Network Rail October 2007 Strategic Business Plan

Supporting document

Rolling stock paper

Introduction

As discussed in the SBP, over the last 10 years freight and passenger traffic has grown significantly. To accommodate this growth the railway network's ability to expand its capacity has been flexed through the application of tools such as re-timetabling, train lengthening, the introduction of new rolling stock, demand management, the provision of new infrastructure and more efficient engineering access to reduce network down time.

The growth in passenger traffic has been catered for by the introduction of additional Electrical Multiple Units (EMUs) and Diesel Multiple Units (DMUs). From 1997 onwards and taking account scrapped vehicles the railway has seen a net increase of 500 vehicles taking to the fleet size to over 11,000 vehicles today. Overall, the average age of all passenger rolling stock in 1999/00 was 21 years and by 2005/6 this had reduced to 13 years. The predominant type of vehicle is the EMU, which makes up about 63% of the fleet (including Pendolinos), with DMUs comprising about 24% and loco hauled vehicles (including HST trailers) about 13 per cent.

The new EMU and DMU vehicles are faster, greener, quieter, and safer than previous generations of rolling stock. Their acceleration and braking performance is better and they have a higher availability for service operation. Reliability growth has been impressive and they are mostly delivering excellent results. They have air conditioning and a wider range of passenger facilities. However, not everything has gone smoothly during their introduction onto the railway network. Perhaps not surprisingly, given the extra functionality, the weight of this new rolling stock has increased when compared to that of previous generations. Equally the higher availability has resulted in a corresponding increase in the annual vehicle mileage. These factors, together with sub-optimal bogie ride characteristics on some classes has resulted in significant increases in track maintenance costs. It has also resulted in a requisite increase in energy usage. This was evidenced by the need for the Southern power supply upgrade to provide increased power for the new trains which replaced the older fleets.

Freight Rolling Stock is evolving with the introduction of the 101.6 tonne bogie vehicle with a corresponding reduction in the older 2 axle vehicles. The use of bogies considered to be more 'track friendly' is becoming widespread and Network Rail is working with the manufacturers, owners and operators to encourage this trend.

Context

Network Rail in conjunction with other industry stakeholders is keen to learn from this recent history. A piecemeal approach to rolling stock development, procurement and introduction is not ideal. We must seek to optimise rolling stock design and deployment to meet demand growth, customer expectations, the future capability of our fixed infrastructure and sustainability of the railway as a whole.

It is in the light of this experience and the significant changes anticipated in the demand for rail services that the requirement for a joined up and cohesive rolling stock strategy has emerged. Clearly as rolling stock is such an integral part of the railway system and as it plays such a significant role in the overall customer experience the development and ownership of the rolling stock strategy must be a cross-industry one. That being the case, the existing Network RUS development and consultation process was felt to be the natural home for such a strategy. The timing of the RUS enables it to be fed into the DfT's work on rolling stock plan for England and Wales

Clearly when thinking about the industry's requirements for rolling stock in the future there is a need to identify the different market segments that it will serve. There is no

shortage of published material identifying and describing these markets and input from stakeholders such as Passenger Focus and franchised operators as part of the Network RUS working group is invaluable in helping us understand the differing passenger requirements. The Government's White Paper on Delivering a Sustainable Railway establishes the following:

1. Urban area services
2. Inter-urban services
3. Regional and rural services
4. International services
5. Freight services

Work on the Network RUS is presently considering a slightly more detailed breakdown for the urban, inter-urban, regional and rural services. Having established the markets the next step is to reflect the passenger, business and environmental requirements associated with them.

Passenger Requirements for rolling stock

Passengers want safe, reliable, bright, comfortable, accessible, welcoming and well appointed trains whose facilities cater properly for the journeys that they make. It is vital for passenger views to be taken into account at the drawing-board stage and at every subsequent stage. Experience has shown that better trains have emerged when the relevant practical expertise has been sought at the earliest opportunity. This is why, as Network Rail facilitates the Network RUS with the industry, the views and involvement of Passenger Focus are being sought at every step.

