AN ASTRONICS COMPANY

WHITEPAPER

THE NEW COMMUTE:

Riding With In-Train Entertainment & Connectivity

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Providing reliable connectivity, engaging entertainment and railway information to passengers could be effortless through Astronics In-train Entertainment and Connectivity unit, Sierra. Offering connectivity on-board creates benefits for operators in the forms of increased passenger experience and ridership, advertising revenue and employee and passenger safety. This system is offered as an ancillary benefit of an equally revolutionary railway safety and control system at no additional infrastructure cost to operators.

Staying Connected

Mobile connectivity has become increasingly paramount in today's world for many consumers worldwide. With evolutions to mobile networks on the horizon with the release of 5G cellular network technology and Intel's WiFi 6, consumer expectations in regards to seamless connectivity in all aspects of daily life will continue to increase. In order to meet this growing demand, service providers must remain

current on these changing technologies. This includes coverage in all conditions, including on-board subway trains traveling above and below ground, and through crowded cities with limited bandwidth and coverage. This presents a unique challenge to providers, which has not yet been solved.

WiFi is an essential part of life and productivity for most people. According to Inmarsat, 78% of over 9,000 people interviewed believed that WiFi connectivity is "fundamental" to daily life. 55% of that group described WiFi as "crucial." Thomas Prendergast, a Chairman for New York City's Metropolitan Transportation Authority declared WiFi, "one of the features that the X'ers and the Y'ers and the millennials consider an expectation or an entitlement, not a luxury."

Future of Wireless

According to studies conducted by Cisco and published in their CiscoVNI forecasts, service providers worldwide are moving from unlimited data plans to tiered mobile data packages. This shift will place increased importance on data transfer through WiFi.

In 2017, 74% of North Americans with data packages used a capped, tiered plan. These tiered packages offer a specific amount of data per month, and either limit or charge consumers when this limit is reached. Often these consumers will connect to WiFi when available to avoid data usage overages and fees.

Global total data offload via WiFi continues to increase as well, as reported by CiscoVNI, in 2017 54% of all mobile data was transferred by WiFi, and will potentially increase to 59% by 2022. Total amounts of data transferred by mobile devices is predicted to rise as well, from 13.4 exabytes in 2017, to 111.4 exabytes in 2022.

With these potential increases to data transfer via WiFi, demand for public connectivity access is predicted to rise as well. Globally, as of 2017, CiscoVNI reports a total of 124 million public WiFi hotspots, and predicts an increase to 549 million by 2022.

WiFi's capability is set to increase with the recent release of Intel's 802.11ax WiFi 6. WiFi 6 will offer three times faster speeds, four times higher capacity and 75% lower latency. Consumers can expect benefits in the forms of increased efficiency, and even longer battery life, as compared to 802.11ac WiFi 5.

On-Track Now

Currently, on-board connectivity provided for rail travel relies on cellular modem networks and satellites on-board that connect to nearby cell towers. Reliability can become an issue, especially when taking certain factors into account, such as tunnels, routes where cell towers are sparse, and how many users are connected to the network.

Bandwidth limitations can be restricting to customer access. Some activities may not be possible, such as downloading, streaming and other high-bandwidth functions. Signal strength can also go through large variations. As reported by The National Journal, connection speed while on-board an Amtrak train from New York to Washington D.C. ranged anywhere from between .1 Mbps to 4.4 Mbps.

Methods can be taken to improve coverage while above ground in these highly dense areas, utilizing line-of-sight cellular towers known as monopoles. As the train moves, the monopoles are strategically spaced to allow for consistent coverage and connectivity. Monopoles were considered by Boston's MBTA to provide complimentary connectivity to passengers. In order to provide this service, they proposed installation of approximately 320 seventy-foot tall monopole towers. Faced with widespread resistance from local community members, the MBTA was forced to cancel plans to install these towers.

Connectivity systems can become further complicated when attempting to provide coverage for subway systems, entirely underground.

One method currently used to provide cellular signal in underground tunnels is through leaky feeder coaxial cables, run along tunnels to emit and receive radio frequency (RF) waves. With this system connectivity is possible at extremely limited speeds. Interference is also common, as leaky feeder radio frequencies utilize the high end of the RF spectrum. This makes it an unviable option for providing WiFi.

Distributed Antenna Systems (DAS) are another method used to provide connectivity in situations where coverage is limited. Connectivity and cellular signal is possible by using a combination of fiber optic cables and coaxial cables connected to individual access points at stations. However, when connected devices begin moving, connectivity and signal is lost once devices are out of range of the access point.

