Marmaray tunnel

Under the sea: public safety, cellular and GSMR Coverage in the Marmaray Tunnel

Overview
The project involved providing public safety, cellular and GSM-R connectivity for the Marmaray underground tunnel, a 13.6km long section of the Marmaray rail project.

The tunnel connects Europe to Asia via an undersea tunnel crossing the Bosphorus strait. It is of significant strategic importance to Turkey, so a solution was required which would deliver reliable connectivity to the rail operator, the emergency services and commuters.

Challenge
Undersea tunnels are a challenging environment to provide coverage. Users of the network should also not experience loss of communication while entering or exiting the tunnel, which provides an additional challenge. A solution was required that would be capable of providing consistent and reliable public safety, cellular and GSM-R connectivity throughout the tunnel.

With such a critical project, it was also important that the deployment was completed in time for the official opening of the tunnel.

The Tech

- The tunnel repeater system consists of master units and remote units
- Cobham Wireless provided the tunnel repeater system, which forms the core of the radio system
- Master units act as the central point for services to be re-transmitted, with remote units placed at the specific areas which need to be covered
- Master units are connected to operators' base stations, and transmit the optical signals to twenty-one remote units which convert the signals to radio frequency and amplify them to the necessary level.
- The signals are fed into the DAS, which consists of cables, antennas, splitters and couplers.

The Challenge

The Marmaray tunnel is a 13.6km long undersea tunnel, with three underground stations along the route. The tunnel connects Europe to Asia via the Bosphorus strait. The project required providing public safety services and critical communications to the emergency services (police, fire service and ambulance service).

Cellular connectivity was also required to connect rail passengers using three Turkish operator networks, and GSM-R connectivity needed to be provided for the rail operator. Therefore, a system was needed that could accommodate multiple radio technologies such as TETRA, UHF and VHF analogue (later migrated to VHF APCO), GSM, UMTS and GSM-R. All of these services needed to be provided simultaneously and without a coverage gap from outside to inside the tunnel.

Undersea tunnels are a challenging environment to provide reliable and consistent coverage, due to the construction materials used, the limited space available inside the tunnel and difficulty of access to the tunnel itself.
With such a critical project, it was also important that the deployment was completed in time for the official opening of the tunnel by the Turkish Prime Minister.

The Solution

Cobham Wireless was chosen by AIR Telekomünikasyon Çözümleri Tic. San. A.Ş. as the partner to implement the Tunnel Radio System for entirety of the Marmaray tunnel crossing, including underground stations, technical buildings and shafts.

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The master units are connected to operators' base stations, and transmit the optical signals to twenty-one remote units which convert the signals to radio frequency and amplify them to the necessary level. The signals are then fed into the distributed antenna system, which consists of cables, antennas, splitters and couplers.

Cellular repeaters on the remote sites broadcast signals for each service (public safety, cellular, GSM-R) via leaky feeder cables and antennas in the underground stations.
All equipment used was designed to support two different power sources, so that in the case of power failure in the first source, equipment would continue to operate using secondary power source.

The immersed section of the tunnel required the equipment to be in stainless steel cases. In the stations and buildings, racks were installed in assigned equipment rooms. Cobham Wireless manufactured three types of units to install: Rack mount units for buildings, wall mount units for tunnel cross passages and stainless-steel wall mount units for immersed tunnel locations.

The Benefit

The tunnel now provides seamless connectivity to all emergency services networks, GSM-R to the rail operator and 2G and 3G connectivity to commuters across three Turkish operator networks. The tunnel network infrastructure is also able to support 4G should operators choose to deploy it.
The project was delivered on-time for the opening of the tunnel and all subsequent upgrades have been successfully carried out without disruption to services.

"AIR and Cobham Wireless had successfully worked together in the past for a project on the Istanbul metro line, so we knew Cobham would be a reliable partner for the Marmaray tunnel project" said Levent Ergun, Sales and Business Development Director, AIR

"Teams from both companies were highly committed to the project from the outset, understanding the strategic importance of the crossing to the Turkish government.

"Thousands of commuters and tourists are now using Marmaray to travel from one continent to another, with seamless connectivity. Both companies continue to deliver results, such as new developments and maintenance of the system.

"Being an exceptional project, Marmaray has set the standards higher than any other transportation project in Turkey."