# COMMSCOPE®

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The Gotthard Base tunnel

CommScope® provides reliable DAS (Distributed Antenna System) coverage 2,300 meters underground at 250 km/h

At times we can't even get a strong enough cell phone signal in our own home. Imagine being asked to provide reliable, consistent signal strength for passengers speeding through the Swiss Alps at 250 kilometers per hour. That's right, through the Alps, not over or around them.

In 1998, the Swiss government envisioned a high-speed rail line connecting the international trading hubs of Zurich, Switzerland and Milan, Italy. Only one thing stood in the way: The Swiss Alps. The solution was a 57-kilometer subterranean rail line blasted and bored through solid rock. Now open, the Gotthard Base Tunnel is officially the world's longest railway tunnel.
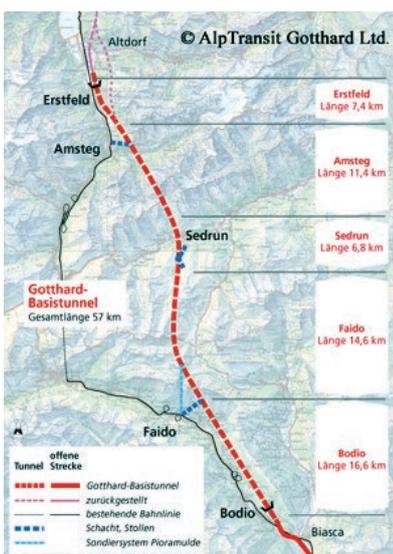
"We needed a versatile, multi-functional system that could handle essential, emergency and commercial communications. CommScope has the proven experience to deliver reliable, active equipment in such scenarios," said Ivo Abrach, General Program Manager at Nokia.

Services:

400 MHz:	PMR
900MHz:	GSM-R, GSM, UMTS
1800 MHz:	GSM, LTE
2100MHz:	UMTS
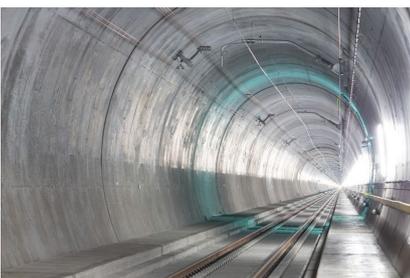
Nokia selects CommScope for the solution

AlpTransit Gotthard, a wholly owned subsidiary of the Swiss Federal Railways, completes construction on the Gotthard Base Tunnel in December of 2016 as part of a new flat rail link through the famous mountain range. Transtec Gotthard, a consortium of four industry leaders, contracted for the provisioning of the railway technology. Initially Alcatel-Lucent Switzerland, and now Nokia, is the partner responsible for furnishing telecommunications and tunnel control technology.

The sheer scope and complexity of the project was literally unprecedented. No less daunting was the job of ensuring that railway employees, train operators and dispatchers can communicate with each other deep underneath 2,300 meters of Alpine granite. To make that happen, Nokia trusted one of the premier global RF solutions providers, CommScope®.

Project parameters and objectives

As the in-tunnel DAS provider, CommScope engineers were asked to design, commission and provide system integration support for the DAS solution. The technical requirements were significant. Trains must be able to connect reliably and seamlessly to the railway's GSM-Railway (GSM-R) network—the system that allows train operators, dispatchers and in-train personnel to communicate. The DAS must also support traffic from public GSM-900MHz and GSM-1800MHz networks, one UMTS 2100MHz network and the PMR-400MHz public safety network. On top of that, the system also supports the LTE-1800MHz public traffic. The objective was to ensure accurate, precise voice and data signal handoffs while trains speed through the tunnel at up to 250 kilometers per hour.

The sheer length of the Gotthard Base Tunnel was also a challenge, since it actually consists of two main parallel bores running in opposite directions—each 57 kilometers in length. An additional 43 kilometers of access and service tunnels require reliable signal strength for critical maintenance and emergency response communication. In total, the project required 153 kilometers of spotless wireless coverage.

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ION®-M—the high-speed railway coverage solution

ION®-M is the heart of CommScope's DAS solution. It is a highly customizable, advanced multi-band, multi-operator, fiber-based DAS that uses master control units connected to multiple remote repeaters via fiber optic cables. It features:

- A radio-over-fiber (RoF) platform that adapts to all existing optical distribution scenarios, while providing exceptional coverage and low interference. This platform ensures that the solution can be upgraded and extended as requirements change.

- Built-in redundancy capabilities that are easily and remotely configured to maintain 99.999% system reliability that is critical to GSM-R and PMR network performance. The system also has on-board AGC (automatic gain control) that enables it to dynamically compensate for optical link loss. This will ensure constant gain regardless of how the link budget changes.

- Remote monitoring and configuration via A.I.M.O.S.™ (Andrew® integrated management and operation system), a proprietary solution that simplifies everything from system supervision and performance oversight to detailed, real-time fault tracking.

A simple, elegant solution to a massive, complex challenge

CommScope engineers began designing the solution by separating the needs of the higher reliability GSM-R and PMR networks from the commercial networks. The GSM-R and PMR networks were assigned to a main system. A parallel system would be responsible for supporting GSM and UMTS commercial networks, including a redundant GSM-R signal.

The completed ION-M DAS solution consists of 31 master control units (17 on the main system and 14 on the parallel system) and approximately 690 remote repeaters. Andrew® RADIAX® radiating cable uniformly distributes the signals from the remote repeaters throughout the main tubes and access tunnels. CommScope used an estimated 150 kilometers of RADIAX cable to ensure complete coverage.

CommScope provides proven expertise and demonstrated success

Through its Andrew® railway connectivity portfolio, CommScope has built an impressive resume of successful high-speed rail projects. The first Andrew® DAS for railway tunnels were developed in the 1980s for use in the construction of the Channel Tunnel—the world's longest underwater passage, connecting England to France. Since then, CommScope has provided critical communication networks for rail projects in Italy, Taiwan, Spain, Switzerland, Canada, Russia, China and Norway.

"Railway systems rely on clear, constant communication among train engineers and control centers for smooth and safe operation," said Markus Kalt, Vice President Business Operations, EMEA, Distributed Coverage and Capacity Solutions, CommScope. "We were honored to be selected to supply coverage solutions that help ensure vital data exchanges."

The Gotthard Base tunnel will to open to rail traffic in December 2016, but long before Zurich and Milan are actually connected, Swiss Federal Railways can be confident that passengers will experience dependable in-train wireless coverage—even at 250 kilometers per hour, nearly two miles beneath the Alps.

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CommScope (NASDAQ: COMM) helps companies around the world design, build and manage their wired and wireless networks. Our network infrastructure solutions help customers increase bandwidth; maximize existing capacity; improve network performance and availability; increase energy efficiency; and simplify technology migration. You will find our solutions in the largest buildings, venues and outdoor spaces; in data centers and buildings of all shapes, sizes and complexity; at wireless cell sites and in cable headends; and in airports, trains, and tunnels. Vital networks around the world run on CommScope solutions.

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