Internet Telephony Services Providers' Association

Improving mobile communications to UK rail passengers

DfT Call for Evidence

About ITSPA

The Internet Telephony Services Providers' Association (ITSPA) represents over 80 UK businesses involved with the supply next generation communication services over data networks to industry and residential customers within the UK. Our traditional core members are VoIP providers. ITSPA pays close attention to both market and regulatory framework developments on a worldwide basis in order to ensure that the UK internet telephony industry is as competitive as it can be within both national and international markets.

A full list of ITSPA members can be found at http://www.itspa.org.uk/

Whilst this response reflects the views of the majority of ITSPA members individual members may dissent from some or all of the views expressed and may submit their own views directly to the Department.

ITSPA Consultation Response

1. Government intervention

A.1 Why is there not already good mobile coverage on rail?

It is necessary to set out what 'good' coverage would be. ITSPA believes good coverage would allow:

- Calls to be made and received reliably throughout a journey.
- Internet connectivity to be maintained continuously throughout the journey.
- There should be no breaks in call or data connectivity and data connectivity should be maintained to at least 150kbps per active user to enable low bandwidth streaming service and cloud service connectivity to be maintained.

We expand on these ideas in our answer to question 17.

In our view poor coverage on trains has technical and commercial causes:

- The national rail network is Victorian. Due to engineering limitations when the railways were built it was necessary to minimise gradients. Britain's railways therefore make extensive use of cuttings

and tunnels and often hug contour lines to minimise the need for civil engineering. All these factors make it difficult to provide continuous radio connection to trains. The underground network similarly consists of many tunnels and cuttings.

- Railway rolling stock significantly attenuates radio signals, particularly if they strike the train at an acute angle.
- The UK mobile market is characterised by bundles. Customers typically purchase a data, voice and messaging allowance sufficient for their monthly needs. Inbound calls are terminated on voicemail services. It is difficult to imagine significant incremental revenue from rail connectivity; whilst usage would increase much of this would be 'in bundle' thus resulting in little incremental revenue. Furthermore the rail network is only really busy during the morning and evening rush hour. In short the incremental cost exceeds the incremental revenue for mobile operators.
- Whilst in theory a network operator with superior mobile coverage along a rail route might hope to achieve a greater market share in practice the effect would be limited. Commuter coverage would be improved but more important 'must have' coverage areas include the home and workplace. The volume of commuters on any given route is low by mobile operator standards.
- Radio transmitters on railway land are notoriously expensive to build and maintain – partly because of safety issues associated with the railways and partly because Network Rail has historically seen mobile sites as a revenue opportunity rather than a customer utility.

In summery the railways are much less attractive than other geographic areas for mobile investment. More specifically the return on investment of rail coverage is lower than the return on investment for other geographic areas and it is not economically possible to support four operators. However the UK market *does* consist of four operators and rail passengers will be spread amongst them. Whilst no player has good rail coverage no other player need invest in it, and if the investment case even for a first mover is poor then the railways and underground will never be covered through private investment.

A.2 Is Government intervention necessary and, if so, how is it best targeted?

If one accepts that

a. the rail corridor cannot economically support four (or even two) networks with 'good' coverage as defined earlier, and
b. rail coverage is not a key buying factor for many customers (so customers will not gravitate in large numbers to an operator who covers the railways), and
c. the government nevertheless wants to achieve 'good' rail network mobile coverage

then intervention will be necessary.

The government must target any intervention carefully to ensure:

- There is maximum benefit to the rail industry (which is a state asset) and therefore taxpayers.
- There is no unfair advantage given to any mobile operator, nor any market distortion introduced to the communications market. In particular, from ITSPA's perspective, the principle of an Open Internet must be preserved and any tendering process mut be open and transparent.
- Any intervention sits above the rail franchising system, which is too short-term to support mobile infrastructure investment.

2. Technical Solutions

A.3 What would be the most effective strategy for meeting the mobile connectivity needs of rail passengers ?

ITSPA believe the most effective technical solution is to build a high-speed 4G network from the train to the trackside and use this as backhaul for an on-train WiFi system. The train would use external roof-mounted antenna to maximise continuous connectivity. Bandwidth on board would be equitably shared amongst users to ensure continuous connection. This is the solution already installed on many trains in the UK. On-train WiFi would probably be free – perhaps with higher speeds in first class.

Whilst ITSPA generally has reservations about WiFi as a reliable IP bearer for voice we believe it is well-suited to the inside of railway carriages:

- Trains will supress external WiFi signals and only one WiFi network would be provided inside the train, so interference should be minimal.
- A railway carriage is an appropriate size for coverage by a single WiFi access point.
- WiFi is universally available on phones, tablets and laptop computers – unlike 3G or 4G radiating from a small cell.
- Recently-introduced voice over WiFi capabilities in phones will allow mobile calls to be seamlessly placed or received over WiFi whilst also supporting alternative voice and messaging networks such as those offered by our members.
- It is the cheapest on-train solution.

