Arthur D Little

Telecommunication, Information,
Media & Electronics/Energy & Utilities

# Field Telecoms in Oil & Gas

## *Getting Connected: How the Telecoms Industry is Enabling the Digital Oil Field*

# Content



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# Executive Summary

The Oil and Gas industry's needs for field communications services have increased significantly over the last 10 years. Complex operations and data requirements, coupled with highly collaborative work processes, often between multiple onshore and offshore locations, are increasingly relying on robust telecommunications. This communication challenge is compounded by the variety of different operational domains to be supported (exploration, development, production and downstream), often situated in challenging geographies around the world.

The oil and gas sector prioritizes stable, reliable and resilient solutions that are available 24/7 – since the implications of losing connectivity, even for short periods of time, are substantial. Nevertheless, although some potentially ground-breaking communication technologies are now emerging, substantial scope for incremental improvement in existing technologies still remains, allowing an operator a diverse array of technologies that could be applied. In fact, often more than one viable solution is available.

This diversity in telecommunication technologies and the variety of operations within the oil and gas sector has resulted in an equally diverse communications supply chain, involving many different suppliers and organizations. Although new operating models have emerged, there is currently significant M&A activity in the telecommunications sector and we expect to see continued change in this evolving market.

Oil and Gas companies also face the challenge of deciding which capabilities they need to build in house, and which they should outsource. They also need to select the most appropriate suppliers to support their business activities. Those service providers who can most effectively work in partnership with Oil and Gas companies, to develop the optimum solutions and capabilities, or are able to offer a niche solution most suited to a specific domain or geography, are likely to be the most successful in the longer term.

# Context and Scope

Exploration and production in the Oil and Gas sector is highly demanding in terms of its needs for skills, resilience and technical capability. In recent years, as relatively "easy to get" oil and gas resources have dwindled, companies have been forced to look for natural resources in some of the world's most challenging and hostile environments. Whilst traditionally this would translate into stationing many experienced personnel in the field, companies are now taking advantage of the latest developments in Field Telecommunication (FT) technologies to remotely monitor and manage exploration, development and production activities at these field locations. This enables them to optimize the use of often scarce technical staff. With large volumes of data flowing in from the field, companies can work more effectively through close collaboration onshore, involving multi-skilled teams, including all the various stakeholders required. Additionally, those workers who do need to be onsite also need to be able to communicate and interact with the outside world, with access to online media as if they were at their home office.

There have been advances in the current generation of FT technologies (e.g. "Virtual Fiber" wireless BB using WiMax, more spectrally efficient 3G technologies, WiFi speeds matching fixed BB speeds). There has also been development and commercial rollout of newer technologies (wireless standards such as 4G/LTE, new satellite constellations such as O3b and other High Throughput Ka band solutions). In combination, these changes are allowing companies to transport very large amounts of data from remote sites to their experienced engineers, based in their onshore offices/technical centres. The data can then be used for analysis and monitoring in near real time, and at a fraction of the cost of what it would take to place all the required technical teams in the field. This allows for highly collaborative decision-making at all stages in the value chain.

Arthur D. Little frequently advises major oil and gas companies whilst they are establishing their project development strategies and processes. We also support telecommunications businesses globally in developing their industrial offering strategy.

We have conducted a recent global study into the usage of FT technologies in the oil and gas industry, evaluating the way in which they are applied in this sector. This review was primarily aimed at IP based technologies that provide access and backhaul connectivity and less towards process control or "Machine to Machine (M2M)" technologies. As part of this study, we substantiated some of our hypotheses with leading organizations who provide FT services to major oil and gas exploration and production projects worldwide.

In this viewpoint, we will address some critical questions facing both oil and gas companies and their suppliers in the selection and deployment of FT technologies:

1. What are the key oil & gas sector field communications requirements which FT suppliers need to deliver?
2. Which technologies are currently being used, or could be used, in the future to address these requirements?
3. Who are the key suppliers of those technologies, and what are the different engagement approaches by which those solutions are deployed?
4. What are the key trends in the FT market and the implications of those trends on the current key participants?