Matching the right features to fit the route profile is vital. Commuter trains will have a different seating configuration and less luggage space than their longer distance counterparts. Trains for middle-distance commuter routes need to accommodate as many seated passengers in as much comfort as possible with sensibly planned and properly appointed standing space for those who cannot be provided with seats. Longer distance services generally need roomier seats and adequate space to stow the larger volume of luggage that passengers usually bring with them for these types of journeys, or sufficient space and provision of a power supply to enable on-train working. All passengers want better information on the status of the service and even more so when trains are not running to time.

By attributing a greater priority to these views and requirements in the rolling stock design and development phases, so the ultimate products should better address the priorities set out by passengers for improvements in their rail services .

Industry requirements

In its White Paper on Delivering a Sustainable Railway, the Government asks the rail industry to plan for a scenario of an ageing, less-mobile population with higher incomes. By implication wealthier people will have higher values-of-time and will be less tolerant of delay and unproductive uses of time. People will place a greater importance on personal safety and security in the passenger environment. The White Paper also focuses on the need to improve the capacity and environmental credentials of the railway to meet the forecast demand.

The design of rolling stock can play a hugely important role in all these areas. Vehicles can be tuned to take full account of the risks posed by the different route types whilst recognising the other increasing advanced methods of assuring overall system safety. Personal on board security can be enhanced through the inclusion of

wider gangways between carriages and CCTV coverage. The in-service reliability of vehicles is one of the key determinants in the PPM performance figures and therefore improving this for routes where there is little or no slack in timetables can make significant differences to the overall system performance.

Rolling stock also plays a significant role in determining the capacity of the railway. Traditional methods of increasing route capacity include train lengthening. This can result in step changes in capacity and developing rolling stock that is designed for lengthening quickly and efficiently represents a very real benefit to the expanding railway. Equally, rolling stock with European continental designs such as carriages articulated on a shared bogie allows for wider inter-carriage gangways and an overall increase in the passenger carrying area of trains without impinging on platform lengths and infrastructure configurations.

Recognising the need for rolling stock design to play a role in the 'whole life' cost optimisation of the railway system is paramount. With our ever increasing understanding of the track-to-train interface (through models such as the Vehicle Track Strategic Interface Model, which predicts how a vehicle's weight and bogie dynamics affect track wear and maintenance costs) we now have clear functional requirements emerging for different route types. This work is being fed into the variable element of the Track Access Charging regime to encourage the optimisation of the wheel rail interface and reduction of impact on track degradation rates. Equally the ability to fit signalling in the cab instead of being reliant on fixing to the track will not only reduce cost on the infrastructure but also makes for a safer operation in extreme conditions.

Environmental requirements

In this section on the requirements for rolling stock, it is important to recognise the role rolling stock can play improving the railway's green credentials. The Government has signed up to tough carbon emission reduction targets and rail wants to continue to play its part in meeting them. Many existing EMUs can already regenerate power back into the overhead line as they brake into station platforms or down gradients. This type of design feature can be extended to work with 750V DC third rail and with the evolution of hybrid drive technology can also be included as part of DMU designs in the future. Network Rail will continue to work with owners and suppliers to assist in the development of alternative fuel systems.

Constraints and enablers

Having considered the passenger, business and environmental requirements for new rolling stock it is important to factor in the constraints and potential enablers into the rolling stock strategy. The network is not new and clearly does present a number of constraints to the rolling stock design.

Today approximately 40% of the UK network is electrified leaving 60% that has to be operated by diesel powered trains and locomotives. As new environmental legislation comes into force in 2012 setting tougher emission targets for diesel engines and as fossil fuel prices rise over the coming years so it may become increasingly attractive to electrify more of the network. This work will, however, take time and therefore any rolling stock strategy needs to consider carefully how it will continue to provide for self powered rolling stock in the most cost effective way.

