MAKING THE BUSINESS CASE FOR INTERNET ON TRAINS

THIS PAPER DISCUSSES ELEMENTS THAT SHOULD BE CONSIDERED IN THE BUSINESS CASE FOR A TRAIN OPERATING COMPANY CONSIDERING THE DEPLOYMENT OF AN ON-BOARD INTERNET SERVICE FOR PASSENGER USE. SOME KEY CONSIDERATIONS ARE IDENTIFIED AND EXPLAINED. COMPARISONS WITH SIMPLER SITUATIONS ARE USED TO ASSIST IN SOME CIRCUMSTANCES AND SOME AREAS OF RISK TO BE CONSIDERED ARE DISCUSSED.

WHY PROVIDE ON-BOARD INTERNET ACCESS?

The answer to this question will depend on the train operating company's market, the rolling stock, the geography and the routes that are covered. Demographics are also crucially important.
The average train passenger today has, potentially, access to a range of technologies enabling him or her to carry on business or personal activities by communicating to others. These include the more or less ubiquitous (in Europe, at least) GSM mobile phone or smartphone (mobile phone including or included in a PDA), and the all-too-common laptop computer.

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For longer journeys, passengers may wish to carry on working. In order to be able to do this, either a laptop with reasonable battery life is required or a seat-side power supply. Provision of the latter will increase the cost of the provision of an internet service and the absence of the former will decrease the size of the addressable market.

FUNDAMENTALS

Determine the addressable market

The market for internet access should be determined by proper, careful, assessment of the travellers using the route, ideally over an extended period of time. If historical data is available, this should be re-validated. Additionally, if there are intermittent events, such as conferences being held from time to time at particular destinations along the route, some additional consideration should be given to the effect of the traffic to that location from time to time.

The result of such an analysis should, ideally, yield parameters such as:

- Peak number of 1st class passengers
- Average number of 1st class passengers
- Average journey time in 1st class
- Peak number of 2nd class passengers
- Average number of 2nd class passengers
- Average journey time in 2nd class
- Penetration of laptops in 1st class passengers
- Penetration of laptops in 2nd class passengers.

From these figures, the total number of passengers in each class of travel that are likely to make use of the service can be estimated. The number may not be a large one. The available bandwidth can be divided by this number to determine how much aggregate bandwidth per person is available or, alternatively, the required bandwidth can be determined by multiplying the average bandwidth per person by the number of users. This latter calculation is a bit hit and miss because there are a very large number of complicating factors that make the determination of how much an average user will use, on average, that it will be hardly possible to come up with a reasonable estimate. Typically, down-link (internet-to-train) bandwidths of between 2Mbit/s and 4Mbit/s should suffice. Trains that comprise two trainsets linked together could either be considered as two separate sets or some way of sharing the bandwidth between the sets could be devised.

Laptop battery life and at-seat power

Whether users who are so inclined will actually use a wireless service may be dependent on whether their laptop can be powered from the train so that they can leave the train with a full battery or so that they can work at all (where their battery life is too short for any useful work to be carried out).

Information should be gathered about the average battery life of laptops in circulation. This should be available through a local market research organisation. A simple rule of thumb today might be to assume that the average battery life of laptops in circulation is about 1.5 hours (up from about 1 hour a few years ago) although the latest designs can exceed 4 hours.

If the average battery life (ideally from real data, not just from a guideline number) exceeds the average journey time, then it follows that the provision of at-seat power may not significantly increase laptop usage by passengers on board. On the other hand, if the average journey time is substantially in excess of the average laptop battery life, then it follows that putting at-seat power in the trains may increase the laptop usage. Providing at-seat power is a non-trivial project in its own right and could take some years to implement. Clearly knowing whether this would be a fundamental requirement for the provision of internet service to be successful is extremely important.

Summary

In summary, the addressable market is made up of those users who can use the service multiplied by the proportion who actually will make use of it. Market surveys will further determine price sensitivity of the users.

To charge or not to charge...

Until recently, it was assumed that the provision of an internet service would be carried out in exchange for a payment from the user. This has been the practice in hotels and coffee shops for many years. However, times are changing.

In many cities in North America, offering hotel guests free internet access is now considered to be a basic requirement of the market. Many coffee shops give away service in order to tempt customers in and in the hope that they will buy more buns and drinks. In London, a growing proportion of quality business hotels are now offering complimentary internet access.

