Offshore link

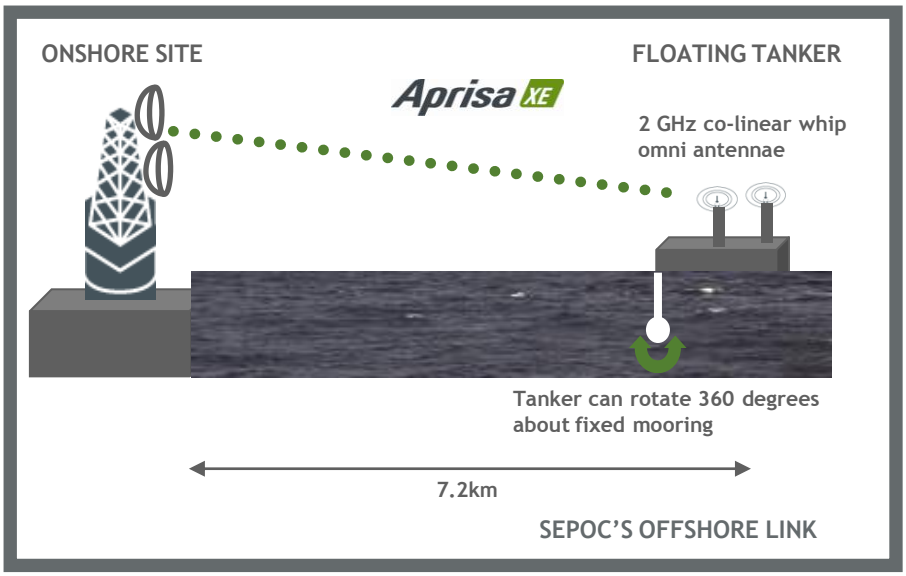
Technical Case study

Achieving challenging offshore link to floating oil platform

When SEPOC, the Republic of Yemen's leading national oil and gas company, needed to upgrade its communications network, particular challenges were presented by the link between its onshore facilities and its floating storage and offloading (FSO) facility, 7.2 km off the coast of Yemen in the Red Sea. A constant connection needed to be maintained, despite the over-water link and the constant movement of the FSO. 4RF implemented a hitless space diversity link, using the 2 GHz band, to provide a reliable high bandwidth link, delivering 24 Mbit/s capacity to the FSO.

Project background

In offshore oil operations it is common to have a floating storage and offloading (FSO) or floating production, storage and offloading (FPSO) facility moored close to an offshore manned or unmanned platform or over undersea wellheads. The FSO collects, processes and stores crude oil, which is then offloaded to tankers for transport, or piped along the seabed to an onshore facility. Communications between the FSO, offshore platforms and the onshore facility are vital for ensuring the safety of the offshore crew as well as providing accurate production information and basic communications such as voice and Internet / LAN access.



The project in brief

- SEPOC: the Republic of Yemen's leading national oil and gas company
- 7.2 kilometre link from onshore site to offshore FSO, with considerable deployment challenges
- 24 Mbit/s capacity reliably and effectively delivered using hitless space diversity link in 2 GHz band
- Considerable deployment advantages over higher frequency microwave systems, including achievable distance and solution cost

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Key challenges

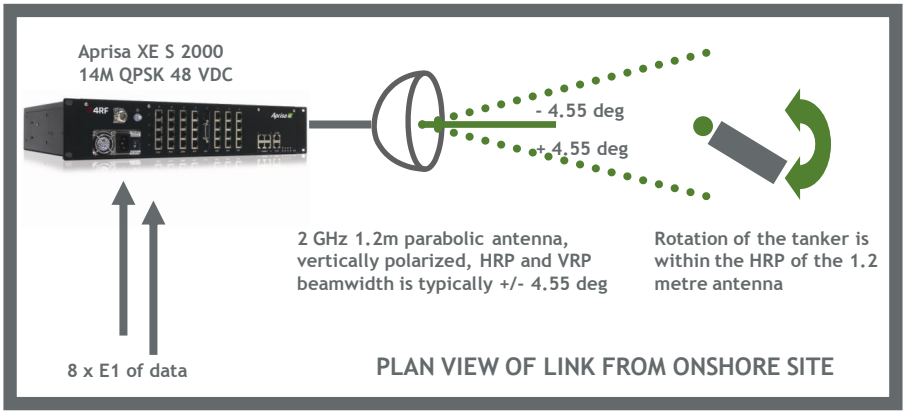
The link between the shore and the floating tanker had to ensure constant communication in both directions, despite the over-water path made even more complicated by tidal variations. Additionally, a relatively high capacity link was desired to service anticipated future traffic requirements. Reliably making this link presented 4RF with a number of complex technical challenges:

- Constant movement of the FSO in all directions, pitch, roll and height with tides, currents and variable weather
- 360 degree rotation of the 350 metre long FSO about its fixed mooring at the front of the tanker
- Changes to the above sea level height of antennas due to crude oil loading variations in the tanker changing its height by up to +/- 5 metres, further complicated by a tidal variation

Achieving the link

Parabolic grid antennas for the onshore site

The onshore site used two parabolic grid directional antennas with a beamwidth wide enough to cover the 900 metre movement of the tanker. Directional antennas were critical because the receive level had to be sufficient for the required distances. Using such directional antennas would not have been possible with higher frequencies, where the beamwidth would not be sufficient for a standard fixed antenna installation.



Omni antennas for the FSO site

On the tanker side of the link, the tanker's rotation meant that omni directional antennas were needed. Two antennas were spaced at separate locations on the FSO to ensure coverage despite the FSO's pitch, roll and height movement. The use of omni antennas was made possible, despite their reduced system gain compared with parabolic antennas, because of the low transmission loss of the low frequency Aprisa XE. At higher frequencies the higher transmission loss means that omni antennas would not be able to make the link to the floating platform, so it would have been necessary to use an antenna tracking system with high gain narrow beamwidth antennas. As well as the expense of such a system, antenna tracking systems can be unreliable at sea, because the harsh environment affects moving parts through corrosion and salt build-up, and if the signal is lost it can take several minutes to regain it due to the fact that the there is no default location for the signal, thus lowering link availability.

Hitless space diversity was essential for this deployment, as it eliminated signal fades over water caused by the changing tides and relative locations of the antennas.

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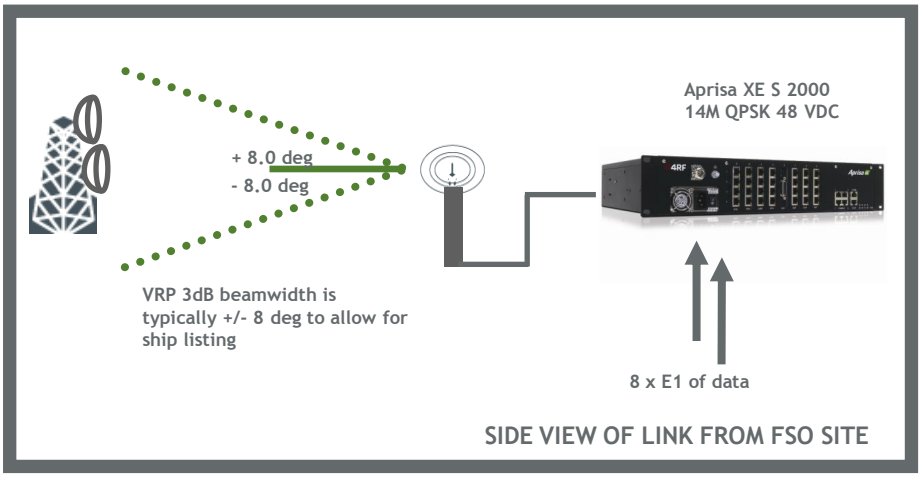
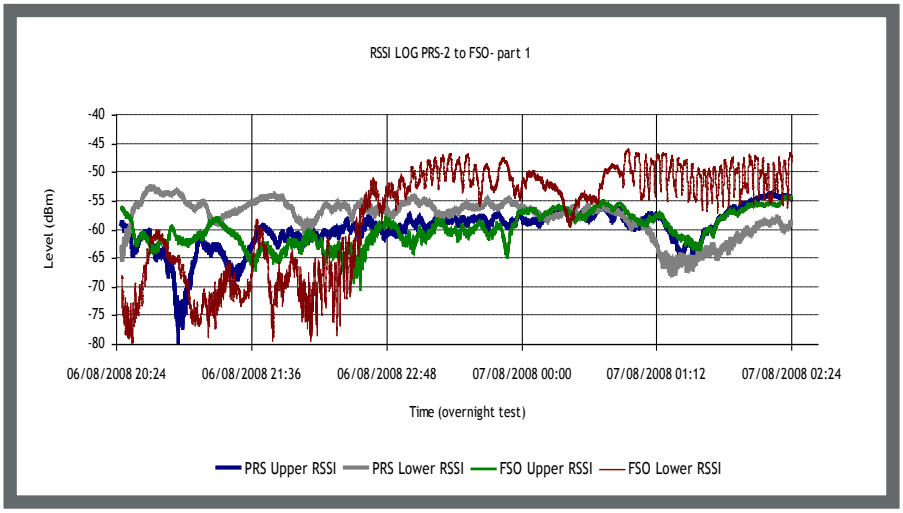
Hitless Space Diversity

