



Deep tube transformation

Piers Connor reports on progress with plans for upgrading the deep tube system

In January 2013, London Underground celebrates its 150th anniversary. But, while the anniversary celebrations are in the public eye, less well known is that a specially formed team within the Underground is looking to the future.

There are many issues to address, not the least being the continuing growth in passenger journeys despite the system already operating at capacity on most lines. The growth, although welcome, brings problems of its own, with overcrowded trains on many lines, crowd control problems at major stations and the continuing difficulties surrounding system cooling.

The DTP

The latest upgrade plans for the Underground are in a package known as the Deep Tube Programme (DTP). Originally intended to cover the replacement of trains and signalling on the Bakerloo and Piccadilly Lines, it has now been expanded to include possible changes on the Jubilee and Northern Lines and the eventual Central Line 1992 stock replacement.

The main driver for this expansion in scope has been the much discussed extension of the Northern Line from Kennington to Battersea, now being called Northern Line

Upgrade 1, and the long-desired split of the line into a Morden-High Barnet via Bank line and a Battersea-Edgware via Charing Cross route, collectively known as Upgrade 2. This would require the rebuilding of Camden Town station.

Upgrades

Much money has already been spent on upgrade work. The Victoria Line has new trains and signalling and a new timetable with a 10% increase in train throughput to 33 trains per hour (tph) is due to start on 20 January 2013.



New trains for the Picc will form part of the plan for the deep tube. Here a Piccadilly Line train to Northfields is seen departing from Leicester Square on 15 December 2006, 100 years to the day that the first section of the line opened on 15 December 1907. Brian Morrison

Upgrading of the sub-surface network is described in an accompanying article. If all goes according to plan (and experience shows that's a big 'if'), by 2018, the Circle, Hammersmith, Metropolitan and District Lines will all have new trains and new automatic train control.

On the deep level tube lines, the Jubilee Line has settled into its new Thales communications-based train control (CBTC) system after a long and troubled gestation period. A 30 trains per hour timetable has been in operation since 25 March 2012.

The Northern Line is having its CBTC system installed now, using the same technology

as the Jubilee Line; resignalling is due to be completed in December 2014.

The DTP focus started with the remaining tube lines, the Bakerloo, Piccadilly and Central, and their upgrades.

Commuter's wish list

The Deep Tube team's task is to develop a system that will deliver more capacity, more energy savings, better comfort and higher reliability. But, if you were to ask a rush-hour passenger on the Clapham Underground what he (or she) would like to see in a new tube train, what would he want and what might the Underground's response be? Let's see:

- A seat? – Oh come on, get real, this is a mass transit railway.
- OK then, enough room to stand in comfort? – Doubtful, but we will create more space by reducing the number of seats and designing a walk-through tube train.
- Air conditioning? – Mmm, difficult – there's no space on the train and no easy way to get the heat out of the tunnels. We're working on this one but it will be very expensive and will need extensive tunnel modifications to remove heat. It will probably mean less room inside the train. Coupled with this are plans for better energy conservation, regeneration during braking and groundwater cooling schemes.
- Reliability – Of course, new equipment, duplication of systems and better maintenance are already improving reliability, but it comes at a cost. Hong Kong's reliability is largely due to a lot more being spent on maintenance there than we are allowed to spend.

EVO stock

To try to get close to some of these ideals, LU introduced a new tube train concept early in 2011, calling it the EVO train (EVolution rather than Revolution?). Perhaps it will become 'EVO stock'.

It was spawned from the 'Space train' concept of the mid-1990s, when LU started

a concept design for a new walk-through style tube train. It was intended for the Victoria Line but it was killed by the ill-fated Public Private Partnership (PPP) scheme. The private partners weren't incentivised to spend money on new train development, so it was largely 'more of the same'.

The revived EVO stock ideas, as we show in the box, include walk-through cars, like those of the subsurface lines' new S stock. To allow this within the small tube dimensions, a 'tractor-trailer' arrangement of car coupling is proposed, so that the bogies do not interfere with the walk-through area. Most cars would have only one bogie instead of two. This reduces weight and it will mean shorter cars.

The original intention was for the Victoria Line to have 12 cars and 13 bogies instead of the eight cars and 16 bogies it has ended up with. The design has been refined so that the existing seven-car Bakerloo train would be replaced by a nine-car formation but with 10 bogies instead of 14.

There would be smaller wheels and motors, more composite components and some radical concepts like emergency on-board power to get a train to a station if there's a traction power failure. If this means batteries, I don't know where they would fit.

Characteristics

At the start of the project, the DTP team formed some basic ideas, starting with a 'Railway Characteristics' concept, which is based on delivering services to 'a Service Plan based on headways and branch occupancy and no longer tied to a timetable or duty schedules', according to a document leaked by one of the trades unions.