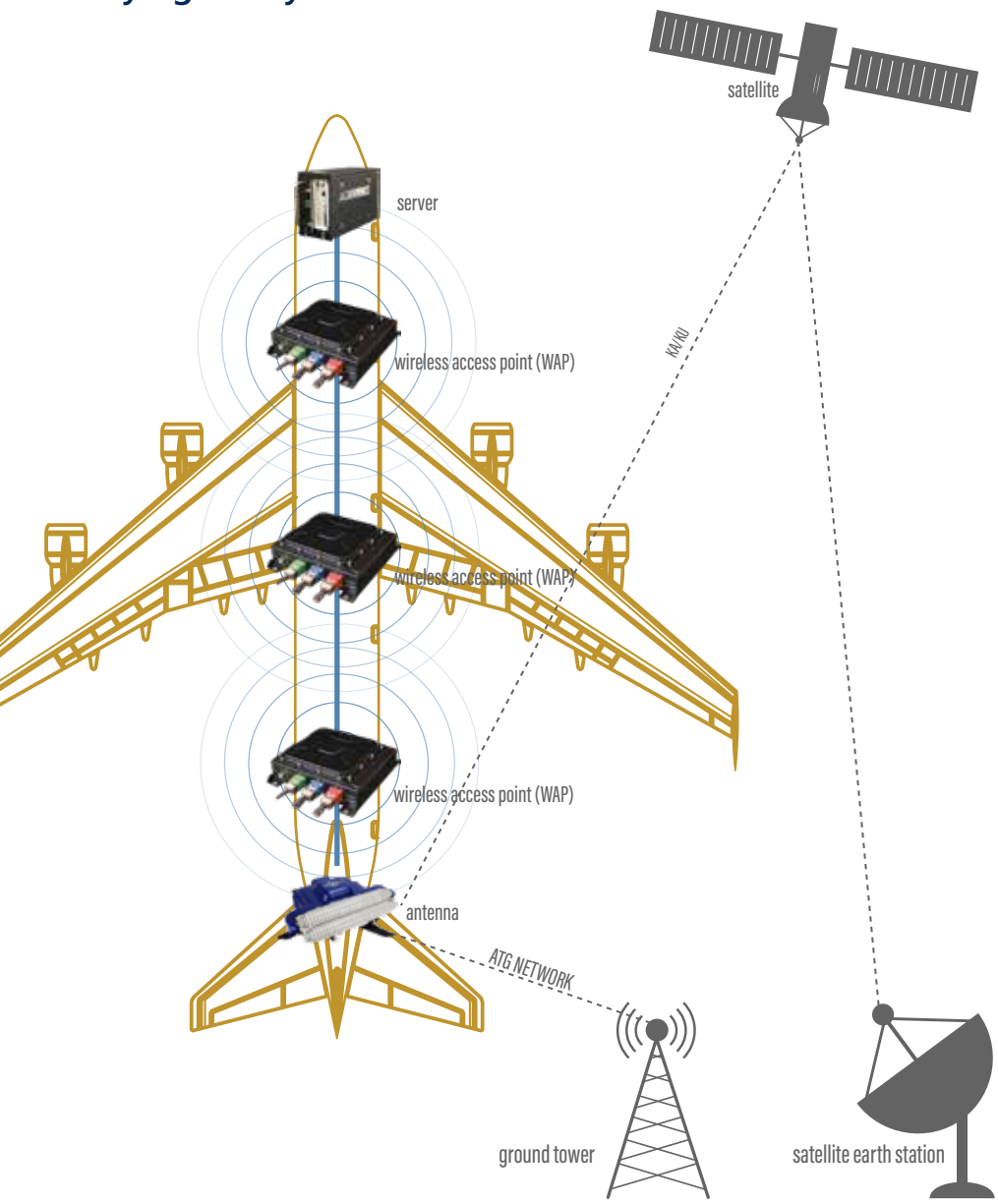
How Important is WiFi Today?

78% OF PEOPLE

view WiFi as "fundamental" to daily life

Source: Inmarsat Study

Inflight Entertainment & Connectivity Systems Are Flying Today



Connections to Inflight

Building the ideal rail entertainment and connectivity system could borrow from an architecture proven by Astronics in providing Inflight Entertainment and Connectivity (IFEC) onboard airplanes currently.

