

PONTI RADIO PR - CASE STUDY: FSRU OFFSHORE TO ONSHORE RADIO LINK

CUSTOMER: OLT S.P.A.



The OLT Offshore LNG Toscana project provides for the conversion of an LNG carrier (Golar Frost) into a floating unit permanently anchored about 22 km off the coast between Livorno and Pisa (Tuscany), which transforms the liquid natural gas (LNG) back to its normal gaseous state.

The FSRU (Floating Storage Regasification Unit) is firmly anchored to the seabed through six anchors with a single rotation point at the bow, to allow the ship to move around the anchoring adapting to the weather and sea conditions without repercussions to its activity.



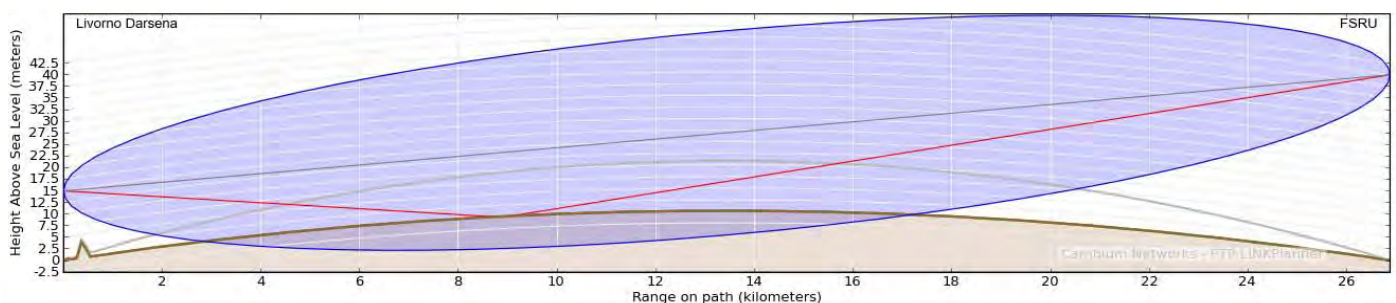
RADIO LINK PROJECT BACKGROUND

The Radio Link Ship-to-shore system provides a terrestrial reliable link for OLT's **communication needs and services**.

The radio link system is the **main communication path** between the FSRU and the on-shore Company's Office, whilst the backup link is achieved with a satellite system.

The link between the shore and the FSRU had to ensure constant communication (with relatively high bandwidth) in both directions, despite the long distance over-water.

As shown in the path profile between the two end points, reliably making this link presented a number of complex technical challenges.



KEY CHALLENGES

LIMITED ANTENNA HEIGHT

The On-Shore Base (Livorno Darsena) is settled at the sea level, where the only possibility is to build a small tower to host the antennas. Due to the long distance (and the curvature of the earth's surface) the sea itself constituted an obstacle to radio wave propagation. Furthermore, given the limited antenna height on the on-shore site, the ships passing through the harbor may have constituted an additional unpredictable obstacle for the radio link.

PROPAGATION OVER SEA SURFACE

Multipath fading is one of the main issues that affect radio propagation over the sea surface. Radio waves are reflected, and the signal joins the antenna with two different paths. The delay introduced by the different path length may cause the two signals to join the antenna with different phases. The received signal is thus obtained by the phase difference between the two signals. Whether the two signals are equal in strength, a phase shift of 180° will cause the zeroing of the received signal. The longer is the path over the sea surface, the biggest is the impact of multipath fading.

CONSTANT MOVEMENT OF THE FSRU IN ALL DIRECTIONS

The radio link had to cope with the following movements of the FSRU:

