Capacity on North-South Main Lines

Technical Report

Report

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Summary

1. This note assesses the capacity of the North-South Rail Lines in the UK from the perspective of how easy it would be to add more trains, whether intercity, regional, commuter or freight on to these routes. It presents a diagram which illustrates, at a strategic level, the main areas of congestion and of train-train conflicts at key junctions on the three main routes: the West Coast, Midland and East Coast Main Lines. The potentially available capacity on the routes is shown in a straightforward 'traffic light' format.

2. The report concludes that, although there is capacity for more trains on some sections of these routes, it cannot practicably be realised without making significant changes to existing services. This is because the constraint on timetable development on these lines is not 'plain line capacity' per se but the capacity limitations imposed by termini, key flat crossings (where one railway line crosses another), the number of sections of route with reduced numbers of tracks and, more particularly, the way these interact with each other.

1 Creating the Timetables that Determine Capacity Provision is a Complex Issue

1.1 For an additional path to be commercially useful means that capacity needs to be identified, at an acceptable journey time, for a train at *each* of:

- its origin station
- along its route
- across key junctions; and
- at its destination station

1.2 On today's busy railway, with passenger train-mileage up by 40% since 1997, this is a major challenge.

1.3 There is no standard, agreed measure of the main line capacity of the UK's rail system. This is largely because of the range of traffic types that use the network (especially their different speeds), their physical characteristics and historical development of timetables (in particular the presumption that once a passenger train has been granted a path, it is hard to alter its timings). The consequence is that a simple headline measures such as 'paths per hour' only have limited relevance to practical timetable construction. Instead, capacity assessments are made based on judgements on how different types of trains, for example with top speeds of 125mph and 90mph, can best be fitted together. The aim is to produce an overall timetable that meets peak loading demands within parameters set for franchised train operators; offers commercially attractive journey times; provides for suitable connections to be made between different services and without significant interactions between trains that could harm train performance. The dense nature of traffic on the West and East Coast mainlines in today's timetable is widely thought to be a major reason why their train performance has plateaued in the mid-80% range in PPM terms.

1.4 The main factors that affect the number and type of trains that can be operated on any route section are:

- *Signalling system capability*, particularly the signal headway (in summary terms, the practical minimum timing of successive trains such that they each pass any given signal when it is showing green).
- *Train speeds, together with acceleration & de-acceleration characteristics*: operating trains on main lines with different speeds quickly consumes route capacity. Between Coventry and Birmingham International, a stopping train takes 6 minutes longer than an intercity Pendolino train and hence consumes 3 paths at 3 min headway. As well the as the speed of the train, the rate at which it can speed up and slow down also affects the amount of capacity it requires. The mix of train types (Intercity, commuter and freight) is therefore a very important factor: this is particularly clear on the gradients at the North end of the West Coast Main Line between Preston and Glasgow where diesel hauled freight services (with maximum speeds of 60 or 75mph, and in practice lower speeds because of lengthy gradients) interact with fast London/Birmingham-Glasgow trains travelling at 125mph. Because they have

less installed power, diesel hauled trains take longer to climb the gradients than electric trains.