In their bid for the former GNER (so-called East-Coast Main Line) franchise announced in 2007, the winning consortium stated that the internet service that was put in place by GNER would be offered for free to all passengers[1]. Previously, the service had been included in the ticket price for first-class passengers but chargeable for second class passengers. This change may encourage other U.K. train operating companies to consider whether the service should be chargeable or whether the charges should be expected to be in place for the longer term. In any event, for the sake of pragmatism, any operator considering the implementation of an on-board internet service should include in their business case analysis an allowance for the service to be 'given away' at some stage during its lifetime. Making this analysis actually makes understanding the business case a bit easier and can reduce the cost of providing it.

The costs of providing the service

Providing internet access on a train is not cheap. It is worth comparing the approach with the more common situation of providing internet access to coffee shop customers:

Access to the Internet

The user connects to a coffee shop internet service by way of his or her Wi-Fi adapter. The coffee shop contains a small Wi-Fi Access Point (AP) which provides the user with an IP address and manages the connection. The same approach can be used on the train. Where a train service differs from a coffee shop is that it may be necessary to have more than one AP per carriage and certainly several per train in order to provide sufficient coverage and, indeed, in order that should an AP fail, an alternative AP can be used until the train can be serviced (this latter point is non-trivial for some train operating companies which have extensive networks and limited opportunities for maintenance, which correspondingly increase the cost of the on-train equipment).

Generally the cost per bit of data to a train will be lower if the volumes are higher. The train company has some negotiating power which will enable a 'volume discount' to be obtained if terrestrial mobile networks are to be used. With satellites, the unit of purchase tends to be, typically, a transponder. A large amount of traffic can be used by a transponder and, therefore, the bigger the fleet the lower the cost per bit. Train companies can share transponder costs using aggregation either managed between them or managed by companies that supply them with a managed service. It is not straightforward to say whether using a satellite is cheaper than using an existing terrestrial network. It is likely, though, that building a 100% bespoke track-side network to supply internet service will be a much more expensive option than using an existing terrestrial or a satellite network. The use of a bespoke network to provide fill-in coverage may be unavoidable, especially where tunnels are not currently covered by the extant networks.

Network management

No discussion of a telecommunications related topic can be complete without a discussion of network management. In this case, the requirement is to monitor the health and performance of the elements of the network. In particular, if a piece of equipment on board a

