Smart Transit Systems
Wi-Fi on the Move
In an era of increasing demand for access to the internet anytime and anywhere, cities dotted with Wi-Fi hotspots are fast becoming the norm.

Yet a truly smart city must also meet the needs of the population on the move. Although ubiquitous high-speed broadband brings huge benefits for passengers and transit operators, the transit industry has only just begun this journey.

This is due, in part, to a lack of wireless infrastructure investment, a lack of understanding of the technology, or both. However, there is an outsourced business model that achieves the benefits of Wi-Fi on the move by enabling the investment to be accelerated at no cost to the rail owner or operator. In the USA, the goal of smart cities has come one step closer to fruition, with the Broadcast Australia Infrastructure (BAI) Group successfully implementing Wi-Fi solutions alongside other wireless offerings, for rail commuters as the investor, owner and operator of networks.

In New York, BAI, via its majority owned subsidiary, Transit Wireless, has constructed the first stage of a Wi-Fi network within the Metropolitan Transit Authority (MTA) subway system. In San Francisco, WiFi Rail is building a Wi-Fi network that operates both in stations and on trains, giving passengers a continuous broadband wireless experience just as they would receive at home. These projects represent major steps in overcoming the challenges, and in the evolution of providing Wi-Fi in an urban rail commuter environment.

Wi-Fi has been available at six MTA subway stations in New York since September 2011 and will be rolled out over the next six years to all 277 stations in the city’s subway system. Transit Wireless’ Wi-Fi solution is partially integrated with its ‘neutral host’ cellular distributed antenna system (DAS) network, which is used by the wireless carriers to expand their 2/3/4G networks.
The Wi-Fi network in San Francisco has been rolled out to 13 stations in the Bay Area Rapid Transit (BART) system. Significantly, WiFi Rail’s solution provides Wi-Fi communications to fast-moving trains, completing the last step in the move to smart transit systems. The services are now available on more than 50 rail cars. Current plans suggest that over the coming three years, all BART stations (above and below ground), and all cars will be Wi-Fi enabled.

In the USA, a 2012 University of California Davis survey of rail transit passengers travelling from San Jose to San Francisco, California, has attributed a three per cent increase in round trips solely to offering Wi-Fi service. This represents 17 per cent of the total increase in round trips from 2011 to 2012. Similarly, UK based Chiltern Railways experienced a 25 per cent increase in ridership since offering Wi-Fi to its passengers.

As more passengers are drawn to their transit systems, operators are also improving revenue and efficiency through advertising, space rentals, smart ticketing solutions, real-time CCTV and the use of live telemetry from train operations.

In Canada, BAI has a similar open access Wi-Fi/cellular implementation strategy for the 61 underground stations in Toronto. On 21st November 2012, the Toronto Transit Commission (TTC) awarded a contract to BAI to roll out a wireless network across Toronto’s subway system.

Wi-Fi and DAS are complementary technologies that can share some common infrastructure components, including the extensive optical fibre backhaul networks. This saves time and money during the implementation phase.

The growing demand for Wi-Fi

As the world experiences exponential growth in the use of data on smart phones, tablets and similar devices, demand for access to Wi-Fi services is increasing at a similar rate. Users expect instant access to email, mobile apps and the internet, regardless of where they are or the time of day. Time is precious, and business people and consumers want to make good use of every moment. According to Cisco Virtual Networking Index (VNI) predictions, by the end of 2012 the number of wireless connected devices will exceed the global population of 7 billion. The Cisco VNI suggests that global mobile data traffic will increase eighteen-fold by 2016.

According to a Gap Intelligence report quoted in the magazine Computerworld, cellular + Wi-Fi and Wi-Fi only tablets shared the market evenly in mid-2010. Only a year later, 75 per cent of tablets sold were Wi-Fi only. Estimates of current Wi-Fi only iPad purchases vary from 75-90 per cent. Regardless of the precise figures, there is a clear trend towards increasing Wi-Fi usage. Wireless carriers are aware of this trend and are seeking to increase their Wi-Fi presence as they use Wi-Fi to offload traffic to relieve congestion of their networks.

