Ground Control

How improved connectivity throughout the well lifecycle could add billions of value for oil production companies

Introduction

"Advanced connectivity to optimize drilling and production throughput and improve maintenance and field operations could add up to $250 billion of value to the industry's upstream operations by 2030."
McKinsey Report 2020

From edge computing devices to artificial intelligence and machine learning, the oil industry has never had more sophisticated capabilities to optimize data capture and automate processes. But for operators planning to enhance their digital infrastructure, their organizations will need to overcome obstacles in places throughout the well lifecycle.

Even with the continuing rollout of faster wireless services (4G/5G), many wells are in remote locations with limited or no terrestrial connectivity. The need to monitor wells, perform analysis and improve production in these remote sites are key drivers behind the need to implement the right satellite-based data extraction solution.

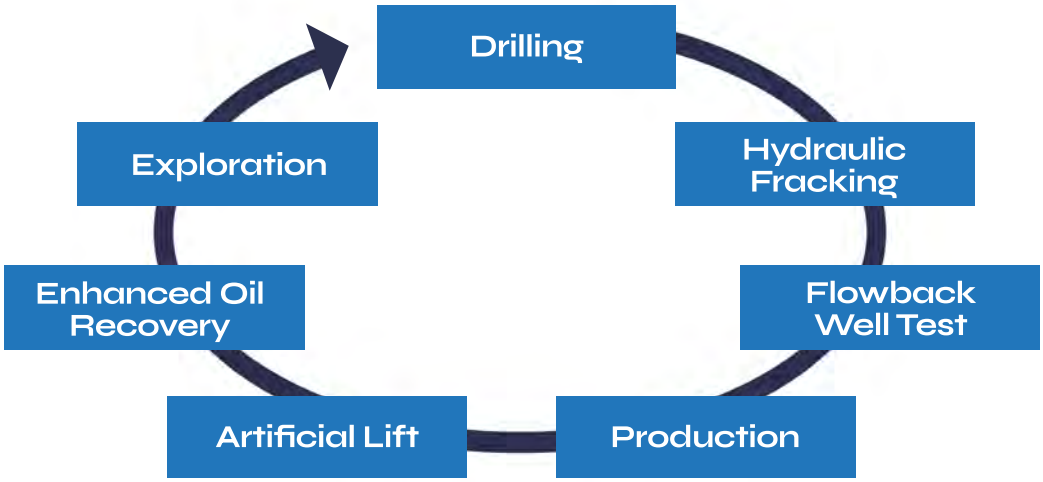
A further challenge is that throughout the well lifecycle - from exploration to flowback testing and drilling to recovery - the functions can be siloed in terms of data storage, management, and data sharing. Not all day-to-day, nonfailure data collected and managed by a functional area will be important to other areas, but some data and failure data is critical and impacts on other functions. If this data is not easily accessible and shareable across the complete lifecycle, misalignment will occur, impacting the entire value chain.

Anyone exploring the market for well life-cycle data management options should look for a complete end-to-end system that is highly configurable and can scale as a company grows. From exploration to well abandonment, the selected solution should offer modules that integrate easily with existing software solutions, enabling the implemented solution to be the central and single source of truth for the organization.

Satellite connectivity and the well lifecycle

How Satellite Connectivity can Optimize Production at Each Stage of the Well Lifecycle

There are data requirement challenges at every stage of a well's lifecycle. In this section, we explore the challenges and possible solutions, stage by stage.



Exploration

Before drilling takes place, geoseismic data is gathered remotely to make decisions on whether to drill in the area or not. Typically geoseismic applications log extremely large amounts of data that's transmitted over satellite due to the remote location of most drilling sites. It is not unusual to have terabytes of data transmitted in a short amount of time.

The data requirements for geoseismic services are so great that the most economically viable satellite-based connectivity solution is VSAT (Very Small Aperture Terminal). However, other data requirements such as VoIP, Email and WiFi can be met with other solutions such as BGAN and Push-To-Talk solutions.

VSAT
A remote location out of reach of terrestrial communication networks, coupled with the, necessity to frequently transmit large volumes of data, poses a problem. VSAT solutions are always on. No matter the location, a VSAT solution provides complete connectivity and unlimited data transfer to keep operations online and up to date.

BGAN
If Operations need seamless connectivity in the field, with email and VoIP connectivity, a BGAN device such as the MCD-4800 ("The Football") is often the best fit. The Football is recommended because it has an IP67 rating, making it highly resistant to rain, snow, flooding or dust.