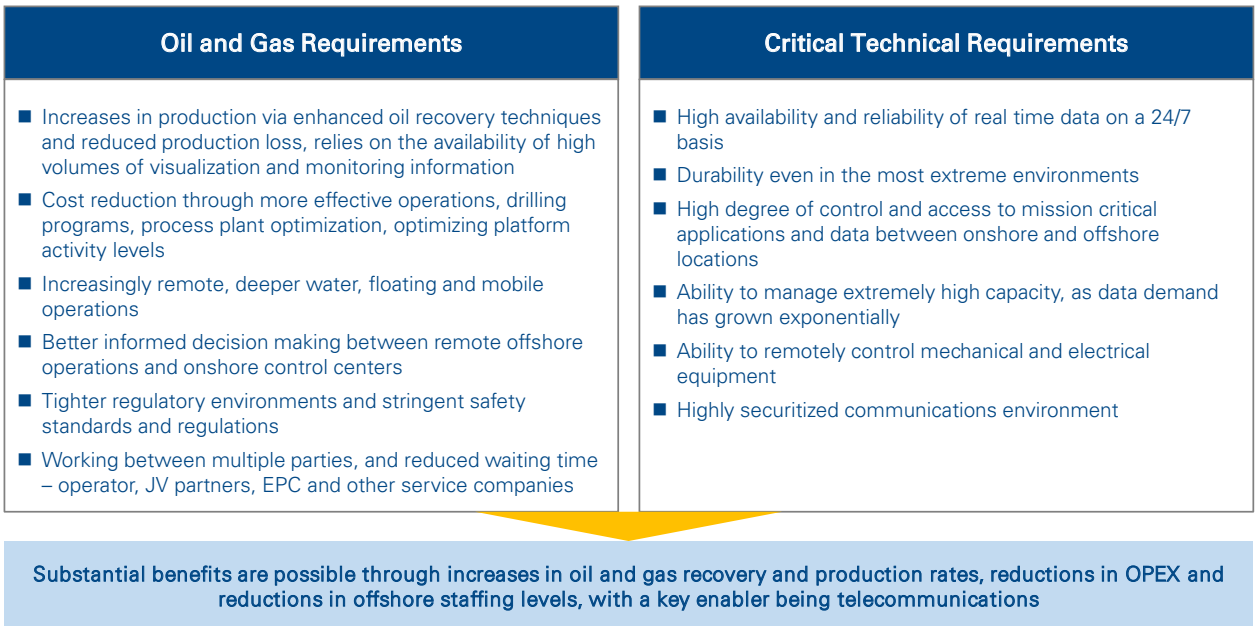
# Digital Oil Field Requirements

With increasing demand, and the challenge of maintaining production volumes from older fields, companies are being forced to search for oil and gas in more remote and often inhospitable frontier environments which present a range of operational challenges. When combined with the current limits in numbers of appropriately trained and experienced staff, and the benefits of more highly data-intensive oil field analysis, these oil and gas companies are increasingly moving towards remote field assessment and management, i.e. the "Digital Oil Field" – bringing the field to the operator rather than the operator to the field.

This "Digital Oil Field" (DOF) concept is central to the future evolution of FT needs. The concept of the DOF is broadly to utilize modern IT, automation and communications to enhance oil and gas operations. This is done by unifying the various processes and the digital information they produce into a more manageable, integrated data-set. Such complex operational data requirements, coupled with the need for highly collaborative work processes between onshore and offshore locations, requires access to secure, real-time data between multiple locations which must be supported by robust and effective telecommunications.