A Wireless Broadband Alliance (WBA) report indicates that most operators regard Wi-Fi hotspots as vital to meet customer expectations and to relieve data traffic on their networks. Nowhere is this increasing usage more prevalent than during the daily commute.
The key to increased accessibility is the infrastructure behind it. BAI, as a leading provider of wireless infrastructure, is at the forefront of this growth. Transit Wireless’ Wi-Fi network roll-out in New York is based on a shared wireless infrastructure that will provide commercial wireless - a 4.9MHz network for the MTA’s use and Wi-Fi services to the estimated 1.6 billion passengers who pass through the MTA’s underground stations annually.

With a long-term license to provide services, Transit Wireless is two years into the eight-year construction project that will see the services rolled out to all 277 MTA subway stations. The construction program began with six stations in New York’s Chelsea district. The next phase will include high profile stations such as Times Square, Rockefeller Center and Columbus Circle.

The project, which incorporates a vast optical fibre network covering the entire New York subway system across four boroughs, represents one of the largest transit communications projects in the world.
There is also scope for sponsored content, provided in a similar manner to in-flight entertainment on airlines. The airline analogy holds true in terms of delivery as well. Some airlines now offer in-flight entertainment as a Wi-Fi experience. There is incentive for the airline industry to take this further. By supplying tablets to passengers for the duration of the flight, or encouraging them to use their own smart phone or tablet, airlines can remove the screens from aircraft, along with the expensive, bulky and heavy wiring required to support the system. This reduces the amount of fuel used during flights. Similarly, in transit systems, Wi-Fi technology saves space, and is as future proof as modern technology allows – access points can be updated fairly quickly as new generations of Wi-Fi evolve.

Passengers, service providers, local businesses, advertisers and transit operators all stand to gain from this improved accessibility.

Thousands of MTA commuters are beginning to enjoy the premium Wi-Fi service at the six stations completed to date. This is not simply confined to emails and internet access. Services are being tailored to the needs of subway commuters, and range from safety and passenger information to digital-media entertainment. With the technology also allowing cellular and VOIP connectivity, passengers can work, study, engage with their friends or simply enjoy the variety of online services.

Wi-Fi technologies can make transit service information more readily available. In addition to checking screens placed on platforms and around stations, commuters can access real-time information from their personal devices about the arrival of their next train, connections to other lines and other transit updates.

One of the biggest issues for passengers is not the inconvenience of delays or changes to schedules – as people understand that things occasionally go wrong, or that maintenance is required. Rather, it is not knowing the cause or how long the delay will be that is the real issue. Being updated with real-time information empowers passengers by giving them the knowledge to make a choice about how to continue their journey. The improved access also means that passengers are more mobile within the station environment as they no longer need to stay close to platforms to monitor train times.

For advertisers, there is the opportunity of promoting products and services to a targeted and interested audience, even though the ‘dwell time’ of a passenger on a platform might only be a few minutes during peak periods.

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Safer in the subway

A major attraction of the smart transit system for passengers, operators, law enforcement agencies and governments charged with the responsibility of protecting the public is the potential for improved passenger safety and reduced cost of crime prevention. Strategically placed CCTV cameras can be linked to the Wi-Fi network with information instantly transmitted to a central monitoring point. In the first week of the six pilot stations going live in New York, there were some 100 calls to the 911 emergency contact number.

While it is not feasible for security personnel to observe the data from each security camera, video analytics technology is available to automate the process. Images can be automatically monitored for unusual activity that may signify an incident that requires operator action and possible responses on the ground. Facial and movement recognition technology can be used to identify suspects and detect unusual behaviour such as left bags, erratic movement such as running hard, or arm movements that indicate a possible assault. Once recorded, these movements can generate an alarm to alert the operator at the control room. If required, advanced network controls are available to enable intervention during a public emergency.

Interference from commercial services to the transit operators, and public safety radio services is often raised as a concern. A smart transit system network can accommodate transit operator and public safety applications in addition to public traffic and applications on separate networks.

