RESTRICTED CIRCULATION

High Speed Two Interfaces

Greengauge 21

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High Speed Two Interfaces

Executive Summary

In taking forward Government plans for a new high-speed rail line (HS2), alongside the work on engineering alignment, consideration needs to be given to interfaces with the existing network and – at least in outline – to the wider network that will be developed in the longer term. Greengauge 21 convened three workshops of interested parties to consider these issues in May and June 2010, and this short report summarises the key points that emerged.

Our conclusion is that Government should initiate a workstream to examine the strategic network issues identified in this report. This strategic planning work should be carried out in parallel with the more detailed work commissioned on alignments that is in hand with HS2 Ltd.

HS2 Ltd has had a remit which has focused on a route from London to the West Midlands and extensions possible from it. This was necessary to make effective progress on Britain's next high-speed line, but it has precluded full consideration of the right approach to developing a genuinely national network (since it was implicitly assumed that all extensions should spring from the initial route). This also meant that only a partial consideration has taken place of the opportunities from high-speed rail (HSR) at Heathrow or connecting to HS1, for example.

While HS2 Ltd has now been asked to examine two network shapes and the question of connections to HS1 and to Heathrow, the view taken of these opportunities may remain too narrowly focused, and ignore the ways in which a genuinely national network can be most cost effectively developed.

Unlike in Greengauge 21's own studies, it has not been possible for HS2 Ltd to compare and contrast the merits of the Y-shaped network with others. Although a rapid study of the reverse-S-shaped network has been commissioned by the new Government, this would still not address the solutions that appear to offer best value for money. This is where Greengauge 21's full studies of a national network completed last year can provide the best evidence to guide decision-taking. **Greengauge 21's work showed a clear advantage in developing a second north-south HSR line. This report sets out some of the issues associated with a Y-shaped network concept and identifies a potential way forward that should form part of the strategic planning work.**

Work ahead on high-speed rail network development also needs to compare and contrast the options of upgrading existing lines and building new (high-speed) lines. This should be used as a key input to the identification of a sensible national long term, phased, rail investment programme. Such a programme, of course, would need to be kept under review and adapted as circumstances and funding positions unfold. But without it, there is a serious risk of nugatory investment on existing lines

which will subsequently be bypassed by HSR; equally, the need for complementary investment to ensure that full value is derived from HSR may be overlooked. This work should not be undertaken by DfT working on its own, but engaged fully with Network Rail and wider stakeholders. Greengauge 21's Public Interest Group could provide a useful framework for this activity.

There are several areas where there are opportunities to further improve on the work done to date and to increase the value for money from HS2 by extending substantially the set of benefits without substantial additions to project costs, and in some cases reducing them. The two top priority areas, which should be considered urgently, are:

- Interconnections at both the north and south ends of the proposed London – West Midlands line: in the north, to provide a connection across to the Midland Main Line with a substantial broadening of early benefits, and in the south to serve Heathrow and to connect with HS1. The connection to the Midland Main Line would be a modest cost addition, although it would only make sense as and when the Midland Main Line electrification proceeds. The south end connections could be phased after the core London – West Midlands route if needed, with careful planning to ensure that future disruption to HS2 is avoided. Connections to HS1 and to Heathrow both reduce the pressure on the planned terminal at Euston and on the central London transport network, and potentially bring cost savings, and add to project revenues.
- Creation of a connection from Crossrail to the West Coast Main line instead of the expensive Old Oak interchange opening up the possibility of savings on the design at Euston.

Considerations of value for money, affordability and financing arrangements will inevitably be viewed as being critical at this time, for HSR as for other areas of expenditure. Our case is that these concerns can and should be addressed by proper strategic planning that examines the wider effects of investment in HSR, and the extent to which the nation can secure sustained long term benefits from it. Work needs to be commissioned to help ensure the success of HS2, both in terms of its progression through the planning consent process and once it is open for business.

1. Context

The new Government has resolved to progress a national high-speed rail network, to be delivered in stages. It is reviewing the work carried out by HS2 Ltd for the previous Government, and this set out detailed plans for a preferred route between London and the West Midlands. This could act as a first stage scheme.

It is intended that this work will progress into a formal consultation phase in early 2011. Government has decided to progress the project through a hybrid parliamentary bill. The aim is that a start can be made on preliminary works by 2015.

2. Workshops

The three workshops took place on 20th and 26th May and 16th June and were attended by representatives of those organisations listed at Annex A. They addressed three broad areas of geography:

(i) HS2 interfaces in the western (WCML) corridor
(ii) HSR on the eastern side of the country
(iii) The London area.

The approach taken in each workshop was to identify areas of uncertainty, to assess the critical issues by thinking through decision areas, and then consider the choices available under decision area headings and the inter-relationships between the decision areas. The workshops were facilitated and made use of *Strategic Choice* planning techniques.

The reports of the three workshops are included at Annexes B-D.

In the following sections, we summarise:

- The key challenges identified
- Decision areas that require to be prioritised for early attention
- Key decision areas that can and should be deferred
- Areas where further study is needed and should be put in hand.

None of what is reported here suggests there should be any delay in progressing to the Government's timetable, and none of the work relates to the alignments proposed for the HS2 scheme London – West Midlands, although there are implications for its interfaces and for adding to the value that can be obtained from the initial investment.

The purpose of the workshops was to identify the key issues. To a large extent they were considered (by participants to have been successful in doing this and in allowing the various parties to learn about the perspectives of other key stakeholders.

In many areas, there was a broad level of agreement. In other cases, key differences of perspective emerged. An example would be on questions of priorities for phasing developments following the first stage of HS2. From a Scottish perspective, where achieving fast London – Scotland journey times is of paramount importance, it would make sense to progressively build out a full (probably west side) north-south route. But if the benefits are seen as being more about creating valuable new infrastructure that provides capacity relief and scope for additional as well as better services in a balanced way across the regions and core cities, there might be a preference to start on an eastern side line after the first stage of HS2 is developed.

Greengauge 21 has taken the view thus far that it is important to follow the business case evidence in suggesting phasing priorities. But it is equally clear that those with economic regeneration responsibilities have a real concern about unbalanced transport developments that risk leaving some part or other of the country at a disadvantage for any significant length of time.

In general, the workshops took as a given both the preferred alignment for the HS2 scheme London – West Midlands and the conclusions of the Greengauge 21 work last year on a suitable national HSR network, as described in the *Fast Forward* report[1].

3. Key challenges identified

Six key challenges were identified. These are:

(i) HSR route capacity

Evidence from around the world suggests that 15 tph is a realistic maximum for peak period use of a two-track high-speed railway. HS2 Ltd envisages 14tph from opening day on the London – West Midlands line, increasing to 18tph with a developed Y-shaped network. HS2 Ltd anticipates some form of automated train control system would be needed to deliver this, but there is a risk that the capacity gains will prove to be unachievable.

(ii) WCML capacity

With HS2 joining the West Coast Main Line (WCML) at Lichfield, there will be demand for additional train paths on the central and northern sections of this existing strategic route (at least an extra three trains/hour through Staffordshire/Cheshire and then at least one extra train path/hour over the remainder of the route) This cannot be accommodated without either investment to increase route capacity or some restructuring of the timetable with potentially the removal of some other services. Analysis of WCML route capacity is also necessary to understand the service benefits that can be provided over the WCML between Birmingham/Crewe and London, including to places such as Milton Keynes, which will be very important in addressing

[1] Available at http://www.greengauge21.net/assets/FastForward_Greengauge21.pdf

questions of national and local/regional interest in the HS2 planning application.

(iii) Serving the East Midlands

Serving the East Midlands by high-speed rail is difficult if it is to be achieved by a connection from the London – West Midlands line. While it may be possible to provide a parkway-style station in the East Midlands, the centre of Nottingham – the largest city in the region and the only one with a mass transit system – cannot be readily addressed through the Y-shaped network.

(iv) Comparing new build HSR with upgrading existing lines

It is generally agreed that to get best value for money from HSR investment, operation of new HSR services needs to extend over existing 'classic' lines as well as over the new infrastructure. But this often will trigger the question of whether some enhancement is needed to those parts of the existing network used in this way (for capacity reasons, or because the case for, say, removing an existing low speed section becomes much stronger). But there has been no systematic look at the choice between upgrade and new-build solutions, and understanding the balance of risks, costs and benefits is crucial to getting the right strategic approach on, for example, the question of the best approach for the cross border HSR services (England – Scotland), as well as on other routes.

(v) European airport competition

If a connection is made between HS1 and HS2 such that direct through services can run from the regions of Britain to continental destinations (which include the airports of Paris CDG, Amsterdam Schiphol and Frankfurt, each of which is served by HSR), then unless a HSR connection is also provided to access Heathrow for HSR services from the continent, Heathrow would be set at a further competitive disadvantage against its rival hub airports.

(vi) HSR links in London

A key question is the function of the potential links in the London area, links such as that between HS1 and HS2. These do not address existing rail capacity concerns in the way that a trunk north-south line does. But such links do address real travel needs that are currently met by the road and air network) which are themselves subject to capacity constraints.

(vii) Dispersal in London

Dispersal of the substantial volumes of additional passengers that will arrive/depart from the new HSR terminal(s) in London is a critical issue. Euston offers a key advantage in that there are several candidate local transport schemes that could address the problem. One of these options which involves connecting the commuter lines on the WCML to Crossrail would appear to be just as effective as and less costly than the Old Oak Common scheme.

4. Priority areas for attention

The following areas have been identified in the workshops as requiring urgent attention in the context of the current planning work (unlike others, where decision-making can usefully be deferred – see below).

a) Resolving the capacity issue of the Y-shaped network

This is an urgent issue, even though on current plans, there would be sufficient capacity for the Day 1 service level on HS2 (London – West Midlands). The reason is that it makes no policy sense to introduce HSR services to destinations, say, to the North West, using existing lines that then would need to be withdrawn as the limbs of the Y-network are added. While the Y-shaped network provides very welcome, balanced connectivity gains to the northern English regions, Greengauge 21 believes it is essential to ensure the operational robustness of HSR plans.

It would be prudent to plan on future automation of train operation over HS2, but not in the period when HSR remains an integrated part of the existing rail network with major active operational interfaces to it – and this is likely to be the case for a long time, perhaps several decades. It cannot therefore be relied upon to deliver the higher service frequency levels it is believed it would attract.