We do not believe other solutions would be viable:

<u>Direct to Device Solutions</u>

- Radiating through the side of the train directly to the device is not economically feasible given the amount of the UK rail network that is in cuttings and tunnels.
- Whilst passive repeaters might help somewhat they will be expensive to retrofit to trains and won't assist with dead spots.
- Active repeaters would be even more expensive and we believe would struggle to cope with handovers. They may also interfere with other mobile devices as the train passes through.

All the above direct to device solutions would require significant investment by all four network to eliminate dead spots and improve capacity.

On-Train 3G/4G Small Cells

The MNOs have recently rejected government proposals for national roaming. In this context it is unlikely that they would agree to roam onto a single 'on train' small cell network were one to be created. Furthermore the rollout of small cells inside trains would be expensive, it would require radio spectrum in a widely-used mobile frequency bands to be obtained (there is none available) and it would not offer a significant improvement over WiFi in a train environment. Given that many TOCs offer free WiFi it's hard to see the femto cells being used for data.

A.4 What would be the costs of delivering each of the technical solutions and what would the passenger experience be in each case?

ITSPA is not in a position to estimate the costs of deploying contiguous 4G mobile connectivity along the railway network. The solution we favour requires the train to maintain connection to at least one network at all times but connection to multiple networks could be supported.

A.5 Are there technical solutions which have not been considered? If so, what are the benefits over other options, and what would be the associated costs?

ITSPA is not aware of any viable technical solutions for heavily-used rail routes (which would generate a lot of mobile traffic) other than terrestrial mobile. ITSPA regards solutions such as balloons and UAVs as impractical.

Satellite connections might be viable for lightly-used rural routes but the government would need to consider the cost-benefit trade-off of providing on-train WiFi on lightly-used rural railways. Satellite

connection would be prohibitively expensive for heavily-loaded trains and would not work in tunnels or deep cuttings.

A.6 What technologies and solutions have been successfully used in other countries or industries to address similar problems?

So far as ITSPA is aware three solutions have been employed:

- Satellite connection (the only practicable solution for long-distance railways in large countries.)
- Terrestrial mobile connecting to an on-train gateway which in turn provides WiFi coverage within the train (our preferred solution).
- Terrestrial mobile radiating directly into the train. This can work acceptably on modern rail routes if they are elevated above the surrounding landscape (as some Chinese lines are) but would not work well in the UK where ITSPA understand over 1/3 of the rail network lies in cuttings.

A.7 Do you foresee any particular safety risks to the railway associated with a particular type of technical solution or strategy?

We do not foresee any particular risks to the railways from a terrestrial mobile network – we note that Network Rail operates a national trackside GSM-R network. Indeed we would expect better coverage of the rail network to enhance rail safety for a variety of reasons set out later in our submission.

We believe some of the 'novel' solutions mentioned could pose a safety risk: balloons (assuming they were higher than a terrestrial mast could reasonably be built) might rupture and fall onto the track or overhead lines. UAVs could similarly crash. Both pose a risk to aircraft.

Benefits

A.8 Are you supportive of initiatives to improve mobile coverage on rail, and do you believe there is an appetite for this from the public?

ITSPA members would welcome the ability to deliver services to customers while using railways. It is apparent from travelling on any train that use of electronic devices is very high amongst passengers and allowing those devices to connect reliably to the internet can only enhance the experience of the travelling public.

A.9 Are there any other parties or services, both Government or otherwise, that could benefit from the improvements to mobile communications on the rail network?

Whilst ITSPA has no special insight into this area we would imagine that contiguous rail coverage would have a number of valuable additional benefits:

- Mobile coverage for rail workers would be improved, which should increase efficiency and safety.
- Network Rail would be able to deploy remote sensing equipment much more widely to monitor a wide range of rail and environmental factors.
- The British Transport Police (in particular), other emergency services and contractors could benefit from direct access to the rail corridor network.
- Mobile services could provide a back-up to landlines where they provide safety-critical functions.

A.10 Are there other quantifiable benefits of introducing improved mobile coverage on trains, for instance by facilitating work for business travellers?

It seems likely that business travellers would be more likely to switch from car to train if they thought they could work effectively. ITSPA believes this has a number of implications:

- Coverage needs to be continuous – business travellers working on trains need to be able to take and receive calls, messages and emails without interruption and increasingly make use of cloud services (including VoIP).
- Data speeds need to be sufficient to support connection to corporate networks, cloud services and support low bitrate streamed services like VoIP. Business travellers would, in our opinion, value a *reliable* connection (i.e. one that does not drop) above an erratic *fast* connection.