Regardless of the configuration, interference issues between various transit, public safety, commercial cellular and Wi-Fi networks are mitigated through techniques such as careful RF planning, proven installation and isolation techniques, filtering, antenna selection and placement, as well as through interoperability testing and commissioning.
As in San Francisco, where Wi-Fi is available in over 50 rail cars, there is scope to extend the MTA service to moving trains. To enable this development, the challenge for Wi-Fi designers has been to devise technology that allows better communication between trains and the backhaul network. Until now the transit Wi-Fi user experience has been limited by the poor backhaul connectivity to the access point in the carriage. Traditional Wi-Fi backhaul techniques such as 3/4G connectivity from carriages to the wireless carrier’s base stations have coverage and capacity issues that result in a slow, low-quality user experience.

The advent of LTE (4G) networks will go some way to improving this situation. However, it will take many years to cover rail corridors and there will still be some coverage gaps. While 2/3/4G networks generally provide a wide coverage solution, they are not designed to provide dedicated targeted full rail corridor coverage.

WiFi Rail has solved this challenge by adapting new rail specific backhaul technology that works...
For advertisers and content providers, this presents a vast opportunity, as dedicated eyeballs on screens are a high value commodity. The number of commuters in large cities such as New York, San Francisco, Chicago and Los Angeles possibly represents the biggest single audience in the USA. The commuting audience is not only large, but more engaged, due to the dedicated content that is offered. As a result of this more personal experience, mobile advertising is regarded as one of the highest value advertising spaces available today. The Cost Per Mille (CPM), or the price for advertising per thousand views, is far higher for mobile communications than for television advertising. This reflects the value of growing mobile advertising, and indicates the commercial potential of Wi-Fi on trains as there is a large captive audience.

In both the USA and Europe, long-distance train operators report that the availability of Wi-Fi is a distinct selling feature. Innovations abound, with some operators offering add-ons such as virtual coupons for the buffet car with each purchase of a movie. Operators report that, because of the availability of Wi-Fi, passengers are attracted to trains as an alternative to coach or air travel.

It is clear from BAI's business modelling that train operators have the potential to significantly increase revenues by tapping into the onboard Wi-Fi market. While figures will vary from city to city due to variables such as ridership levels, the increased revenues are expected to far outweigh the costs of providing additional infrastructure.
The benefits are not confined to revenue for advertising and sponsorship. Where Wi-Fi infrastructure is available in stations, along the wayside and on trains, either unlicensed Wi-Fi or a parallel licensed frequency band can be deployed and used for security CCTV, wireless ticketing, reservations and train telemetry. This provides improved operational capabilities and efficiencies. The additional telemetry data from trains serves a number of vital functions. With improved access to larger volumes of data, it is possible for railway companies to save time, money and resources.

Remote condition monitoring that uses a ‘predict and prevent’ methodology rather than a ‘find and fix’ approach is a well proven concept in many industries. Recording and analysing train performance information can reduce down time and improve maintenance and asset management programs considerably, resulting in savings of tens of millions of dollars annually.

With accurate knowledge of the state of braking systems for example, planned maintenance periods can be extended. At the other end of the spectrum, inconvenient and costly breakdowns can be prevented by continuously monitoring mechanical and electrical parts. Parts failures can be more accurately predicted and trains can be pulled out of service before a failure occurs.

Other important parameters such as engine performance, door status, fuel usage, stock-monitoring, heating and air conditioning, and railway system condition monitoring can also be measured. This allows operators to better optimize the performance of their rail network and reduce operating expenses.
Behind all smart devices and smart cities is sophisticated technology, and smart transit systems are no different. The key is to provide the advanced network technology and the infrastructure to make this possible, and satisfy the ever-growing business and consumer demand for access to voice, data and media anytime and anywhere.

Wi-Fi and next generation cellular technologies are complementary. With standards increasingly converging, this allows for cellular/Wi-Fi inter-working. Tomorrow’s personal smart devices will be able to seamlessly roam between the technologies as best suits the customer.