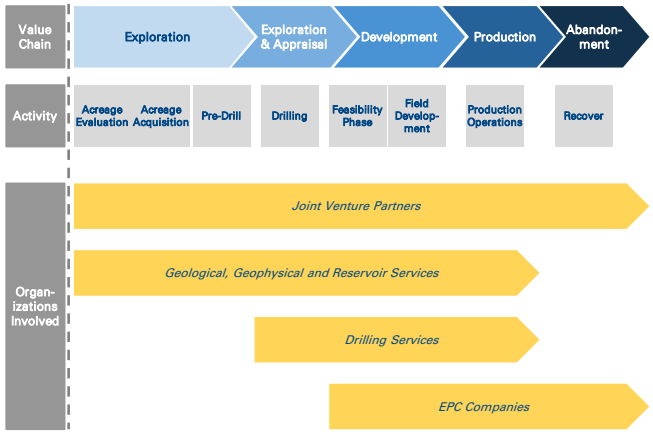
The oil and gas industry's main technical requirements from FT lie in the areas of resilience, availability (24/7), data security and reliability in the harsh environments involved. However, the sector's technical requirements in other respects (e.g. bandwidth, latency needs, etc.) are rather modest in comparison to other sectors (e.g. for financial services or military applications). The highly standardized nature of many of the technologies involved (e.g. cellular radio, microwave, fiber) coupled with the fact that technical roadmaps are already well-developed, ensures that there are several interchangeable existing technologies that can successfully serve the needs of oil and gas companies.

Figure 1. Oil and Gas FT requirements




Source: Arthur D. Little analysis

Figure 2. Oil and Gas value chain




Source: Arthur D. Little analysis

There are several practical factors that might influence the selection and deployment of FT technologies across the oil and gas value chain:

- Geo-political factors
  - E.g. Import licenses for certain telecommunications equipment can be particularly onerous to procure.
- Market regulations
  - E.g. Spectrum licenses for the use of scarce radio-magnetic resources.
- Asset type
  - E.g. Asset location, i.e. whether it is onshore/offshore as well as the changing requirements at each stage of the field lifecycle (such as exploration, development or production).

Figure 3 illustrates different technologies (and their combinations) that might be used to connect different operational domains to the head office/data center in order to provide real time data connectivity to support timely monitoring and decision making.

A major oil and gas project could span several operational worksites. During the lifetime of such a project it may deploy most of the key telecoms technologies either at once or as it evolves.

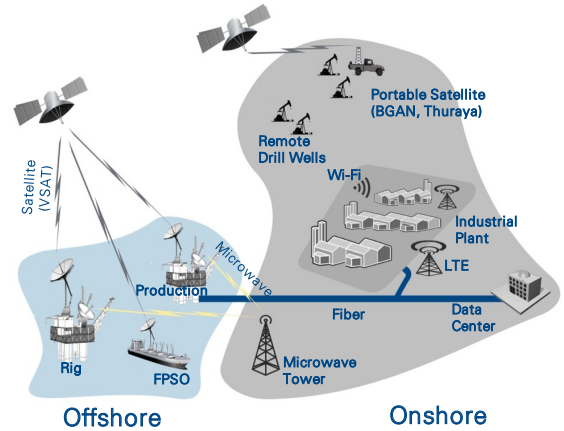
**Offshore Exploration:** Historically in shallow or inshore waters, but increasingly in more remote, deeper waters, such as offshore Angola or the Pre-Salt play of Brazil (located in the Brazilian continental shelf). These activities involve drilling wells to considerable depths in search of hydrocarbons:

- Due to the nomadic nature of the requirement, the predominant backhaul technology used is satellite (VSAT) or Microwave. Additionally, developments in High Throughput Satellites are also being selectively trialled.
- For user connectivity on the drilling rig involved (i.e. access point connectivity), the technologies are typically industrial WiFi or Portable Satellite terminals (like BGAN and Iridium).

**Offshore Development:** If a commercially viable volume of reserves is identified during exploration, the field may then be developed by construction of appropriate production and logistics facilities:

- During the development stage (typically lasting 2-3 years), there is a peak communication requirement as development wells are drilled and completed. Multiple parties are involved at this stage, including oil companies, EPCs and other contractors, who all need robust telecommunication solutions. Based on economic considerations, organizations could install Fiber or backhaul WiMax (depending on the distance from platform to shore).