Network Rail is looking with the rest of the industry at opportunities for strategic infill electrification as part of the Network RUS. This would focus on routes where existing traffic uses both electrified and non-electrified lines thereby potentially enabling the elimination of diesel passenger trains on these routes. Growing traffic will enable the

industry to amortise the capital cost of electrification over a much greater number of people.

Even so, at a purely financial level, there are many challenges to be overcome to make a really compelling business case for a change in strategy across the railway as a whole. Our own work is showing that a rolling programme of electrification targeted progressively at urban and suburban networks, infill of the main line network and creation of key diversionary routes can be achieved in a more cost effective manner than currently assumed. Such a programme could have a major impact on rolling stock procurement in the coming decade and, in particular, allow ordering of more electric trains competitively from the world's manufacturing base.

There are also the environmental benefits from the wholesale electrification of the network. Given the topicality of climate change and carbon emissions, these benefits may in the end contribute more significantly to the business case.

Although our asset data knowledge continues to grow and be refreshed in shorter timescales, long standing and substantial structures cannot be modified or adapted overnight. New vehicle gauges (the physical size of the vehicles) can be improved and optimised using this improved asset data, but only within certain limits. Most routes are made up of a number of key infrastructure assets such as bridges or tunnels. These structures cannot be modified quickly. Typically it is only cost effective to make significant changes when they have reached the end of their life. As a result the rolling stock designed to run on these routes has to be built and designed to run within the gauge, the station layouts, platform heights and track qualities economically justified for these routes.

The introduction of in the European 'in-cab' Train Control System (ETCS) presents significant opportunities for meeting both present and future business and passenger requirements. ETCS has the potential to provide improvements in capacity, safety and economies in operational and maintenance cost. It is specified in the European technical specifications for interoperability for train Control, Command and Signalling. The accompanying GSM-R programme for the introduction of GSM over the railway network will also provide for and increase future rolling stock's functionality.

There is a strong need to coordinate the ground based implementation of ETCS with the rolling stock renewal and cascade programme. The costs associated with retrofitting this type of equipment to existing rolling stock are significant and a far more cost effective method is to fit to new. This coordination is now taking place and future rolling stock orders will not only be managed in conjunction with the emerging national ETCS implementation plan but will also influence this plan to ensure that it represents the most economically sensible approach.

The availability of land for depots and people for a workforce can also represent a significant constraint on rolling stock design. It is no good designing rolling stock for frequent light maintenance or servicing if the facilities to do this are awkward to access or difficult to staff. In the future it will be increasingly necessary to consider the rolling stock maintenance workforce demography. Rolling stock will have to be designed for longer inter-maintenance periods and simpler, perhaps semi-automated servicing.

Equally the operating practices that have come to be the norm in many train operations can act as constraints on rolling stock design or enablers to new solutions. Optimising deep routed operational practices is difficult to effect and Network Rail, through the Network RUS process, will work to explore the opportunities in this area.

The forthcoming European non-road mobile machinery legislation, setting emissions limits for new diesel engines has already been mentioned above, but this is in many ways is just the tip of the iceberg when it comes to future legislative constraints. Within a matter of years there is likely to be increasingly stringent noise emission legislation as the results of the European directive on transport corridor noise mapping is

published. Similarly, although significant steps have already been taken to reduce rolling stock noise in the UK (in particular freight wagons through the replacement of cast iron brake blocks with quieter synthetic materials) new designs will have to continue to improve to retain rail's leading credentials. Accessibility legislation in the form of the European technical specification for interoperability setting out the mandatory requirements for people with reduced mobility will also need to be complied with.

Naturally, in common with any product, rolling stock must be designed and developed to a price that the market is prepared and able to pay for. Any long term strategy needs to consider this, particularly given the UK specific gauge constraints outlined above. Care must be taken within the rolling stock strategy to align our design requirements as much as possible with those emerging in Europe and the rest of the world. This approach should enable the industry to maximise opportunities and build upon international best practice in rolling stock procurement thereby realising efficiencies.