- *Infrastructure characteristics*, for example main line trains sometimes have to slow down where there are speed restrictions for tunnels and curves.
- *Stations and termini*, particularly where trains 'turn round', often pose constraints. Minimum turnround times are needed to service trains and so that a train going out can leave on time even if an inbound service is delayed. This causes significant constraints on platform use, for example at King's Cross. Stations along routes can also pose constraints, if there an insufficient platforms available. For example, until Reading station was rebuilt all fast trains from London had to call at just one platform meaning that, were there any delay in the train departing to head West, a queue of other Westbound trains could easily form leading to substantial consequential delay. In future, Reading will have two platforms for westbound trains.
- Likewise, *junctions* pose constraints particularly where speed has to be reduced to safely negotiate them or where they are not grade-separated meaning that traffic in the other direction has to be timetabled to permit a 'crossing move' over the junction. The UK network still has many non-grade separated junctions on mainlines, whereas the Continental networks, many of which had to completely rebuilt after the war, often have full grade separation introduced at that time. *Freight* requires access to/from freight terminals and freight loops, and the entry/exit arrangements generally require low operating speeds which can erode main line capacity.
- *Regular interval timetables* are popular with passengers and make the railway easier to operate hour-to-hour by avoiding the need for very different operating patterns each hour, but the main lines link with each other at places and link together conurbations which may each have their own locally specified regular interval pattern. Repeating sequences of typically 15, 20, 30 or 60 minutes are used, but some 'white space' has to be left in the timetables between the building blocks this creates with a repeating pattern of (say) 15 minute services. The unused time provided for by 'white space' allows a 'firebreak' in case of late running. In addition, there can be practical problems in weaving together, for example, routes with signal headways of six minutes with a 15 minute repeating sequence meaning that not all of the theoretical capacity of a route can be used.
- *Different demand patterns in the peaks* as opposed to off-peaks also impose some constraints. In the peaks, demand increases and it is often necessary to adapt a regular interval off peak timetable to provide sufficient capacity. Whereas in the off peak, a semi-fast train calling at five or six stations before its terminus might not fill to capacity, in peak hours it might be oversubscribed. It may then be necessary to have a number of trains that serve a sub-set of the places served, 'skipping' some intermediate calls in a bespoke pattern that creates attractive journey times and avoids overloading of individual trains. One way of achieving this is to put more intermediate calls into what would otherwise be fast trains, but this may further erode line capacity.

1.5 When it comes to a route such as the West Coast Main line, these complexities can prove irreconcilable when a service enhancement is contemplated. This was the case with the West Coast Upgrade which was to progress under a track access supplementary agreement entered into by Virgin Train and Railtrack in 1998 which protected the rights of all train service operators, added specific additional paths for freight at the behest of the Rail Regulator as well as an enhanced service for Virgin Trains. Despite planned network enhancements, Railtrack could not devise a timetable that met all of the pre-existing access rights (which are held under contract by a significant number of train operating companies in the case of this route).

1.6 Capacity allocation is both complex and open to detailed scrutiny. Regional and local stakeholders have an obvious interest in the decision-making process, culminating in decisions that the Office of Rail Regulation (ORR) makes balancing its various statutory duties. Funders (DfT, Transport Scotland, TfL and so on) have their own perspective, including a need to scrutinise the value for money consequences of decisions taken. There are also 'open access' passenger train service providers to be considered.

1.7 A common situation is one in which train operators have existing access rights of various kinds, but overall capacity utilisation could be increased if they altered them for example by shifting departure times by a few minutes or accepting slower running times. The 2008 West Coast timetable was the result of train operators across the route, working with local and regional stakeholders, accepting a range of changes in order to permit a high frequency, high speed mainline service on the route. This was a particular feature in Manchester, where a number of 'cross-Manchester' routes had to be separated in order to provide capacity for the increase from two to three fast intercity trains per hour into Piccadilly Station.

1.8 More strategically, the need to fit with timetables on other trunk routes, such as the Bristol – Birmingham – Leeds corridor, and regional services, such as the local services at Birmingham, Manchester, Glasgow, Leeds and Edinburgh, all affect the timetable set for the West Coast Main Line (and an equivalent set of wider services in the cases of the Midland and East Coast Main Lines).[1]

[1] Even Switzerland's *taktfahrplan*, the best known regular interval timetable in the world, necessarily doesn't quite fit together where two or more routes, with different patterns, meet up, such as at Visp/Brig.

2 European Comparisons

2.1 Capacity is a particularly important issue in the UK primarily because the strategic approach to rail development adopted since the 1960s has been to fit more trains on existing routes, whilst progressively and incrementally upgrading their signalling and speed, rather than building new routes as has been the case in, for example, France, Spain, Germany and Italy. Work done for the SRA's strategic planning process in 2002 showed that the number of passenger trains on the intercity network had more than doubled since the mid-1960s and it has further increased since.