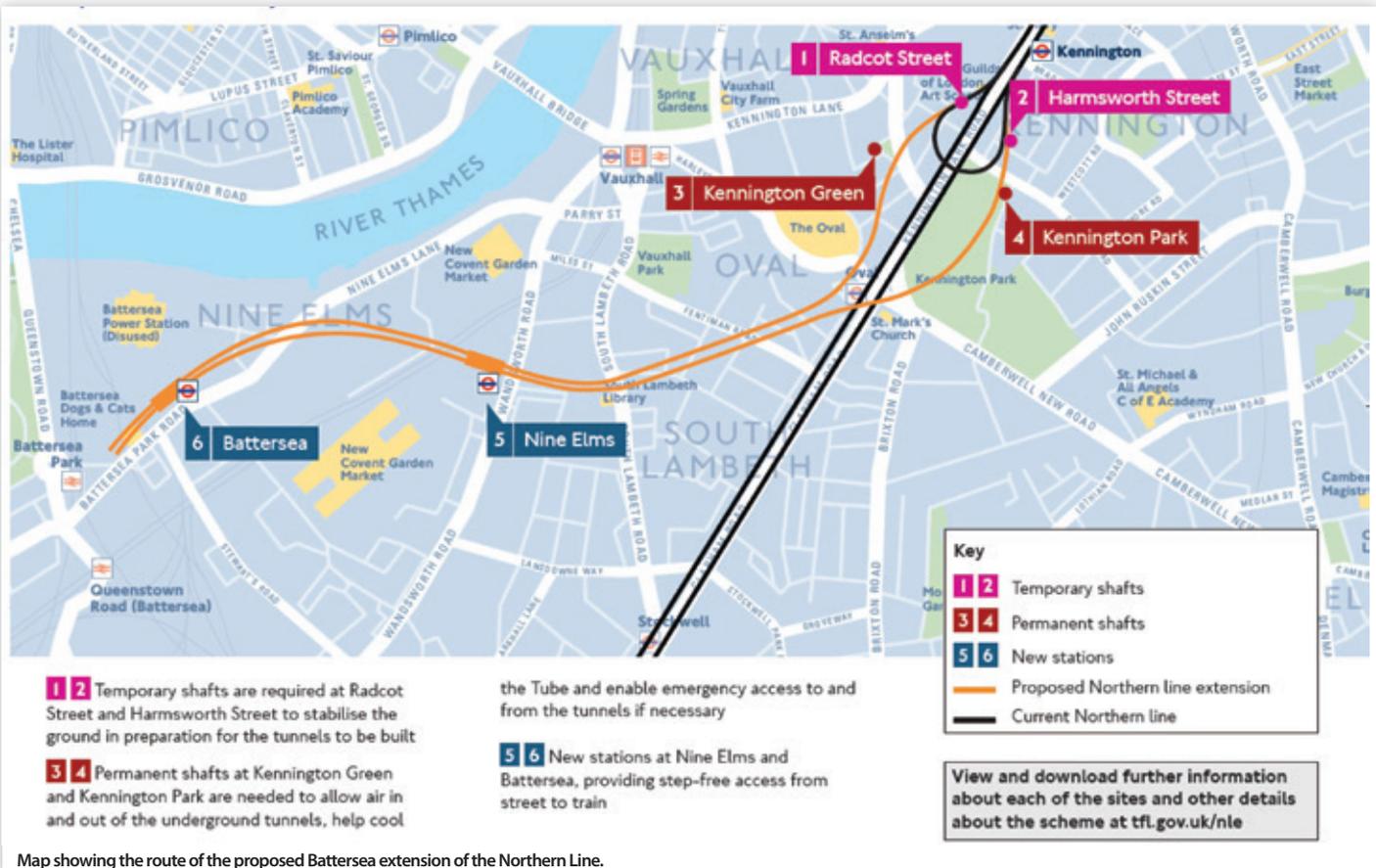
This concept assumes that crew duty schedules are not required and therefore that permanent, on-board train operators are eliminated. This has generated much heated discussion about practical operations under failure conditions and of acceptance by passengers and staff (*Modern Railways*, September 2012).



Siemens' vision of a new tube train for London: this model was displayed at the InnoTrans exhibition in Berlin in September. Keith Fender



Will stock be transferred from the Jubilee to the Bakerloo? A Jubilee Line service to Stanmore awaits departure from Stratford on 25 March 2009, while a service from Stanmore arrives. Brian Morrison



Map showing the route of the proposed Battersea extension of the Northern Line.



Regardless of the arguments, there is no doubt that one of the main obstructions to service recovery after a disruption is the re-allocation of train crews. The length of London's Underground lines and the distances between crew depots adds to this problem. Getting rid of this issue would see a huge improvement in service performance following a delay.