The workshops identified other options available and their strategic implications. Ministers may wish to see further evidence, before forming a definitive view. The other options are (a) to plan for four tracks over the stem (trunk) route between London and Birmingham (b) to plan for lower service frequencies or (c) to plan on a second north-south high-speed line.

The four track option may have some merits, and might work more readily if there is to be a connection to Heathrow as well as to central London, but would undoubtedly add to the planning and consent issues for the line, since it is not possible to add a second pair of tracks cost effectively at a later stage, and a four track solution would also add very significantly to HS2 capital costs (which might be near-doubled).

Restricting service frequencies below current intercity levels – for instance to two HSR trains/hour between London and each of Birmingham and Manchester – would mean that even with higher capacity trains, peak demand levels would soon reach capacity. It would also compromise the benefits that HSR would bring over existing rail services, where daytime frequencies to Birmingham and Manchester are now three trains/hour).

So, the better approach, as anticipated by HS2 Ltd, would be to presume that there will need to be a second north-south high-speed line in due course and plan accordingly. While this creates a fresh set of planning challenges, it has a demonstrable business case, and resolves the problems associated with the thinking in Cm 7827.

b) Complementary investment on the existing network

It has been envisaged in the work of HS2 Ltd that some (as yet unspecified) upgrade will be needed to the existing rail network to accommodate HSR trains, but this needs to be assessed in parallel with the work on HSR alignments.

There is a range of options, looking northwards in the WCML corridor from Lichfield, for solutions which rely on completely new alignments, or on using existing routes for extended HSR operations (for instance to Manchester and Liverpool) or on some enhancement of the existing lines. Quite possibly, a blend of these arrangements would be the best approach. There are some candidate investment schemes (which have not been committed under current spending plans) that may address this problem. Over the section of line north of Preston, it may be necessary for freight services to be operated with electric traction to optimise line capacity. And the choices here are compounded by the possibility of non-tilt HSR services running at lower line speeds than existing Pendolino (tilting) trains, with the need to minimise any timing extensions in some cases by appropriate local investment.

While new HSR alignments need to be developed, their appraisal needs to be set within a context that permits examination of comparator schemes that rely on upgrading (at least on an interim basis). The existing range of candidate schemes for the Stafford area illustrates this point. Network Rail should of course be involved in this process.

c) Connections to the Midland Main Line

It would seem likely, with a phased approach to network development, that there would be a period when the northern end of HS2 would be connected into Birmingham and the WCML at Lichfield only (i.e. the current plan). This phase of development allows the benefits to be extended to the North West (and to some extent, North Wales) and to Scotland, but does not provide any benefit to the East Midlands, to Yorkshire/Humber or to the North East. Yet this could be provided, and potentially quite readily, as pointed out in the *Fast Forward* report.

Connections could be provided at Lichfield not only to the WCML but also to the Birmingham – Derby main line. This joins the Midland Main Line (MML) at Derby, and continues to Sheffield, Leeds and the North East. To make use of such a connection, there may be a need for some enhancement investment (just as described above for the WCML) and in particular, the MML would need to be electrified. However, this is a reasonable likelihood by 2025/6 when HS2 would open.

A connection of this sort would add relatively modestly to the scheme cost but bring very substantial benefits including a transformation of the Sheffield – London journey times and capacity relief to the MML as well as to the WCML (offering wider benefits to the East Midlands cities of Nottingham and Leicester as well as to the Northamptonshire commuting towns).

d) Resolve the question of how to address Heathrow and the connection to HS1

Government has these questions in hand (Lord Mawhinney review and the new instructions given to HS2 Ltd). The addition of these links to HS2 adds to the value of the primary investment and the evidence suggests that the incremental business cases can be very strong. There are significant synergies between the various inter-linkages which would allow a substantial broadening of the benefits of HSR. Their availability for HSR service use would reduce the concentration on the central London travel market and the need for passenger interchange to be made in central London, which adds to congestion on the Underground. The challenge is to think through the relatively complex strategic network design issues and develop a clear and flexible phasing plan.

5. Areas needing further study

Some of the areas identified as priority decision areas require further studies to be put in hand. Their scale, in terms of level of research or analysis required, varies considerably. For guidance, we have labelled them as (S,M,L) to aid judgment.

(i) Phasing of investment in HSR and existing rail routes in the 'Eastern Corridor' (L)

There are trade-offs to be assessed here between delivering additional capacity, reducing journey times and serving new markets (such as the East of England) with HSR. Uncommitted elements of existing route upgrades need to be considered along with developed proposals for HSR to serve the eastern side of Britain, in order to develop a coherent plan and reduce the risk of wasteful expenditure.

Inescapably, this analysis will need to consider the choices around a second N-S line and/or the Y concept (which connects Yorkshire and the North East into the HSR network at Birmingham). Thus far, HS2 Ltd's terms of reference have precluded such comparisons, and this arbitrary constraint should be removed.

(ii) The need to plan infrastructure capable of resolving the 'perturbation interface' between the HSR and existing networks (S)

Trains arriving on to HS2 from the classic network are unlikely to offer presentation times as consistently as would be needed to ensure reliable high-frequency service operation over HS2 and this needs to be taken into account in the planning stages. In the first instance, this may affect the design of the track layout and facilities at Birmingham Interchange HSR station, although other options may exist depending on complementary investment decisions on the existing network.

(iii) The value of tilt (M)

HS2 Ltd's work presumes that the new high-speed line will not see operation of tilting high speed trains. When operating over the existing WCML (to Glasgow, for instance) this means there will be some time losses against existing (Pendolino) services. HS2 Ltd plan to mitigate these time losses by increasing the speed permitted for non-tilting trains on the WCML. The feasibility, costs and operational practices around this proposal need to be worked up and compared with a HSR tilt option. A HSR tilt concept would be a train design that would operate in tilt mode on existing lines (at speeds of up to 200-225 km/h), and with tilt switched off over high-speed rail lines (at speeds of 330-360 km/h).

This comparative analysis is needed so that journey times and timetabling can be progressed, and the decision on 'no tilt' confirmed.

(iv) Great Western Main Line (M)

Several issues were raised about the Old Oak Common proposal. Some of the most critical are the issue of impact on journey times of Great Western Main Line services and on capacity of the route, which some have suggested would be reduced with the addition of a station at this location. More detailed operational studies are needed.

(v) Euston (L)

The scope to relieve Euston through the use of a WCML – Crossrail connection has already been noted, but there are other potential schemes to consider too. These may have a bearing on the costs, footprint, buildability and timescale for HS2 works (Euston is currently on the critical path in construction terms). Some of these solutions may provide a better alternative to the Old Oak Common proposal.

(vi) Plans for the wider London area (L)

These include consideration of Heathrow, where BAA plc has been developing options for HSR stations at the airport. There is also a need to consider options for a second London terminal and the various inter-connection schemes. Then decisions can be taken on whether to incorporate any works into the HS2 core scheme or to add them later (and if so, what provisional works may be needed).

This is an opportunity to identify a way forward where there are synergies between strategy elements and to avoid wasteful incremental expenditures over the decades ahead.

6. Key issues that can be deferred

The workshops found several areas where decision-making now would be unnecessary, and in some of these cases, better decisions could be taken later as further information is available later.

The most critical of these areas is the question of whether or not it would make sense to try to enhance the gauge of existing lines – and the northern sections of the WCML and ECML are the likely candidates. In practice, this question is interlinked with the choice of the mix of the HSR train fleet (part of which is expected to be 'classic compatible' – that is can operate through existing rolling stock gauge restrictions – and the other part, HSR-captive – which can use standardised European train designs). The appraisal of the gauge enhancement options hinges critically on the cost differentials between these two types of train. By the 2020s, their respective costs should have become apparent as well as any other significant differentiating matters.

There would only be a need to bring forward a decision in this area if it was felt desirable to avoid the use of 'classic compatible' trains entirely. But this would entail a very substantial gauge enhancement programme (for instance of the entire route from Lichfield to Glasgow/Edinburgh) which is very unlikely to be sensible, given the scale of cost and disruption it implies.

Annex A: Workshop Attendees

Association of North East Councils

Atkins

ATOC

BAA

City of London Corporation

Department for Transport

East of England Development Agency

East Midlands Development Agency

Glasgow-Edinburgh Collaboration Initiative

Greater London Authority

Greengauge 21

HS1

HS2 Ltd

London Borough of Newham

London Underground

MVA

Newcastle City Council

Northern Way

Nottingham City/Shire Councils

SEStran

South East England Development Agency

SYSTRA

Transport for London

Westfield

Note: not all organisations were represented at each of the three workshops.

Annex B – Workshop 1: HSR on the West Coast northwards

20 May 2010
Greengauge 21

Introduction

The Greengauge 21 HSR Public Interest Group has noted that there is a need to look further at the interplay between HSR and the existing network. Three workshops are planned to examine this issue, and this report summarises and distils the first of these workshops, held in London on 20th May.

The subject of the workshop was the northwards extension and operation of HS2 in the WCML corridor.

Existing work – the report of HS2 Ltd, Command Paper 7827, and the work of Greengauge 21 and Network Rail – was taken as given. However it was acknowledged that there can be no certainty about the stance of the new Government to decisions reached in the Command Paper of the previous administration.

The workshop used three key concepts: uncertainty, scenarios and decision areas. A number of issues emerged that were discussed in some detail ('key issues').

Uncertainty

Information Uncertainties

- Demand growth rates, especially in the longer term
- The cost premium associated with adoption of UK-gauge compliance for the classic-compatible train fleet (estimated to add c.£1bn to HS2 capital costs in the workshop on the basis of HS2 Ltd assumptions)

Related Decision Uncertainties

- Decisions on eastern side HSR options (which could either add or reduce pressure for train paths on HS2 northwards extensions and the HS2 stem)
- The potential availability of connectivity for through running from HS2 (north) to locations south and west of Birmingham (which could affect path demand on HS2 northwards)
- Extent of enhancement on the classic network
- HSR planning in Scotland, and in particular, arrangements for Edinburgh and Glasgow

Objectives Uncertainties

- The response of the new Government to the work carried out to date (not known at the time of the workshop). This raises questions of timescale and of the shape of the HSR network.

Scenarios

Five exemplar versions of HSR development in the west coast corridor were identified.

