

# DAS Solution for EurAsia Tunnel

## Providing tunnel network connectivity across Europe-Asia



EurAsia Tunnel in  
Istanbul, Turkey

### Tunnel Coverage Challenges

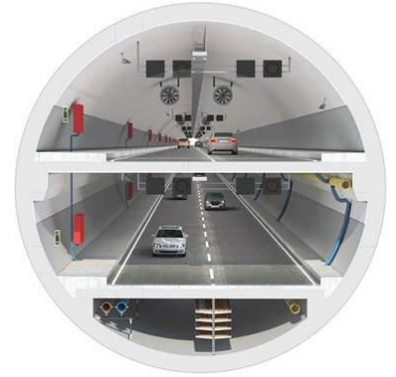
Network coverage systems for tunnel solutions can often be designed by combining DAS with radiating cables. The precise approach and implementation, however, is greatly dependent on installation limitations and challenges inside the tunnel.

In terms of RF design, we need to ensure a smooth handover among different tunnel sectors. It is also crucial to provide sufficient signal levels and consider the capacity design for the vehicles moving in and out of the tunnel. Radiating cables need to be mounted at the elevation level of vehicle windows to allow penetration of mobile signal which aims to ensure continuous network coverage inside the tunnel.

In a nutshell, a careful design practice and detailed tunnel coverage planning will help assure a superior user experience and an efficient mobile network operation under restricted circumstances and requirements.

### Project Background

The EurAsia Tunnel (Avrasya Tüneli in Turkish) is the first undersea road tunnel connecting Europe and Asia crossing the Bosphorus strait. The 5.4km double-decked tunnel connects Kazlıçeşme from the European part of Istanbul to Göztepe, the Asian part via a 14.6km route, crossing the seabed beneath the Bosphorus. In this project, Comba Telecom provided a turnkey solution where the ComFlex Modular Distributed Antenna System (DAS) was deployed to support seamless user experience and stable network connectivity inside the tunnel.



### Solution

Working together with the local partner, Comba Telecom offered an end-to-end mobile coverage and capacity solution accommodating multi-operator and multi-technology to support 2G GSM900/1800, 3G UMTS2100, 4G LTE1800 and upgradable LTE2600 systems inside the EurAsia tunnel.

ComFlex active DAS products comprising of Active Conditioning Unit (ACU), Combiner Unit, Optical Control Unit (OCU) and Remote Unit (RU) were supplied for this project. The RUs are mounted on the tunnel wall with leaky cables to provide simplex transmission coverage along the tunnel. Within the tunnel, the RU separation distance between East Bound and West Bound is about 700m.

Figure 1 shows the tunnel network sectorization. Each tunnel deck has 2 sectors for GSM, UMTS and LTE systems. Only UMTS2100 coverage is required in invert tunnel sections using base station or RU as a source for Sector 3 & 4.

