UNDERSTANDING UK INTERCITY RAILWAY CONNECTIVITY... AND BUILDING THE NETWORK

The rationale behind the HS2 project is simple:

- Connectivity between communities and between businesses is vital for our prosperity.
- Our existing transport systems, especially our railways, are now so congested that they cannot practicably be developed as the primary intervention to deliver the increased capacity and connectivity that we need.
- The building of new high speed railways is the best option for delivering the required step-change enhancements in capacity and connectivity.

This rationale is encapsulated in the evidence given by former HS2 Ltd Technical Director Andrew McNaughton to the HS2 Select Committee on 30th November 2015:

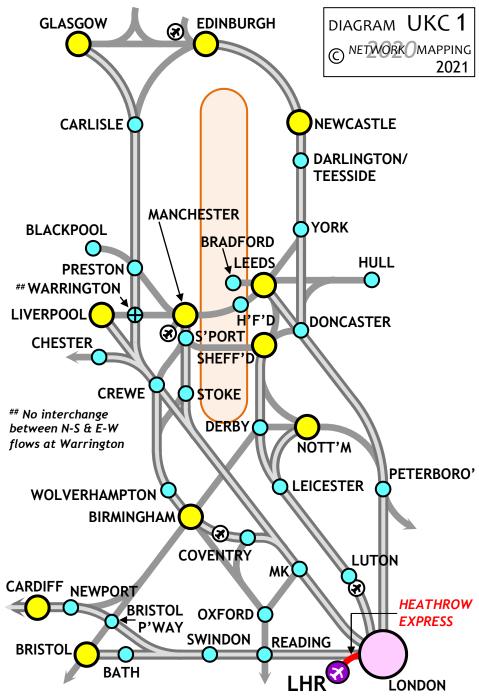
"The aim of the HS2 project is to deliver hugely enhanced capacity and connectivity between our major conurbations."

Mr McNaughton's statement seems incontrovertible; yet it fails totally to recognise the reality of the HS2 project. HS2 is all about building new super-fast lines, mostly focussed upon London and with minimal connection to the existing network. But the project's aim of "hugely enhanced capacity and connectivity" is only achievable if HS2 brings about an improved national network that will create enhanced links between the all of the key regional communities that form the bedrock of the UK economy.

To develop such an improved network, it's vital to understand how the existing network works, and where its weaknesses currently lie. Only then is it possible to design the new high speed lines to optimise the achievement of "hugely enhanced capacity and connectivity" between all major communities (not just the headline primary cities such as London, Birmingham, Manchester and Leeds), and therefore deliver the promised economic gains.

It's clear, from the astonishingly poor connectivity provided by HS2 (see sheet UKC5), that despite his long railway career, Mr McNaughton simply doesn't understand the crucial importance of network. Otherwise he wouldn't have designed proposals as spectacularly inadequate as HS2. The belated 'sticking plaster' remedy offered by Northern Powerhouse Rail (see sheet UKC6) can do little to redress HS2's massive connectivity deficiencies.

To assist Mr McNaughton (and others at HS2 Ltd and in the DfT) we've prepared this paper *Understanding UK Intercity Railway Connectivity*. We hope that this will prove a valuable, if belated, learning experience.



UNDERSTANDING UK INTERCITY RAILWAY CONNECTIVITY - 1

The fundamental purpose of any new intercity railway conventional or 'high speed' - must be to connect cities. Through connecting to local networks at city centre hub stations, the benefits of the new connectivity are extended to the widest possible population.

Connectivity - the linkages enabled by a transport system, either single or multimode - is vital for economic prosperity. With connectivity optimised, economic gains are optimised. Hence economic prosperity is maximised where the greatest connectivity is achieved.

With rail connectivity optimised, potential for modal shift from higher-emitting cars and planes - and hence CO_2 emissions reductions - is also optimised.

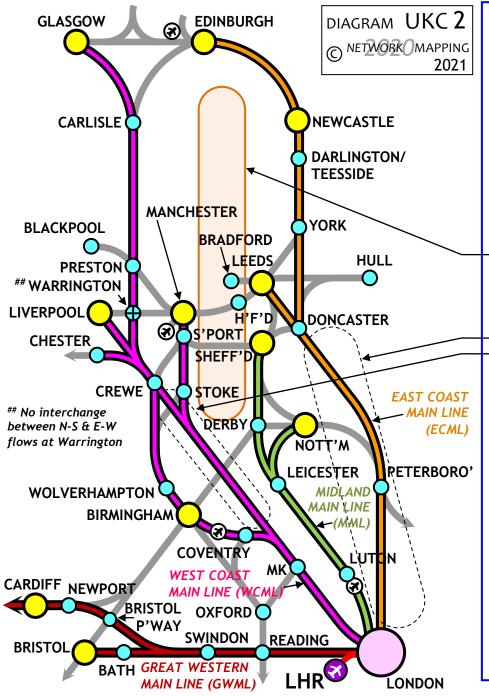
Key stakeholders in UK intercity rail connectivity are:

- Capital city i.e. London ~ 10M population, and gateway to international intercity rail services via HS1.
- 2. Primary (or 'core') regional cities of 500k plus population, usually at hub position in larger regional conurbation.
- 3. Second-tier centres circa 200 500k population, often with only uniaxial connectivity on intercity network.
- 4. Heathrow Airport, UK's only 'hub' airport and vital for international connectivity but only linked to London via Heathrow Express.
- 5. Other regional UK airports, international links mainly to Amsterdam & Paris CDG.
- 6. Intercity route to London.
- 7. Other intercity route.

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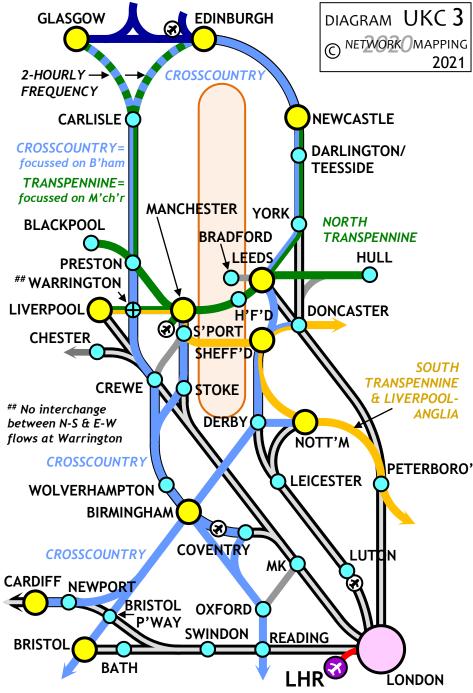
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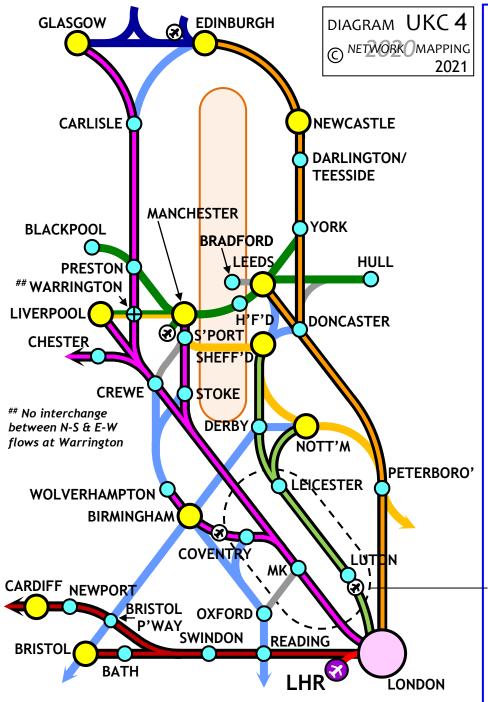
UK I/C RAILWAY CONNECTIVITY - 2 LONDON-CENTRICITY OF NETWORK

- Primary economic logic for existing intercity rail system - dating from 19th Century - was to link principal regional cities to London.
- 2. This produced a primarily London-centric system, with ECML, MML, WCML & GWML radiating from London.
- 3. Access to city centre hub stations e.g. Leeds City, Birmingham New St, Manchester Piccadilly - is vital for wider connectivity around conurbation and region.
- 4. Division between systems was reinforced by Pennine divide, and by intercompany rivalry.
- Difficulty of aligning time-sensitive routes through conurbations surrounding principal cities resulted in creation of bypassing routes to further-flung
 destinations (e.g. Great Northern from London to
 - Doncaster, Trent Valley from Rugby to Stafford).
- 6. Hence all principal cities e.g. Leeds, Birmingham, Manchester - are located clear of trunk main lines, with south-facing spurs funnelling towards London.
- 7. Hence intercity rail links from principal cities to London generally comprise 'single city pair' links.
- 8. Newcastle (on ECML between London and Edinburgh) is the only exception to this rule.
- 9. All other intermediate calling points comprise secondtier centres, for example:
 - Milton Keynes, Coventry, Stoke, Crewe, Warrington, Preston, Carlisle on WCML.
 - Luton, Leicester, Derby on MML.
 - Peterborough, Doncaster, York, Darlington on ECML.
- 10. There is no direct rail connectivity from regional cities to Heathrow Airport (LHR).