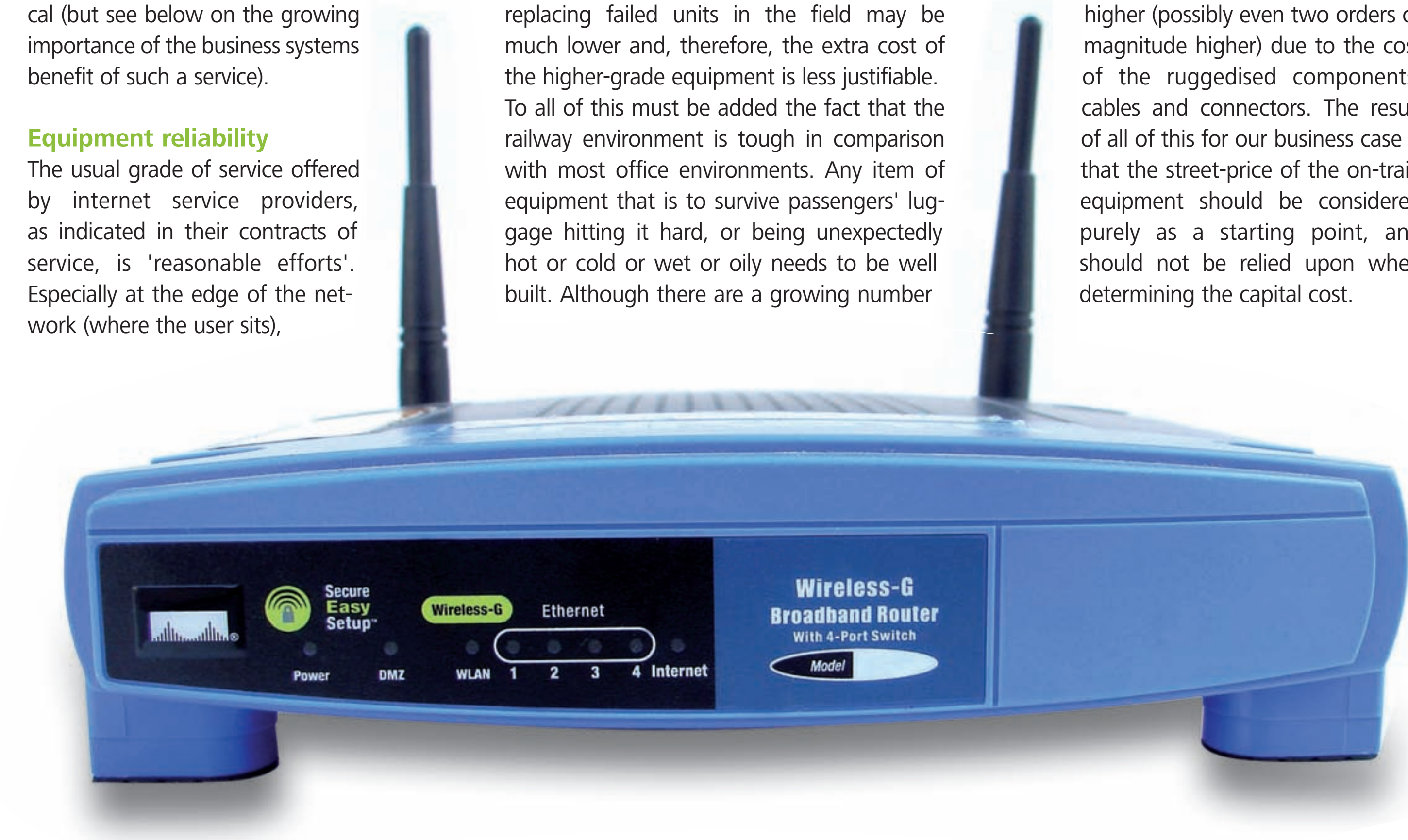
train should fail, even if a duplicate is in place to take over, someone needs to know so that it can be repaired or replaced at the next available opportunity. There are two important features of network management that distinguish the railway network from a simpler coffee-shop model. **These are:**
a) The surveillance has to operate over a network where the connection back to the surveillance centre is not guaranteed to be reliable. Alarms should be raised when a failure occurs but not when the network is just out of contact for a short while. This places some burden on the on-train system to, perhaps, cache and filter alarms so that the operations centre does not get bombarded with false alarms; and **b)** Each item of equipment installed on the train should be manageable. The bargain basement APs used in coffee shops are seldom manageable. Supporting manageability is a significant cost impact on what would otherwise be a rather inexpensive unit, but in the case of a distributed network this is certainly a worthwhile expense. Finding out at the earliest opportunity whether attention is required is important in the railway business, especially as it is unlikely that the internet service will be mission critical (but see below on the growing importance of the business systems benefit of such a service).

Equipment reliability

The usual grade of service offered by internet service providers, as indicated in their contracts of service, is 'reasonable efforts'. Especially at the edge of the network (where the user sits), the term 'cheap and cheerful' is frequently used when describing the design of the network or the equipment that delivers the service. Even before we start worrying about how the equipment will physically survive in a railway environment, we need to consider the basic aspect of routine maintenance and field replacements.

If an AP in a coffee shop fails, someone will find out soon enough and the replacement can be arranged without much difficulty. Even the most bargain-basement service could have a replacement unit sent by next-day post. Railways are different as trains do not always end up at the same location at the end of each day, if they stop running at all, and it is generally rather hard to predict in advance where any particular unit will be at any time. So, equipment on trains needs to be more reliable to reduce the need for field repairs. One evaluation of the required reliability suggests that heavy-industrial or military grade reliability would be an appropriate benchmark. This increases the cost, understandably, and somewhat reduces the choice. Train operating companies with smaller fleets may benefit in this regard as the cost of replacing failed units in the field may be much lower and, therefore, the extra cost of the higher-grade equipment is less justifiable. To all of this must be added the fact that the railway environment is tough in comparison with most office environments. Any item of equipment that is to survive passengers' luggage hitting it hard, or being unexpectedly hot or cold or wet or oily needs to be well built. Although there are a growing number of suppliers familiar with the installation of sophisticated equipment on trains, it is likely that some of the units that will make up the internet delivery system will be conventional office-grade equipment (with a suitable number of redundant units to allow for the lower reliability) re-packaged into robust enclosures to give a greater degree of physical resilience. The same applies to connectors and cables. In the IT world, network connectors cost pennies and last years because they tend to be located inside locked cabinets where they are seldom touched. If those simple connectors, designed for low cost and high performance, are exposed to any form of environmental trauma, they fail. Office IT connectors are not suitable for any form of industrial environment. Industrial-grade connectors and cables will be required and are available at a higher cost.