Rotation of the vessel 360°

Roll: ± 17.84°

Pitch: ± 5.25°

Heave: ± 7.46m

Yaw: ± 2.03°

Surge: ± 4,56m

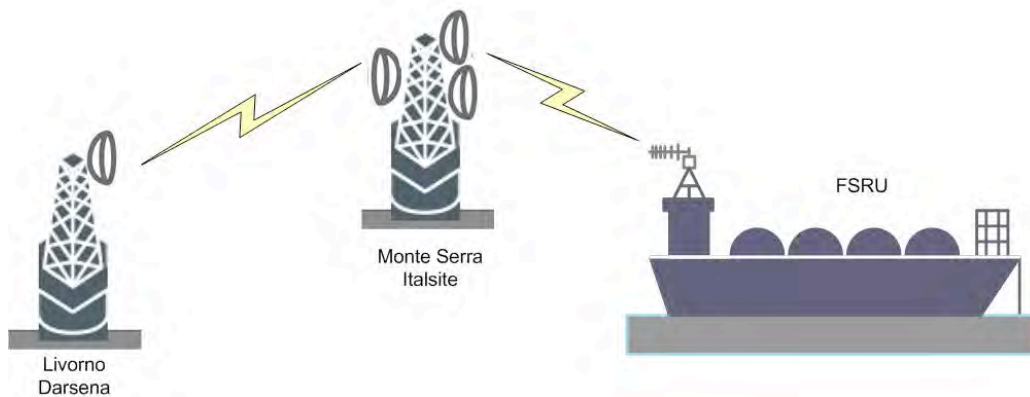
Sway: ± 6.19m

THE ROLE OF PONTI RADIO PR pontiradio

- The Radio Link project was carried out by **OLT**. During the project, **Ponti Radio PR** was engaged by **OLT** in order to search for the smartest solution for the Radio Link.
- **Ponti Radio PR** was also engaged by **OLT** for the installation, the activation and the tuning of the Radio Link when the FSRU joined its final destination.
- **Ponti Radio PR** developed the Antenna Tracking System software (ATS) for Radio Link Control and Antenna Pointing
- **Ponti Radio PR** is now supporting **OLT** for maintenance activities on the Radio Link equipment and on the other radio systems in the FSRU.

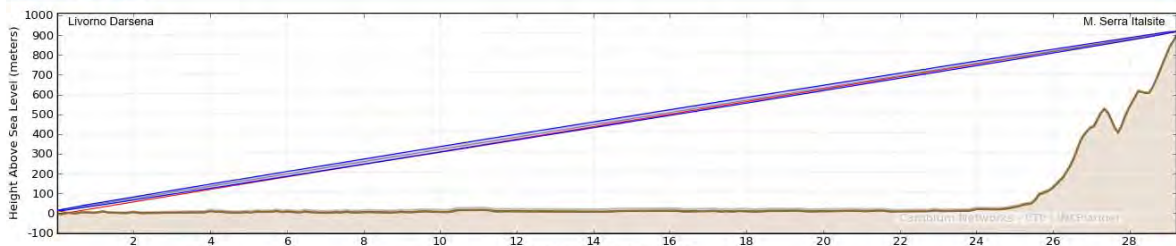
THE TECHNICAL SOLUTION

The Antenna's height limit was solved introducing an intermediate repeater - Ponti Radio PR offered its site of Monte Serra (located on a mountain close to Pisa), whose elevation is about 900 mt a.s.l. In the FSRU, in order to find a free-from-obstacle positioning for the Radio Link Antenna, it was necessary to modify the Radar Mast. The tower infrastructure in Monte Serra was also modified in order to host the needed antennas.



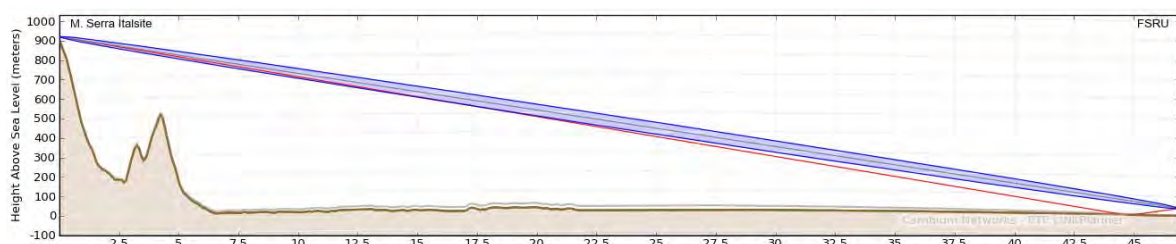
The Radio Link was thus realized in two steps:

A first link was made between Livorno dock and Monte Serra. This link (29 Km) was set using a **Aviat Eclipse** in the 7 GHz band.



A second link was made between Monte Serra and the FSRU.

This link (47 Km) was realized with **4RF Aprisa XE** in the 1.5 Ghz band. In order to minimize the impact of multipath fading, the Hitless Space Diversity configuration was used. This solution provides both radio link protection from fading and redundancy.



FSRU Movements was the biggest challenge to solve:



FSRU rotation's issue was solved using a **Moog QPT-50** computer-controlled rotary joint.

A Tracking Control Unit running **Ponti Radio PR ATS software** was installed, controlling the rotary joint by calculating second by second the antenna PAN from the current FSRU heading. ATS software provides also OLT with an early notification in case of fault.

