Efficiently Enabling Better Outcomes Offshore

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Figure 1: Offshore Satellite-Based Connectivity (Credit: Shutterstock)

Over the last several years we've seen the energy industry undergoing significant changes brought on by the adoption of new digital technologies. Known variously as the Digital Oilfield, Field of the Future, Connected Oilfield, these are representative of the broader trend of digital transformation projects sweeping through a wide spectrum of industries. Digital transformation is about more than simply increasing the amount of data that is collected. The key benefits are derived from changing the underlying business approach, processes and culture. How can data help make better decisions? How can data enable more desirable outcomes? How can

data help avoid bad outcomes? At the same time, digital tech has increased relevancy in the working environment, it has also become more important to the crew off-watch.

Predicative Maintenance

Perhaps one of the most exciting applications for digital technologies in energy is predictive maintenance or condition-based maintenance. Traditionally, equipment maintenance has been done according to well-defined schedules, precisely carried out and documented. But, the majority of failures do not correlate with age, so time is probably not the best indicator that maintenance is needed. Predictive maintenance relies on a combination of Industrial IoT plus analytics and machine learning to identify issues before they become serious.

Figure 2: Monitoring & Trend Analysis (Credit: Shutterstock)

The stakes are high since a rig or platform shutdown can last for days with costs measured in millions of dollars. It is important to recognize the early warning signs and address small issues before they become big ones. This isn't always easy to do since the root cause is often different from how it presents itself. Many companies have been able to reduce downtime by 50% or more, saving millions of dollars and often providing a positive return on investment by avoiding a single outage.

The key concept is that instead of just monitoring for equipment failure, supporting data is collected and analyzed to identify trends that point to issues. The ancillary data to be collected might include vibration, temperature, flow rate, pressure, tank level, fuel consumption, power consumption and exhaust emissions. Changes in these parameters could be early signs of a problem and indicate that a maintenance intervention is needed. An example timeline is shown below in Table 1.

Time to failure	Observation
2 weeks	Change in oil pressure trend
2.5 days	Change in vibration signature
0 days	Engine failure

Table 1 - Example Failure Timeline

By collecting the supporting data and using analytics to identify trends, the early warning signs can be identified, and a maintenance crew dispatched well in advance of the actual failure. This approach provides several benefits:

- Reducing costs by avoiding unnecessary maintenance of systems that are operating well
- Reducing downtime by deploying resources before the equipment failure actually happens
- Improving worker safety by providing a wider time window to allow time to avoid bad weather or awkward crew shift changes

In one example, a company was able to provide an annual saving of $20M in reduced outages by monitoring

1716 data points, requiring 1.1 Mbps of satellite capacity. In this case, like the vast majority of cases, the business value far exceeds the cost to implement these solutions.

Crew Welfare

More sophisticated technologies like predictive maintenance being deployed offshore require more sophisticated employees to operate them. Offshore crew are now expected to have not only their "old school" skills of maintaining and repairing the machinery and systems, but also have the digital skills to work comfortably as the technology advances. These advanced skill levels mean that it is more important and more challenging than ever for companies to attract and retain employees to work offshore.

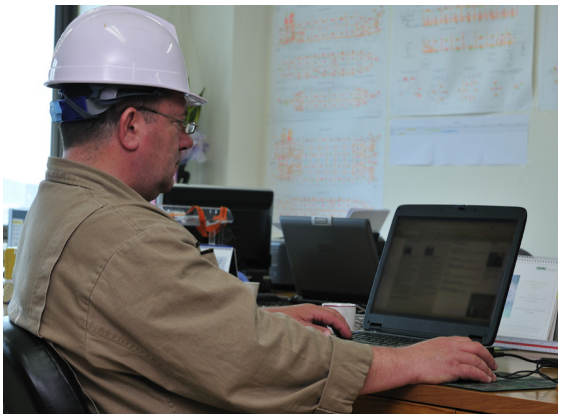

Figure 3: Crew Welfare Connectivity (Credit: Fotolia)

Crew who are used to working in a digital world are also used to living in a digital world in their personal life when they go off shift. Applications such as social media, YouTube and Facetime are important in keeping offshore workers connected to their friends, family and the outside world. Employee satisfaction surveys regularly show that Internet connectivity is playing an increasingly more important factor in choosing employers and assignments. Employers who hope to attract the best employees for today's high-tech environment are becoming used to the need to include off-watch Internet connectivity to support personal devices.

In certain national jurisdictions, regulations are even being put in place as governments adopt the idea that the Internet is a fundamental right that should apply to everyone, even offshore. Brazilian Labor Regulators are in the process of implementing a new regulations policy called NR 37 for Oil and Gas companies operating within its territory. This new policy establishes minimum requirements for safety, health and working conditions on board oil platforms. Under one of the provisions of NR 37, it is mandating Wi-Fi service for recreational and interpersonal communication, with reserved access to electronic mail and social medias for all workers.

Faced with this new regulation, Service Providers are working to comply and are looking for cost-effective ways of improving existing services to meet the demand. Along with the rapid digitalization of the energy sector, including increasing use of IoT and Cloud services, crew access to high-quality Internet has become a necessity.