The design and fundamental construction of the hardware that makes up a train-based internet distribution system is likely to be little different than that in a corporate office using Wi-Fi connection to link users' computers. However, the cost could easily be more than an order of magnitude higher (possibly even two orders of magnitude higher) due to the cost of the ruggedised components, cables and connectors. The result of all of this for our business case is that the street-price of the on-train equipment should be considered purely as a starting point, and should not be relied upon when determining the capital cost.



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> EVEN BEFORE WE START WORRYING ABOUT HOW THE EQUIPMENT WILL PHYSICALLY SURVIVE IN A RAILWAY ENVIRONMENT, WE NEED TO CONSIDER THE BASIC ASPECT OF ROUTINE MAINTENANCE AND FIELD REPLACEMENTS

Summary of inputs

I have introduced several areas of a possible business case argument:

- The addressable market – for which at least some survey work is required;
- The method of connecting the train to the Internet – which requires at least some physical survey work to determine which possible 'back-haul' approaches can be used;
- The options for charging, or not, which do add to the capital and operational costs;
- The need for network management and surveillance in any case;
- The need for rugged on-train equipment.

The risks

Terrestrial telecommunications companies are working hard to deliver 3rd generation (3G) mobile telecommunications services Europe-wide and many rail passengers will already be carrying a 3G capable handset. Three issues determine whether, even it were free, an on-train service would be of benefit to the passengers:

- Whether the mobile service works on board the train at all;
- Whether the train design precludes the use of wireless devices; and
- Whether the geography permits existing services to function.

The risk, therefore, is that a rail company could provide an on-board service, at some expense, and find that users are satisfied with their existing arrangements. This obviously has to be determined by a combination of market (demand) and propagation (supply) surveys. The final note on this topic is that even though a mobile telecom signal may not be useable at the passenger's seat on board a train, it may still be useable with a proper antenna mounted on the roof (that is, by the train communications system itself). A number of companies are offering systems that can enhance the mobile network operators' signals within the passenger compartment. Care has to be given to considering the degree to which such systems may enhance the customer experience and the degree to which such enhancement might cannibalise the internet service investment. This is a matter of policy and research.