Leisure travellers and commuters would similarly value continuous connectivity. All travellers would value the ability to connect to travel-related services whilst on-board. This could include awareness of delays on connecting services, access to journey planners, e-ticket purchasing, taxi booking and a host of other services.

The government should consider carefully the potential for e-commerce on trains. Rail passengers have time on their hands and might choose to take advantage of this to buy products. Train companies would benefit from reliable on-line connection to payment processing systems for on-train sales.

A.11 To what extent will improved mobile communications make rail a more attractive travel option?

See our answer to Q10. We note that many railways are already very crowded at peak times. Whilst on-train WiFi will no doubt improve the passenger experience, other factors such as convenience and cost will have a larger impact on people's use of railways.

A.12 Are there any other benefits associated with this work?

ITSPA is not aware of any.

Delivery Strategy

A.13 Are the requirements of passengers consistent throughout the UK? If not, where should investment be targeted? Are there areas which would benefit more from voice rather than data services, and vice versa?

ITSPA believes that WiFi alone is sufficient for on train connectivity. Mobile phones increasingly support 'voice over WiFi' which means that, when connected to WiFi the device will operate as if it were connected to a cellular network. EE have already launched this service and we expect it to become standard on devices as it is a software feature. This service works over any good quality WiFi connection thus a WiFi access point on a train can support customers of all mobile networks. Therefore DfT need not choose between voice and data – data alone is adequate. Of course customers may choose to access 'over the top' data services via WiFi as well as those offered by their network operator.

Regarding passenger requirement, we see no reason to suspect this varies by geography. The most significant factor is the number of passengers who would benefit from any investment. This would suggest the most heavily-used parts of the railway are the most appropriate to cover.

A.14 How do the requirements of passengers vary by journey type e.g. commuter, business, leisure, etc.?

See our answer to Q10.

A.15 Who are the key stakeholders who should be directly involved in this work and how can these organisations work together to aid delivery?

The key stakeholders are:

- Government
- Network Rail
- Train Operating Companies (TOCs)
- Mobile Network Operators (MNOs)
- Providers of communications services (ISPs, VoIP operators and the like.)
- Emergency Services (British Transport Police, fire brigades, ambulance services)

There are considerable challenges to establishing a productive working arrangement.

- Network Rail has no obvious incentive to improve the on-train experience of passengers. In the past it has seen provision of WiFi on stations and mobile base station sites as a financial opportunity rather than a customer amenity. This is a barrier to success.
- Train operating companies are governed by franchising arrangements. Whilst they are incentivised to improve the on-train experience for their customers they may be unwilling to pay for it or make investments in on-train equipment if their franchise has a limited period remaining. It should be noted that a heavily-loaded train is capable of generating a lot of mobile data traffic and the associated mobile bills for train operating companies would be material. In any event getting agreement amongst all the train operating companies to a consistent approach appears challenging. ITSPA imagines that Train Operating Companies would be responsible for maintaining any on-train equipment, so their cooperation is essential.
- It would make sense for any rail corridor 4G network to also be part of the Emergency Services Network. This will require coordination with that government programme.
- Mobile Network Operators are commercial organisations who will support this programme only to the extent that it is profitable for them. As stated above it is plain that commercial roll-out is not viable (otherwise it would have happened already). Provision of a dedicated track-to-train mobile network would, unless managed, provide the successful MNO with an advantage over its competitors. To the extent that this advantage resulted from government intervention or use of public assets there would be difficulties in complying with state aid rules. Any solution must avoid this issue.
- Any implementation must ensure that it results in an open internet for rail passengers. This is essential to maintain effective competition within the communications market; it cannot be right for some operators or technologies to receive a government-funded advantage over competitors. It is also important in terms of meeting the needs of passengers.

A.16 What risks are there in pursuing this initiative?

The greatest risk is that the stakeholders will (once again) fail to deliver a solution due to misaligned incentives. If the government wants this to happen it probably needs to mandate it and intervene if necessary to ensure that the parties that benefit from the infrastructure pay for it.

Behavioural insights

A.17 What does a good passenger experience look like?

A good passenger experience would deliver continuous connectivity for voice, messaging and data whilst on the train and at stations. It is important that connectivity is continuous – not only do streamed services (like voice) require continuous connection but customers are increasingly making use of cloud services (by which we mean anything that requires a continuous session – including e-commerce.)