Figure 3. Technologies observed in the Oil & Gas FT environment




Source: Arthur D. Little analysis

Figure 4. Relevant and emerging technologies

| Classification/ Technology | | Traditional and Current Usage | Future and Planned Usage |
|---|---|---|---|
| Field Backhaul | Fiber | ■ Future-proof technology provides the best combination of performance and reliability – primarily deployed for producing assets (onshore and offshore) | ■ Continues to be the favored technology for onshore assets, however for offshore, developments in microwave and MEO satellites will offer viable alternatives |
| | WiMax | ■ Provides high-capacity/short-range or mid-capacity/long-range services. Substantial use for unconventional oilfields for providing digital canopy | ■ Developments in cellular technology (primarily 4G) will be able to provide a better service (higher bandwidth, more spectrally efficient, and more devices) |
| | Microwave | ■ Provides medium range coverage with fixed mast installation and operates in line - or near line - of sight. It remains a valid technology choice for offshore rigs | ■ Technology developments have allowed longer range, faster (closest to speed of light) as well as Non-LOS deployments |
| | VSAT | ■ Provides flexibility for rapid deployments in the most remote and harsh locations. Constrained by high cost, limited bandwidth and high latency | ■ Deployments in Ka-band will increase bandwidth; O3b will reduce latency; also more capacity to be launched on Ku-band making it attractive for renewing on-going contracts |

| Classification/ Technology | | Traditional and Current Usage | Future and Planned Usage |
|---|---|---|---|
| Field Access | Ethernet (LAN) | ■ Provides managed network connectivity for PCs, printers, laptops, as well as providing "local hub connection" | ■ Wi-Fi will become the default medium to connect devices, however, LAN will be useful for fixed devices that require high bandwidths |
| | WiFi | ■ Provides managed network connectivity for mobile devices, however, users are constrained to move within limited distances | ■ Likely to continue to be the favored technology for last mile connectivity for mobile devices |
| | Cellular Radio 3G, 4G | ■ Currently mostly 3G coverage and limited 4G. 3G connectivity typically in urban areas – however, users constrained due to contention ratio, signal unavailability, spectrum and ATEX compliant end devices | ■ Increases in 4G deployments will increase the data bandwidth (compared to 3G). Also can be used for canopy coverage on offshore locations |
| | Portable Satellite (BGAN, Thuraya) | ■ Several service providers (BGAN, Iridium, Thuraya) provide telephony + data solutions. Plug and play type services; however, relatively expensive data rates | ■ New contractual models being rolled out, that make the services more attractive compared to previous deployments |

Source: Arthur D. Little analysis

**Offshore Production:** During this stage the commercial production of crude oil and natural gas will commence and continue until the end of field life:

- The main difference in the production environment is the long term nature of the asset which allows a more economic business case for Fiber deployment (at least in certain situations) for backhaul connectivity. Other technologies may also be used, in line with offshore exploration.

**Onshore Exploration:** Terrestrial exploration of oil and gas reserves. One of the most common examples of this activity is shale gas exploration in North America:

- As with its offshore counterpart, onshore exploration is one of the most nomadic activities, moving across a target area in the search for natural resources. For backhaul connectivity, it will also typically use a satellite solution (VSAT) or a commercial WiMax or Microwave solution.
- In the case of end-user connectivity, onshore exploration sometimes benefits from commercial cellular connectivity. Commercial 3G/4G could therefore be a viable alternative to portable satellite terminals in some cases.

**Onshore Production:** Terrestrial facilities to produce, process and export oil and gas:

- Typical technologies deployed in this case would be Fiber or WiMax for backhaul connectivity. For access connectivity, there might be commercial (or sometimes private) cellular connectivity. There will also be industrial strength WiFi deployment.