Push-To-Talk
Push-To-Talk (PTT) devices are like satellite-connected walkie-talkies. Provided to your key field operatives for mission-critical comms, they have no reliance on public infrastructure, and so will keep your team connected in any event. The Iridium Extreme 9575 is a best-in-class example of a PTT device.

Drilling

Once drilling commences, any disruption to drilling operations is of course undesirable; repairing and replacing parts is costly and time-consuming, and drilling contractors can be, and are, penalized for lost time.

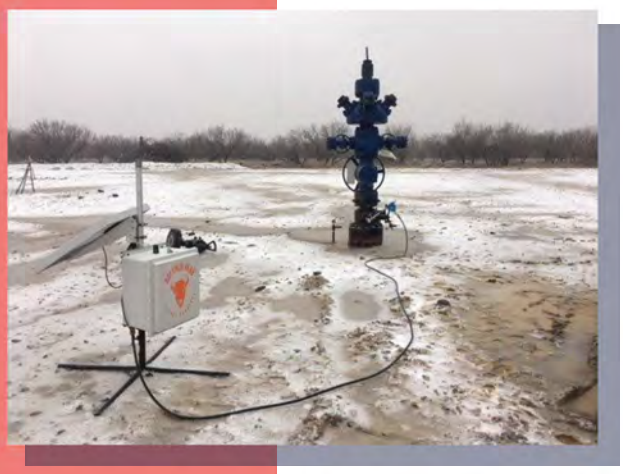
As a result, it's standard practice to have sensors monitoring pressures, temperatures, flow, particulate, and HSE variables such as hazardous gas (H2S). Real-time notifications ensure operators are aware of any issues that can impact productivity, and can react quickly to minimize disruption.

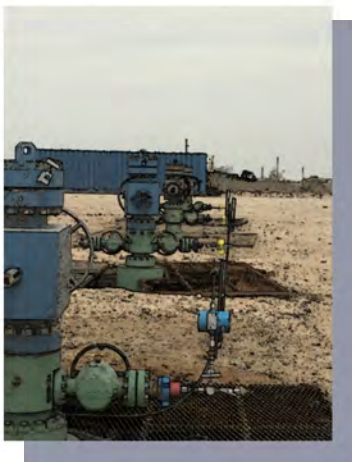
For instance, any particulate in the lubricant for rotating equipment can cause a catastrophic failure. If mud pumps become blocked or degrade on-site, loss of pressure can occur resulting in the pumps working harder for little output. Separation of mud gas can also shut down drilling operations if not managed and expelled correctly.

RockBLOCK
TheRockBLOCK, which provides plug-and-play satellite connectivity, delivers real-time data, so that if a process strays out of tolerance parameters, an alert is triggered instantly. Another benefit of RockBLOCK technology is its reach beyond terrestrial networks for truly global, 24/7, 365 monitoring and alerts.

Hydraulic Fracturing

Upon completion of drilling operations, many wells are then completed using Hydraulic Fracturing (Fracking). Prior to fracking, a completion engineer may want to get additional science on the well and order a Diagnostic Fracture Injection Test (DFIT). The DFIT provides the completion engineer with the data necessary to design the hydraulic fracturing of the well.





The data requirement for a DFIT is typically one second data resolution and can last days; sometimes weeks. It's completed before the full team arrive on site, therefore, there's no power, and the unit must be powered by a solar array - including the means of transmitting the data back to the engineering team. BGAN devices are known for requiring little power and can run on a 50W solar panel with a 35Ah 12 VDC battery.

Offset fracture monitoring is now a requirement for drilling in some areas and will continue to grow as regulations are put in place to monitor the effects of drilling and hydraulic fracturing. Hence, it's essential to mitigate the risks associated with pressure-induced hydraulic fracturing and to obtain valuable formation and reservoir data.

For this application we would recommend a BGAN or RockREMOTE device for data backhaul; the former is very well known in the Oil industry, and the latter is a relative newcomer leveraging the Iridium Certus 100 service.

RockREMOTE
The two-part RockREMOTE features an omni-directional antenna, with no pointing required - ideal for hilly areas where it's not easy to point the antenna at a geostationary satellite. It has dual-mode satellite and LTE connectivity and has the capability to deliver edge processing, materially reducing costs, as data can be transmitted on the exception rather than routinely.

Flowback Well Testing

Flowback is necessary for initial well cleanup, to remove fluids that were introduced to the well and any debris that accumulated in the wellbore. The produced fluids are collected for recycling or disposal. But beyond this necessary task, once the well has been cleaned up, well testing can be conducted.