2.2 The consequence is two-fold: our network is both very full and carries a much more complex mix of trains of different types and speeds, from 125mph intercity trains to 40mph freight trains, than any other European system. Other countries have busy routes, but don't have the complex speed mix we have. For example:

- In the **Netherlands**, the Utrecht-Amsterdam-The Hague-Rotterdam routes connect the main cities of the Randstad (the 'ring city') with a mix of four fast and four slow trains every hour, interspersed with freight traffic and occasional fast ICE trains to Germany. But the fast trains are limited to about 90mph and much of the route is segregated so that the slow trains run on their own lines. The new High Speed Line between Amsterdam and Rotterdam currently carries at most four trains per hour per direction
- In **Denmark**, the 'Kystbanen' main line between Copenhagen and Elsinore offers a train every 10 minutes along much of its length in a mix of fast and semi-fast services. The same stock is used on both types of service, meaning that the semi-fasts can accelerate as quickly as fast trains and there are no freight trains.
- In **Germany**, almost all 'S-Bahn' commuter networks around the cities are largely segregated with their own tracks and platforms, allowing the long distance services to operate separately. Even then, few sections have more than four trains per hour and freight trains often operate on their own lines or on bypass routes through major cities. A prominent exception is the two track section between Karlsruhe and Basel in the South West of the country, which carries two long distance, two Regional Express and one stopping service as well as an intense freight network of 2-3 trains per hour as this is the main route for freight trains into Switzerland and across the alpine crossings into Italy. The route is being partially widened to allow some separate sections for fast passenger trains and long distance trains are limited to about 100mph on the other sections to make it easier to timetable. None of the new high speed lines, built since the late 1980s, carries more than four passenger trains per hour.
- In **France**, the extensive TGV network is used only by fast passenger trains and is normally linked into cities by what are, in practice, segregated existing tracks. The main North-South axis, from Lille – Paris – Lyon – Marseilles, is completely paralleled by a high speed route and the old main line routes are served by semi-fast and stopping passenger trains and freight, which cannot operate on TGV lines. The busy two-track route from Marseilles – Cannes – Nice

– Ventimiglia remains, shared between TGV, regional and freight services, but here TGVs can only travel at the prevailing line speeds of about 90mph. The busiest section is the TGV line from the Ile de France region to Lyon, after the junction for trains from the 'interconnection' route via Charles de Gaulle Airport and Disneyland, which carries up to 13tph to a mix of destinations: Nice, Marseilles, Montpellier/Perpignan (and shortly Barcelona), Lyon, Grenoble, Evian, Annecy, Geneva, Lausanne, Berne, Zurich and Mulhouse. However these are all TGV trains with (nearly) uniform maximum speeds and acceleration and leave the line at a number of purpose built fully grade separated, high-speed junctions, making timetabling easier.

- In **Switzerland**, none of the intercity routes currently has better than a half hourly frequency and they operate on tracks that are shared with a 30 minute stopping services and with freight, although some sections are effectively four tracked. There are also passing points at many secondary stations, allowing fast trains to overtake slow ones. The prevailing line speed, at about 100mph, is lower than in the UK, and this is the key to making such a dense service work effectively. By contrast, the dedicated high speed route from near Olten to Berne carries four fast trains per hour in each direction at up to 170mph.

2.3 A mix of train speeds is particularly damaging to route capacity. Although measures were taken under West Coast upgrade to separate out intercity from regional and local trains, there are still many interactions between them at key junctions and routes, not least the two-track section through the West Midlands from Rugby to Birmingham and Wolverhampton.