The use of a hitless space diversity system was essential for this deployment, as it eliminated signal fades over water caused by the changing tides and relative locations of the antennas. The system switched to the antenna with best signal level as the platform changed relative locations. The constant rolling and pitching motion of the tanker was accommodated by the antennas' vertical beam coverage and the 360 degree transmission pattern of the omni antenna allowed the tanker to rotate completely about its mooring.



The results

SEPOC's link provides a reliable 24 Mbit/s Ethernet capacity to the FSO, with an overnight antenna receive level variation shown below. While the fade levels of the individual antenna signals vary widely, there were no traffic errors.



The success of this deployment was due to the use of the 2 GHz band, which provided significant advantages compared to higher frequencies, in terms of achievable distances, complexity and the cost of antenna systems. Correct frequency band selection, combined with the hitless space diversity configuration and antenna system design, ensured a reliable and effective link was achieved.

About SEPOC

SEPOC is the Republic of Yemen's leading national oil and gas company. It is the upstream operator of Yemen's premier Mareb Block (18) and the second largest producer of oil and gas in the country.

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Detail of link calculations

The table below shows the actual link calculations for SEPOC's deployment.

DETAIL	LINK
MEASURED LAT. / LONG.	.
ONSHORE	N 15 12 8.44 E 042 38 17.28
FSO	N 15 07 17.4 E 042 35 54.6
APRISA RADIO DETAILS	
Radio	Aprisa XE S 2000 14M QPSK 48 VDC SD
Software version	8_2_10_EA
IP setup	172.18.13.31 C Class 172.18.13.41
	172.18.13.32 C Class 172.18.13.42
INTERFACE	
Gross	Up to 11 x E1 channels or 23992 kbit/s
E1	2 x E1 unframed
Ethernet	20 Mbit/s
ANTENNA	
Type	ONSHORE: 2 x 1.2 metre parabolic FSO: 2 x vertical co-linear
Polarization	Vertical
Height	ONSHORE: 15/5 metres AGL FSO: 43/55 metres ASL*
Feeder	ONSHORE: 20/25 metres 7/8" foam filled feeder FSO: 35/25 metres
LINK DETAILS	
Calculated availability	99.99997%
RSSI: theoretical	-56 dBm
RSSI: measured	-47 to -75 dBm
Fade margin: theoretical	29 dB
Fade margin: measured	37 to 7dB

* the actual height of the FSO above sea level varies as much as +/- 5 metres depending on the loading inside the tanker

ABOUT 4RF

Operating in more than 130 countries, 4RF provides radio communications equipment for critical infrastructure applications. Customers include utilities, oil and gas companies, transport companies, telecommunications operators, international aid organisations, public safety, military and security organisations. 4RF point-to-point and point-to-multipoint products are optimized for performance in harsh climates and difficult terrain, supporting IP, legacy analogue, serial data and PDH applications.

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