Systems use either satellites or Air to Ground (ATG) cell towers and antenna receivers mounted inside radomes on top or below planes, receivers relay signals to a server located in the planes electronics bay. From there data is transmitted to Wireless Access Points (WAPs). Content can be used inflight by seat-back displays connected to WAPs, or with passengers WiFi enabled mobile devices optimized for streaming through airline's mobile applications. This allows customers to access preloaded entertainment from their device without access to other features of the WiFi network, preserving bandwidth. A selection of content is made available by the airline, often including select movies, television shows, music, podcasts and games. Full access to WiFi is available, generally at an additional charge.

The Sierra System

Creating a connectivity platform for the next generation subway system presents a unique challenge. As trains go above and below ground, and across large distances, providing consistent connectivity becomes challenging.

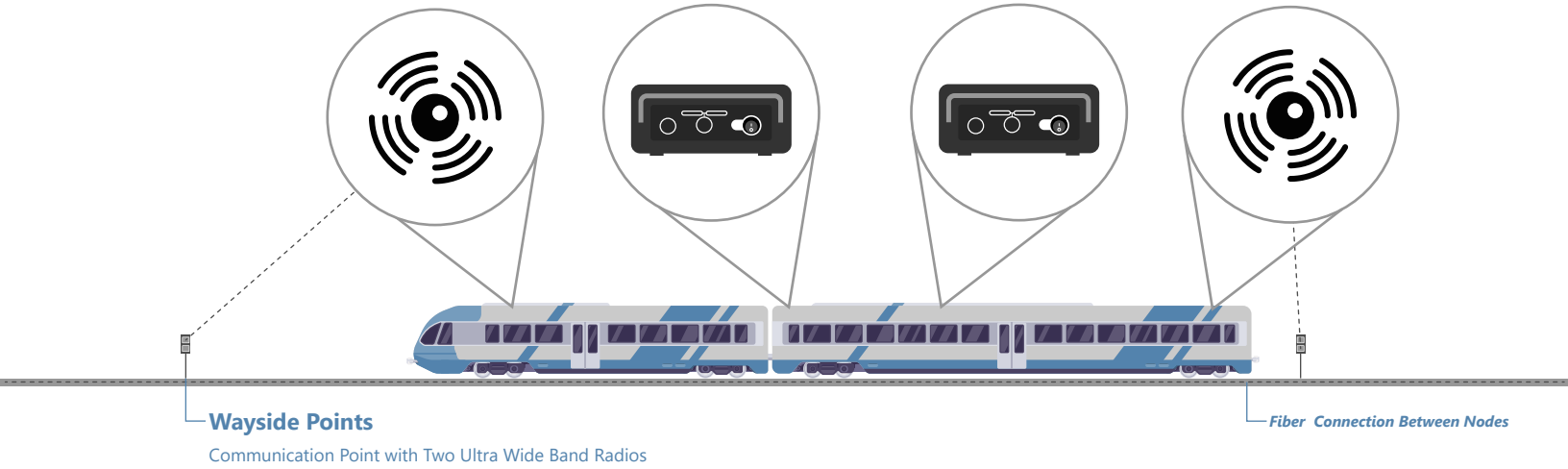
By borrowing from the concepts utilized by inflight entertainment and connectivity systems, uninterrupted connectivity and entertainment for passengers is possible.

With Ultra-Wideband Radios (UWB) attached to the front and rear of train cars, data is relayed in and out. This data is communicated to wayside network points alongside railroad tracks. These wayside network points are connected by fiber optic cables, and run the entire length of the track. Strategically placed points output data in order to provide a stronger signal, by avoiding bandwidth restrictions. As the train passes wayside network points, it wirelessly communicates via UWB radios on-board. Connection is established to the nearest access point and more ahead to ensure communication is never lost, providing seamless connectivity for the train.

Through this multiple UWB radio system, providing connectivity for passengers is possible, at no harm to the primary safety functionality. As the primary radio provides control for the train safety functions, secondary radios remain idle as back-up, should the primary radio stop working. Instead of letting these secondary radios sit idle, redundancy allows these back-up radios to communicate with the Sierra unit on-board. This provides connectivity for passengers, until the radios are needed, should the primary radio fail.

Working through a modified inflight entertainment wireless access point modified for rail use, providing high quality streaming entertainment and passenger connectivity is possible. Utilizing built-in Ethernet, the system provides high-speed connectivity for all passengers on-board. These units also contain a built in cellular modem, as a supplement to cellular network, when available.