Content offered to riders though the Wi-Fi network will consist of either a free ‘walled garden’ or unlimited access to the web for browsing and email. Access to the web for browsing will be via a paid or partly-subsidised subscription service. The free service will be available via a mobile website or app download. In both cases, it is envisaged that the commuter will be presented with 20 to 30 pages of content behind the walled garden. Transit updates, news, sport, weather, stock reports and sponsored content will be included. Under the free app arrangement, content will be automatically updated each time the commuter arrives at the next station Wi-Fi access point or on a regular basis if Wi-Fi is available on board the train.
**The BAI Group** is an independent owner and investor in key communications infrastructure in North America, Europe and Asia Pacific. BAI’s core business is the ownership and operation of communications infrastructure in a range of neutral environments.

Subsidiary companies include New York based subway commercial wireless group Transit Wireless; Hong Kong-based confined space coverage group Radio Frequency Engineering Limited (RFE); broadcast and telecommunications provider; Broadcast Australia; emergency communications specialist, Airwave Solutions (Australia); and critical application and hosting provider, Hostworks.

BAI is 100% Canadian owned, with the majority owner being the Canada Pension Plan Investment Board (CPPIB) - on behalf of 18 million Canadian pension contributors and beneficiaries. As of 30 June 2012 CPP Fund assets under management totalled approximately $C165.8 billion.

For more information on the BAI Group visit [ba-infrastructure.com](http://ba-infrastructure.com)

**Transit Wireless**

**Transit Wireless** is a New York based company rolling out coverage for wireless services that include 2G/3G/4G cellular and Wi-Fi within the 277 underground subway stations in the New York City Subway. Transit Wireless provides a long term, fully managed service to Wireless Carriers from design, build, through to 24/7 operations and maintenance. Anchor tenants are AT&T, T-Mobile for cellular and Boingo for Wi-Fi.

The Transit Wireless designed open access communications network is a robust, cost effective, wideband, multi-user/multi-technology platform that is currently being rolled out progressively, with work having commenced mid-2010 and completion due mid-decade. The network provides wireless coverage for more than 5 million subway customers per day.

For more information on Transit Wireless please visit [transitwireless.com](http://transitwireless.com)

**Arqiva is BAI Group’s partner company.**

Arqiva provides wireless communications in the UK and has a significant presence in Ireland, Europe and the USA.

Arqiva is the UK’s largest independent Wi-Fi provider. Arqiva’s travel and hospitality clients include; Virgin Atlantic, British Airways, BAA Airports Ltd, Travelodge and Premier Inn.

Arqiva also works with the UK’s five cellular network providers; emergency services; major broadcasters; and commercial radio groups. The Wi-Fi network handles over 3 million sessions every month.

For more information on Arqiva please visit [arqvawifi.com](http://arqvawifi.com) and [arqiva.com](http://arqiva.com)

**Radio Frequency Engineering** (RFE) is a Hong Kong based company that is a leader in the tailored design and integration of wireless confined-coverage systems. RFE specializes in multi-carrier, multi-band wireless communications systems for large scale complexes and tunnels.

RFE has completed or been actively involved in numerous landmark cellular coverage projects in the subways of Hong Kong, China, Singapore, Thailand and Taiwan; including future-proofed systems that can readily accommodate the addition of new services, including Wi-Fi, Wi-Max, digital trunked radio and 4G cellular.

RFE’s key client in Hong Kong is the transit operator MTR Corporation Ltd (MTRC) involving large scale design and build projects as well as long term maintenance contracts. MTRC is a world leader in the deployment of wireless services for subway customers having deployed first services (2G cellular) in the 1990’s.

For more information on RFE please visit [rfe.com.hk](http://rfe.com.hk)
[about BAI]

BAI deploys, operates and invests in communications infrastructure across multiple technologies and applications in telecommunications, broadcasting and public safety. A leader in tailored design and integration of wireless confined coverage solutions, BAI implements major wireless communications projects around the world.

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