3 How Capacity can be Measured

3.1 There are a number of ways in which capacity can, in principle, be measured:

- Paths per hour, i.e. the number of trains of a particularly characteristic on any given route. This is the approach commonly referred to within the rail industry. It is readily comprehensible and was used by the Strategic Rail Authority in preparing an indicative capacity statement for intercity trains as an input to what became the Route Utilisation Study (RUS) process. This simply assumed that capacity planning should be anchored around a core 'long distance, high speed' network of intercity trains running to a 30 minute or better frequency across most main lines. It is relevant and usable only at a high level, expressing a strategic intent, for example, rather than an outcome applicable to a specific section of route
- An extension of this is the Capacity Utilisation Index (CUI), which is the ratio between the number of trains timetabled in a route section and the number that theoretically could be timetabled in the absence of constraints such as junctions. The CUI measure does not, however, address the effect of junctions or mix of traffic with the result that a route that has a low CUI score could still in practice be capacity constrained because of these factors. So the CUI is not generally used in (for example) the Route Utilisation Study process.
- Network Rail has been looking at ways of illustrating the trade-offs between capacity, performance and journey times as part of the work it has been doing for Periodic Review 2013. Although the complexity of the network has meant that it was not yet possible to develop a set of high-level trade off graphs, it is understood that further work is in development on this.

4 Technological Advances

4.1 Network Rail plans to fit the new European Train Control System (ETCS), which is part of the European Rail Traffic Management System (ERTMS) to routes as they are resignalled. Earlier versions of this technology are in use on High Speed 1 and all high speed lines in France, Belgium, Italy and the Netherlands have either a predecessor of ETCS or ETCS with in-cab signalling. In Control Period 5, it is planned to fit ETCS to the Great Western Main Line and the East Coast Main Line south of Doncaster. The system essentially provides speed indications to drivers, based on traffic conditions ahead. The practical effect of this for train operations is that it *might* be possible for trains to operate slightly more closely together and for trains to resume their normal speed once a signal clears ahead more promptly (at present, a driver cannot know that a signal has cleared until he or she can see it). This may mean that line capacity can be increased somewhat (it has been suggested by perhaps a train per hour at most) although the limitations imposed by junctions, the mix of traffic types and speed restrictions will, of course, remain ,and in most cases these are very likely to remain as the controlling factor. In short, it would be wrong to presume any generalised capacity increase arising from ECTS at this time.

5 Capacity and the North-South Routes

5.1 To assess capacity and timetabling issues, we have prepared a schematic chart of the position on the three main North-South routes. It reflects Steer Davies Gleave's current understanding of timetabled and committed paths on these lines following the various upgrades that will take place in Control Period 5 funded under the Final Determination that ORR will issue on 31st October (on the assumption that Network Rail accepts this settlement and does not appeal to the Competition Commission). It also reflects other known service changes. The major changes of both of these are:

- A junction project at Stafford and Norton Bridge, which allows for increased physical separation for cross-country trains between Birmingham and Stoke on Trent
- An additional Midland Main Line train per hour to Corby,
- Completion of the upgraded freight line between Peterborough and Doncaster via Lincoln, potentially also including a grade separated junction so that Northbound freights don't have to cross the East Coast Main Line on a flat crossing.
- Completion of station upgrades at Reading, Birmingham New Street and Peterborough
- First stage of electrification in the North West, connecting Manchester and Liverpool.
- Line speed improvements on the Midland Main Line.

5.2 We have also identified what the main constraints are in each case in providing more trains. In most cases, although these constraints are particular to the long term development and circumstances of each route they have an effect on total route capacity because they interact with each other.

5.3 Taking each route in turn:

West Coast Main Line

5.4 Although originally built as a 2-track railway, the **West Coast Main Line** between London and Milton Keynes was soon expanded to four tracks at the start of the 20th Century and two further tracks were added at that stage to carry an electric stopping service between London and Watford thus (uniquely in the London area) freeing up no fewer than four tracks for intercity, outer suburban and freight trains serving destinations beyond London with limited need to stop at stations within the Greater London area.[2] , It operates with the a core London – Scotland trunk route together with high speed branches serving Birmingham, Liverpool and Manchester, which means the operation of the 'branch' junctions is particularly crucial. These are:

- ***Rugby***, for the route to Coventry, Birmingham and Wolverhampton,

[2] All other four track main line routes (South Central, South West, Great Western, Midland, East Coast and Great Eastern) have a fast line and a slow lines, the latter serving the smaller stations on the route meaning that timetables need to be balanced to allow a sensible mix of 'all stations' and 'semi-fast' trains.