Scenario	New HSR built	HSR operation over classic lines	Journey time London – Edinburgh/ Glasgow*	Comment
A	London – West Midlands	Lichfield northwards on WCML	4 hours	As per HS2 Ltd report
B	London – Manchester/ Leeds	Preston northwards on WCML	3h 30	As per Cm7827
C	London – Manchester/ Glasgow/Edinburgh and Birmingham – Leeds/ Newcastle	Newcastle - Edinburgh	2h30	Fully developed HS2
D	In Scotland	WCML in England	4 hours	
E	London – Manchester and in Scotland	WCML Preston – border	3 hours	Combination of scenarios B and D**

*Journey times are shown rounded to the nearest half hour. They relate to the standard (rather than headline) journey times. Scenario A journey times are 20 minutes faster than achieved on WCML to Glasgow and on ECML to Edinburgh. Scenario B journey times may be similar for Edinburgh if routed via HSR to York and thence using ECML rather than Preston and WCML

** If London – West Midlands rather than Manchester (i.e. combining Scenarios A and D), this scenario offers a journey time of 3h30 London – central Scotland

Scenarios A and D each offer a useful (if limited) journey time reduction for London – Glasgow/Edinburgh journey times via the West Coast.

These scenarios represent very different contexts within which to consider the interplay between HSR and operation of services extended over the classic network. Clearly, they may be adopted sequentially, but each is worthy of consideration, since it is recognised that a full build out (to Scenario C) would take several decades.

Key Issue 1: East Coast questions

Two important issues were identified triggered by discussion of eastern side HSR development.

The first is the question of the development of eastern side HSR and the choice of **how to route London – Edinburgh HSR services**. The HS2 Ltd work is open on this issue, and the Command Paper illustrates both routes to Edinburgh. However, potential parity of journey times (via York and Preston) would only be achievable in Scenario B; otherwise it would always be possible to achieve a faster journey time via the West Coast.

The Transport Scotland position is that it favours a HSR design that allows both Edinburgh and Glasgow to show similar journey time gains from HSR and this means an approach that connects from the 'Carstairs' area.

The evidence from Greengauge 21 is that there is a good business case for northward extension of HSR in the west coast corridor, and that, having implemented such a scheme, there is a relatively weak business case for a second new cross-border HSR line, although upgrading the ECML could well prove worthwhile. A summary of Greengauge 21 appraisal results on this matter is reported in *Fast Forward*.

Key Issue 2: Stem capacity

The second issue is the **question of stem capacity**. Operation of the 'Y' shaped network relies on being able to accommodate over 15 trains/hour over the stem section between Birmingham and London. SNCF experience suggests that 15 tph is possible, and is achieved on TGV-Nord, but only in peak periods, not day long. Japan does not exceed 12 tph.

HS2 Ltd assumes that in 2025/6 after building London – West Midlands, 14tph would operate at 330 km/h (top speed capability 360 km/h) over HS2, with most operating to/from the WCML. Utilisation increases to 18tph under Scenario B (with the Y 'limbs'). To achieve this *either* there has to be substantial segregation of HSR from other traffics on the classic lines *or* there would need to be a buffering arrangement. This implies either capital spend/timetable restructuring on the classic lines or some provision of journey time extension (pathing time). In addition, operation over such an intensively used HSR line would probably need to be computer controlled (i.e. automated train operation).

The existing constraints on the various sections of the WCML were described and noted. In summary, although there are some exceptions, much of the route north of Lichfield is subject to capacity constraints which have already been reached with the current mix of services. There are some specific low-speed sections where localised schemes could bring worthwhile benefits. Over much of the route north of Preston, timings are extended for some trains (especially freight) because of the steep gradients, and this increases journey time differentials (for instance freight vs Pendolino) and reduces line capacity. The

replacement of diesel with electric traction for freight trains could improve capacity and line speed. The line speed for non tilting trains is typically 110 mile/h.

In the case of Scenario A, there would appear to be a net increase of 3 trains/hour north of Lichfield on the WCML (arising from the mix of HSR and revised Pendolino services on WCML-south). North of Weaver Junction, there would be a net increase of I train/hour. How this would be achieved becomes a key decision area (see below). In any event, the addition of HSR services between London and Edinburgh would add a further train/hour (in all scenarios, over the full route north of Lichfield) and there could be additional cross country or Heathrow services to consider too.

A review of demand forecasts suggested that from the outset, HSR services would be operating with about 60 – 70% load factor overall, confirming the scale of service frequency/capacity provision as being appropriate (but in need of expansion into subsequent decades).

Key Issue 3: Journey Times

The HS2 Ltd work assumes that classic compatible trains are 200m long, capable of paired operation at 400m, and are not tilt equipped. The absence of tilt causes an extension of journey times *vs* Pendolino of 3 minutes Lichfield – Preston and 4 minutes Preston – Glasgow. These estimates are *not* based on current line speeds for non tilting trains, but assume that, where train performance characteristics and line curvature/signal sighting permit, speeds could be increased. So the trade off would be between an additional 7 minutes on the London – Scotland journey time (already reflected in the Scenario A estimate) or adoption of higher weight tilting classic compatible trains with higher costs. The option of using existing Pendolino trains on HS2 during Scenario A early phase operation risks losing the business case because it is destructive of HS2 line capacity.

Station stops are of course critical to end-end journey times, it was noted. A station stop on WCML adds about 5 minutes; a station stop on the TGV high-speed network adds 7 minutes.

There is an option to divide/join trains (at say Carlisle or Carstairs) – and possibly for other locations in the Lancashire area – but splitting/joining of trains is only an option that would add to journey times and risks poor punctuality and may not offer adequate capacity at peak periods.

Decision Areas

These were described as being: “a means of describing any problem where people see an opportunity to choose between different courses of action”. In the first instance, it is the question that is identified, rather than the possible solution.

The workshop identified nine decision areas, as summarised below.

Decision area	Label
What is needed so that the classic network (WCML northwards) can accommodate the mix of service demand with HSR partly built?	Classic capacity?
Should the gauge on the classic network be increased to allow European standard HS trains to operate?	Gauge?
What length HS train operation should be allowed for on the classic lines – 400m?	Long Trains?
Should classic compatible trains be tilt-equipped?	Tilt?
Would it be worth speeding up (selected sections of) the WCML northwards?	Speed up WCML(N)
What intermediate stops should be provided for over WCML between Preston and Glasgow/Edinburgh, and how?	Station calls?
Should freight be permitted on HSR as it progresses northwards and how should freight be routed?	Freight route?
Should HSR be built through Manchester or serve the city by a spur(s)?	Manchester?
Are there specific infrastructure requirements needed for (a) splitting and joining trains and (b) to accommodate the need for performance buffering between the classic and new HSR lines?	Operational Infrastructure?

Discussion took place on these decision areas noting:

- Candidate **decision options** (solutions for some of the decision areas)
- Relevance against the scenarios in terms of **timing and phasing** implications. This can be extended to identifying where decisions can and should be safely deferred and where they are imminent.

To this we can add:

- Consideration of the **linkages** between these decision areas to help identify a 'decision field', that is to say, where decisions are inter-related (and also where they are separable).

Decision Options

Decision Area	Options	Comment/Implication
Classic capacity?	• known WCML enhancement options (Stafford/Norton Bridge, Manchester Hub • freight to use electric traction only • further schemes to tackle pinch-points • new train control systems	

Decision Area	Options	Comment/Implication
Gauge?		Implication for intermediate station calls, since existing platforms are incompatible with UIC GC gauge
Long Trains?	• Selective door/portion opening • Enhancement for 400m (selected stations) • (3 x) 133m set lengths	
Speed up WCML(N)?	• Cut offs	Might be related to pinch point schemes (e.g. Carlisle)
Station calls?	• Served by classic compatible services that join HS2 • Served by Pendolino (i.e. WCML south trains – but note journey time extension risk) • Key location of Carlisle may need selected HSR service station calls (and has been suggested by NWDA as a joining/dividing location rather than Carstairs)	Importance of ensuring that any arrangement provided on an interim basis can be sustained through subsequent stages
Freight route?		Night-time operation over HSR when extended north has environmental/consent issues. Diversion over G&SW has electrification, route re-doubling and terminal access issues
Manchester?	• Through station • Spurs (north as well as south)	Outcome will depend on detailed route studies
Operational Infrastructure?	• Additional platforming at 'border' stations to hold trains for slot regulation	

These identified options could be subject to an 'analysis of interconnected decision areas', and made subject to initial appraisals using existing evaluation tools. We would propose to determine the value of such activity following completion of the other two workshops, in conjunction with Steering Group guidance.

Timing and Phasing

Some important conclusions can be drawn in any event by considering these decision areas and the decision options against the five scenarios.

We can think of the scenarios as representing a staged development of HSR in the West Coast corridor. While other sequences are possible, and we cannot be certain of timescales, we can expect that each of the following stages may exist for a significant number of years:

Stage 0 no HSR built (say up to 2025)

Stage 1 HS2 built London – West Midlands (say 2025 – 2030s)

Stage 2 HS2 extended to Manchester/Preston (as per Cm 7827) *and* HSR (or new infrastructure to accommodate HSR) built in Scotland central belt (say 2030s/45)

Stage 3 HSR complete London – Glasgow/Edinburgh (say 2045/50 and onwards).

Other HSR developments may be associated with these stages, and so too may related investments in the classic network.

