Concepts Meet Reality…

Networking the Digital Oilfield

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Introduction

As oilfields mature, real time asset management of oil reserves becomes as important to oil companies as real time supply chain management is to Wal-Mart. Developing a network infrastructure to support the technologies for real time asset management requires more than adding enough bandwidth to handle the increases in traffic; it involves analyzing the specific business drivers of a field to make sure that capital investment in the telecom infrastructure makes sense. This white paper provides an approach to providing a strategic framework for developing the right network infrastructure to support your digital oilfield.

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Background

Oil and natural gas are often found in some of the world's most remote locations. In addition to the logistics and accessibility of these locations, information access has always proven challenging due to lack of all kinds of infrastructure – power, roads, transportation, etc..

New challenges have emerged in recent years for the oil companies - production decline in mature fields, fewer engineers looking after more wells, tougher environmental compliance regulations, and getting the so called "tougher barrels" out of the ground. Some of these factors have combined to require the oil companies to make a step change in how the operate. One approach is to achieve a co called "digital oilfield". In a digital oilfield process digitization, real time data collection, and intelligent controls are combined to improve recovery, accelerate production and reduce downtime.

As new technologies are deployed in existing fields, they place increasing strain on the legacy IT infrastructure. Many fields currently have limited connectivity and limited availability of power due to their remote locations. The telecom infrastructure may have been originally designed to handle Process Control Network (PCN) transmissions or other low bandwidth SCADA traffic, but later co-opted to support business traffic such as email or VoIP communications. Network architecture can become extremely convoluted as a result. One very important aspect of these new networks is the need to isolate the SCADA networks and automated control traffic from intrusions and failures in the enterprise data systems. This separation has in turn complicated the delivery of productivity software to employees within an oilfield.

As IT departments have struggled to develop a comprehensive plan to deal with the demands of new applications and solutions, their efforts have been complicated by several factors. One of the most fundamental factors is that not all fields share the same primary business drivers. A very mature field will not produce the same return on investment as a field that is very early in its life cycle. The primary business driver for a field in the San Joaquin Basin may be steam injection while the primary business driver for a field in the Gulf of Mexico may be transportation cost. Another factor is that many of the proprietary systems and technologies deployed

within oil fields are incompatible with each other and may cause interference if they are deployed incorrectly.

These complications require a strategic overview to map out the best overall framework for moving forward with the technology choices for a field's network infrastructure. This strategic roadmap should be flexible enough to account for the specific environmental factors and business drivers of a specific field. It should also include a value analysis to make sure that improvements satisfy the business drivers in the most cost effective manner possible.

Analysis

The strategic framework described below is a method for taking the general business drivers within a specific field and driving them into a concrete, long term, methodology and plan for delivering network services to a digital oilfield. This process involves five distinct steps:

Perform a Field Characterization Study

The main objective of a Field Characterization Study is to identify the characteristics of a field that must be taken into account to successfully provide last mile connectivity to that particular field. Understanding these characteristics makes it possible to leverage previous findings on technology solutions for those types of fields. This allows us to arrive at the list of best alternatives for connectivity much faster, with better alignment to the business.

Figure 1: line-of-sight study in mountainous terrain

One of the most important aspects of the Field Characterization Study is field potential, or upside, since that predicts future levels of investment within a field. The greater the field potential the more likely that high bandwidth technologies, such as 4D seismic or real-time drilling, will be deployed within that field.

Another key aspect is the method of extracting the hydrocarbons as that tends to have a direct impact on the macro-level cost drivers for the field. For example, a steam injection field will have applications to monitor and optimize the steam across multiple wells from a field office, and then schedules have to be sent out and updated several time daily to the maintenance crews that are out roaming around.

Finally, environmental factors need to be taken into account. These environmental factors will have a direct impact on which technologies are suitable for a particular field. For example, mountains may interfere with line-of-sight communications, roads may impact the right-of-way for potential fiber runs, and limited connectivity to the power grid may require remote equipment in a field to be run off of solar power.

Identify the User Requirements

Once a Field Characterization Study has been completed, the next step involves developing a set of business drivers for each of the different field user groups. These business drivers differ from organization to organization and depend greatly on the level of business process automation and how a specific user group interacts with the field. Experience has shown it is effective to classify User Requirements according to the following three key aspects:

The first aspect to consider is the mobility of a user group. Will they be primarily working from a field office, or will they need a network of wireless "hotspots" throughout the field? The ideal situation for an operator in the field would be, for example, to connect wirelessly from anywhere to obtain real-time data about their wells and be able to update status information (althought that would require a very heavy investment in networking infrastructure to accomplish).