Brazilian Use Case

One of Comtech EF Data's customers is a key service provider to the energy sector in Brazil and developed a plan for upgrading their network to support the new crew Internet requirements of NR 37. They considered two choices 1) adding more bandwidth to their existing TDMA platform or 2) transitioning to Comtech EF Data's more efficient SCPC technology.

The service provider conducted side-by-side tests over the air to compare the spectral efficiency – a measure of how much data is carried in a fixed amount of satellite bandwidth – of their existing TDMA platform and Comtech EF Data's CDM-625A high-performance SCPC modems. Their testing showed that they were able to

more than quadruple the link efficiency from 1.75 bits/Hz to 7.7 bits/Hz without having to change out any of the stabilized antennas or amplifiers offshore while at the same time improving the link availability significantly. Over a 1.5 meter stabilized antenna, an impressive throughput of 25/25 Mbps was achieved over Ku-band with a link availability of 99.7% a year even considering the regions notoriously challenging tropical storms.

Figure 4: CDM-625A Advanced Satellite Modem

The key to supporting increasing bandwidth needs – whether from digital transformation projects or better crew welfare – in a cost-effective way is efficiency. For small networks, the advantage of bandwidth sharing and gains from statistical multiplexing is usually negligible, so it is often more effective to use SCPC point-to-point links with DoubleTalk® Carrier-in-Carrier® to maximize spectral efficiency. TDMA platforms are optimized to support sharing and over subscription, which is not a key driver in offshore applications where the number of sites is usually small and bandwidth needs are relatively steady.

In the Brazilian case above, Comtech's SCPC approach was able to provide 4.4 times the throughput per MHz compared to TDMA. SCPC will provide the more efficient solution for networks where the traffic oversubscription is less than 4.4x. In most offshore applications, the opportunity for oversubscription is quite limited because the bandwidth needs to support applications like the collection of sensor data for predictive maintenance are relatively constant and minimum bandwidth regulations for crew welfare are fairly high.

The SCPC approach using CDM-625A modems also helps minimize up-front CapEx investment by avoiding the complexity of an NMS and chassis designed for large networks.

The CDM-625A is the workhorse of the offshore oil and gas industry precisely because it is so efficient for small networks:

VersaFEC®-2 – Comtech EF Data's CDM-625A Advanced Satellite Modem uses a high-performance LDPC forward error correction (FEC) specifically designed to optimize performance at low and mid-tier symbol rates. VersaFEC-2 long-block provides performance generally better than DVB-S2 at significantly lower. All higher order constellations are quasi-circular for optimal peak-to-average performance. Both CCM and ACM operation is supported for long block and short block.

Doubletalk Carrier-in-Carrier – patented "Adaptive Cancellation" technology, allows transmit and receive carriers of a duplex link to share the same transponder bandwidth. DoubleTalk Carrier-in-Carrier is complementary to all advances in modem technology, including advanced FEC and modulation techniques. As these technologies approach theoretical limits of power and bandwidth efficiencies, DoubleTalk Carrier-in-Carrier utilizing advanced signal processing techniques provides a new dimension in bandwidth efficiency.

Regulations play an important role in the energy sector and have a significant influence on network design. Compliance with government mandated connectivity requirements can be difficult to prove in an oversubscribed TDMA environment where capacity might not always be available depending on traffic demands from other sites. Dedicated SCPC links provide guaranteed bandwidth for these requirements, and sophisticated Quality of Service (QoS) support of the CDM-625A allows service providers to support a mixture of traffic types

and still meet Key Performance Indicators (KPIs) on important traffic.

Conclusion

The offshore energy market is characterized by companies operating a small number of platforms with the traffic mandated to land in-country. With new exploration moving further and further offshore, this is continuing and will result in fewer, larger platforms. The use of digital technologies such as preventative maintenance and increasing bandwidth for crew welfare are combining to drive increasing bandwidth consumption. In this environment Comtech EF Data's high-performance SCPC technology provides a number of advantages for offshore service providers:

Efficiency Reduces OpEx – SCPC links support the highest performance coding and modulation and allow the use of Doubletalk Carrier-in-Carrier technology to maximize the efficient use of space segment, which reduces the OpEx spend on expensive satellite capacity.

Simplicity Minimizes CapEx – Up-front investment is minimized by avoiding the cost and complexity of a hub and NMS for small networks.

SLAs and regulatory compliance – Provisioning dedicated links ensures that capacity is available to meet regulatory requirements. Integrated QoS ensures that high priority traffic is protected, and the requirements of SLAs are complied with.

It is easy to understand why Comtech EF Data's solutions have earned the trust of energy partners globally for enabling better outcomes offshore.

David Burr *is Vice President, Business Development for Comtech EF Data where he develops strategies and applications to address the maritime and satellite operator market verticals. Burr is passionate about the role of efficiency and its application to satellite communications technology and business models. As a 30-year veteran of the satellite communications industry, he previously served in various Product Management, Sales Engineering and Project Management roles at SES, O3b, New Skies, Polarsat, Comstream and GTE. Burr holds a degree in Electrical Engineering from Boston University.*