These stages (scenarios) can be arrayed against the decision areas:

Decision area	**0: No HSR**	**1: W Mids**	**2: Man/Scot**	**3: Full HSR**
Classic capacity?	All options identified to be implemented pre-stage 1			
Gauge?		Could there be a limited gauge enhancement approach that would significantly reduce the costs of the classic-compatible train fleet?	Only at this stage is the high infrastructure cost likely to justify gauge enhancement	
Long Trains?	Increase length of Pendolinos to 11 coaches		400m trains needed certainly by this stage	
Tilt?		This is the stage when most benefit would be derived from a tilt capability		
Speed up WCML(N)	Virgin plans?	Significant benefits	Significant benefits	Minimal benefit
Station calls?		No problem	No problem unless gauge enhanced	May require provision of connections between classic and new HSR
Freight route?		Requires freight to have electric traction		Freight capacity released on WCML classic lines

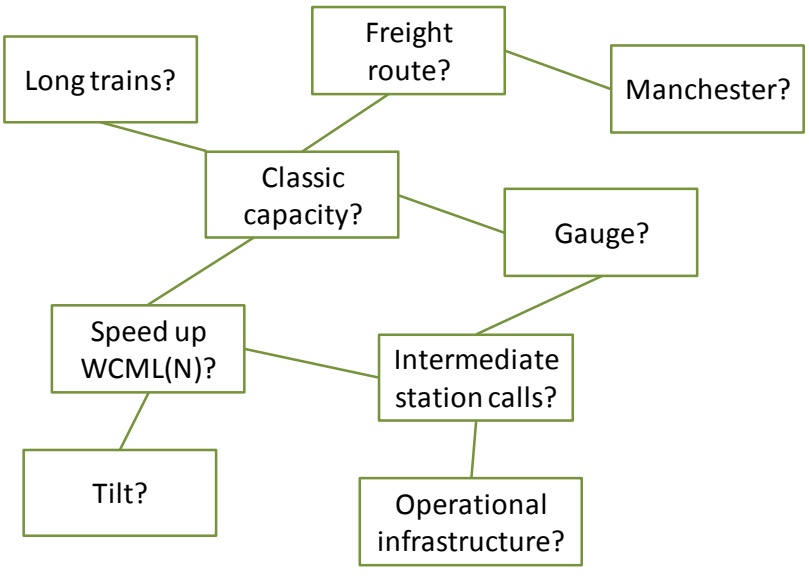
Decision area	0: No HSR	1: W Mids	2: Man/Scot	3: Full HSR
Manchester?	Manchester hub?		Issue arises at this stage	
Operational Infrastructure?		Implications for design of Birmingham International	Implications for design of 'frontier' stations (eg Preston)	

This shows that some decisions can be usefully deferred. The questions on intermediate station calls and full gauge enhancement only seriously arise at Stage 2. This is particularly helpful given that it will allow the experience of tendering for and procuring of both classic compatible and European-gauge rolling stock to be taken into account (currently, much of the uncertainty in the business case hinges on the risk element in rolling stock cost differentials). On the other hand, questions of complementary capacity investment in the classic lines, of the need to ensure freight is electrically-hauled and the assessment of the value of a tilt capability need to be resolved now, prior to Stage 1. The latter issue essentially rests on proving the acceptability of enhancing permitted speeds over the northern WCML for non-tilt passenger rolling stock. There is also the possibility that a limited gauge enhancement approach could deliver a better value for money solution from the outset.

If the gauge enhancement question arises later, then it will still of course be necessary to procure classic-compatible stock for Stage 1. The proposition would then be that fleet expansion, if classic line gauge is enhanced, could be through the more efficient/better value larger gauge fleet, with the classic-compatible trains cascaded on to further services (Aberdeen was suggested, for example).

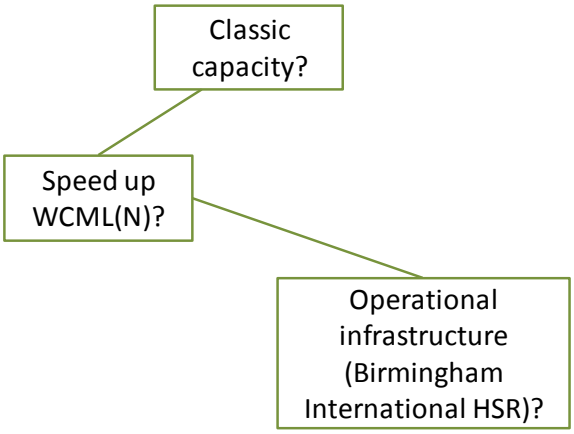
Linkages between decision areas

The question of linkages between the decision areas can be shown visually. In the following diagram, connections are shown between decision areas if joint consideration of the issue could lead to a differing set of options.

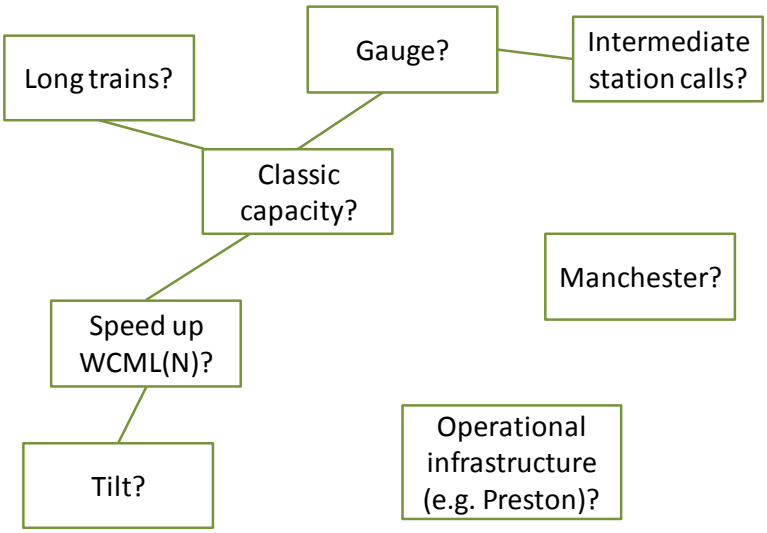


In essence, what this shows is a high level of separability of the decision areas. The inter-connected areas relate to capacity and to a lesser extent speed. But these connections can be refined further when consideration is given to the applicability of this diagram to the various stages introduced earlier. Some of the decision areas simply don't apply in specific stages (scenarios).

Thus for stage 1, we can simplify the diagram to three loosely interconnected decision areas:



In stage 2, the diagram is very different:



Conclusions

It was agreed that a note of this type, recording and developing a little the conclusions reached at the workshops would be circulated in draft to workshop attendees.

It was also noted that some significant work is required in Scotland – beyond the current brief of HS2 Ltd – to develop suitable solutions. An estimate of £1m preliminary engineering/planning costs was estimated (for each of Glasgow and Edinburgh).

Annex C – Workshop 2: HSR on the Eastern side of the country

26 May 2010
Greengauge 21

Introduction

The Greengauge 21 HSR Public Interest Group has noted that there is a need to look further at the interplay between HSR and the existing network. Three workshops are planned to examine this issue, and this report summarises and distils the second of these workshops, held in London on 26th May.

The subject of the workshop was HSR in the eastern side of the country. The geographic scope covers London, East of England, East Midlands, Yorkshire/Humber, the North East and Scotland

Existing work – the report of HS2 Ltd, Command Paper 7827, and the work of Greengauge 21 and Network Rail – was taken as given. However it was acknowledged that at the time the workshop took place, no specific guidance was available from the new Government; HS2 Ltd was progressing for the time being on the basis of the decisions reached in the Command Paper of the previous administration.

The workshop used three key concepts: uncertainty, scenarios and decision areas. The question of risk (related to some specific uncertainties) was also covered. A number of issues emerged that were discussed in some detail ('key issues'). On occasion, use was made of the outcomes of the first workshop which examined the west coast corridor.

Business case evidence

The HS2 Ltd work showed a very high BCR for a Birmingham – Leeds/York extension (c.25:1), certainly much better than for Birmingham – Manchester. This is because the North West already benefits from the Stage 1 London – West Midlands scheme whereas the eastern side of the country is assumed to get no benefit at all from the first stage. It should be noted that HS2 Ltd had only an outline concept for these two 'limbs' of the Y-shaped network (in contrast with the detailed costings available for the 'stem' of the Y). It was assumed that capital costs would be much lower than those developed for the London – West Midlands scheme.

The business cases prepared by Greengauge 21 of relevance are as follows:

London – Manchester	2.9:1
Manchester – Glasgow/Edinburgh	7.6:1
London – Leeds & Newcastle	2.0:1
Newcastle – Edinburgh	1.0:1

In each case this shows the business case for full new HSR construction assuming the preceding stages have been built. Clearly there are other possible sequences[2]. The overall network BCR is 3.5:1.

The national network developed by Greengauge 21 has two full north-south lines. The Newcastle – Edinburgh section is assumed to be an upgrade approach rather than new-build throughout, and the same assumption was made in the HS2 Ltd work, but this took the basis of the network as being a Y-shape rather than two separate lines north form London.

Uncertainty

Information Uncertainties

- Demand growth rates, especially in the longer term. What if the economy under-performs and /or rail demand growth ends? What if the link between GDP and (longer distance) travel demand is totally broken (it has already declined, but still exists, according to work by Dr Joyce Dargay for the ITC, 2010)? Could aviation policy also have an impact?
- Construction costs, given HS2 Ltd evidence on UK premia vs Europe?
- Future oil prices?

Related Decision Uncertainties

- Extent of enhancement on the classic network and rolling stock (ECML, MML, IEP)?
- The level of funding available in the short, medium and longer term? It was noted that c.10% of the costs would be incurred before construction started.
- Personal security measures that might be added to HSR, increasing costs, reducing attractiveness?
- How will the Scottish Government play its hand, and how will planning for HSR in Glasgow and Edinburgh progress?
- Loss of regional plans potentially weakening resolve/support for HSR and harming implementation?
- Effects on business case estimates of do minimum specification as cut-backs are made?
- Revised planning arrangements impact on project deliverability? Will the planned National Planning Framework help (Scotland has one, complete with a reference to HSR)?

Objectives Uncertainties

- The response of the new Government to the work carried out to date (not known at the time of the workshop); the effect on timescale, phasing and shape of the HSR network? It was noted that the coalition agreement talked of HSR to Scotland, to be developed in phases. Funding of HS2 Ltd does not form part of the initial round of £680m transport sector cut-backs. The 'Y' shape network is not yet confirmed, and the position with respect to Heathrow remains unclear.

[2] For example, the benefits of northwards extensions from Cm 7827's full Y-shaped network have not been assessed. If it is decided to proceed with this configuration (with both sides of the Pennines being progressed in parallel), then it would be necessary to look at the case for HSR investment north of Preston and north of York afresh, and on a consistent basis.

Note: there were two more 'uncertainties' identified which can be more usefully treated as decision areas – and these follow later.

Scenarios

Seven exemplar versions of HSR development were identified.