Well test interpretation is the process of obtaining information about a reservoir through analyzing the pressure transient response caused by a change in production rate. This information is used to make decisions about how to produce the reservoir to maximize its net present value.

The well is plumbed to a 3 phase separator and the flowback of oil, gas and water is measured and logged. The data is then imported into software that calculates a decline curve over time, thus forecasting the performance of the well. Typically, the system includes:

2 pressure transmitters
2 turbine flow meters
2 temperature transmitters
1 differential pressure transmitter

These values are collected and stored locally, as well as transmitted to other stakeholders that wish to have the data. The data resolution is typically once per minute using traditional "poll and respond" technology such as Modbus.

However, an edge computing device such as the RockREMOTE can be configured to only publish the data if the values change by *x* percent or any other criteria. This allows the client to manage the data footprint on the satellite connection and save money.

Production

The next data challenge is getting the production data from the field into the SCADA system.
Typical data values that are logged are:

- Casing and Tubing Pressure
- Casing and Tubing Temperature
- Oil Flow
- Water Flow
- Gas Flow Computer values
  (often referred to as EFM – Electronic Flow Measurement)
- Tank Levels
- Ambient air for H2S and LEL gases

Source: https://www.oilandgasonline.com/doc/flow-measurement-0005

Once a well is in the Production phase the data requirements are less stringent than the steps in the well completion. The data resolution typically ranges from once per minute to once every 15 minutes using traditional **"poll and respond"** technology such as Modbus.

BGAN devices have enjoyed much success with Production Engineers over the past decade or so. BGAN is still extremely reliable, has low power requirements, is easy to deploy, and integrates with existing SCADA. And now, with MQTT based IoT gaining acceptance in the Oil and Gas industry, BGAN has a new lease of life.

Legacy systems can be integrated with an Edge Client / Device that will manage the "poll and response" characteristics of the Modbus-based controller locally. By utilizing the Publish / Subscribe nature of MQTT to reduce the data footprint by as much as 60%, engineers can anticipate huge savings in BGAN data costs.

Similarly, edge computing facilitated by devices like the RockREMOTE allow data transmission on exception - if the values move out of a set of defined parameters - which will materially lower transmission costs.

Artificial Lift Systems (ALS)

Over time (and sometimes at the outset of production) a well will require assistance to produce the most oil or gas possible. One of the most commonly deployed options is Artificial Lift Systems (ALS), achieved using mechanical methods such as Rod Lift, Electric Submersible Pump (ESP), Progressive Cavity Pumps, or Gas Lift.

Artificial Lift Systems must be closely monitored as the lift is created from rotating equipment (pumps) that often use a controller to adjust the speed of the pump to optimize production.

Artificial Lift Systems utilize a control system such as a PLC or Variable Frequency Drive (VFD). These systems typically require remote monitoring and control capabilities. Since the system is controlling the speed of the pumps, the data resolution time is relatively tight - typically once per minute.

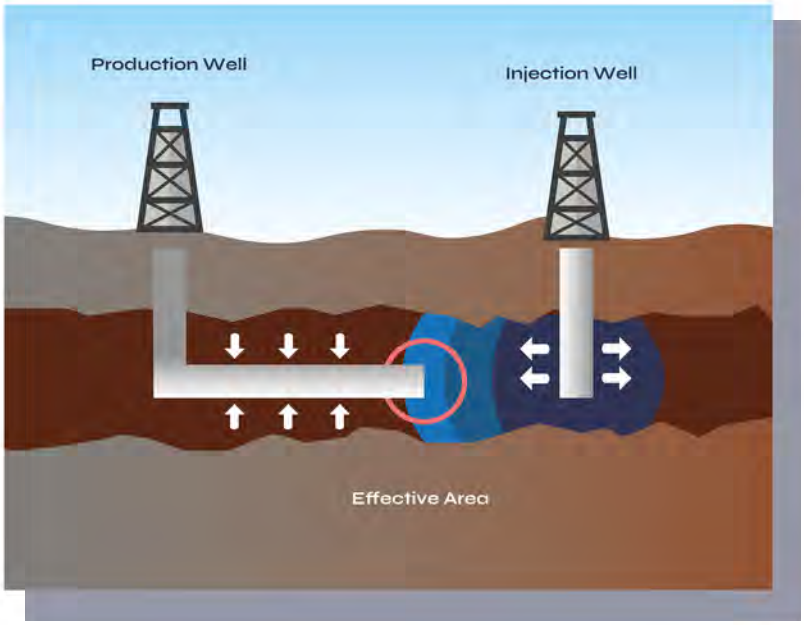
Pump too fast, and all the well will pull is water, or cavitation issues occur. Too slow, and paraffin builds up and the well begins to gum up and underperform. Therefore the data requirements for ALS typically range from once per minute to once every five minutes.