A second major aspect is the amount of data the user group needs access to. Access requirements are very different between Exploration & Production (E&P) applications and corporate applications such as email. A decision as to whether or not to allow email access within a field is a fundamental choice that can greatly simplify or greatly complicate the network design for that field.

Finally, the collaboration needs of a user group need to be identified. Will there be a need for video and other tools to monitor production and drilling from a central environment? How much information needs to be compiled centrally and then re-distributed (e.g., data historian architecture)? These requirements play a major factor in deciding the appropriate bandwidth and connectivity options within a field.

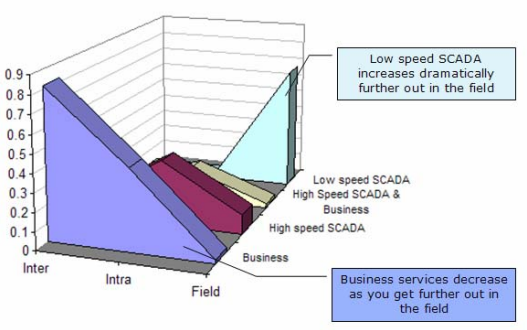

Figure 2: Data service category requirements within field

Develop Field Layout

The next step in this strategic framework involves mapping the Field Characterization Study to the User Requirements. This is used to create a field layout which depicts the current networking solutions that are deployed within a field (effectively the As-Is environment for all network links currently installed). The field layout identifies the environmental obstacles within a field and to begin matching the business drivers with potential network solutions. This is done by categorizing the data produced by the current and projected business drivers into four primary service categories:

- Low speed SCADA (such as serial radios transmitting daily temperature readings)
- High speed SCADA (such as Ethernet, IP enabled solutions)
- Business – E&P: Production Operations, wellwork management
- Business – Corporate: Email, access to ERP systems

These service categories each have different bandwidth requirements and different requirements for connectivity back into the corporate network. For instance, Corporate Business data, such as Microsoft Outlook email, would require a lot of bandwidth and is sensitive to latency issues, while some of the E&P Business applications can be native web-based designs and require a little as a 56k connectivity across a field. When the requirements of these service categories are extracted from the Field Layout, they can be used to perform a gap analysis between the capabilities of the existing network and the capabilities required to fulfill the business requirements of the users within a field and inherent within the field itself.

Perform Value Analysis

At this point we have developed a strategic set of criteria for evaluating networking technologies for a digital oilfield. The key economic factors impacting delivery to the field have been identified, environmental barriers have been accounted for, and future technologies that could be deployed within a field have been anticipated. This information can be used to

Rank	Criteria	Description
1	Reliability	The ability of a particular architecture option to provide appropriate levels of reliability
2	Performance/standard capability	The extent to which an alternative ensures standard capability across the enterprise
3	Opex	Relative cost of operating an infrastructure based on an alternative
4	Maintainability	Level of effort required to maintain standards through evergreen processes
5	Capex	Cost to migrate to a given architecture
6	Fit to business strategy	Extent to which an alternative provides infrastructure that closely meets business requirements for individual fields
7	Flexibility	Ability of an alternative to meet business requirements for a variety of field characteristics.
8	Scalability	Ability of an alternative to meet the business requirements as fields increase in size and complexity
9	Time to implement	Amount of time to implement designs based on the architecture alternative

Figure 3: Evaluation Criteria

identify a short list of applicable networking solutions appropriate for deployment within a specific field.

The final stage is in preparing the value analysis of the solutions in light of how well they serve the business. The value analysis is really the lynchpin for the entire strategic effort as it puts a number to a particular solution in light of all of the variables that have been studied.

Some common criteria for evaluating solutions are how they score relative to others in terms of reliability, performance, impact on operating and capital expenditures, maintainability and business alignment The real value to the business may also come in the form of improvements across multiple assets in terms of process standardization, reducing diversity of equipment, increasing speed of deployment, reducing travel costs and time for field workers and also providing a key set of standards to use for creating Request for Proposals from solution providers.

Conclusion

The infrastructure in a given field today will most likely have grown organically over time driven in large part by the needs of the SCADA and automation solutions. What has become apparent as a result, as presented in a recent study by CERA, is that “more automation requires more bandwidth” – but that growth only reflects one aspect of the network requirements.

The real picture of the true connectivity requirements become apparent only after performing a study across multiple disciplines and understanding where a field is today and where the business wants to take it in the future. Developing a good blueprint for growing the network backbone in a more strategic manner will be the key to developing a more sophisticated field of the future.

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