Working with existing rolling stock fleets

Having considered the requirements for rolling stock in the future and the factors that will influence and constrain its development there is also a need to look at how Network Rail will work to accommodate the new rolling stock anticipated to meet the immediate HLOS demands set out for CP4. We will also take into account the DfT's rolling stock policy due to be published in early 2008.

Here there is a need to match the physical attributes of the existing rolling stock designs with those of the routes onto which they will be deployed. Network Rail will work closely with the industry and government in order to determine the best new introduction and cascade options. Where possible the existing plans for infrastructure enhancement and maintenance will be aligned with these emerging rolling stock deployment requirements so as to optimise and take advantage of the incremental improvements that may be possible. Where existing vehicle designs are not optimised for whole system costs, steps will be taken to address as many of the key areas as possible within the timescale constraints. Processes associated with the introduction of new rolling stock will be optimised within Network Rail following the introduction of the new Railway Group Standard GE/RT8270 covering the assessment of compatibility of rolling stock and infrastructure.

Functional requirements for rolling stock families

As discussed above, the requirements for future rolling stock designs will arise not only from future passenger demand in the different markets, but also from wider industry, environmental and overall network capacity requirements. Network Rail is engaged though the Network RUS process in developing the overall industry rolling stock strategy. To create value from the strategy it is essential that the industry as a whole has a clear appreciation of the type of services it wants to offer in the different market segments not only in this coming control period but to 2035. By describing these services in ways that relate to rolling stock and infrastructure providers they can begin to align their product and service suites to match. This may lead to rolling stock families emerging in the market place.

Set out below are some typical descriptions of the service opportunities that will present themselves during CP4:

Urban area services

For high density suburban metro type routes such as those that will be served by the Thameslink upgrade and Crossrail project, a new fleet of high capacity, high performance, lightweight, electric trains for both routes is required for delivery from 2012 to 2017. This fleet size will initially be of the order of up to 2,500 vehicles for both projects but if deployed to replace life-expired trains on other high density urban routes

after 2018 the fleet size could be up to 6,000 vehicles in the 2020s. The business case and functional specification for such a fleet is now being developed by the DfT with a view to issuing an OJEU notice for the procurement and an ITT in 2008.

The business cases for these services are typically strong reflecting the fact that these services are heavily loaded and under high demand. This is likely to result in the vehicles being optimised to handle the forecast high passenger loadings. The functional requirements for the vehicle design will drive the necessary investment in the supporting infrastructure to ensure that the overall system operation is continually capable of meeting the high-demand. On the electrified parts of the network, the stock can be designed to be light weight (reflecting the need for frequent stopping and starting), extremely reliable and available. Infrastructure intervention and maintenance windows will be small and access will often be awkward therefore there will be a strong reliance on intelligent infrastructure monitoring and reporting.

For lower density routes where the business case is less strong rolling stock will have to be optimised to the route infrastructure where there is not the business case to make widespread infrastructure enhancements. Vehicle consists will need to be flexible and standard to allow for as much interchange as possible. Vehicles may either be self powered or electric.

Inter-urban services

Great Britain's high speed routes are predominantly serviced today by Pendolino and High Speed Trains (HSTs). The routes allow for top speeds of 125mph to achieve competitive journey times around the UK. On most routes, trains stop on average every 30 minutes or so with appropriate dwell times. Work has begun to develop the next-generation replacement fleet for the HST, currently known as the InterCity Express Programme. The projected fleet size will initially be between 500 to 2,000 vehicles. The business case and functional specification for such a fleet is now being developed and an OJEU notice for the procurement of the new train has been issued. Once again the business cases for these services are typically strong reflecting the fact that these often premium services are subject to high demand. Vehicles will be optimised to meet passenger requirements, in particular comfort, space and seat availability. The functional requirements for the vehicle design will drive the necessary investment in the supporting infrastructure to ensure that the overall system operation is continually capable of meeting the level of comfort and ride quality purchased. As the distances covered by these services are long, there will again be a strong reliance on intelligent infrastructure monitoring and reporting. New vehicles servicing these lines will be lighter, more track friendly and energy efficient. Trains will be designed to run under 25kV AC overhead electrification and these trains will regenerate braking energy back into the power supply network. On lines where there is currently no electrification units will be powered by generator cars.

