Marmaray Tunnel

Under the sea: public safety and cellular coverage in the Marmaray tunnel

Case Study

The most important thing we build is trust

Overview
Deploying a communication network that can provide seamless coverage throughout the length of the tunnel for both public safety and commercial use.

Challenge
Enabling emergency and commercial communications into the tunnel situated under the sea. The tunnel totalled 13.6km in length and has to contend with extreme heat and the possibility of earthquakes.

The Challenge
In 1860 an Ottoman sultan came up with the idea of tunnelling under the ocean, to join Europe and Asia in a complex undersea engineering project.

Over a century later, work finally began in 2004, but archaeological excavations further delayed the construction efforts until 2013; when the tunnel opened.

The tunnel was officially opened by Turkish Prime Minister Recep Tayyip Erdogan on 29th October, 2013 – poignantly, which also happened to be the 90th anniversary of 'Republic Day'.

The railway tunnel underneath the Bosphorus Strait comprises of 1.4km of underwater tunnel, with the total length reaching 13.6km and it sits at 60 metres below sea level. The rail service will be capable of carrying 75,000 people per hour in either direction, from the east side of Istanbul to the west and back again.

As a brand new construction project capable of carrying such a high number of passengers, and with no legacy infrastructure, it was important to commission a communications network for both public safety services and the public to keep them all safe and 'connected' on their journeys. But the project brought challenges such as working in the confined environment of a tunnel, using equipment that could withstand dust and high temperatures and even taking into consideration the very real threat of earthquakes in the region.

An example of a 900/2100MHz multi-band fibre remote unit used to provide cellular coverage

The Solution

Due to the challenges and constraints that this project would bring, Cobham Wireless was commissioned to provide TETRA, GSM-R, VHF and cellular 2G and 3G coverage using the latest in fibre-optic DAS (Distributed Antenna System) technology.

A DAS can be fed using a base station close-by, a base-station located off-site, or alternatively it can be fed using an off-air digital repeater. A master unit then takes the Radio Frequency (RF) signal and converts it into optical signal, then re-distributes it through fibre optic cable to a series of optical remotes. The signal is then converted back at the remote unit and distributed to the network users via a series of coaxial cables, antennas and leaky feeder cable.

In this deployment, all technologies share the same DAS infrastructure within the tunnel. The VHF signal is collected via an off-air repeater. The TETRA, GSM-R and cellular signals are all received from a series of base stations located at various train stations on the network.

The DAS is made up of a number of remote units and a significant amount of leaky feeder cable placed within the tunnels and stations.

For the cellular network, 18 dual-band 900/2100MHz remotes were deployed. For the GSM-R coverage, 18 channel selective remotes were used. Providing the public safety coverage involved 63 band selective remote units in total and 6 channel selective units (covering Police, Fire and Ambulance). 21 band selective remotes were used to provide the TETRA coverage for train communications and the TETRA, GSM-R and VHF networks are all fully redundant.

The tunnel section allows for two, bi-directional tracks to be used by commuter and long-distance trains. The TETRA equipment supplied by Cobham Wireless was used to provide train communications coverage for the commuter trains and the GSM-R equipment was used to cover the high-speed long-distance trains.

Both VHF and cellular 2G and 3G coverage was provided across all tunnels.

The Benefit

This deployment brings a series of benefits to different stakeholders.

The Marmaray website confirms that "Istanbul is a city where historical and cultural values must be preserved and at the same time modern railway facilities have to be installed to decrease the environmental impact of public transportation and increase the capacity, reliability and comfort of the railway systems".

Passengers that travel through the tunnel will now remain 'connected', allowing them to continue to communicate with the outside world via phone, text and email even though they are 60 metres below sea level. For the commuter trains this is essential, as passengers often use their travel time as part of their working day.

When it comes to the public safety coverage of the tunnel areas, regulations are stricter than ever. The system that has been deployed within the tunnel allows emergency services workers and train personnel to communicate if the worst should happen. Providing fully redundant, reliable public safety coverage was a must for this deployment.