A Yagi Antenna was mounted on top of the rotary joint, providing a relative high gain and avoiding the spread of RF signal in not-needed directions (this constraint was introduced by the Regulatory Authority in order to avoid interference with foreign frequencies).



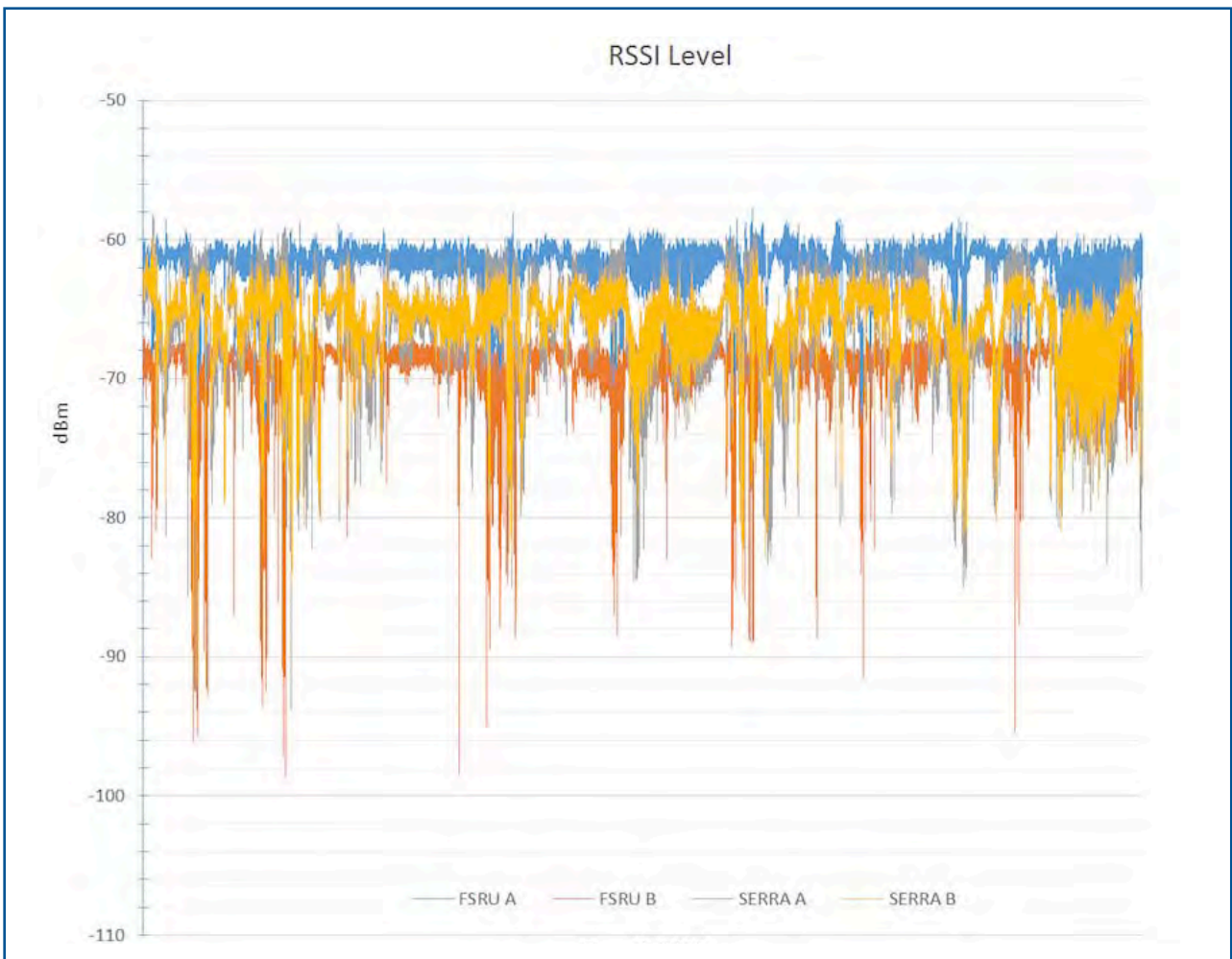
In **Monte Serra** two high gain grid antennas with a diameter of 2.4 mt and vertical space diversity of 8 mt were used, in order to have, at the right location of the FSRU, a footprint wide enough to solve issues related to other antenna movements.

