POWERSHIFT® METRO FOR RAIL AND ROADWAY NETWORKS

APPLICATION NOTE

INTRODUCTION

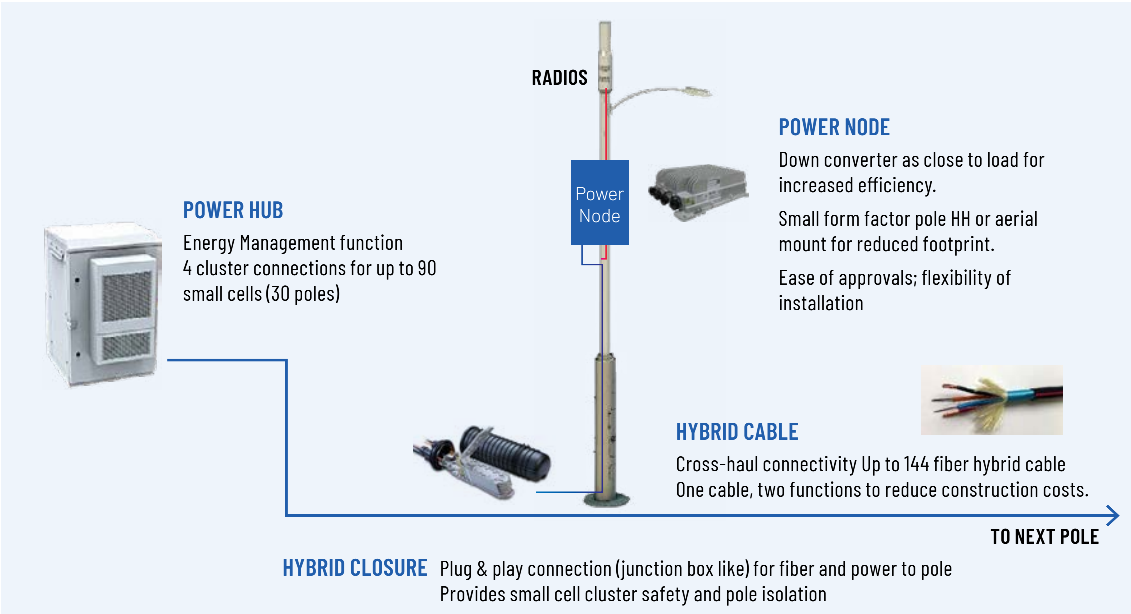
As demand for high-speed, uninterrupted wireless connectivity grows along transportation corridors, mobile network operators face increasing pressure to densify 5G networks across rail and roadway systems. Train passengers and operators alike expect seamless coverage from station to destination, yet delivering consistent, high-capacity service along long-distance routes presents significant infrastructure challenges. This application note introduces the PowerShift® Metro solution—an innovative, centralized power and fiber distribution system designed to simplify small cell deployment, reduce costs, and enhance network performance across rail and roadway environments. Through a real-world metro rail case study, the document outlines how PowerShift Metro enables faster deployment, greater design flexibility, and a more sustainable approach to powering next-generation transportation networks.

Network challenges

Mobile network operators (MNOs) are in a race to increase 5G network density along high-traffic, long-distance transportation lanes, including railway tracks and busy roadways. Today's passengers expect it, and railway operators need it for their internal operations. Delivering ubiquitous coverage alongside tracks and roads, however, is becoming more difficult for MNOs.

Most transportation use cases require highly predictable and consistent RF patterns to project at 180 degrees from each over long distances. To ensure necessary blanket coverage, MNOs are adding more small cells to fill the coverage gaps in their macro network. Each small cell has specific power and fiber requirements that mobile operators must deliver on in the most efficient way possible.

Typically, individual power drops are needed at each cell site, forcing MNOs to design the network based on the availability of power—sacrificing network coverage and capacity in the process. Even if every small cell were in proximity to a power access point, each small cell must be supplied with its specific fiber needs. More than providing small cell coverage and capacity, MNOs must manage their growing network complexity while ensuring reliable, flexible power and fiber connectivity to every small cell.