UK I/C RAILWAY CONNECTIVITY - 3 LINKS BETWEEN REGIONAL CITIES

- 1. High quality direct rail links between regional cities are necessary to balance London-centricity of primary UK intercity network (ie ECML, MML, WCML & GWML) radiating from London.
- 2. 'Single city pair' operation is generally not viable for high quality links between principal regional cities.
- 3. Strongest interregional corridors ie TransPennine and CrossCountry - comprise multiple city pairs e.g Bristol/Birmingham/Derby/Sheffield/Leeds/York etc.
- 4. These routes (focussed on Manchester & Birmingham) are vital to provide northward connectivity from principal regional cities onto WCML & ECML.
- 5. More stops and generally less favourable topography make interregional routes considerably slower (75kph) compared with London-centric routes (120kph).
- 6. Higher speed and higher quality of intercity services to London (and lack of direct regional services to Heathrow) are indicative of London's superior connectivity. This is both a symptom and a cause of the North-South divide afflicting the UK economy.
- 7. Optimum functionality of UK intercity rail network is dependent upon maximised through routeing and (if direct journey not possible) interchange between interregional and London-centric intercity routes.
- 8. Primary interchange points are located at Birmingham New St, Manchester Piccadilly, Leeds and Edinburgh Waverley (for connection with Scottish national network).
- 9. It is vital to maintain the integrity of these interchanges, not just for overall UK rail connectivity, but also for connection to the local rail networks focussed upon these stations.



UK I/C RAILWAY CONNECTIVITY - 4 EXISTING NETWORK PERFORMANCE

The table below sets out the key connectivity deficiencies of the UK intercity rail network.

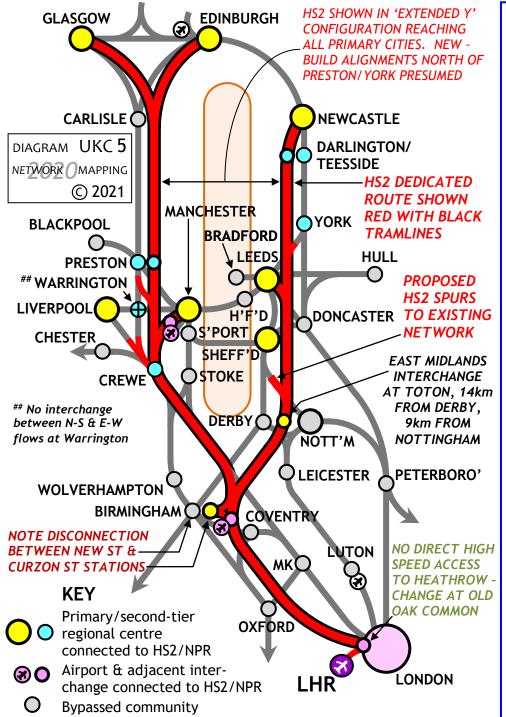
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Liverpool						LI	_				
Leeds							LS				
Newcastle								NE			
Edinburgh					2				EH		
Glasgow		2		2	2		2	2		GL	
Heathrow		No direct regional links to Heathrow LHR									
	LO	BI	NG	SH	MA	LI	LS	NE	EH	GL	LHR

These deficiencies can be summarised as follows:

- 1. Highest quality and fastest trains on routes to London.
- 2. Liverpool, Manchester and Nottingham (i.e. North-West and East Midlands) lack the necessary high-quality hourly-frequency direct links to Scotland.
- 3. Glasgow is especially poorly connected, with domestic air services predominant intercity mode.
- 4. Interregional rail services are generally slower and poorer quality than London-centric services.
- 5. No direct services from regional cities to Heathrow.
- 6. London-centricity perpetuates North-South divide.

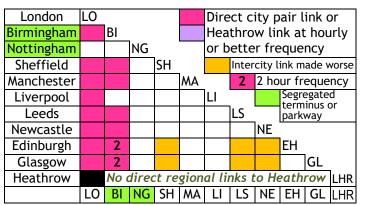
Additionally, there are major connectivity deficiencies between second-tier cities on uniaxial routes, especially in South-East Midlands, with no rail links whatsoever between adjacent communities e.g. Luton to Milton Keynes & Leicester to Northampton/Coventry along M1/M6 corridor.

Connectivity *and* capacity improvement must be a primary aim of the UK high speed rail project.