Whilst customers would no-doubt like high speed internet access ITSPA believes it will be very difficult to deliver this to a train given that a heavily loaded train may have over a thousand people on board. It is more sensible to provide functional internet access to support activities that *must* access the internet and use on-board caches for high bandwidth entertainment services.

A.18 What devices can we expect the majority of rail passengers to use to communicate while on the train in the next 2, 5 or 10 years?

ITSPA expects devices to continue to evolve and diversify to suit the needs of individuals but this will not greatly impact the provision of WiFi on trains. We expect phones and tablets to dominate on-train communication for the foreseeable future and WiFi connectivity offers the greatest opportunity for connection.

A.19 What capabilities of mobile devices will passengers seek to use while travelling? What will be the most important and frequently used functions by passengers?

See our answer to previous questions. We expect voice, messaging, browsing, and access to cloud and e-commerce services to dominate. Customers will seek to use entertainment services but track to train bandwidth will probably be inadequate to support these services unless content is cached on trains.

A.20 Is the ability to make and receive phone calls or being able to access the Internet with high-speed data more important to passengers?

If DfT pursues a WiFi strategy on trains then it need not choose between voice and data. We do not believe high-speed internet access to trains is viable under any circumstances or using any reasonable approach because of the very high concentration of passengers and their very high propensity to consume data when travelling.

A.21 Will consumers prefer to access the Internet using Wi-Fi or 4G/LTE in future? If both are available, what is the preferred method of connection?

Customers care about the quality of their connection but not the underlying technology. Since WiFi devices are more prevalent than 4G devices (and will remain so) customers will obtain more benefit from a good WiFi signal than a good 4G signal. Making 4G available on trains is unnecessary given the emergence of voice over WiFi.

A.22 How do passengers' preference towards using Wi-Fi change with the requirement of needing to register and log-in?

It is not necessary to register and log in to use WiFi. Technologies exist today that provide automatic connection to specific WiFi networks. If a national or TOC-based WiFi network were created then customers need only sign up once. We do not see this as a barrier at all.

A.23 In 5 years, what would the data throughput to a train need to be to ensure that all passengers of that train are satisfied with performance?

By 2020 4K video will be common and tablets will be capable of displaying it. If on-train WiFi is free then the propensity to consume could be massive if video is supported because pretty much every passenger would be carrying a device capable of displaying streamed video. If 25% of passengers on a 1000 seat train wish to consume 4k video at 20mbps then the train would require at least 5Gbps.

To truly satisfy customers this throughput must be stable – i.e. it must not drop when another train with a similar demand passes. This suggests that a doubly track route might need at least 10Gbps and quadruple track routes – common around London – might need even more. Whilst ITSPA is not expert in mobile communications we believe this sort of throughput would be far beyond the ability of 4G. Whilst 5G mobile may have theoretical speeds adequate to support this sort of level of demand it relies on large allocations of very high frequency radio spectrum which is unsuitable for covering railway lines.

For these reasons we do not think DfT can hope to satisfy all passengers. However if expectations are properly managed, resource is fairly allocated amongst passengers and (where appropriate) on-train cached content is made available to passenger we believe a valuable service can be provided with much more realistic levels of throughput. Providing 50mbps to a train would allow half the passengers on a full 1000 seat train to make a voice call simultaneously – far more than is likely in practice. In reality this sort

of level of connectivity would provide a very reasonable browsing / e-commerce / voice and messaging experience to a large number of passengers and is well within the capabilities of 4G networks.

Commercial arrangements

A.24 How can we ensure that all relevant parties have the right commercial incentives to support successful delivery of a solution?

ITPA has no particular views on this but we draw attention to the issues raised in our answer to Q.15.

A.25 What sources of private funding could be used in this initiative?

The obvious source is mobile network operators. However they will only invest if they believe they can achieve a return on that investment. Government will need to be very careful to avoid the risks we identify in Q15 – in particular the risk of distorting the communications market by giving one MNO an advantage in serving rail passenger and the risk of falling foul of state aid rules.

More broadly we suggest the government considers carefully its objectives here. MNOs have demonstrated that connectivity to the rail corridor is not commercially viable therefore they will only build it if other players – passengers, the rail industry of government - make it worth their while. Given the government has a much lower cost of capital than MNOs it would be more sensible for the government to fund any network build.

A.26 What existing infrastructure could be shared or used to improve coverage, and what commercial arrangements could be established to encourage this?

ITSPA is not expert in mobile communication networks and is not well placed to answer this question.

A.27 What arrangements could be made for the integration of an alternative service provider or aggregation network with mobile network operators?

Our proposal for on-train WiFi following open internet principles supports all MNOs, alternative service providers and over the top and application operators. It is the obvious model for DfT to adopt.

A.28 Do you have suggestions for any innovative commercial options to support this initiative?

No.