Adding IFE to Existing Wireless Train Control Systems



Scalability is possible to provide full train coverage, no matter how many cars are in operation, utilizing the unit's built in server. With strategic data-out points in the wayside network, the system can avoid bandwidth restrictions by offloading data, offering consistent speeds for all passengers.

Sierra is designed to operate through train power as a low-powered unit. Operation is as simple as placing it on-board and plugging it in.

Enhancing Passenger Experience

The ideal train connectivity and entertainment system will need to be able to connect passenger devices quickly and provide content that can be accessed easily. Content will need to be consumed equally as quickly, while keeping devices connected seamlessly throughout the trip.

As reported by Moovit, the average round trip aboard public transit in New York lasts 87 minutes, and the average distance for a round trip is 5.90 miles. This places a larger emphasis on content that can be skimmed during relatively short trips, such as news articles, journals or brief streaming video.

Content of all types can be preloaded on the system in order to provide entertainment content, should the off-train streaming connection be unavailable. This also allows passengers almost instant access to content with no lag in performance.

Passengers can expect to utilize the Sierra unit as an all-in-one point for internet access. Sierra can also provide passengers with information in real-time through connectivity, such as moving digital maps to show precise location, or interactive kiosks for better customer support.

By connecting passengers on-board without disruption, passenger experience is significantly more positive. Providing this service especially helps establish an advantage over other forms of transportation. Increased ridership over other forms of transportation is one noticeable effect of increased passenger satisfaction and experience. As it relates to inflight entertainment, a recent study by Inmarsat revealed that 67% of all passengers would be more likely to rebook with an airline if WiFi was offered on-board.

What can Sierra do for passengers?

Operator Benefits

Sierra is a system designed to operate at no additional infrastructure cost to operators, working through the back-up radios of the installed train safety control system as a free byproduct.

Through wireless connectivity, revenue generation is possible in real-time. Connectivity and entertainment can be offered as a premium service,

generating revenue based on passenger selected purchases, or subscription based plans.

Static advertisements could be replaced by connected video screens to provide dynamic advertising content. Traditional static advertisements are cumbersome to install and maintain, and limit the number of different advertisers possible at any given time. With digital advertising, displays become flexible and interactive, displaying new content after certain periods of time and greatly expanding possibilities as compared to traditional displays. In a study conducted by Nielsen, digital billboards generate high recall for ads and positive consumer attitudes as compared to traditional billboards. In addition, 70% of respondents were impressed by digital advertising's potential for immediacy of content.

Sierra also offers the potential of the Internet of Things, by connecting and integrating devices and applications on-board. The Internet of Things continues to increase in prevalence as the importance of connectivity becomes paramount. Connectivity can offer real-time customer support through digital moving maps, or interactive information kiosks for passengers.

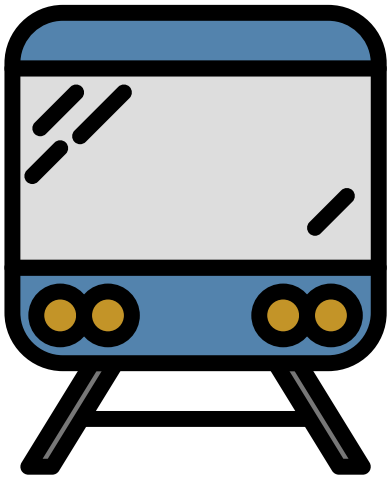
Conclusion

Keeping up with passenger expectations is possible by offering wireless connectivity and entertainment on-board. Connectivity and entertainment provided by Sierra enhances the passenger experience at no cost as a byproduct of an equally as beneficial train safety control system. Utilizing proven technology borrowed from inflight entertainment system hardware it provides passengers with high speed connectivity through bandwidth provided by UWB radios. Working through wayside network points track-side to offload data, the system offers seamless connectivity, avoiding common obstacles faced in urban environments as well as tunnels. In addition, as an ancillary benefit, the system unlocks the potential of the Internet of Things, supports customers and drives revenues through connected digital advertising.

How will Sierra change your experience on a train?

CURRENT

Your connection is dependent on how strong your cellular connection is. External factors such as tunnels can greatly impact staying connected.



SIERRA

You're able to stream content so fast that you forget you are on a train. Your connection remains uninterrupted due to the consistent access to Wayside Tags.

To learn more about the Sierra in-train entertainment and connectivity system contact PDT, an Astronics Company.

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