Working without a fixed timetable is possible and even desirable in some cases, and could be done with operators on every train. It just needs the crew changes to be at the terminals and not somewhere along the route. It also needs crew dispatchers at each terminal. This gives a better chance of recovery after disruption. Trains would work to a regular headway adapted to the crews available. Perhaps keeping train operators but with a more flexible operating regime would offer benefits for them and for the passengers.

Bidirectional operation

Another stated target for the DTP is bi-directional operation of each track. This is a curious addition to a tube wish list. In theory, it offers the prospect of flexibility by allowing trains in both directions to use a single track to by-pass an obstruction or engineering

work on the other track but, in London conditions, this is unlikely to offer a workable solution.

The wholesale withdrawal of crossovers over the last 30 years has left very long sections without connections. Just imagine trying to run a service on a single track along the Piccadilly Line between King's Cross and Hyde Park Corner. You would get a train every 25 minutes in each direction. Not much use when passengers expect a train every 2½ minutes. Stations would quickly become dangerously overcrowded.

More trains

The Underground needs more trains in addition to the existing fleets. If the Battersea extension goes ahead, the Northern Line will need some. Just how many depends on several schemes coming together.

First, TfL says, the new CBTC signalling should allow more trains over the two central area branches, increasing frequency from 20 to 24 trains per hour at peak times. Then, introduction of a scheme to partially separate the services at the southern end will see all Morden trains working through the Bank branch and all Kennington trains going via Charing Cross.

This should push throughput to '28-32' tph 'on all branches' according to TfL. Quite what this means for individual routes without the permanent Northern Line split (Upgrade 2) isn't clear, since terminal working at Morden will be one constraint and the junctions at Camden Town another, but there will certainly be further increases in frequency. If Upgrade 2 ever happens, then '28-32' tph becomes possible.

A guesstimate based on the proposed Northern Line improvements suggests another 21 trains would have to be added to the existing fleet of 106 trains of 1995 tube stock. Would it be sensible to order new trains to the same design as the 1995 stock? It's almost 20 years old and mixing old and new trains rarely works well. If that's not acceptable, could the new trains be EVO stock? But this would give the Northern Line two types of trains – another problematic mix.

Meanwhile, on the Jubilee Line, LU wants to increase service from 30 to 33 trains per hour but the company needs about seven more trains to do it. It could order more of the existing stock, the 1996 tube stock, or order a new design, but this would raise the same issues as on the Northern Line.

The Bakerloo needs new trains. Its fleet dates from 1972 and it should get 36 trains, assuming services remain roughly as today. No one really thinks an extension to Watford is necessary or desirable and the idea of extending south-eastwards to Hayes has been shoved to the back of the shelf by TfL.

Any new train order is bound to include an add on for the Piccadilly Line. Originally, when Tubelines was the independent Public-Private Partnership contractor, it invited bidders for new Piccadilly stock and a couple of suppliers

made offers but, largely as a result of the financial dispute between TfL and Tubelines, the order was cancelled in July 2010. So long as the Piccadilly's 1973 stock continues its current excellent reliability, an extension of its life beyond 2018 isn't regarded as a problem.

Cascades

The latest thinking is based on the idea that new trains would be allocated on the basis of first, standardisation, then the most effective redistribution with the available fleet. This would trigger a cascade programme where trains would be shuffled around the system to get the best arrangement.

One idea put to me by an LU insider was that the Northern's 1995 fleet would be broken up and used on the Bakerloo (36 trains) and the Jubilee (seven trains). The design is broadly similar to the Jubilee fleet but the maintenance regime would be somewhat changed as the equipment on the two stocks is different. This would leave a big slug of unused stock – maybe to work the Battersea-Edgware service while EVO trains are purchased for the Morden – High Barnet route.

Alternatively, perhaps the logical approach is to break up the Jubilee Line 1996 stock fleet where, of the existing 63x7-car trains, 40 or so could be used on the Bakerloo, where seven-car trains will fit, and with the rest on the Northern, reduced to six-car formation. Their use on the Northern wouldn't be noticed by most of the passengers, since the body design is broadly the same as the existing stock on the line.

If this programme was to be adopted, EVO stock would be introduced on the Jubilee Line and then on the Piccadilly and Central Lines. The big drawback for the Jubilee is that the new stock is likely to have a new door layout and this would not align with the platform edge doors provided on the Jubilee Line extension. The choice is therefore either to alter the platform door arrangement, a not insignificant task in itself, or to keep the line's 1996 Stock. London Underground is looking to have firmed up its ideas by July 2013. 

Ideal train

The Underground's ideal new tube train would have:

- no driver;
- shorter, walk-through cars;
- articulation;
- fewer bogies;
- smaller wheels;
- on-board 'power supply' to enable it to move forward if there's a traction current failure;
- obstacle detection at the front;
- remote push out facilities;
- air and humidity control;
- 10% less weight;
- permanent magnet motors;
- some trains will have built-in track monitoring systems.