- ***Colwich***, for the route to Stoke on Trent and Manchester
- ***Stafford***, where two main lines from Birmingham and London to Lancashire and Scotland merge together
- ***Crewe***, where a second route to Manchester, via Wilmslow rather than Stoke-on-Trent, diverges, as does the main line to Chester, North Wales and Holyhead
- ***Weaver***, for the route to Runcorn and Liverpool.

5.5 There are also other junctions on the route, especially between Warrington and Preston, which constrain capacity significantly.

5.6 Under the 2002-08 upgrade, the route was further upgraded between Rugby and Colwich junction to provide four tracks, two fast and two slow, along practically the whole section in order to improve capacity for freight and stopping passenger trains once the fast, frequent Pendolino service to Manchester, Liverpool and Scotland began. Use of higher performance trains has meant that the line speed was also increased to 125mph on most sections. As a consequence, the West Coast fast line inter-city trains operate largely separately on the main southern section of the route itself, although flat crossings remain at two places South of Rugby in order to allow suburban trains to Leighton Buzzard, Milton Keynes and Northampton to use the fast lines out of Euston. (A third 'reserve' crossing is available at Bourne End, further south.) But this doesn't mean that there is no interaction with freight and slower local passenger services, since all of the intercity trains operate over sections of line in the Midlands and further north where track is shared with these other categories of train. Where fast and stopping services operate over the same tracks, the slow services are typically timed to commence their journey on the shared section just behind the fast service, in order to maximise use of track capacity. This causes a significant performance risk in the event of the fast service running late.

5.7 The main capacity constraints on the line are:

- **Rugby-Birmingham**, which is a two-track section which, each hour, carries a mix of:
  - three fast intercity services,
  - three stopping trains for Birmingham,
  - one cross country service from Reading to Birmingham and further North, and
  - at least one intermodal North-South freight that crosses over the line at Coventry.
- **London – Milton Keynes fast lines**, which are constrained by the need for outer suburban trains to cross over to the slow lines at one of the two main possible crossing points (Ledburn and Hanslope)
- **London – Milton Keynes slow lines,** which are constrained by the mix of freight trains and semi-fast and stopping passenger trains.
- **Rugby – Nuneaton,** which contains a three track section so that northbound freight and fast passenger trains share the same track
- **Colwich/Stafford Junctions,** where a mix of flat crossings and interactions between the Birmingham and Trent Valley routes constrain capacity.

- **Stockport – Manchester,** especially the approach to Piccadilly station where the mix of fast and stopping trains severely curtails operational flexibility.
- **Crewe – Preston**, which is largely a two track section carrying a heavy mix of intercity, freight and stopping trains, with crossing movements of regional services at a number of locations such as Crewe and Warrington.
- **Preston-Motherwell,** which is also a two track section carrying substantial freight traffic, which has lower speeds than passenger, with a very limited number of points at which passenger trains can pass freight trains.
- **Motherwell-Glasgow,** where Anglo-Scottish intercity trains interact with the Strathclyde regular interval suburban network.