Regional and rural services

Regional and rural journeys are typically no longer than 60 minutes or so and will comprise less than half the journey time door to door. Therefore the railway system only becomes attractive if connections are easy and reliable at each end of the train leg of the journey. The infrastructure and rolling stock needs to be robust, simple and easy to maintain making maximum use of technology to keep solutions as economical as possible.

These are examples of some of the rolling-stock service group requirements that are emerging from the Network RUS working group. Full consideration will be given to these and other service groups through our development of the rolling stock section of the Network RUS.

Emerging Rolling Stock family solutions

In response to these markets and enablers and constraints the concept of rolling stock families is being developed. The concept is of a flexible family of trains that can be assembled from a minimum number of common building blocks. Vehicle consists will be developed from the common building blocks and configured and optimised for the market that it is intended to serve.

High density suburban metro family

The future suburban metro train family will be light, all electric units with good acceleration characteristics. They will need to be highly reliable and therefore based extensively around proven solutions for continuous and demanding operation. They will be optimised for regenerative braking where stopping frequency results in an economic and environmental benefit. The top speed will continue to be circa 100mph. The vehicles will be designed around the need to provide for high volumes of passengers. There will inevitably be compromises on comfort levels although this will be tuned to the particular route. They will provide for the best possible access and egress to minimise dwell times. Passenger movement on board will be facilitated by wide gangways and excellent inter-car circulation. Fast door cycle times and wide doors will allow operation of these vehicles on a wide variety of platform interfaces and with the latest dispatch methods. Units will be DOO and SDO enabled. Consist will be fixed and vehicle gauges optimised for use on traditional 8 or 12 car railway configurations and allowing maximum car widths and minimum stepping distances.

Intercity Express Programme family

The future intercity express train family will be light, presenting better energy efficiency and reduced emissions. Costs will be optimised on a whole-life and whole-system basis, considering ongoing maintenance, availability and reliability, fuel consumption and the effects of the train on infrastructure and infrastructure on trains. Designs will be standardised where possible to enable maximum flexibility in deployment across the network while retaining flexibility in terms of fit-out. There will be high levels of seating capacity optimised in relation to vehicle length and train length, offering higher capacity per train and efficient use of on board space, while still providing a quality environment for passengers. Energy consumption will be reduced through a reduction in overall weight per seat. This will probably require low weight but very strong vehicle bodies to be used, as has been done on several modern trains, including the West Coast ‘Pendolinos’ and the new ‘Javelin’ trains for Kent. Train formation will be flexible in terms of coupling/uncoupling capability and power supply. This will allow trains to accommodate change in deployment, service pattern, demand patterns and energy source throughout their life. Improvements in train performance, resilience and energy efficiency characteristics will be aimed at delivering improvements in journey times for passengers.

Other families

Above we have highlighted just two of the emerging rolling stock family types that have been identified through the Network RUS process so far; other families of vehicles are under consideration through further development of the Network RUS. A new generation of multiple units will be necessary to provide for the low density urban network and regional and rural markets. In some cases this may also be supplemented by tram-train technology. This could benefit the network with the use of ‘drive-on-sight’ methods, and releasing capacity at key city centre stations by circumventing the station and creating interchanges directly on the street. Network Rail is intending to trial tram-train technology in Great Britain during CP4 in order to assess the suitability of this technology for such capacity relief.