perhaps being hinted at in ¶15 ?]

## 5 AN ALTERNATIVE STRATEGY

### 5.1 If

- \* a quantum of capacity cannot be allocated because it cannot be predetermined;
- \* access cannot be at random;
- \* all foreseeable interactions must be identified, assessed and specified; and
- \* the way in which capacity is utilised forms an essential tool of carbon-reduction policy,

it follows that there must be a strong emphasis on some form of central planning. In turn that means that a timetable-led approach becomes a credible proposition and may indeed be the only workable strategy.

5.2 It is telling that in a document ostensibly grounded in regulatory assumptions about marketised allocation there are nonetheless a number of references to the importance of timetabling to system operation:

- \* “the need to make the best use of the current network, including through effective timetabling” [¶6];
- \* “capacity ... allocation (e.g. timetabling ...)” [¶26];
- \* a recognition that use of the network, and by whom, may need periodic review to ensure continued maximisation [¶33];
- \* the requirement of long-term planners to have a view about the likely timetabling of services [¶35];
- \* the relationship between the quality of the timetabling and performance on the day [¶35];
- \* “... timetabling (which is a core system operation activity) [¶43];

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13 The lowly status of timetabling, coming below access decisions and the sale of rights in the penultimate column of Figures 5 and 7, would be raised up to a central role in this scenario.

\* “individual services are coordinated [so that] passengers can make ... connections” [¶51 and Box 1, p.16].

5.3 The implications must be followed through. For the reasons set out above [in ¶2.2, ¶3.3 and ¶3.4] designing a good timetable has to be a core function of a system operator charged with acting as a 'guiding mind' to secure efficient use of the network, although it may well be preferable for a separate agency to manage the task [see ¶5.7 below].

5.4 The most relevant model is the Swiss system. Its key features for the present context are

\* a consensual approach that ensures that both market and public-interest objectives are balanced (at all geographic levels) in each iteration of the timetable plan;

\* a regular pattern of services whose memorability is embedded in citizen's minds;

\* a complex network of routes and the highest intensity of use in Europe<sup>14</sup>;

\* for freight, a 'catalogue' of paths, especially for the Alpine crossings, that can be sold to operators in a competitive and flexible manner;

\* for passengers, a highly connected network of services derived from a determined focus on interchange nodes and strictly regular patterns;

\* deploying the timetable aspirations, desired inter-node link timings and specifications to shape the programme of infrastructure enhancement<sup>15</sup>; and

\* a long time-horizon<sup>16</sup>.

5.5 The outcome of this approach is a higher modal share than has yet been achieved in Britain and the embedding into daily life of the system of public transport – a feature, accompanied by a strong brand, that fragmented and transient operators in Britain have failed to achieve. Similar but less comprehensive policies have been adopted in the Netherlands, in some German Länder, for the framework of services throughout France (at the instigation of the system operator, following recognition that disjointed timetabling was creating inefficiencies in capacity utilisation) and elsewhere in Europe. Many of these systems employ Swiss timetabling software. And a public campaign is running in Germany for the introduction of 'Deutschland Takt'.

5.6 It is accepted that this line of argument challenges the regime assumed in the System Operation document<sup>17</sup>. It also runs counter to the thinking at the European Commission in preparing the Fourth Railway Package, but recognition of the benefits of a timetable centrally-planned in the public interest helps to explain the sustained political opposition to the liberalisation proposals in the market 'pillar'. In Switzerland, which follows European Union law and practice, the spirit of liberalisation is respected through the establishment of *Trasse Schweiz* as a regulator

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14 Measured by train-kilometres per year / route-kilometres x days.

15 This is not a well-established practice in Britain, and the document is right to draw attention [in Fig. 9, Outcome 6, p.20] to the risk that “solutions that involve operating cost are more seldom considered compared with solutions involving capital expenditure”. In our experience of designing integrated timetables we find extravagant construction projects listed by Network Rail that could be much more modest if timetable-led; this is particularly the case with schemes to double-track single-lines.

16 Starting with the introduction of the *Taktfahrplan* in the 1980s Switzerland has benefitted from a series of forward-looking timetable-based plans. They underpinned the overnight recast in 2004 on completion of the Bahn 2000 programme and the revisions following the opening of the Lötschberg Base Tunnel in 2007. The next big change will be at the opening of the Gotthard Base Tunnel in 2016, and the planning continues with outline timetables prepared for 2050.

17 See for example the assumption of a business rather than a public-interest model in Consultation Question 4.

ensuring there is no unfair discrimination. Open access services are theoretically possible, but the standard *Taktfahrplan* paths are absolutely protected from variation.

5.7 Note, however, that none of this presupposes a monolithic public corporation. A 'guiding mind' agency, separate from Network Rail and charged with timetable design in the context of long-term planning, would be expected to work with the national and devolved governments, with whatever regional structures emerge from the present devolutionary reconfiguration of responsibilities in England, with representatives of user groups and other stakeholders and with employees. It is true that Switzerland has the benefit of a deep tradition of consensus-seeking, but it would be defeatist to think that that could not be created in Britain.

5.8 Similarly, operation of the service certainly does not require a single provider (Switzerland has over 100 companies). Indeed it is desirable that there should not be. It is perfectly possible to envisage delivery by a wide range of organisations under contract to the public-interest planning body. This has some similarities to the scheme under which London's integrated bus network is organised. Finally, one may note that the Labour Party's (and the Green Party's) broad-brush commitment to renationalisation of the railway will demand fleshing out with a scheme of this kind since the simple pledge lacks substance.

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