PowerShift Metro simplifies the distribution of power and fiber to small cells providing a separate power feed from a central location, eliminating the need for an onsite power rectifier and meter, and relieving equipment congestion at the small cell pole.

Solution overview

Power Hub

The solution is built around the Power Hub—a compact, standalone unit that contains a rectifier, site controller and battery backup, is located near the small cell cluster, and connects to an AC service supply. The Power Hub can be deployed wherever there is access to power and network fiber, and it contains enough battery backup to deliver full power to the small cells should the grid power fail. One Power Hub supports up to four small cell clusters arranged in a hub-and-spoke architecture.

Hybrid, Power + Fiber, Cable

Each Power Hub provides power and fiber to the cells within their assigned clusters. A single hybrid cable delivers up to 10 kilowatts of power and as many as 144 fiber strands to small cells located up to 2 kilometers away.

Hybrid (Power + Fiber-optic) splice closure (FOSC)

The ANDREW FOSC-450D hybrid closure connects each small cell to its Power Hub. It has a capacity of up to six drop cables in addition to a feed-through cable. Measuring 75 cm (30 inches) in length and 29 cm (11.5 inches) in diameter, the FOSC-450D hybrid closure can be deployed in a vault, on an aerial strand, or on a pole to ensure minimal visual impact.

Solution architecture

The PowerShift Metro solution uses a hub-and-spoke architecture, with each Power Hub supplying fiber and power to the small cells in its assigned clusters.

Features and benefits

Fast deployment, lower costs

- Hybrid cable and quick-deploying hybrid closure reduce cable and construction costs up to 50%
- Factory connectorized cables provide consistent and reliable plug-and-play efficiency
- Completely modular design and repeatable architecture scale effortlessly and quickly
- Long-reach powered fiber enables ideal cell location for optimized capacity and coverage

Centralized management, individual flexibility

- Configurable conductor and fiber count provides 200-4,000 watts and up to 144 fibers per site
- Auxiliary Controller Shelf (ACS) at each Power Hub centralizes power and backup energy
- Power to each cell can be converted to AC and/or direct current (DC) voltage
- Variable voltage and boosted distributed bus enable peak shaving and load balancing

Low visual impact

- Compact Power Hub and FOSC increase design options for easier permitting
- One Power Hub can service as many as four small cell clusters
- FOSC can be deployed via vault, aerial strand or pole to minimize visibility
- Power Hub houses power rectification/backup equipment, minimizing small cell size

Application: Metro Rail Network

Scope

The application involves a North American metro area commuter rail line consisting of ~254 km (158 miles) of track. The required coverage extends along both the roadways and tracks. Meeting commuters' communication needs requires at least 274 km (170 miles) of hybrid power/fiber cable, 20 Power Hubs, and more than 330 small cell sites.

Application parameters

- Single cable along track or roadway, using a bus configuration
- Trunk splits at track switches and tunnel splits
- Continuous run of hybrid cable
- Halogen-free trunk cable within the tunnels and stations

Key information needs

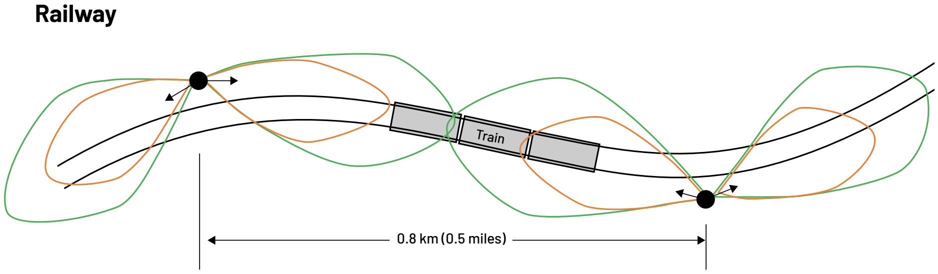
Network designers must determine:

- Power and fiber requirements for each small cell
- Minimum number of Power Hubs for each railway station or roadway service area
- Fiber count (including redundancy) from each railway/roadway station to each small cell
- Location of AC feed and network fiber with power and fiber distribution routes
- Power/fiber split locations to enable one cable in the wayside troughs, tunnels, and stations
- Mounting locations for each Power Hub, FOSC, and power node.