Scenario	New HSR built	HSR operation over classic lines	Journey time London – Edinburgh/ Glasgow*	Comment
A	London – West Midlands	Lichfield northwards on WCML	4 hours	As per HS2 Ltd report
B	London – Manchester/ Leeds	E/WCML Preston/York – northwards	3h 30**	As per Cm7827
C	London – Manchester/ Glasgow/Edinburgh and Birmingham – Leeds/ Newcastle	Newcastle - Edinburgh	2h30	Fully developed HS2
F	London – Birmingham – Leeds/York	ECML York - Edinburgh	See note ** below	Y network but with only the eastern branch built
G	London – Manchester/Preston London – Leeds/York	E/WCML Preston/York – northwards	3h 30	
H	As G plus York – Newcastle	Preston/Newcastle northwards	3h (Edinburgh)	
I	S-shaped: London – Birmingham – Manchester – Leeds – Newcastle – Edinburgh – Glasgow	None	3h (Edinburgh)	Possibility of adding a direct ECML(S) connection to follow

*Journey times are shown rounded to the nearest half hour. They relate to the standard (rather than headline) journey times. Scenario A journey times are 20 minutes faster than achieved on WCML to Glasgow and on ECML to Edinburgh. Scenario B journey times may be similar for Edinburgh if routed via HSR to York and thence using ECML rather than Preston and WCML. Where journey times are shown as (Edinburgh), journey times for Glasgow are 30 minutes+ longer.

** In scenarios B and F, it might be that a London – Edinburgh journey time of 3h30 would be achievable via ECML (N): it requires a 50 minute time saving over current standard ECML times. It is notable that Preston – Edinburgh journey times are currently 20 minutes faster than York – Edinburgh journey times – hence the greater certainty in Scenario G estimates

These scenarios represent very different contexts within which to consider the interplay between HSR and operation of services extended over the classic network. Clearly, they may be adopted sequentially, but each potential stage is worthy of consideration, since a full build out would take several decades.

Key Issue: Scenarios and the Y-shaped network

At 320km/h the evidence and advice is that 15tph is a maximum throughput for a new HSR line. There are ambitions here and elsewhere to allow higher speeds and to retain the same braking capabilities and distances, but they have not yet been achieved. It is very difficult to get above 16tph, although with the use of automated train operation 17/18tph may become possible. It is also notable that the maximum speed through a diverging switch is 220 km/h and so network complexity (number of stations with loops, and the number of junctions, etc.) has a real-world bearing on what can be achieved in terms of sustainable route capacity.

If a safe maximum is taken as 14-15 tph, then Scenarios B and C which assume 17-18 tph have an additional delivery risk. It would be risky to assume that a throughput of 15 trains/hour could be routinely exceeded on a HSR network with an extensive interaction with the existing network if operating speeds are set at 330 – 360 km/h. In these circumstances, there are various variants to Scenarios B and C to consider:

- develop a second N-S line
- re-consider a 4-track scheme for the Y-shaped network scenarios
- plan for lower service frequencies than those assumed in the HS2 Ltd business case work, which is based on an assumption of 17tph on the common section of the HSR route from the outset.

It is interesting to note that on the eastern side of the country, regardless of the outcome of decisions reached on this very important strategic choice, an HSR route from Nottingham to Yorkshire and Newcastle would be a feature of a national HSR network: this section of route doesn't fundamentally depend on the choice between one or two route configurations further south (or further north).

The existing constraints on the various sections of the ECML and MML were described and noted. Both routes are seen as approaching capacity constraints by Network Rail by the 2020s, after the application of various measures to add route capacity through the use of longer trains and various infrastructure schemes. If the increase in capacity that IEP offers is unavailable, the ECML could run out of capacity earlier – by say 2020. After 2030, major schemes such as the relief of the Welwyn two-track bottleneck become needed. The application of ERTMS is expected to allow an increase from 19 tph to (say) 23 tph.

Timing of the capacity constraint on ECML in particular is seen as critical. If it arises early – because of deferral of investment while demand growth continues – then HSR could be a solution that obviates the need for major capital spend on the ECML. In this case, there is an investment choice between HSR and on the classic network. If the capacity 'crunch' comes later, then there would be a need (or a desirability) for investment in the classic line, and this would worsen the investment case for HSR and likely defer its implementation.

The MML is getting busier and journey times, for example to/from Nottingham, have become slower as a consequence. So while a 90 minute Nottingham timing might be feasible with no stops south of Leicester, growing long distance commuter demand makes this

increasingly difficult to provide. A worst case outcome could be the loss of terminal capacity at St Pancras (because, say, of HSR schemes) and further decline in journey times.

Key Issue : Serving the East Midlands

The Y-shaped network has the eastern limb diverging from north of the delta junction that leads into central Birmingham and north of the proposed new HSR station at Birmingham International. Its alignment has not yet been developed and a number of options exist.

It might follow the course of the M42 motorway, in a north eastern direction. This would require a route across the National Forest, and would reach the M1 corridor near the crossing of the Trent Valley. From this point, the alignment might turn northwards and follow the M1 towards Sheffield. However, such an approach would most naturally serve Nottingham and the East Midlands through a parkway style station west of Nottingham. Direct access by HSR to the city centre would be harder to achieve whilst maintaining a reasonably direct route for destinations further north.

It would be something of a 'forced fit' to serve Nottingham city centre with the Y-shaped network. Yet the view of stakeholders (and, it should be noted, the wider Public Interest Group), is that while parkway style stations may have a role in certain circumstances, they should not be seen as an alternative to central city stations for major cities. Stakeholders do not favour a parkway station(s) for the East Midlands, since there are seen as adding to access times and end-to-end journey times.

Of course, smaller cities would struggle to justify a HSR station, but Nottingham is the largest city in the East Midlands, one of eight English core cities, and a city that has taken a considered approach to its urban transport policies, equipped with an expanding LRT system that will radiate from the main railway station and which could also serve a HSR facility in a central location.

It is not possible for the Y-shaped network to serve Leicester either – except by means of an alignment that would join the 'Y' stem further south – and there is also Derby to consider. This is a circumstance where a joined-up solution that confers benefits across the three East Midlands cities would be desirable, perhaps partly serving the area through HSR directly and partly through re-allocating use of the Midland Main Line, once HSR frees up some MML paths.

Decision Areas

These were described as being: "a means of describing any problem where people see an opportunity to choose between different courses of action". In the first instance, it is the question that is identified, rather than the possible solution.

The workshop identified 12 decision areas[3], as summarised below.

[3] The workshop identified several more that were subsequently 'talked out'. Included in the table are two decision areas that were originally suggested as uncertainties.

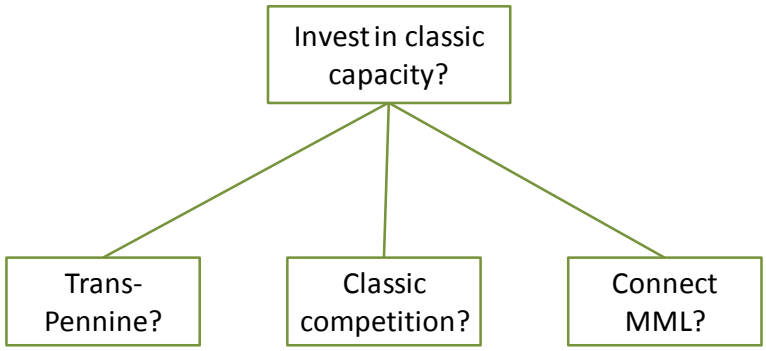
Decision area	Label
How many London stations are needed to address the wide geography of the capital and to ensure that dispersion problems are manageable?	London termini?
Is the capacity of the stem in a Y-shaped network sufficient to accommodate eastern as well as western services?	Stem capacity?
Should the first stage of HS2 to the West Midlands (Scenario A) be built with a connection into the East Midlands (for Yorkshire/NE)?	Connect MML?
Should there be a second HSR line to London?	2 N-S lines?
On the eastern side, should there be city centre or parkway stations?	Parkways?
What economic geographies do we want to serve, in the East Midlands and the East of England?	Eastern catchment?
Is it important to serve the shorter regional markets by HSR (to assist mode transfer from car)?	Region-region HSR services?
Is gauge enhancement worthwhile on the existing network?	Gauge?
Can HSR be built southwards (as well)?	Scotland southwards?
Is it workable to allow low-price alternatives on the existing network?	Classic competition?
Should there be investment in capacity on the ECML/MML in the meanwhile?	Invest in classic capacity?
Trans-Pennine – upgrade or new line?	Trans-Pennine?

Decision Area Interconnectedness

Discussion took place on these decision areas and their implications and inter-relationships. These have differing relevance as the various stages of HSR network development proceed. We can think of the scenarios as representing a staged development of HSR. So, for example, by the end of phase 1, HS2 would be built London – West Midlands (say 2025) i.e. Scenario A.

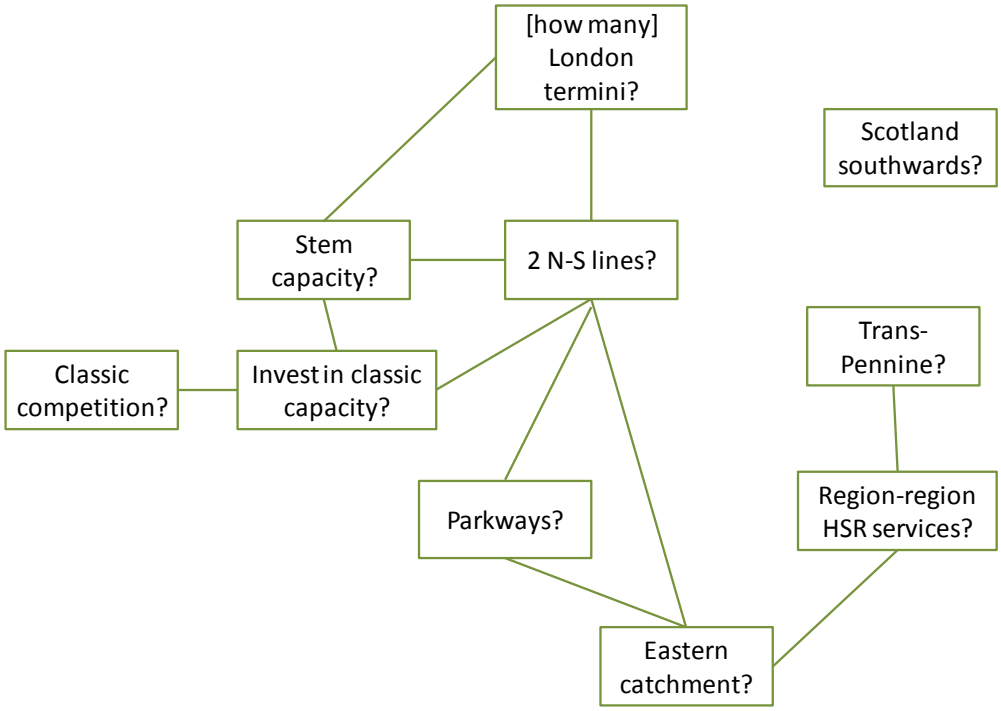
The decision areas have linkages (that is to say, different conclusions would be reached if interconnected decision areas are considered together). While the workshop had insufficient time to develop these, the linkages are fairly clear and can be set out as follows.

