UNDERSEA TELECOMMUNICATIONS SYSTEM DESIGN CRITERIA FOR OFFSHORE OIL AND GAS FACILITIES

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The recent increase in oil prices and the development of deep water production technologies has elevated the importance of reliable bandwidth for offshore oil and gas facilities. The current and future potential of a field, the value of the infrastructure and the extent of the reliance on telecommunications dictates the level of investment and the range of technical solutions available to a facility or group of facilities. The technologies and economics of undersea telecommunication systems are becoming increasingly relevant, especially as the need for bandwidth grows along with the cost of failure.

There is a range of technical and economic solutions for offshore applications of undersea telecommunication systems. In order to achieve the optimal solution, the several key design and decision criteria need to be considered, including:

Basic communication requirement:
Performance definition including target platforms, on-shore destination, initial capacity and interfaces.

Anticipated bandwidth uses:
Consideration of the growth in demand of current bandwidth uses such as voice, internet, video conferencing, operations monitoring, and cable television plus the addition of future bandwidth uses such as reservoir monitoring and remote control.

Flexibility:
Anticipated need to add existing platforms or new platforms as they are brought on line, and the utility of the ability to change or re-prioritize the level of service to platforms during their life cycle.

Robustness:
Ability to withstand direct impacts such as hurricanes and the acceptable level of reliance on other facilities.

Technology risk:
Choice of position on the technology continuum, from deploying new technologies to technologies with a demonstrable performance history.

Business case:
Life cycle costs, costs of outages and trade studies against other media.

A given technical solution will give priority to some criteria over others. Conversely, the relative priority of these criteria suggests an optimal system configuration. In addition, individual facilities served by a system may have different priorities, suggesting different technical solutions may be appropriate. This paper will present the fundamental technologies, the system configuration options and discuss how those options impact the key design and decision criteria.

Enabling Technologies

Undersea telecommunications is a mature industry with highly evolved technologies in both the undersea "wet plant" and in the "dry plant" in the terminal stations ashore. Fiber optic cable and undersea optical amplifiers are now routinely deployed in trans-oceanic lengths, providing extremely reliable performance and engineering design lives in excess of 25 years. Dense wavelength division multiplexing (DWDM) has increased the potential bandwidth of undersea systems such that a single fiber pair can have an ultimate capacity approaching 1 terabit.

For oil and gas applications, undersea system technologies are being enhanced to meet the special requirements for reliable connections from shore to offshore floating and fixed platforms. In the wet plant, optical add drop multiplexing (OADM) branching units facilitate the delivery of discrete amounts of bandwidth to individual platforms, eliminating the need for high fiber count cables. Dynamic fiber optic risers have been developed to provide connectivity to floating platforms in deep water. Undersea optical junction boxes with wet mate connectors enable the interconnection, or "subtending", of platforms on the seabed, a convenient means of expanding an offshore communications network. The optical dry plant has been miniaturized, minimizing space and power requirements on each platform and GigE interfaces allow direct connection to user routers.

System Configuration Options and Design Criteria

There are several basic system configurations which may be suitable to offshore oil and gas applications. Short haul systems (<400 km) are typically unpowered, or "repeaterless", and utilize undersea cable with terrestrial-grade dry plant. Long haul systems are powered, utilizing shore based power feed equipment to energize in-line optical amplifiers, allowing transmission over long distances. The dry plant utilizes specialized submarine line terminal equipment (SLTE) that provides extraordinary performance over long distances.

System configurations for repeaterless oil and gas systems are either 1) festoons with individual segments between each platform and east- and west-bound transmission equipment on every platform or 2) trunk and branch designs where individual fiber pairs are branched to each platform and the transmission paths are from each platform to shore. Festoons exploit the advantage of DWDM and do not require a high fiber count in the cable, but at the expense of interdependence between platforms. Conversely, the trunk and branch eliminates the platform interdependencies but requires 1) a separate fiber pair for each platform, which can be limiting in a production field where there are numerous existing or planned platforms and 2) all platforms must be less than 400 km from shore.

Powered systems are typically trunk and branch. Utilizing OADM to deliver bandwidth rather than fiber pairs to each platform, there are no platform interdependencies, which is important in areas prone to hurricanes or other potential disruptions to production.