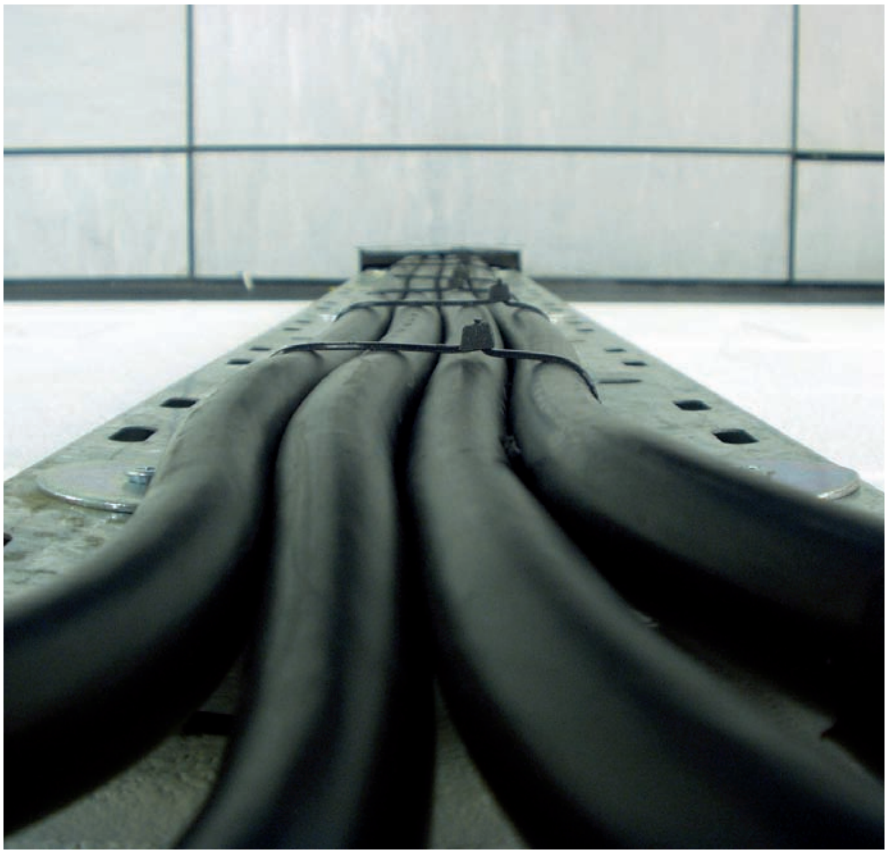
Evaluating options from suppliers

Whether the service is to be charged to users or included in ticket prices, there are substantial potential advantages for using a third party supplier to operate the service. There are a number of players in the market whose offers range from merely providing a management service, to providing a full turn-key, to providing a service with their own brand. These either operate on a fee basis or, in the case of the latter two, with some form of revenue sharing arrangement. The decision as to which route to take will need to be made taking into consideration the operating company's branding and whether brand projection is important or not and also whether there is a strong desire to retain control.

For the purpose of levelling the field between offers, I recommend comparing the offers on the basis that the service will not be chargeable. The reason for this is that any hidden costs associated with running a service from a supplier must, of necessity, be exposed when this comparison is done. In this way, the train operating company will also know a-priori what costs it may incur if the market starts to demand that the service be included in the ticket price sufficiently in advance to enable recovery by other means (such as by building in the cost to tickets over a period of time or giving the regulatory authority sufficient notice).

An alternative consideration

Regardless of the outcome of the above business case consideration, it is likely that the result will be that to provide internet service to passengers will prove to be rather costly. However, it is worth considering another, crucial, point before the whole project is scrapped for being an expensive luxury: by providing an on-train internet service for passenger use, you will also be providing a very fast data connection between the train and the rest of the business. As mentioned above, internet services should only be considered to be 'best efforts' but, nevertheless, a number of communications needs that currently use costly proprietary networks or that are not satisfied at all, could make good use of the available bandwidth. One example might include enabling the buffet or



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restaurant service to re-stock during a journey via an internet link (suitably secured) to a central stock control system. One could even envisage a Kanban[2] system being possible for stocking at stations along the route, with end suppliers being automatically informed of when and where stocks are required.
Other internal uses that could be satisfied are real-time or near real-time updates for staff, near-real-time data collection from the train and a certain degree of passenger surveillance.
Many train operating companies are now considering that the savings available from the ability to make use of train-to-shore communications (non-safety-critical) over such a network could, either totally or significantly, justify the expense on its own with the public access being an incremental cost and benefit. This is certainly worthy of thought. Cost savings from old, proprietary and/or expensive systems being retired could be significant in their own right. The management of the bandwidth made available to the customers can be done simply using inexpensive router technology that would be needed to support the service in any case ■

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Ian Beeby, an experienced technologist with a background in the defence and telecommunications industries, is currently engaged in advising two train operating companies. He has presented papers on telecommunications network design and optimisation, Wi-Fi for rural internet access and, most recently 'Demystifying Wireless Communications for Trains' and 'The Future for Terrestrial Wireless Services for the next Five Years: Myths and Realities for Wi-Fi on Trains' at the BWCS Train Communications Conferences in 2006 and 2007 respectively. He is a Fellow of the Institute of Physics and a registered European Engineer.

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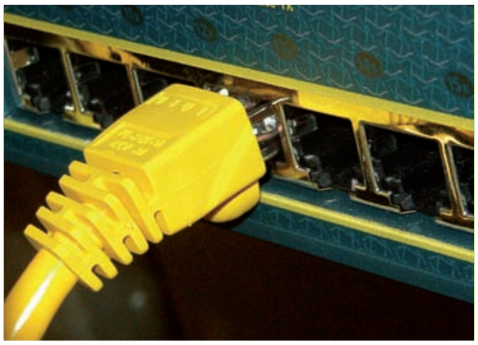

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[1]'Free on-train Wi-Fi for everyone – National Express pledges free Wi-Fi for East Coast line', Dan Grabham 15th Aug 2007, tech.co.uk, http://www.tech.co.uk/computing/mobile-computing/news/free-on-train-wi-fi-set-to-rollout?articleid=560637220

[2]http://en.wikipedia.org/wiki/Kanban