Solution design

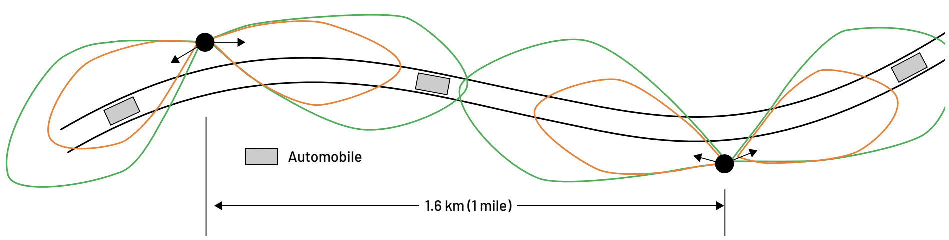
The solution design is divided into two topologies—one that supports coverage along the rail line and another for coverage along the roadway.

Railway



- 274 km (170 miles) of new, halogen-free hybrid cable—106 km (66 miles) of which is inside tunnels and railway stations
- 330 power nodes and 380 FOSCs terminate power/fiber along wayside splits, tunnels and rail splits
- 20 Power Hubs used, providing 76 kW of power to support 330 network devices

Roadway



- 22 km (14 miles) of roadway coverage via 13 small cell or mini-macro sites
- Power and fiber are not available today at these sites
- Fiber can be brought into one location for distribution via hybrid cable to the rest of the sites
- Four Power Hubs distribute approximately 60 kW of power (15 kW per site)
- Lower gauge conductor to minimize line losses.

Results

- The number of AC connections was reduced from 330 to 20 for the railway application—all of which used existing AC power feeds at the railway stations
- Reduced expensive AC service panels by a factor of four for the roadway application, significantly reducing the cost of power
- The hybrid cable and flexible FOSC closure enable a low-profile solution and simplified deployment
- Streamlined design supports future ICT expansions via railway/roadway conduits and micro-trenches
- Utilizes highly reliable FOSC 450D hybrid closures, field-tested and proven over three decades; well known, understood, and trusted by installers, the FOSC 450D deploys quickly with virtually no learning curve

Conclusion

Train travel is an efficient and more sustainable mode of transportation, especially when it offers high-capacity, seamless wireless coverage from station to destination. Delivering on this expectation increasingly relies on the deployment of small cells that are easy to install, power, and connect with fiber.

As demonstrated in this application note, the PowerShift Metro solution provides a more agile, reliable and cost-effective alternative to conventional grid power. Controlled by the mobile operator, it provides a separate power feed from a central location—eliminating the need for an onsite power rectifier and meter and relieving equipment congestion at the small cell pole. The result is significant savings, greater design flexibility, easier management and more.

The entire PowerShift Metro platform is designed, engineered and supported by ANDREW, a leading global provider of leading-edge outdoor wireless network solutions. With nearly half a century of experience and a comprehensive range of resources, tooling and technical expertise, ANDREW supports you through the entire process: from planning and design to commissioning, deployment and testing. One partner—a world of opportunities.

Since 1937, ANDREW, an Amphenol company, has driven the evolution of wireless technology. Trusted by mobile network operators and enterprises globally, we work closely with our customers to deliver innovative solutions that enhance connectivity experiences both outdoors and indoors. Our dedicated global team is committed to advancing the industry, fueled by the vision that a better-connected future is possible.

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