Phase 1: Scenario A



Most of the identified decision areas do not apply to this, the first phase of HSR development (London – West Midlands). There are inter-linkages between the questions on investing in and the use of the classic network, and the connections to it via the Midland Main Line (MML).

Phase 2: Scenarios B/C/F/G



For this second stage, there are a number of important decision areas and they are mainly closely interconnected. Only the decision on whether to start with some works in Scotland is separable and independent.

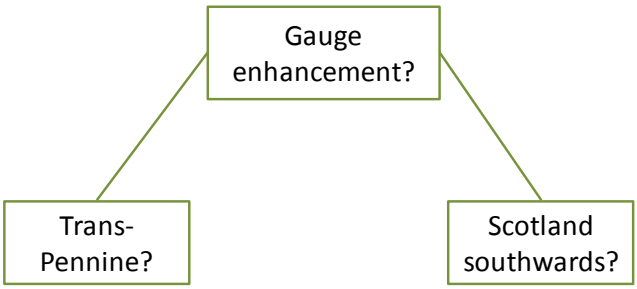
There is a cluster of decision areas around the one or two north-south lines question.

Key Issue: Investing in the Classic Lines

If the first phase (Scenario A) is not immediately followed by further HSR development, the ECML and West Anglia Main Line, and the southern section of the Midland Main Line will be operating at capacity. As routes become full, there is a tendency for journey times to be extended. Cities such as Leeds and Newcastle will not be enjoying the benefits experienced in Birmingham and Manchester. The question of programming enhancement expenditure on the existing routes therefore becomes critical.
In total, the investment necessary to add 1- 2 train paths/hour on these routes can be very considerable – and in due course, there is the prospect that these lines will be relieved by a HSR line. This doesn't mean that the value of interim investment will necessarily have a short life, but the post-HSR service pattern on the classic lines, stopping patterns, line-speeds, and the balance between freight and passenger traffics might all change.

This suggests that there would be real value in an integrated 'whole network' approach that anticipated HSR and provided carefully targeted investment on the classic main lines designed to offer enduring benefits given the inevitable uncertainties around the timings of future phases of the national HSR network.

Phase 3 (later, un-numbered scenarios)



Once the HSR is well-advanced (perhaps in the 2030s), the question of gauge enhancement of (the relatively shorter sections of the) connected parts of the classic network become relevant. The questions of best approach in developing the network in Scotland and across the Pennines may remain, and in each case there is likely to be a question around gauge.

Further key issues around identified decision areas

At the workshop, discussion concentrated on exploring some of the new issues specific to the eastern side of the country.

The East of England was noted as being a region unlike the others examined, in that while it has a large and growing economy, it lacks any major centre. This meant that the choice here was not between parkway and city centre stations so much as the need to identify a suitable interchange site(s) for HSR that could serve the dispersed geography (as Peterborough does today).

The number of stations needed on the HSR network could be as low as one per region.

With regard to airports, the view from stakeholders was that provincial airport access was of secondary importance compared with serving their city centres. Heathrow was seen as a different question.

Other findings

Some further important conclusions were drawn at the workshop by considering some of the decision areas and the way the HSR network could develop, as explored through the various scenarios.

Are there any HSR elements that are needed in the long term regardless of ultimate network shape?

Once the first stage (London – West Midlands (Scenario A)) is implemented, clearly there are some major choices on priorities for the next stage (as reflected in the number of scenarios identified in the workshop). Despite the existence of all of these options, two further areas of HSR network development can be identified as having added value, irrespective of how the final network shape develops. These are common to all scenarios and comprise:

- The Edinburgh – Glasgow HSR
- HSR between Newcastle and (the northside of) Nottingham.

It may be considered unlikely that these sections of line would be the highest priority investments, to follow on from the London – West Midlands scheme, but they do have the virtue of fit with all of the identified development scenarios. And it could be argued, for example, that a high speed service between Edinburgh and Glasgow would free up valuable track capacity in the Central Belt of Scotland and could therefore (at least in due course) be seen as a high priority.

If HS2 is built to the West Midlands (or further, into the North West) but subsequent HSR lines do not proceed rapidly, then how can the Eastern side of the country benefit – and avoid being disadvantaged?

The workshop identified a fundamental issue with the Scenario A scheme as far as the eastern side of the country is concerned. If it is built as defined in the HS2 Ltd work, with a connection to the WCML but not to the MML at Derby, then the longer this stage of development survives unextended, the greater the potential economic downside for eastern-side economies, because only the West Midlands, the North West and to some extent Scotland will be able to benefit from the connectivity gains that HSR brings. **If HS2 is built as per Scenario A, connected only to the WCML, then it would prove neither easy to reserve line capacity for future HSR services from the east/north east nor alternatively to anticipate the withdrawal of WCML service extensions once an eastern limb is added subsequently.**

For this reason, there is a good case for the work of HS2 Ltd to be progressed including examination of the design and costs of a connection to the route to Derby (to which it is very proximate at its northern limit at Lichfield). While it is true that this may give rise to the need for works over the existing route northwards *via* Derby, such considerations are

equally likely (as was found in the first workshop) for the route onwards from Lichfield over the WCML.

There is an argument that such developments might weaken the case for subsequent investment in the two limbs of the Y-shaped network. In effect, the choice may be between early investment (in effect, to ensure that the benefits of the London –West Midlands route can be fully exploited further north) and the possible deferral of full HSR construction over the same geography (from the Midlands northwards).

In any event, connection to the Derby route would make electrification of the connection to the MML at Derby and thence of the MML to Sheffield and potentially beyond a necessary corollary to the operation of HS2. The major beneficiaries would be Derby and Sheffield – and also Leeds and Newcastle. Nottingham and Leicester would not be served by HS2 in this format. However, these two East Midlands cities could still benefit substantially, because if the northern part of the MML would be necessarily electrified, then the case for what would become an infill electrification scheme between Bedford and Derby and Nottingham would be very much stronger, and there would be scope to re-specify the use of the MML.

In other words, for this first stage (Scenario A) to bring benefits to the eastern side of the country, it would seem likely that there would need to be a complementary scheme to electrify the MML. The benefits could then be shared across a wide geography, with fast Sheffield services switched to HS2, leaving scope to speed up and intensify services for Leicester and Nottingham over the MML.

Scenario A: with a balanced service plan

HSR services over HS2	**HSR destinations over HS2 and WCML**	**HSR destinations over HS2 and MML**	**Other key locations with better classic line services**
Birmingham	Manchester	Sheffield	Milton Keynes
	Liverpool	Newcastle	Leicester
	Glasgow	Leeds	Nottingham
	Edinburgh	Derby	Wolverhampton
	Chester		Bedford
			Northampton

Note: Leeds, Newcastle fastest London times still via ECML. Non-London services (e.g. from northern locations to central Birmingham) not shown.

How should subsequent stages be prioritised? (Scenarios B onwards)

Prioritising the next stage of HSR development is a complex question, and there will be a need for further comparative studies. **These will need to extend beyond the network shape constraint that has affected HS2 Ltd work to date, to allow consideration of network evolutions that do not rely solely on further build out of the London – West Midlands line.**

It can be assumed that, based on the findings of Workshop 1, some works will have to be made to the WCML (as well as potentially to the MML as described above) to get best value

out of Scenario A. These would likely bring joint benefits – as many rail investments do – of performance reliability, capacity, journey times and acceptance of longer trains. Thus journey times for Scottish destinations may have faster journey times than could be achieved without these investments, for example.

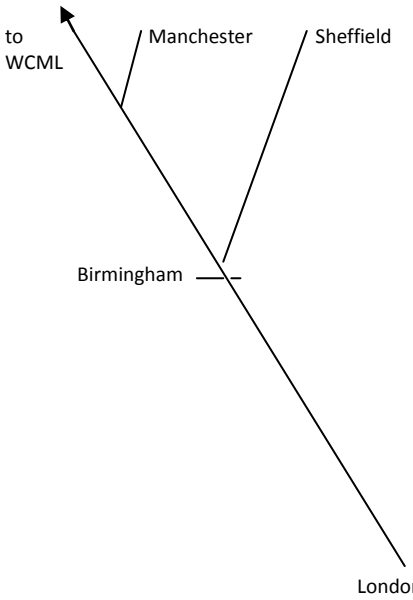
The subsequent prioritisation choices in practice will be taken based on the benefit-cost ratio evidence and the need to think carefully about how the balance of advantage is conferred across the national geography. The evidence points to a good benefit cost case for completing a western-side route between London and Scotland; while the capacity limitations are not so critical over the northern sections of such a route (and the benefits from overcoming capacity constraints are therefore less) the journey time benefits against air travel have a high value. Against this has to be weighed the problem of unbalancing regional impacts and the need to address capacity constraints on the eastern side of the country as well. The choice lies between prioritising extending HS2 to Manchester and/or Preston and then perhaps further north to Scotland, on the one hand, and making a start on introducing HSR to the eastern side of the country on the other. The latter could be achieved by:

1. Creating the Y-shaped network in phases, but this requires changes to the current plans as noted above, with either restricted service frequencies or 4-tracking[4]
2. Starting the development of relevant parts of the Nottingham – Newcastle section of HSR, operating services to the south from this new HSR route over existing lines (MML, ECML) to London. This begs the question of feasibility and of where the existing network would be most able to accommodate additional demand from HSR
3. Developing a second line on the eastern side of the country, starting with London – Nottingham and with connections northwards to the ECML, in a way analogous to the HS2 Scenario A scheme.

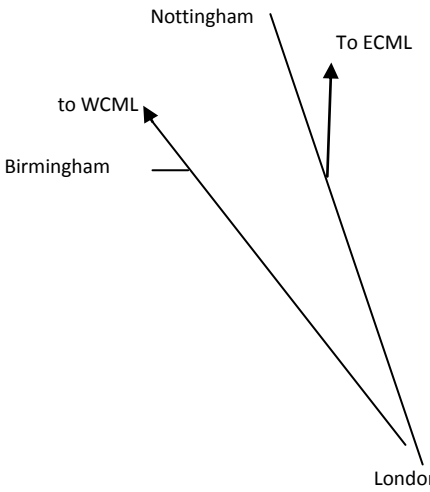
Because the capacity constraints are most severe on the southern section of the ECML, there is little point in relieving the northern parts of the ECML if the bottlenecks remain at its southern end. This means that the second concept would necessarily require some significant enhancement of existing lines (MML and ECML) to accommodate the additional services from the new HSR line. It would therefore be unlikely to be as cost effective as the other two approaches.