Figure 5. Different operational domains

| | Offshore | | Onshore | |
|---|---|---|---|---|
| | Exploration | Production | Exploration | Production |
| Asset Lifetime | *Short (a few months – 1 year)* | *Very long (1-3 decades)* | *Very Short (2-3 months)* | *Very long (1-3 decades)* |
| Mobility Requirements | *High* | *Limited* | *Very High* | *Limited* |
| Preferred Technologies | ■ Satellite (VSAT, Portable)<br>■ Microwave | ■ Fibre<br>■ Satellite<br>■ Microwave<br>■ Wi-Fi | ■ Satellite (VSAT, Portable)<br>■ Microwave<br>■ Cellular radio | ■ Fibre<br>■ Satellite<br>■ Microwave<br>■ Cellular radio<br>■ Wi-Fi |

Source: Arthur D. Little analysis

# FT Buyers and Typical Purchasing Patterns

**International Oil Companies (IOCs) e.g. ExxonMobil, Shell, ConocoPhilips, BP**
IOCs operate a number of large capital projects worldwide and, as such, they need to manage considerable geopolitical situations. However they have a key advantage as they generally have internal resources that are well versed in telecoms and IT to successfully manage the communication needs of both exploration and large capital projects on a global basis.

Depending on the stage of the field (exploration, development or production), these IOCs will typically engage with different categories of tier 1 suppliers who might in turn work with several tier 2 and tier 3 suppliers in order to provide the FT services required.

**National Oil Companies (NOCs) e.g. Saudi Aramco, Gazprom, Petrobras**
Two contrasting NOC approaches to FT service management have emerged. Whilst some companies outsource all aspects of FT services (requirement definition, procurement, installation and operations) to a dedicated project management company (typically an Oil Field Services company), certain NOC's are becoming much more involved in the technology themselves:

- A leading South American NOC buys whole transponder capacity on satellites.
- A European NOC has commissioned its own satellite.

**Oil Field Service Companies (OFSCs) e.g. Schlumberger, Halliburton, Baker Hughes**
OFSCs typically approach FT services on a tactical basis. Consequently the relationship is localized, as it often relates to a specific field development or capital project. More often than not, they utilize the telecom service provider that is already available on the rig/production platform:

- A major OFSC recently explored a global contracting model with a leading FT service provider.

**Engineering Procurement and Construction Companies (EPCs) e.g. ABB, Kentz, Thales**
Large EPCs (e.g. ABB and KBR) generally get involved at the very initial stage of a capital development project, depending on their role. They are involved in the design and development of the main physical structure and are therefore often involved in the deployment of new communications hardware on a platform. However, they are not usually involved in day-to-day production operations.

# FT Supplier Approaches

## The supplier ecosystem

Fundamental differences between the various oil and gas field operating categories, in terms of asset lifecycle, geographic location, ownership of telecommunications equipment and market structure, allow different supplier categories to play a variety of roles in the provisioning of FT services, creating a highly fragmented FT market. Suppliers in different categories bring diverse strengths to the table, whereby they can provide 'best in class' FT services in specific operational categories and geographies. Consequently, several operating models have developed, by which suppliers tend to provide FT connectivity to their clients. We identify five major categories based on the core business areas in which the company operates as well as the typical role it currently performs in the FT space.

Figure 6. Supplier categories

*Illustrative/Non-exhaustive*

| FT Supplier Type | Example Companies | Supplier Type Assessment |
|---|---|---|
| Field Telecoms Specialists | ■ Harris Caprock<br>■ RigNet<br>■ Hermes datacomms | ■ Have the specialist core offshore services<br>■ Dominates offshore exploration areas but they are actively trying to grow into other value chain roles |
| Systems Integrators (incl. EPCs) | ■ ABB<br>■ Siemens<br>■ Page Europa<br>■ Thales | ■ Project management and engineering capabilities to deliver FT for complex megaprojects from offshore production to onshore plants |
| Global Telecom Operators | ■ AT&T ■ Telstra<br>■ Vodafone ■ Orange<br>■ BT | ■ Offer relatively complete technology portfolios and skills in solution design, but typically lack offshore FT capabilities<br>■ Challenged by O&G environments |
| Satellite Providers | ■ Hughes ■ EMC<br>■ Astrium ■ Eutelsat<br>■ Inmarsat ■ Newsat | ■ Provide VSAT and portable satellite phones, although some have expanded to cover additional technologies<br>■ Typically sell their services via channel partners |
| Equipment Providers (global/ niche) | ■ Redline Communications<br>■ Cisco<br>■ EON | ■ Strong technology innovators<br>■ Do not typically provide integration services or operations, and can struggle with delivering to challenging environments |