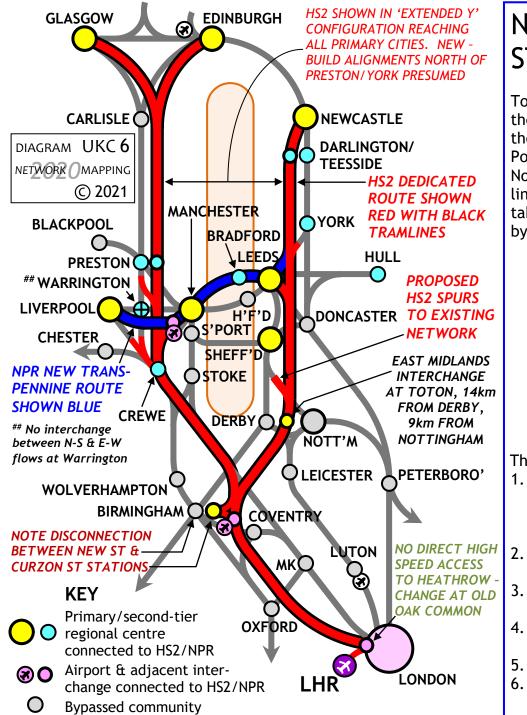
HS2 - IMPLICATIONS FOR UK INTERCITY RAIL CONNECTIVITY

The table below sets out the connectivity performance of the HS2 proposals, in 'extended Y' configuration.



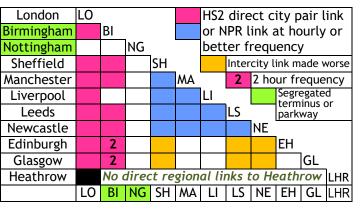
The HS2 proposals raise major connectivity concerns:

- 1. Routeing of HS2 close to Heathrow dictates Chilternaligned route with high tunnelling costs.
- 2. M1-corridor cities as far north as Nottingham bypassed.
- 3. Split at Birmingham leaves inefficient and Londoncentric 'Y' as only option for network development.
- 4. The 'Y' is incapable of improving transpennine connectivity between key Northern Powerhouse cities.
- Network connectivity is further damaged with high speed stations often remote from existing city centre hubs e.g. Curzon St in Birmingham and Toton 'Interchange' 9km from central Nottingham. This will lead to 2-tier system with many communities bypassed.
- 6. With even greater London-centricity than the existing intercity rail network, London/regional 'speed divide' is exacerbated (180kph vs 75kph). HS2 cannot improve overall connectivity of the UK rail network, and seems certain to aggravate North-South divide.
- Unachieved imperative for HS links to Heathrow causes massive cost, and damages HS2 as an intercity network.



NORTHERN POWERHOUSE RAIL -STICKING PLASTER ENGINEERING

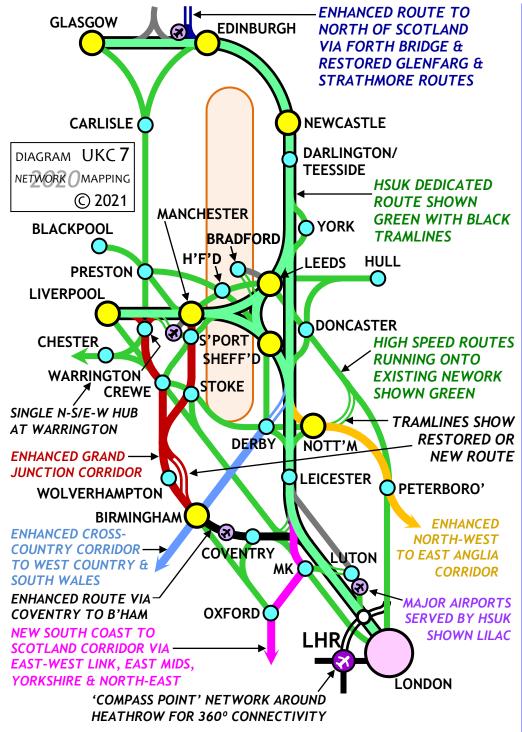
To address the primary connectivity deficiency of HS2 i.e. the lack of a transpennine link between the major cities of the North, the Government developed the Northern Powerhouse initiative. In January 2018, Transport for the North advanced outline proposals for a new transpennine line linking Liverpool, Manchester, Bradford and Leeds. The table below sets out the additional connectivity achieved by the current Northern Powerhouse Rail (NPR) proposals.



The NPR proposals fail to remedy HS2's many faults:

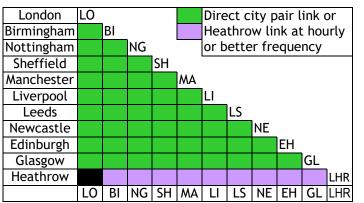
1. HS2's route in Yorkshire - designed with no thought for transpennine connectivity - is too far to the east to integrate successfully with the single new transpennine route originally specified for the Northern Powerhouse.