5.8 Examples of **problems** that have arisen on route capacity on the West Coast are:

- Reinstatement of intercity services to Shrewsbury and Blackpool, which was turned down by ORR in July 2013.
- Local services connecting Rose Hill in Manchester with Bolton via Oxford Road. The Rose Hill trains now have to terminate at Manchester Piccadilly because of shortage of paths across all the tracks at Piccadilly.
- Through services from Liverpool to Leeds and Newcastle, where aspirations to increase frequency cannot be met for the same reason stopping trains between Birmingham and Stoke.
- Calls by intercity trains at Macclesfield which have been significantly reduced.
- Pathing of possible open access services, including those from Huddersfield.
- Calls by intercity trains at Watford Jnc. Milton Keynes which have had to be significantly reduced, making it harder to reach Birmingham, the North West and Scotland in peak times.
- Stopping trains between Coventry and Birmingham which had to be split into two services to fit in with fast intercity trains, necessitating a change of train on some journeys.
- Cross Country trains, where one train an hour on the 30 minute service between Southampton, Oxford and Birmingham has had to be diverted away from Coventry while the remaining train has had to be (marginally) slowed down because of capacity problems at this busy junction.
- The option of accelerating the Class 350s on the fast lines between London and Rugby so that they reach 110mph, since capacity is heavily restricted. It has so far proved possible to find one off peak path for these and discussion is continuing about whether two peak paths can be identified with acceptable performance impacts. This is proving highly challenging
- Good quality day-time freight paths that do not require trains to be put in passing loops for extended periods.
- Regional trains between Crewe, Liverpool and Preston, particularly at Winsford, where the two track bottleneck poses particular problems.
- Acceleration of London-Glasgow intercity services to a long term goal of below 4 hours, given capacity constraints between Motherwell and Glasgow Central.

Midland Main Line

5.9 Following the opening of the first stage of the Thameslink project in 2007 and the major reconstruction of St. Pancras station, the four-track Midland Main Line now

feeds into both a high level terminus at St. Pancras (for intercity trains) and the low level through platforms (for commuter trains), offering six platforms altogether. Once the second stage of Thameslink opens in 2019, the line will carry 19 intercity and suburban trains per hour at the peak in each direction, its limit, given the need to work the service with the 10 Thameslink commuter trains per hour that will operate onto the East Coast Main Line from the low level platforms. Beyond Bedford, the route is mostly two track as far as Leicester (with a separate largely single freight line running in parallel) and Loughborough where it splits into three: Sheffield (via Derby), Sheffield (via Erewash valley) and Nottingham. The approach from the South to Sheffield is also busy, as the number of intercity and regional trains approaching the city from the London, Birmingham, Nottingham and Manchester directions has increased by more than a quarter over the past decade.

5.10 The main constraints on this line are:

- **Interaction between fast and slow Thameslink services.** North of St. Pancras a three tier service (intercity, outer suburban and inner suburban) operates over two pairs of tracks. Therefore fast Thameslink trains emerging from the Thameslink tunnel cross over onto the fast lines in order to overtake stopping trains and then cross back over to the slow lines further from London. Each of these 'moves' is over flat crossings (and due to the arrangement of tracks, conflicts with traffic in the opposite direction) and so must be timetabled and operated with great precision given the density of traffic on the line.
- **Leicester area:** Where the main passenger and freight route from East Anglia to Birmingham crosses over the Midland Main Line. Some improvements are being proposed here for CP6.
- **Sheffield area:** Sheffield has become a very busy station, with trains merging from three routes to the South (from Manchester, Nottingham (Erewash) and Derby).

5.11 Examples where route capacity constraints on the Midland Main Line have precluded the introduction of desired service increases:

- Further increase in the number of Thameslink trains to St. Albans and beyond, using the fast lines
- Expansion of regional services between Nottingham – Sheffield/Leeds.

East Coast Main Line

5.12 The last major capacity upgrade of the **East Coast Main Line** was in the 1950s, when additional tracks were constructed North of Barnet as far as Welwyn Garden City, but this still left a substantial section of two-track track across Welwyn Viaduct and through two tunnels immediately North of it, as well as a further two-track section between Huntingdon and Peterborough. These impose a considerable bottleneck on operations but removing them would be (particularly in the case of Welwyn) a major engineering and planning challenge. The line was electrified throughout by 1991 and the track layout at King's Cross simplified following the closure of the large freight terminal to the West of the Station in the 1970s. An improvement planned for the next Control Period is the diversion of freight trains between Peterborough and Doncaster on an upgraded cross-country route via Lincoln. This will give more recovery time for fast intercity trains between these