ALS connectivity is best managed with an Inmarsat BGAN M2M device or an Iridium Certus 100 device, as they balance relatively frequent sends and low to medium volumes of data.

Enhanced Oil Recovery (EOR)

There are three primary techniques of EOR: gas injection, thermal injection, and chemical injection. Gas injection, which uses gases such as natural gas, nitrogen, or carbon dioxide (CO2), accounts for nearly 60 percent of EOR production in the United States.

The EOR systems utilize a controller also, but it is only controlling the actuation of a small injector or valve to inject chemicals, steam, hot oil, or gases into the well bore. EOR can be used in conjunction with ALS to reach optimal levels of production.



EOR control systems are set to inject on either a time delay, or criteria met by measurements taken by instrumentation to the controller. Therefore data transmission is typically set to longer intervals making data footprint smaller, but the need for bi-directional communications is essential for making setpoint changes remotely.

EOR can leverage the relatively low cost Iridium SBD or Inmarsat IDP, as the data throughput is smaller and needed less frequently.

Not All Satellite Connectivity Is The Same

Satellite connectivity has sometimes been considered costly and inflexible. But as we hope this eBook has illustrated, that has changed as satellite companies have diversified their offerings. This is a quick snapshot of the best solutions for each part of the oil well lifecycle, so you get the data you need, when you need it, at the best price possible.

RockREMOTE

RockREMOTE as a Solution to Well Lifecycle Data Requirement Challenges

RockREMOTE offers a reliable and flexible communications solution for truly remote applications. The device combines a range of serial and digital integration interfaces, with seamless failover between the resilient Certus 100 and LTE cellular networks. The new Iridium-certified device (October 2021) guarantees robust communication and provides the vital link to ensure that critical data analysis and monitoring from well sites keep flowing.

The device has the ability to fully support and integrate into legacy systems that exist in the field today while providing a progression path forward and providing a robust platform in which clients' existing IP can be embedded.

Designed for easy remote industrial site deployment, the RockREMOTE combines a small form factor, industry-standard DIN rail mounting, and an omnidirectional antenna.

The device is specifically designed for ease of installation and operation in remote industrial environments. Its integrated processing, storage and security also enable the evolution towards Edge Computing. This facilitates the development of applications that communicate over industry-standard protocols such as MQTT into commonly used cloud services from Amazon, Google and Microsoft.

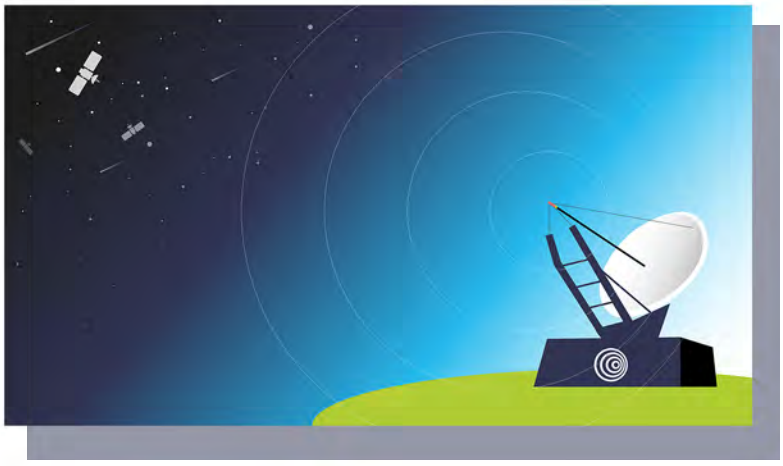
Summary and Conclusion

Typical criteria to enable sound satellite monitoring choices would include the following:

- Highly configurable, with the ability to scale as the organization grows
- Easily integrated, with the means to pull data in from software packages already in place
- Software modules for functional areas that currently have no software solution to store, manage, and share data
- Workflow capabilities including automatic notification for approval management
- Easily implemented to meet the company's needs and timeline

This paper outlined the challenges of data monitoring throughout the well site lifecycle and identified many areas where developments in satellite-based solutions

At Ground Control, it is our aim to earn your trust and become a valued partner to provide data and voice solutions for Oil applications in the immediate and long-term future.



Thanks for reading!

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