The first and third concepts are illustrated below. In the Option 3 diagram, the onward connection to the north over the ECML is shown diverging south of Nottingham, in an equivalent manner to the arrangement for Birmingham/WCML in HS2 Ltd's plans. Alternatively, Nottingham might be located directly on a through HSR route to Yorkshire/North East.

[4] In general, four tracking has been found to be not significantly cheaper than building two 2-track alignments in separate corridors. However, the most critical problem would be a London terminus but if one pair of tracks served the London terminus as planned and the other served Heathrow and destinations that could be linked beyond Heathrow, the problem of an overly complex London terminal (at least) might be avoided.



Option 1: extend HS2 northwards
(335 miles HSR line)



Option 3: start on a second HSR line
(250 miles HSR line)

Option 3 could be a straightforward follow on from the current worked-up HS2 scheme and would bring journey time reductions of 30 mins+ to the key eastern side destinations of Nottingham, Leeds, York, and Newcastle (with Sheffield and Derby benefitting from the earlier stage of HS2 development, suitably adapted) . The East of England would benefit from the capacity relief on key routes to Peterborough/Cambridge and, depending on the routing and connections offered, there could also be services from other locations across the dispersed geography in the East of England operating over HSR, joining the HSR network at suitable locations. There could also be good connectivity with HS1 depending on the choice of second London HSR terminus location.

Conclusions

In summary, then, we can conclude that investment sequencing needs to be the subject of further study, and we have pinpointed the prioritisation options that need assessing:

- Extending HS2 to Manchester and/or Preston and beyond to Scotland; or
- Introducing HSR to the eastern side of the country, through:
    (i) Extending HS2 to Leeds and/or York and beyond to Newcastle and Scotland
    (ii) Creating a Y-shaped network in phases[5] *or*
    (iii) Developing a second line on the eastern side of the country.

We have identified a case to add connectivity of the northern end of the initial HS2 scheme to the East Midlands to broaden the spread of economic benefit. We have shown that there is a risk around the assumption that the Y-shaped network would have sufficient capacity to accommodate the traffic demand from both 'limbs' of the network, and identified the various possible resolutions to this problem.

[5] Options (i) and (ii) here also require a resolution of the Y-network stem capacity problem in order to be practicable.

We have identified that the question of investment on the classic lines – and on the MML and ECML in particular, are critical.

We have also identified the key areas of uncertainty, the set of decisions that need to be taken, and in which phase of HSR development they become critical and how separable or inter-related they are.

Annex D – Workshop 3: HSR network in the London area

16 June 2010
Greengauge 21

Introduction

The Greengauge 21 HSR Public Interest Group has noted that there is a need to look further at the interplay between HSR and the existing network, and also between the various components of a future national HSR network. Three workshops took place to examine these issues, and this report summarises and distils the third of these workshops, held in London on 16th June.

The subject of the workshop was HSR in the wider London area.

The timing of the workshop followed the Westminster Hall debate at which Transport Minister Theresa Villiers had outlined the new Government's position on HSR. In summary, this is:

- Commitment to a genuinely national network (in addition to the North and the West Midlands, this means Scotland, Wales, East Midlands)
- No commitment at this stage to the shape of the network beyond Birmingham (so the Y shaped network of Cm7827 cannot be taken as a given)
- Planning consent to be pursued through a hybrid bill and first phase enabling works to start in 2015.

Key points of relevance to the third workshop from the first and second were noted at the start of the workshop.

Business case evidence

(1) Heathrow

Greengauge 21's work setting out a set of connections between HS2 and the main (existing) lines to the south and west of the Airport shows a business case BCR of 5:1, with capital costs of £3.2bn. Work by HS2 Ltd noted that currently 80% of Heathrow's passengers were from London and the wider South East and shows a poor business case for loop and spur schemes connected only to HS2.

(2) Links between HS2 and HS1

HS2 Ltd's work included an assessment of the case for such a link. With limited demand for a Birmingham – Paris service, it concluded that the scheme it had identified to facilitate through running (which has a cost of £810m) would not be viable, since service frequencies would be very low. Greengauge 21's work (based on a 4tph service which made use of the Heathrow interconnections and served a HS-NE route as well as facilitating HS2 – HS1 connections) showed a BCR of around 5:1.

Key Contextual Issues

(i) Capacity
A key problem on the key routes into London. Usage of the WCML continues to grow (the inter city service is showing over +5% CAGR, currently) and commuter demand growth is being handled by the introduction of longer trains (12 cars), but the timetable offer is capacity-constrained, and the pressures will be felt strongly within a relatively short period (5 years).

The MML is running at 20tph in each direction south of St Albans, and freight cannot be accommodated through a lengthening peak period (6 hours long). The ECML capacity can be increased marginally but this would require a series of investments at locations such as at and south of Doncaster.

(ii) HS1
HS1 capacity is around 16tph (note that speeds are restricted west of Ebbsfleet, the section which carries most services). Freight will operate on HS1 (to Ripple Lane/Dagenham).

With the potential use of Stratford (International) on HS1, is there scope for a connection between HS1 and HS2 to reduce the number of platforms needed (and hence the cost, disruption and timescale) at Euston? A critical question would be the independence of the alignment that would connect HS1 and HS2, or, more specifically, its impact on freight and North London Line services.

Connections to Heathrow would be worth looking at for through services to Europe.

Changes emerging through the IGC[6] processes are opening the way for international open access operations.

HS1 has an investment grade listing and is to be offered for sale shortly.

(iii) Stratford
HSR could help deliver the Olympic legacy, as part of HSR's 'place-shaping' role in spatial planning. The local authority sees the creation of a third centre for London as well as providing a major access point for Docklands. Stratford International was built for international services to the regions and is currently used only by Southeastern services to Kent.

(iv) Heathrow
There is strong support from the economically important Thames Valley sub-region for direct rail access to and connectivity at Heathrow, in order to maintain the success of the sub-region.

The HS2 Ltd report didn't rule out Heathrow (hence the referral of the question to the review by Lord Mawhinney), but did not find a positive business case within the terms of its remit, which was restricted to its interface with HS2.

The importance of Heathrow's unique role as the UK's only hub airport was reviewed. Each of Heathrow's continental competitors has HSR connections and the airlines are supportive

[6] The Channel Tunnel Intergovernmental Commission, which supervises all matters concerning the construction and operation of the Fixed Link.

of bringing HSR to Heathrow. BAA and the airlines are in favour of air-rail substitution within the UK because this helps meet the carbon agenda, and because this would improve international connectivity with the British regions.

Therefore the question of HSR at Heathrow can be considered as part of an integrated transport project, offering the 'right mode for the right journey rather than a 'narrow' rail issue'. The target market for air-rail substitution is the increasing volume of short-haul flights from British regional airports to continental hubs for long haul flights. It is important to get the details of the connection right, otherwise it would not be perceived as a direct link.

A key risk was identified: if there is a link from HS1 to HS2 but not to Heathrow, then the accessibility of Heathrow's continental competitors will be strengthened, to Heathrow's disadvantage.

(v) London termini
Passenger dispersal is the critical question. This is related to questions of how to distribute demand across the various centres in central London and across the rest of London, and how best to meet the needs of passengers who would travel to HS2's London terminus and then make a continuation beyond London (various pieces of evidence on this suggest perhaps about 25% of terminus users are likely to be in the latter category).

Current work at TfL includes examining how to create road access at Old Oak Common (for buses) and the option of extending a branch of Crossrail on to the West Coast Main Line (seen as addressing the well-known imbalance problem on Crossrail, the demand problems on WCML and the dispersion/congestion issue at Euston). This second scheme would mitigate the land take of the HS2 at Euston significantly. It was noted that this scheme is compatible with the HS2 Ltd Old Oak Common Crossrail/GWML/HS2 station proposal and independent of it (either one or both schemes would be possible).

(vi) Funding
While not specific to the London area considerations, discussion on funding pointed up lessons from the Crossrail and HS1 experience and the desirability of exploring private finance approaches in the current fiscal climate. This might be particularly attractive in respect of stations.

(vii) M25 Corridor
Could this form a useful feature of plans, for instance over the Heathrow – Watford segment (there are no credible public transport links in this sector)?

Uncertainty

Information Uncertainties

- Demand growth rates, and the link between GDP and (longer distance) travel demand (see workshop 2). Also the question of London growth (see London Plan +1m people in 20 years (similarly, growth in the south eastern regions), but note that growth has been maintained through the recession
- Future oil prices and the cost of fuel and electricity charges for rail (EC4T)?
- Value of infrastructure created (see current issue of *Infrastructure Journal* for a view on HS1 sale value)

Related Decision Uncertainties

- Availability of funding sources e.g. EU, and the question of treatment of the loss of value to existing rail franchises/network?
- Assumptions made on security measures/border controls?
- Interoperability regulations and ERTMS compatibility?
- Decisions at Heathrow e.g. cordon charging, pattern of development of airport usage?
- Progress with Crossrail given possible interdependency at Old Oak?

Decision Areas

These were described as being: "a means of describing any problem where people see an opportunity to choose between different courses of action". In the first instance, it is the question that is identified, rather than the possible solution.

The workshop identified four decision areas, as summarised below.

Decision area	**Label**
What functions would a through connection between HS1 and HS2 serve?	HS2 – HS1?
How should the wide geography of the capital be addressed and how can the dispersion problems at Euston best be addressed?	London termini?
Should Heathrow be connected to HSR?	Heathrow?
What cross-London HSR connections should be provided?	Across London?

Decision Area Interconnectedness

Each of these decision areas is inter-connected with the other three. In some cases the inter-connectedness question centres on specific issues, some of which can be readily identified:

Inter-connectivity of Decision Areas	**Determined by choices made on**
HS2 – HS1? *and* London termini?	Potential use of Stratford International
Heathrow? *and* London termini?	Airtrack and other rail access provision, and hence the wider accessibility of a Heathrow HSR station for non-airport traffic

Decision Area Options

(i) HS2 – HS1 connection?