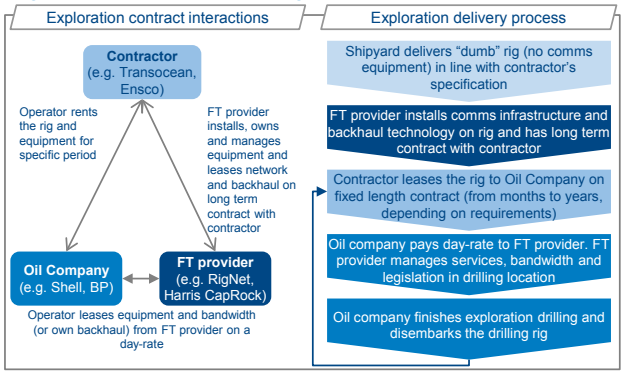
**The breadth and complexity of IOC's FT requirements suggest that finding a 'sole supplier' from any supplier type will be challenging at this time**

Source: Arthur D. Little analysis

### Offshore Exploration – "Multi-Client Managed Service Contract" Model

FT specialist firms like RigNet and Harris CapRock have established long term contracts with rig-owning firms, thereby pre-installing FT infrastructure on the majority of oil and gas exploration rigs. RigNet and Harris CapRock provide managed services to the various parties involved in the day-to-day rig operations including the rig operator (e.g. the oil company), the oil field specialist company (e.g. Schlumberger) and any other service company involved. Due to the market structure and the incumbency factor (market domination of the offshore exploration domain by Harris CapRock and RigNet), the oil and gas operating companies have reduced flexibility over the sourcing of communication equipment and supplier choice on mobile drilling rigs.

Figure 7. Multi-client managed service contract model




Source: Arthur D. Little analysis

### Offshore Production – "EPCs and Specialist System Integrators (SSIs) Dominate"

Unlike offshore exploration, offshore production assets are set up for long term operation. Since an oil production platform is typically installed for a period of at least 20-30 years oil companies will consider significant capital outlay. Many companies naturally consider Fiber as the long term technology of choice to invest in. However the substantial cost, long deployment timelines and risk of damage has somewhat limited widespread Fiber deployments to date. Other alternatives can also be attractive for example; the recently launched Medium Earth Orbit Satellite Constellation O3b offers a viable backhaul option.

Oil companies typically contract provision of the physical infrastructure (oil platform) from an EPC contractor. When the platform is delivered, it typically comes equipped with all the equipment (e.g. VSAT terminals, network cables etc.) but not with a full service agreement. The service contract is then outsourced to a third party (typically the FT arm of the EPC or a specialist systems integrator). There have also been strategic initiatives by certain FT specialist firms so that they are able to offer integrated FT services during the production stage to oil and gas companies.

### Onshore Exploration – "Local Rules – Local Carriers"

One of the key differentiators of working onshore is that many sites have local cellular coverage (e.g. AT&T is rolling out its 3G

and 4G networks in certain parts of the US). As a consequence, unlike offshore environments, oil and gas companies can potentially use commercially deployed cellular networks for their day-to-day communication purposes.

Onshore exploration is the most versatile environment in terms of categories and number of suppliers who can (and do) provide FT services to companies. The categories of operators providing FT services in this environment ranges from global telecom operators to FT specialists and even local "Mom-and -Pop" service providers.