RESULTS

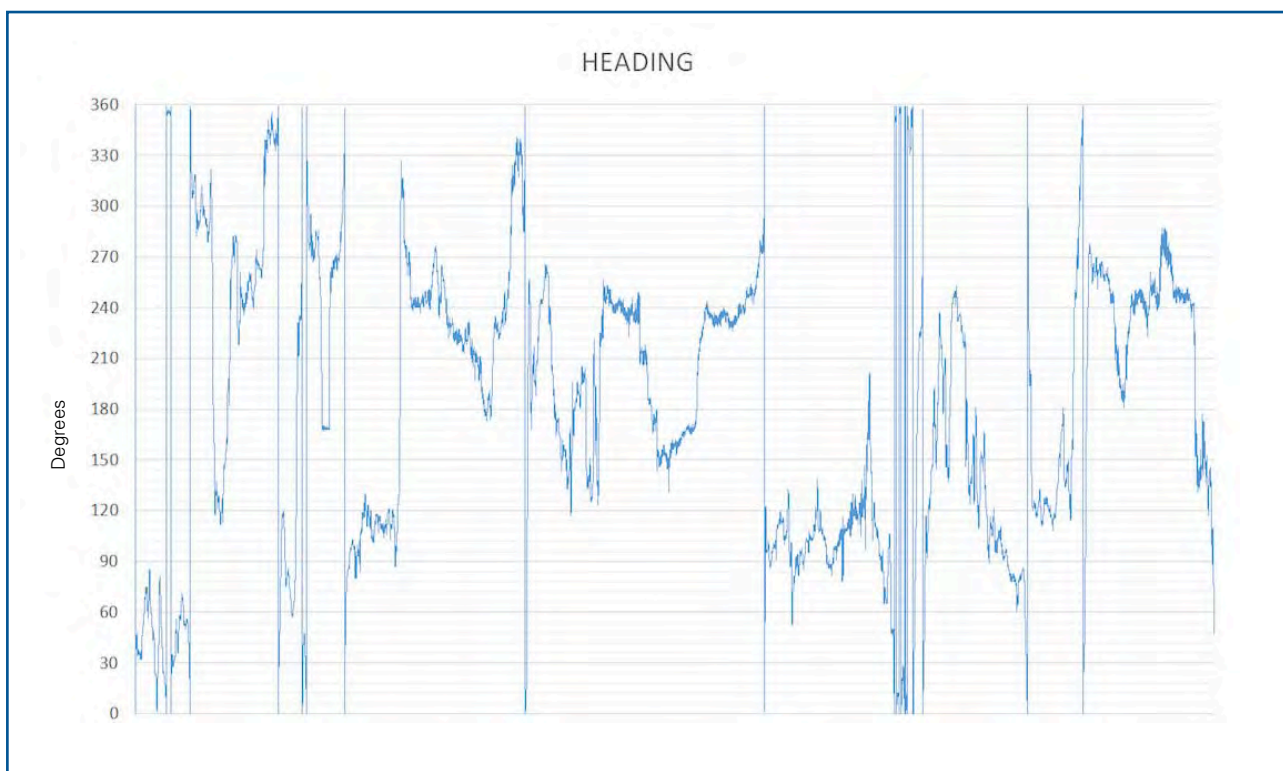
The implemented radio link provides a **reliable 11 Mbit/s Ethernet capacity to the FSRU**. The following diagrams show the received signal level of the 4 radio of the link. Even if multipath fading causes rapid variation of the received levels of the individual antenna, there were no traffic errors, as the space diversity makes only one antenna at a time being affected by fading.

The success of this deployment comes from to the correct frequency band selection, combined with hitless space diversity in Monte Serra and computer Controlled Rotary Joint in FSRU.

The following diagram shows the received signal of the link of the 4 radios



The following diagram shows the continuous FRSU movements



About Ponti Radio PR:

Ponti Radio PR is an Italian System Integrator specialized in Private Radio Networks.

Ponti Radio PR was founded in 1962 and since the beginning established its key role in the Oil and Gas market providing turn-key assistance on radio link used by SNAM for radiomobile communication and SCADA telemetry.

The product portfolio of Ponti Radio PR includes:

Engineering:

- System Integration
- RF Planning
- Structural Engineering Assessment
- SW Development
- Assistance in Regulatory Matters

Site Rental

Over 100 towers in strategic locations all over Italy

Installation and Commissioning

Towers, Shelters, Antenna and Equipment

Network Management Services

Maintenance

- Call Center and Help Desk 24/7
- Trouble Ticketing
- On-site maintenance
- Spare parts management
- Repair Service

Ponti Radio PR has 15 branch offices to serve the whole Italian territory with high-quality SLA, with a central coordination from its Headquarters in Milan.



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