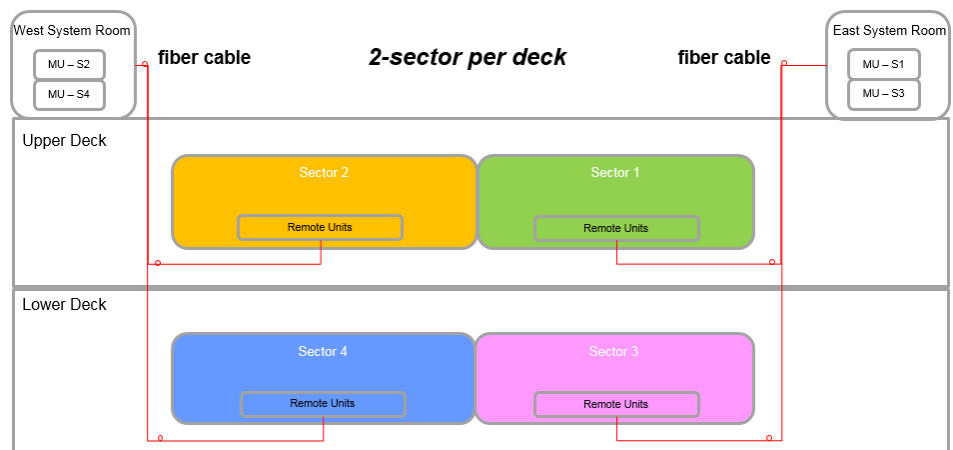


Figure 1: Tunnel Network Sectorization

The transmit (TX) and receive (RX) signals for each operator and mobile systems are combined and distributed through the ACU into a combiner unit. The combined signals are then converted to optical signals and transmitted via fiber network to the RU and eventually to the DAS network of the EurAsia tunnel. Traditionally, customized POI is required at the front-end of the tunnel DAS network, but such customization typically results in longer product lead time and reduced flexibility. To address this concern, the modular design of Comba's ComFlex ACU can support any combinations of all commonly deployed EUTRA frequency bands.

All 3G and LTE drive test results passed the Acceptance Test Procedures. Details are shown in the table below.

ASYA-AVRUPA 3G Band 2100 SITE GENERAL SUMMARY					
Operator	SC	RSCP (dBm)	ECNO (dB)	DL PHY (MAC/RLC) Average Rate (Mbps)	UL PHY (MAC/RLC) Average Rate (Mbps)
Operator A	001-491	-69.99	-3.96	24.75	3.64
Operator B	016-395	-70.7	-3.7	24.55	19.46
Operator C	348-498	-71.0	-4.8	48.06	27.25
Criteria		> -72 dBm	> -8 dB	> 10 Mbps	> 2 Mbps

AVRUPA-ASYA 3G Band 2100 SITE GENERAL SUMMARY					
Operator	SC	RSCP (dBm)	ECNO (dB)	DL PHY (MAC/RLC) Average Rate (Mbps)	UL PHY (MAC/RLC) Average Rate (Mbps)
Operator A	002-493	-69.81	-3.37	29.39	3.68
Operator B	012-349	-70.7	-5.6	25.92	15.75
Operator C	090-338	-68.3	-4.9	47.96	23.45
Criteria		> -72 dBm	> -8 dB	> 10 Mbps	> 2 Mbps

ASYA-AVRUPA LTE 1800 SITE GENERAL SUMMARY					
Operator	PCI	RSRP (dBm)	RSRQ (dB)	DL PHY (MAC/RLC) Average Rate (Mbps)	UL PHY (MAC/RLC) Average Rate (Mbps)
Operator A	492-475	-74.46	-8.34	63.55	34.54
Operator B	501-187	-76.5	-7.9	76.57	20.89
Operator C	501-503	-77.7	-10.0	66.02	10.17
Criteria		> -85 dBm	> -12 dB	> 34 Mbps	> 5 Mbps

AVRUPA-ASYA LTE 1800 SITE GENERAL SUMMARY					
Operator	PCI	RSRP (dBm)	RSRQ (dB)	DL PHY (MAC/RLC) Average Rate (Mbps)	UL PHY (MAC/RLC) Average Rate (Mbps)
Operator A	491-472	-77.81	-8.18	59.52	18.81
Operator B	503-186	-75.7	-8.7	59.95	16.61
Operator C	485-493	-74.2	-8.5	54.31	11.94
Criteria		> -85 dBm	> -12 dB	> 34 Mbps	> 5 Mbps

Comba's turnkey ComFlex DAS solution provides professional services such as system design, commissioning, technical support and maintenance services. The ComFlex system brings together the latest wireless technology with high capacity and comprehensive multi-band functionality. It is an award-winning solution and is one of the most flexible active DAS offerings in the market today.



## Equipment

ComFlex Modular Active DAS Products:

- Active Conditioning Unit (ACU)
- Combiner Unit
- Optical Control Unit (OCU)
- Remote Unit (RU)



## Product Features

-- The multiband DAS system is designed especially for multi-operator & multi-technology coverage inside the tunnel. The Remote Unit is IP65 with convection cooling chassis for tunnel wall installation.

-- Industry's most efficient and compact Remote Unit, for space restricted/site limited installation.

-- User friendly web GUI which supports remote monitoring and control of all different models/types of Comba's remote units along the tunnel.

## Site Photos

RU mounted on the road tunnel wall



ACU & OCU installed in equipment room



Commissioning