Another major difference between onshore and offshore exploration is that with onshore, one needs to be much more aware of the local nation's rules and regulations, especially in developing countries. The need for contracts based on local law and requirements for translated documentation, means that many companies prefer to engage with a local telecom operator rather than an established global player (at least at second tier).

### Onshore Production – "EPCs and Specialist SSIs Dominate"

Like offshore production, an onshore production asset is typically commissioned and installed for a period of at least 20 – 30 years. Considering the long term nature of the asset, companies tend to deploy dedicated telecom infrastructure for backhaul (often Fiber) and commercial or private cellular connectivity for access, along with industrial grade WiFi availability. In addition, some oil and gas companies are taking advantage of the latest developments in broadband wireless technologies to deploy rugged solutions that are specially designed to meet the requirements of an oil and gas company (high throughput, low latency and large area coverage with minimal towers etc.).

## Trends and Implications

Customer requirements for 24/7 connectivity and the ability to transfer large volumes of data securely to any corner of the world in real time have promoted the take-up of the latest set of IP technologies. Companies would rather invest in long term future-proof IP technologies and work with a set of highly trained and qualified suppliers who can deliver end-to-end services. However, the FT supplier market is highly dynamic with M&A activity, new global entrants, and the prospect of potential disruptive technologies impacting technology selection.

### Technology Is Not the Limiter

Highly standardized technology roadmaps and a lack of particularly demanding business requirements means that several different technologies could be "fit for purpose" for oil and gas companies. However, even in such a technologically placid environment, the potential for technology evolution and disruption needs to be continuously evaluated. One such disruption is happening in satellite technology:

- A new satellite constellation (Middle Earth Orbit Constellation O3b) is a potential disruptor technology, and several companies are actively planning their contracting and negotiating route to ensure access to this constellation.
- The development of High Throughput Satellites (HTS) with throughput capacity (x10-20) of a normal satellite could potentially disrupt the global satellite backhaul market.

### Value not Cost

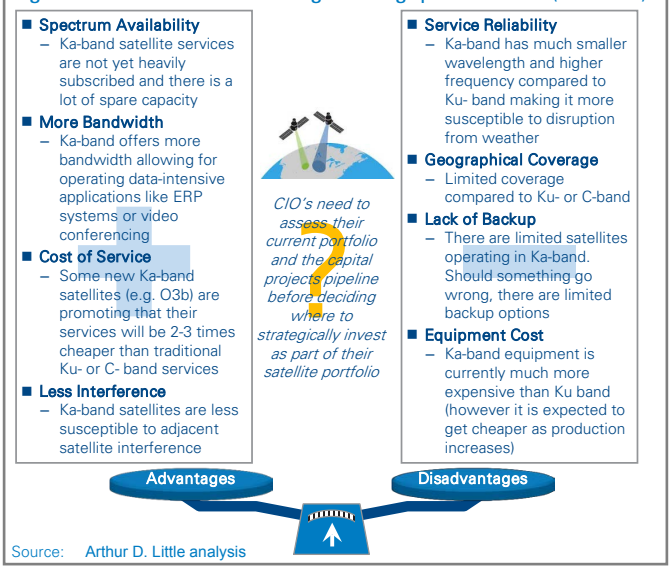
FT are of critical importance within the oil and gas industry because the nature of oil and gas demands absolute reliability, resilience and robustness. As the dependence of the oil and gas industry on resilient 24/7/365 connectivity increases, companies want to ensure that they are deploying the most reliable and effective solutions – and not necessarily the cheapest (e.g. a leading FT specialist's communications day rates represent <1% of total rig day rates).

Keeping this in mind, oil and gas operators typically request the most stable and resilient telecom solutions, with cost not being one of the main criteria for vendor selection. However, they do impose extremely stringent Service Level Agreements (SLAs) and have very challenging global delivery requirements.