points although a new grade separated junction to allow freight trains from the London area to access the line is needed to maximize capacity. Leeds station and its southern approaches were completely rebuilt in 2000-02 (the Leeds six tracking project), when two new through platforms were added. The complex junction at Doncaster (where East-West and North-South trains meet each other at a set of flat crossings) is a significant constraint. As noted above, Network Rail is intending to fit the new radio-based signalling system (ERTMS) to the line by 2019. By providing a more sophisticated set of speed indications to drivers than is possible under the current 'colour light' system, this may make it easier to recover when trains are late. The DfT is also procuring new bi-mode and electric IEP trains for the route, providing more capacity and reduced journey times.

5.13 The main capacity constraints on the line are:

- **Alexandra Palace to Welwyn Garden City**, where a three tier service (intercity, outer suburban and inner suburban) operates over two pairs of tracks
  - Welwyn Viaduct and Tunnels, and Huntingdon-Peterborough, which are both two track sections
  - Doncaster – Leeds, which is a two track section carrying a mix of intercity, cross country, regional and stopping trains. In addition, with the growth of traffic into Leeds, platform capacity is now a problem again despite the additions in 2002.
  - Newcastle - Dunbar – Edinburgh, a two track section with minimal passing points, carrying an increasing number of freight and passenger trains. The mix of passenger and freight services feeding into Edinburgh Waverley from the East has emerged as a major constraint in recent years as commuter travel into Edinburgh has increased.

5.14 Examples where route capacity constraints on the East Coast Main Line have precluded the introduction of desired service increases:

- Further expansion of open access services, for example from Lincoln, Grimsby or Middlesbrough.
- Intercity calls at Stevenage, which are now reduced to every two hours in order to maximise capacity.
- Increase of peak trains from Cambridge to London.
- Increase of commuter services from Wakefield to Leeds.
- Local services in Scotland from Berwick/North Berwick to Edinburgh

Route section categorisation: green/orange/red

5.15 As explained above, there is no single measure of route capacity used by the rail industry in Britain. The question of whether or not a further train service can be added is therefore a matter pursued by a *process,* rather than by reference to a database or a directory.

5.16 The various factors that affect capacity were listed above. In attempting to describe the status of various sections of the north-south main lines in respect of capacity, it is necessary to take account of the reality that different applications by train operating companies to run a single extra train over a given section of route may have differing outcomes in terms of regulatory approval, depending on

the way in which ORR assesses its statutory duties in each case. In other words, a view has to be taken, which is inevitably judgemental, about regulatory outcomes.

5.17 When considering how timetables might be changed, the starting point is set by the access rights of existing train operators (both passenger and freight). These are expressed in Track Access Agreements between the train/freight operating companies (TOCs) and Network Rail. The TOC and Network Rail will develop a Track Access Agreement and seek approval from the Office of Rail Regulation (ORR). If sufficient 'white space' is available in the timetable without interfering with other trains at junctions or stations, then the process is relatively straightforward: the TOC and Network Rail will put together an agreement and send it to ORR for approval. However, it is normally the case that some changes to existing times have to be made. This process was envisaged at privatisation and, as a consequence, access rights do not confer an unalterable lien on any particular timetable time: there are mechanisms in the agreements to allow all train times to be altered ('flexing rights') by a few minutes in order to better integrate the timetable together. In addition, other rights ('quantum rights') are sometimes granted in higher level terms which set out the number of trains that can run but without specifying timings. Finally, it should be noted that all track access agreements are time limited and that rights to any particular slot will therefore eventually lapse through the effluxion of time.

5.18 From time to time, broader changes need to be made. Recent examples have been the timetable behind the West Coast route modernisation, Crossrail and the new East Coast 'Eureka' timetable introduced in 2010. In this case, discussion needs to be had between train operators about changing some of their access agreements. In the case of West Coast, a negotiating process, led by the SRA, was needed to establish the changes and tradeoffs needed to refocus the West Coast Main Line timetable.