Four options were noted in the context of the Minister's comment of the previous week that HS2 Ltd had been directed to work on the question of direct connections to HS1. These are:

- Locating the HS2 terminus at St Pancras (but there was no indication that the advice of both HS2 Ltd and TfL on the advantages of Euston would be ignored)

- A people mover link (but the practicality of this was seen as being far from straightforward, and hardly appealing for through journeys where a direct air alternative exists[7])

- A double interchange solution using both Old Oak Common and Stratford and Crossrail (but this has journey time penalties on both HSR lines and even less appeal for those making long distance journeys)

- A through-running connection. Costs for the latter would vary between £800m and £350m – the saving being achieved by using parts of the existing network (although the need for gauge enhancement when using existing rights of way should be noted).

Capacity of a through-running link would be 4tph onto HS1 (because of capacity constraints on the latter), but the inter-connection frequency could be higher if:

- it was found desirable to switch any Kent high-speed services to a cross-London route (e.g. Stratford – Milton Keynes/Heathrow, or GWML destinations if/when the route is electrified) in place of St Pancras terminations. This would potentially free up some platform capacity at St Pancras, and would mean that some of the usage of the HS1-HS2 link would be for domestic cross-London services

- the connection is also used to connect from western side routes also to ECML/HS-NE as well as to HS1[8].

It was also noted that new IGC rules may permit the use of standard 2 x 200m trainsets through the Channel Tunnel and thence over HS1, so trains could be operated over this link and divided to serve a wide geographic foot-print, without increasing the number of train paths needed on capacity-critical sections of line.

(ii) London termini?

On dispersion from Euston, a number of options are on the table:

- Various levels of investment in the Northern Line (partial or full separation of the two routes)

- Upgrade to the Victoria Line

- New (eastern) access to Euston Square station

[7] A possibility noted here is that one of the candidate extensions for the DLR eastwards from Bank is a route to KX/St Pancras and Euston, which has the effect of creating the potential for a (semi-) purpose-designed automated high frequency people mover connection.

[8] The Greengauge 21 national network has a second north-south line, with an assumption of a second London terminus at Stratford (a new station with interchange to the existing international and regional stations). This would have the effect of freeing up capacity on the southern section of several main lines including the ECML which carries 7 long distance tph in the business peaks, all of which could be transferred to the new HSR line. This means that it would be possible to operate over a new connection from the west through Camden Road and onto the East Coast Main Line (at say 1-2 tph). In the national network, it was assumed that this was the route used for trains running between GW stations and Heathrow and then on to the HS-NE corridor (which would be joined between London and Peterborough where the new HSR line crossed the ECML).

- Cross River Tram
- DLR extension from Bank
- Addition of a WCML (slow line) branch connected into Crossrail
- Transfer of the Watford DC line services to other destinations (Bakerloo Line or the North London Line).

Each of these could have a significant impact on easing the dispersion challenge from HSR at Euston.

Old Oak Common (HSR station and interchange as per HS2 Ltd work) was seen as a means of achieving a reduction of as much as 30% of the Euston HSR demand. Indeed this was seen as its principal benefit (along with providing access to HSR from the GW corridor), since it was evident from HS2 Ltd's work that it would be largely ineffective at creating an attractive route to access Heathrow Airport.

However, it was noted that the effect of creating a route from the WCML slow lines into Crossrail (which would also be effected in the Old Oak area, but with different physical works) would offer roughly twice the capacity relief and could be achieved at a lower cost, potentially bringing greater benefits but without the time penalties of the Old Oak HSR station[9]. It would be possible to provide a Crossrail station in the Old Oak area with such an approach (at lower cost, but without the interchange) to meet any local regeneration potential.

A number of questions about the Old Oak Common station were raised. Network Rail has indicated that it believes it would lead to a 10-15% capacity loss on the GWML, the disbenefits of which would be considerable. The assumptions on dwell times also appear optimistic, but the assumption that all GWML services would call at the station could be scaled back to reduce this impact.

It is clear that more work needs to be done (some is evidently in hand at TfL) to examine other ways to relieve the dispersion challenge at Euston, since the Old Oak Common solution is only one of several and it is not clear that it is the best.

On the question of a **second HSR terminal**, participants offered to give some fresh consideration. The Greengauge 21 assumption of a new terminus at Stratford may not prove attractive given the extent of build out in the Stratford City & Olympics developments. A low level station at Liverpool Street might have some attractions but the technical constraints and challenges of a deep level solution are recognised as being considerable, and there seems to be little support for a facility at Kings Cross/St Pancras.[10]

While it may be thought of as being for the longer term, there is a pressing need for work in this area to identify a preferred site if the London area network issues are to be fully resolved.

[9] 30% of 15HSR tph of 1,100 passengers each is 4,950pax/hour removed from Euston; 10 tph WCML Milton Keynes Crossrail trains would carry at least 1,000 pax each, which is 10,000pax/hour.

[10] This suggests that if an underground site is adopted, a through station, which would have a smaller foot-print, might work best (with, say, four operational platform faces).

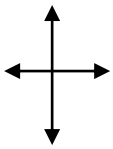
(iii) Heathrow

BAA plc has work in hand examining sites for HSR stations at Heathrow. Four on-airport sites have been identified, plus the Arup site at Iver. CTA, T5 and Bath Road have good inter terminal connectivity. The Iver site has good connectivity to the GWML but longer transfer times to the terminals. BAA in conjunction with the Airlines will continue to examine proposals for a HSR station at Heathrow.

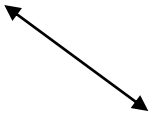
The Old Oak Common solution is seen as being unlikely to deliver air/rail substitution. It was noted that the Heathrow question is a bigger and wider issue than can be addressed usefully by solutions such as Old Oak Common

On its own, air passenger rail demand is unlikely to support attractive service frequencies, which is why BAA has argued that it would be best if a Heathrow station was on the line of route of HS2. A similar effect, with service frequency underpinned by other travel markets is achieved by Greengauge 21's 'Heathrow Opportunity' network, which in effect attempts to replicate the French approach with Paris' CDG Airport TGV service.

The difference between the Greengauge 21 proposal and placing Heathrow on the line of HS2 – aside from the fact that the latter adds to HS2's costs and extends HS2 journey times – is in terms of the geographic scope of the interconnections:



Heathrow Opportunity
(Greengauge 21)



Connection to/station on
HS2

(iv) Cross-London connections

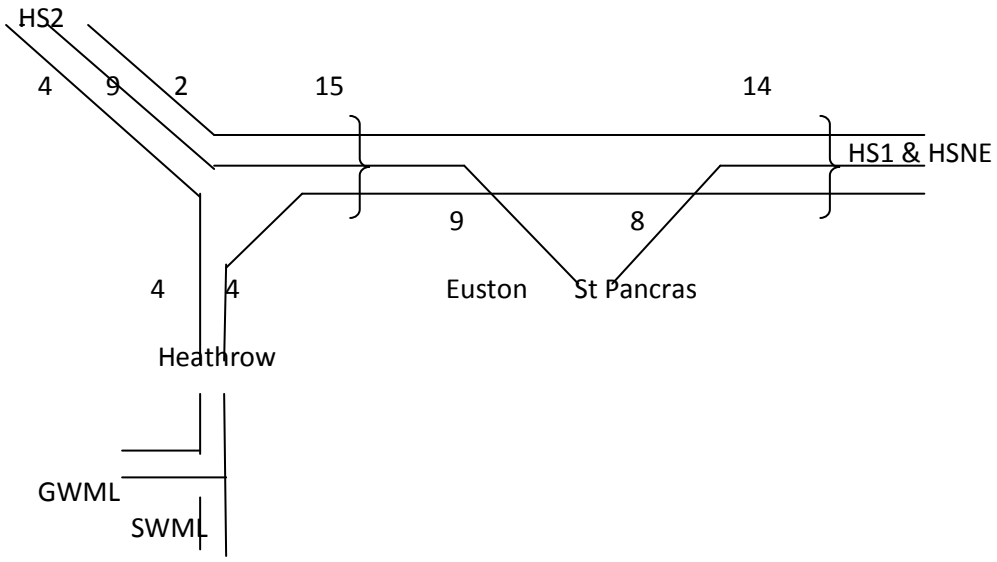
There are synergies between the various possible connections.

To some extent, HSR at Heathrow can relieve Euston dispersal and deliver part of the dispersed demand requirement.

While there may be an ambition for an early creation of a Western Connection into Heathrow, in the absence of a new link eastwards from the airport, there would be either a need to operate such services on a Heathrow-terminating basis (which risks poor commercial viability) or unwanted additional pressure would be added to the capacity-constrained section of the GWML between Airport Junction and central London. So while the Western Connection could be developed before other additional links are created at Heathrow, the creation of a through network is likely to offer a better commercial basis for the investment.

There is a downside risk for LHR if the HS1 connection is created without HSR access to the airport, as noted earlier. But the creation of both an airport set of connections usable by HSR trains and a HS1 connection creates additional benefits.

In practice this could be developed in a number of ways. In the case of the analysis in the Greengauge 21 *Fast Forward* work, the assumed service pattern was as follows:



As may be seen in the diagram above, the key to efficient path utilisation on a HSR network as proposed here is the use of delta junctions and the creation of cross-Heathrow and cross-London linkages, including between HS1 and HS2.

It does however beg the fundamental question: what is the purpose of these additional connections over and above the basic HS2 line? And what implication does this have for phasing and for priorities?

It is suggested that while HS2 is fundamentally directed towards creating the best value solution to the network capacity problem (which is most apparent on the southern section of the WCML), these interlinkages address a different question, which is to address travel markets which are primarily served by the road and air networks rather than rail. By doing so, there is a proportionately higher scope for modal diversion, and for increased environmental benefits. The business case for these relatively short connections is high because there is little offsetting disbenefit which arises in the core HS2 case from the large-scale abstraction from existing rail markets. This means that the effect of the interlinkages is to add to the value and economic return from the much larger investment needed to create HS2.

However, these connections cannot exist in isolation and they only make sense once HS2 is built. However, there is a strong advantage in the combination of the Heathrow connections and the HS1-HS2 link being available together, which is much diminished if only part of the network connectivity is created.

Conclusions

The workshop brought together for the first time a set of interests and perspectives on the question of how the HSR network should develop in the London area. The key aim was to establish the key questions that need to be addressed and these were helpfully distilled into just four strategic questions (albeit that there are inter-relationships between them).