

Kirunavaara and Gällivare

**COVERAGE
SYSTEMS**


Powerwave GSM Coverage Solutions Deployed in Kirunavaara and Gällivare Mines

Reduce Initial
Investment &
Lifetime Costs

Complex Environments

Speedy Implementation

Challenge

Conduct a site survey within this challenging underground environment determining the most efficient technology and system design that would provide a GSM coverage solution throughout.

Solution

Two base stations, one base station master unit, fiber optic repeaters, a distributed antenna system and the utilization of a wavelength division multiplexing technology (WDM) as a cost saver for limited fiber optic capacity.

Result

An efficient GSM cellular coverage solution throughout the mine to include 15 km of transport road, offices, workshops and restaurants.

Powerwave and Swedish telecom operator Telia Mobile Luleå successfully implemented GSM coverage in the Kirunavaara and Gällivare mines in northern Sweden. The Kirunavaara mountain contains the world's largest subsurface iron-ore mine, owned by Luleå Kirunavaara AB (LKAB). The new system is part of a novel communications solution for LKAB provided by Telia. LKAB implemented the GSM system to replace an existing internal VHF safety and communications system. Miners can now use GSM cellular phones all the way down to the deepest level, some 1045 meters below.

The Kirunavaara mine Transport roads wind through long tunnels down into the mine, to restaurants, tool shops, offices, and production facilities at various levels. Roughly hewn wall surfaces glisten wet, with average temperatures hovering around +10°centigrade – truly a challenging environment for implementing cellular coverage.

Site Survey The purpose of the Coverage System Innovations site survey was to pinpoint suitable repeater sites and antenna locations, and where to drill holes for the shortest possible routes for fiber optic and coaxial cables. RF propagation measurements were taken throughout the mine. With fiber optic cables up to 7 km long, good signal overlap in hand-over zones was a crucial factor. Other vital considerations in designing the system focused on timing advance and multi-path limitations.

System Design Two base stations were installed at the 775 m level. One of these base stations serves a tool shop and offices on one level. Both base stations transmit low-level signals to the Powerwave base-station master unit located in the service area. The transmitted signal modulates lasers in the base-station master unit, which fiber optically distributes the signal to the fiber optic repeaters. Each repeater receives, filters, and amplifies the GSM signal, then retransmits it via a distributed antenna system, covering a well-defined section of the mine.

Saving money on optical fiber With only limited fiber optic capacity available in the mines, a system using wavelength division multiplexing technology (WDM) was chosen. In such a system, optical uplink and downlink signals share the same optical fiber. To match cell sectorization, each fiber optic repeater has its own optical transceiver in the base-station master unit.

Hands-on training Early on in the project, a live test of the system was run at the Telia Mobile office in Luleå, northern Sweden. Commissioning activities were combined with a course on fiber optic repeaters, and with practical on-site training for installation and service personnel.

Mines



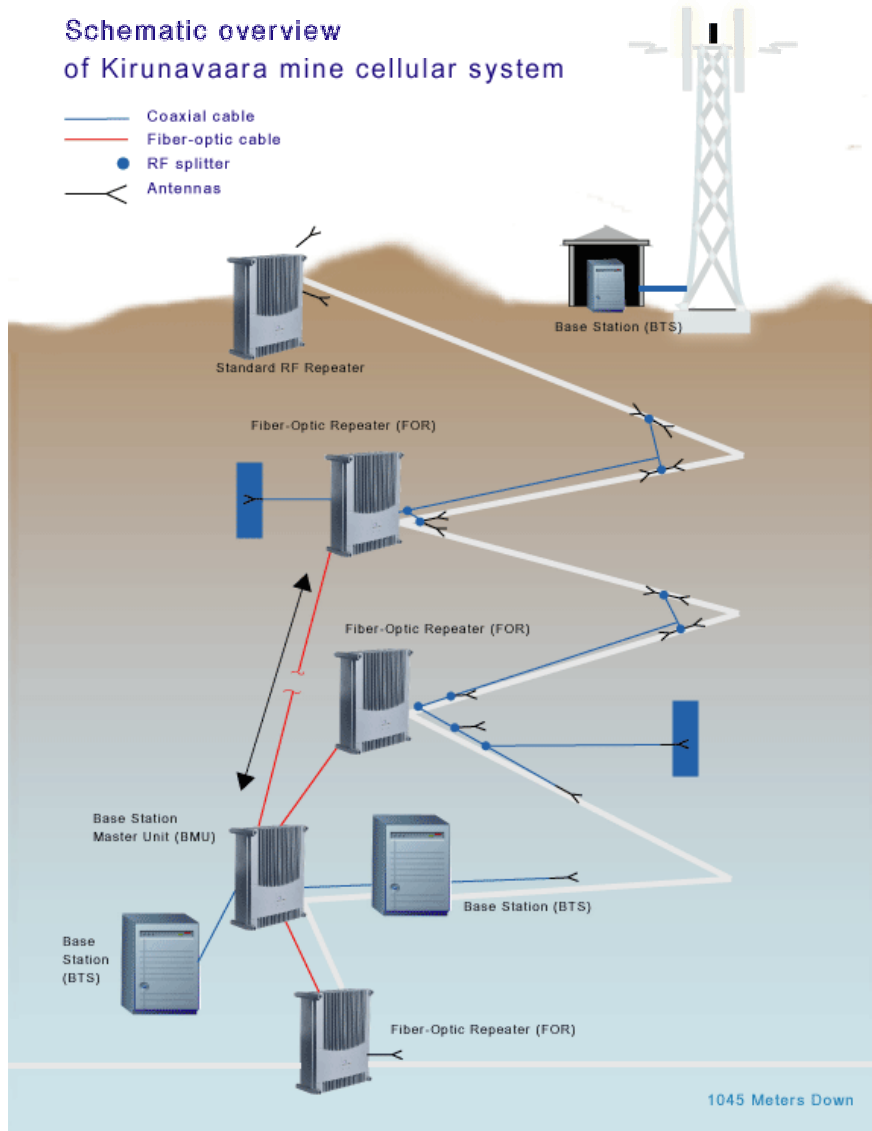
Powerwave's Coverage System Innovations Team are a team of RF- and system engineers within Powerwave who manage, or assist you in, your projects for cellular coverage worldwide. Increasing complexity of wireless systems today combines with regulatory restrictions and a variety of practical considerations to demand comprehensive experience and know-how for cost-efficient cellular coverage solutions. Based on Powerwave's outstanding track record of customer projects completed, and on our extensive experience and know-how in quality wireless communications, Powerwave offers novel solutions that are carefully tailored to your specific needs.

System Verification At system start-up, optical and RF output power was checked and general system performance verified. Fiber optic repeater and base-station parameters were then optimized for hand-overs, signal strength, call quality, and system sensitivity.

Final optimization was performed using TEMS equipment and analyzers. Some 15 km of transport road, offices, workshops and restaurants inside the mine now had efficient cellular coverage. Finally, the system was thoroughly documented, then turned over to LKAB.

Schematic overview of Kirunavaara mine cellular system

- Coaxial cable
- Fiber-optic cable
- RF splitter
- < Antennas



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