### Ways of Working with Clients

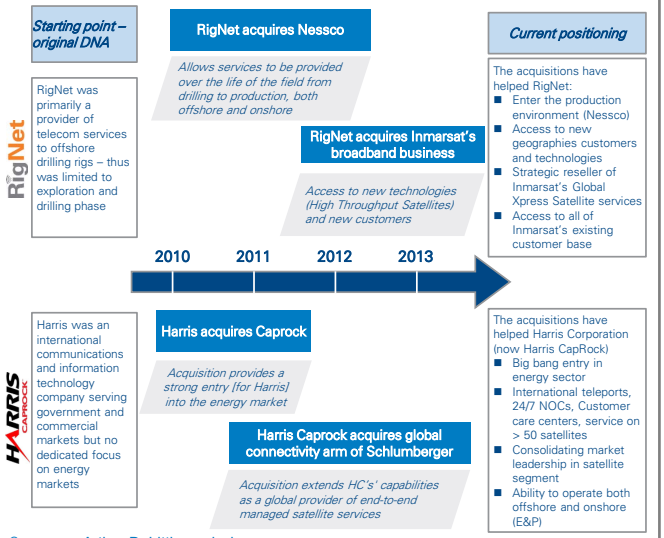
FT is a complex subject and the ownership of key standards, controls, process and project delivery is split across multiple business units with no clear ownership and control.

Figure 8. Pros and cons of high throughput satellites (Ka-band)




Source: Arthur D. Little analysis

Figure 9. M&A's in the specialist FT domain




Source: Arthur D. Little analysis

Navigating such complexity requires separate channels for effective Go-to-Market (GTM) approaches and developing specialized product propositions that demonstrate deep expertise in the oil and gas and allied sectors (e.g. defence, mining etc.). A few companies like Harris CapRock and RigNet are specialists in this arena (especially offshore exploration). Other players (especially global Telcos) will need to develop highly specialized business verticals to cater to these segments.

## Dynamic Nature of the Market

The FT market has witnessed quite a few M&A's in the last few years. FT specialists have been especially active as they try to move from exploration and drilling towards the production environment, which offers them additional long term stable annuity revenues.

Additionally as major global Telecoms companies look to develop industry focused business verticals, they might try to boost their capabilities by inorganic expansion – their targets might be FT specialist firms or even FT arms of large EPC firms.

## Conclusions

Based on our study, we can summarize our findings into four key challenges:

- **The Digital Oil Field** - Effective FT are a key enabler for "Digital Oil Fields" and are a critical support for efficient exploration (particularly in remote environments), growing production volumes from existing assets, optimizing the use of onsite personnel support, and for improving the health and safety profile.
- **Emerging Technological Trends** - Whilst some potentially ground-breaking technologies are presently emerging, there are also many incremental improvements being made to existing technologies, all of which provide operators a choice between different technologies that could be applied.
- **Supplier landscape** - The variety in FT requirements has resulted in a diverse supply chain, involving many suppliers and organizations. New operating models have developed, there are occurrences of M&A activity, and many further changes can be expected in this market.
- **Sourcing Skills and Capabilities** - Oil and gas companies are faced with the challenge of deciding which telecommunications capabilities they need to retain in-house, together with selecting the right suppliers to support their business activities.

Embracing long term strategic technologies and working in partnership with the right suppliers to address these challenges should ensure that oil and gas companies are able to garner the maximum benefit from rolling out the "Digital Oil Field" across their operations.

**Digitalization of the upstream energy is ongoing**

Technological advances will increase real-time information sharing, improving the working environment and driving up operational efficiencies.

## Arthur D. Little

As the world's first consultancy, Arthur D. Little has been at the forefront of innovation for more than 125 years. We are acknowledged as a thought leader in linking strategy, technology and innovation. Our consultants consistently develop enduring next generation solutions to master our clients' business complexity and to deliver sustainable results suited to the economic reality of each of our clients.

Arthur D. Little has offices in the most important business cities around the world. We are proud to serve many of the Fortune 500 companies globally, in addition to other leading firms and public sector organizations.

For further information please visit **www.adlittle.com**



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