- Instead, 2 new transpennine routes are required to link Leeds and Sheffield to Manchester.
- 3. So far, no credible proposals for Sheffield-Manchester upgrade. Sheffield will be bypassed by HS2 *and* NPR.
- 4. Overall, HS2 and NPR offer just 20 links out of a possible 54. This compares very poorly with HSUK's 54.
- 5. NPR costs £7billion more than the HSUK equivalent.
- 6. NPR's failure is the perfect example of the imperative for holistic network design to achieve full integration.



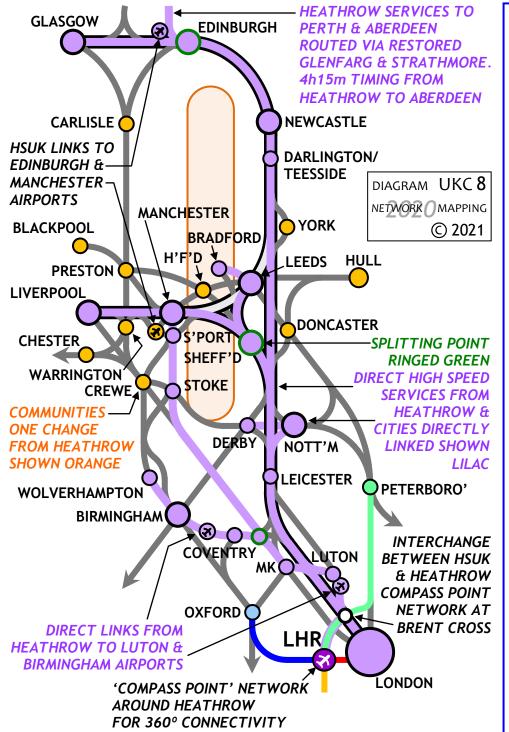
HIGH SPEED UK - ENHANCED UK INTERCITY RAIL CONNECTIVITY

The table below shows High Speed UK's comprehensive intercity connectivity i.e. all primary cities linked with direct trains, and also directly connected to Heathrow.



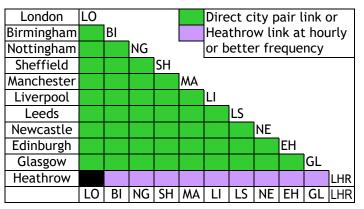
This is achieved through the following strategy:

- 1. Configuration of high speed network in 'spine & spur' format, aligning with all primary intercity corridors.
- Network efficiency optimised by aligning network along existing corridors clear of Heathrow. Independent 'Compass Point' network enhances Heathrow access.
- 3. Greater acceleration/enhancement achieved on interregional than on London-centric corridors.
- 4. Full integration between high speed & classic network, with services running onto existing lines to reach all present major intercity destinations, accessing also currently isolated Pennine communities e.g. Bradford.
- 5. High speed terminals co-located with city centre hubs.
- 6. Targeted capacity/speed enhancements along specific routes (e.g. Grand Junction, CrossCountry) and restoration of strategic routes to maintain functionality of existing network and improve it where necessary.
- 7. Construction of High Speed UK along M1 corridor as 4-track railway creating comprehensive rail links between South-East Midlands communities.



HIGH SPEED UK - ENHANCED UK REGIONAL ACCESS TO HEATHROW

The table below sets out the performance of High Speed UK in linking UK cities to Heathrow Airport.



Comprehensive connectivity between UK regional cities and the national hub airport will bring major economic benefits to the regions, attracting inward international investment. This investment is normally predicated upon proximity to an international airport; with surface connectivity to Heathrow vastly improved, it becomes possible to spread its 'proximity benefits' across a much wider area of the UK.

These benefits are achieved through the following strategy:

- Compass Point network, utilising existing Heathrow Express infrastructure, provides 360° regional links around airport and connections at outer-suburban hubs to national rail network.
- 2. Insufficient traffic exists to fill dedicated trains from Heathrow to any regional city and operation of such poorly-filled trains could not be justified on congested radial routes from London.
- 3. Network efficiency of HSUK's 'spine & spur' with several cities on a single line of route - requires just 4 hourly trains to link central hub stations of all principal cities of Midlands, North and Scotland with the heart of Heathrow Airport.
- 4. With comprehensive surface connectivity across mainland UK, rail links become the 'spokes' to the aviation 'hub' at Heathrow, replacing wasteful short-haul flights with new routes to emerging economies, and transforming airport operations.