Transportation

Delivering Wireless Service in Subways and Tunnels

State and local authorities providing subway system and vehicular tunnel transportation infrastructure are recognizing that users want cellular service as they travel. Commuters use this otherwise down time to catch up on both leisure and business communications. In addition to providing passenger convenience, transportation managers and wireless operators see potential passenger safety improvements and revenue enhancement opportunities in providing cellular service in underground tunnels and stations. ADC's FlexWave™ Prism RF transport system addresses these needs cost-effectively, offers end-to-end management and broad configuration flexibility to suit any deployment environment.

Challenges

Cellular providers, transit and highway authorities deploy radio distribution systems to provide service in tunnels and subway stations. These systems link up to base stations or RF repeaters. But to be successful, a radio distribution system must overcome environmental and RF challenges:

Non-RF Friendly Underground Environments – Radio distribution can be limited by factors such as curves, changes in elevation, and even the surface texture of a tunnel wall. Radio waves travel farther along smooth surfaces than along rough ones. When RF distribution from an antenna is not line-of-sight, the dips or curves can block the signal. To overcome these issues, radio engineers sometimes use leaky coax to distribute signals along a curved path since the cable can bend around the corners.

Space Limitations – Subways and tunnels can be quite crowded and access to them is limited due to logistics and security issues. These challenges make it difficult to install and maintain radio infrastructure. RF designers should be sure to use remote antennas that will fit into these space and access-constrained environments.

Dirt/Dust – Subway and auto tunnels collect dirt and dust rapidly. Contaminants often clog radiating cable and electronic equipment fans and circuitry. Dust can reduce the performance of RF distribution systems, requiring periodic maintenance in areas that are not easily accessible. If possible, the RF system should be sealed against contaminants to eliminate the need for maintenance.

Frequency and Protocol Flexibility – Wireless service providers deliver multiple services across multiple licensed RF bands. Despite a multiplicity of needs, they or the transit authority may desire a shared radio distribution infrastructure. The solution chosen should be frequency-agnostic (as coax cabling is) or it should support multiple frequencies and the ability to change or upgrade as needed.

APPLICATION NOTE

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Solution

ADC's FlexWave Prism uses patented digital-over-fiber technology to distribute RF to desired locations. The Prism digitizes the entire designated RF band and transports the digital bit stream over fiber. The signal is reconstructed at full bandwidth, regardless of modulation technology, and amplified at the remote locations. ADC's digital RF transport allows RF signals to be replicated at full dynamic range, independent of the link length, for improved data throughput.

A major benefit of the all-digital technology is Prism's ability to simulcast signals to provide broad coverage of a single sector, minimize interference and promote superior uplink performance. This functionality provides superior voice quality as the call remains on a single sector and is especially beneficial as service providers migrate to 3G and 4G services promoting industry leading data rates. The system performance is not subject to link distance as timing can be remotely adjusted.

The Prism is environmentally hardened, making it impervious to dust and dirt. This eliminates costs related to periodic cleaning, degradation of service experienced with leaky coax transport and the time those systems require to pin-point points of failure and service.

The Prism can support up to four separate RF frequencies or operators in each system, and it is available in four different form factors to optimize space usage and deployment costs. This versatility allows service providers and transit authorities to quickly deploy networks in areas where access is restricted.

Each FlexWave Prism can drive RF up to eight remote units via fiber.

FlexWave Prism Host Units can be linked to local or remote base stations via fiber, allowing carriers and municipalities to use existing fiber runs and RF resources to deliver the RF to the tunnel or subway. The RF can be combined in multi-carrier "base station hotels" that can be located miles away from the DAS. This centralization of base station resources reduces capital expenditures and operating costs.

Installation References

ADC systems have been widely deployed in tunnels and subways worldwide, including the Chesapeake Bay Bridge tunnels, Harbor and Ft. McHenry Tunnels in Baltimore, Maryland; Mexico City Subway System, Midtown and Downtown Tunnels in Norfolk, Virginia; New York City Transit Authority, the Squirrel Hill, Fort Pitt, and Pittsburgh Airport Tunnels in Pittsburgh, Pennsylvania; Santiago, Chile Subway System; Sofia, Bulgaria Subway System; Sucre, Bolivia Subway System; and Washington Metropolitan Area Transit Authority.

Features and Benefits

- Prism is scalable and modular, supporting multiple frequency (non-contiguous segments of 1.5 to 75 MHz) bands and wireless protocols
- BTS future-ready interface supporting RF and OBSAI/CPRI standards
- Transport rates support use of dark fiber and millimeter wave
- Embedded element management system, supporting end-to-end alarming and management via a web-based access and SNMP
- Fully sealed, maintenance free electronics for harsh outdoor applications
- Multifunctional RF distribution system reduces CAPEX and site development
- High power output and lossless fiber transport system
- "Backfire" deployment architecture minimizes interference between remote antennas

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