5.19 The heart of the process is the development of a timetable, based on the precise technical capabilities of the trains that will actually operate as opposed to the expected characteristics of trains not yet in place. The timetable needs to cover the entire day to make sure that maintenance and stabling patterns can be encompassed with the technical and crewing requirements of the various fleets that will be used. It is only when a timetable of this detail is created that Network Rail, train operators and ORR can ultimately form definite views on how much further (if at all) the capacity of any route can be increased. Some of this has been done in order to support the West Coast LM110 project, which potentially will produce two additional fast line peak paths per hour, but a more comprehensive analysis of the three lines alongside each other would be needed to fully examine the question of what useful spare capacity remained.

5.20 In today's structure, this would be carried out by Network Rail under the Long Term Planning Framework studies which are reviewing capacity on each route in turn and their outcome would be subject to scrutiny by ORR. In addition, Network Rail operates an 'Event Steering Group' process which is designed to finally resolve the detailed timetable once the main decisions on access rights on any given section are taken. Such Groups are currently meeting to resolve the detailed timetables for West Coast in 2016 and East Coast in 2018.

5.21 In addition, where changes to track access agreements are needed these must be consulted upon so that other train companies, stakeholders and others with an interest, such as MPs, can input into the process. ORR must consider the views of all parties and, in reaching a decision, state its reasoning for reaching it. In the case of the recent Virgin application to reinstate services to Blackpool and Shrewsbury this process took about 18 months and the application was ultimately turned down because of ORR's concern that performance on the route would be adversely affected. The process of developing new access rights can therefore be categorised as broad-ranging, open and not necessarily very rapid.

5.22 Despite the absence of a comprehensive analysis of this kind , it is possible to illustrate the state of affairs on the main lines – as shown in Figure 5.1 (at the end of the document), using the following system to grade the availability of spare capacity:

- **Green** means *low pressure*: there is a significant amount of spare capacity in that route section
- **Orange** means *medium pressure:* that there is *some* spare capacity in that route section
- **Red** means high pressure: that the route is 'at capacity' (see definition below).

5.23 'At capacity' means that it is judged that in relation to today's working timetables and with today's mix of potential train types, after allowance is made for changes being brought about in Control Period 5, it is not possible to add a further train path in peak travel periods unless something else significant changes, such as:

a. A deterioration in train service punctuality,
b. The need to make some changes in the timetables of existing services (e.g. changing stopping patterns, or extending some journey times),
c. The introduction of a different type of train, with performance capabilities that allow, for example, greater homogeneity in the section timings of successive trains[3]
d. Route re-signalling, and/or
e. The need for a complete re-cast of the train plan.

5.24 Clearly, there are situations where these conditions could be met – for example in the margins of peak hours of operation (but not within the 'high peak 'period') and when a wholesale timetable recast is being contemplated. But it should be recognised that in general there will be some loss of outputs for some passengers or freight customers somewhere wherever additional services are added to 'red' section routes.

5.25 It is clear that the 'red' sections, which are at key points on each of these routes, pose significant constraints. Thus, for example, although there is capacity to operate more trains solely between Grantham and York, these cannot readily be extended to London or Newcastle because these are in 'red' sections.

5.26 Orange denotes that some capacity is available. In these sections it would be possible to timetable additional trains without significant detriment to the existing

[3] Two examples are the adoption of electric traction for freight operation over the northern section of the West Cast Main Line, and the deployment of faster commuter trains (with an operating speed of 110 mile/h, closer to the operating speed of the intercity stock at 125 mile/) over southern sections of the West Coast Main Line).

train plan on those sections. Similarly, green indicates that significant capacity is available on those sections of routes. But of course, the usability of 'spare capacity' in orange and green sections depends on circumstances and is dependent on avoiding areas marked red.

FIGURE 5.1 ASSESSED POST-2019 CAPACITY PRESSURES ON NORTH-SOUTH MAIN LINES