TECHNOLOGY TRENDS IN THE ENERGY INDUSTRY

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Abstract: Technology already plays a huge role in the search for and production of hydrocarbons, but the adoption of cutting-edge technologies in the Energy Industry will yield further improvements in Exploration, Production, Worker Productivity, and Safety. All of these new technologies will increase the demand for global bandwidth. The proposed abstract will review the hottest technology trends in Energy Industry, including: Connected Workers, Cloud Computing, Internet of Things, Rig Automation, and 4D Seismic.

1. INTRODUCTION

Technology plays a huge role in the search for and production of hydrocarbons, but the adoption of cutting-edge technologies in the Energy Industry will yield even further improvements in Exploration, Production, Worker Productivity, and Safety. When the Internet was new in the 1990s, the general public had no idea of the tremendous impact it would have on their daily lives, including: work environment, business tools, how they would communicate, personal entertainment, shopping and social interaction. On a similar note, a handful of disruptive technologies will have same potential to create major paradigm shifts in the Oil & Gas Market, ultimately driving future demand for bandwidth around the globe. The technologies include: Blockchain, Connected Worker, Internet of Things (IoT), Cloud Computing, Rig Automation, and 4D Seismic.

The Energy Market is multifaceted, and is generally broken into three major segments: Upstream, Midstream, and Downstream. For simplicity sake, if you think of an oil refinery as midpoint, the terms upstream and downstream are easier to conceptualize. The upstream market segment includes all the activities that happen before oil reaches a refinery. This includes exploration, drilling, and production.

Midstream is a relatively new term that replaced Refining as the middle segment of the Oil & Gas Market because it is more inclusive. The Midstream Market Segment includes: gathering pipelines, refineries, and natural gas plants, as well as a transportation options, such as pipeline, rail, ships or barges, or trucks, for moving crude, refined products and natural gas to downstream distributors. The Midstream Market Segment also includes storage and wholesale marketing.

The Downstream Market Segment includes the marketing and distribution of products derived from the processing of natural gas or the refining of crude oil. Transportation and Retail are large segments in the Downstream Market.

Let's examine some of the hottest technology trends and how they will drive the demand for global bandwidth:

2. BLOCKCHAIN

Blockchain is best known as the underlying technology for crypto currencies but it is an emerging technology that is being used in the Energy Industry. The secret to blockchain is a distributed ledger than can be duplicated but not edited. Every time a new transaction is made, the ledger is updated and then

distributed. Multiple parties receive and distribute the same blockchain ledgers. Since the data in the ledger can't be edited, the ledger provides a reliable audit trail that can used by all parties as a perfect record, and since there are multiple copies of the ledger, it is inherently safer than data stored in a central repository.

There have been multiple applications proposed for blockchain technology within the Energy Industry. "A blockchain implementation provides a platform for multiple parties to transact with one another, without the need for third party validation, creating a ledger of records that is by design more secure and trusted than other approaches," explained Ansar Nubeel in his article in Digital List.

One practical application for blockchain is the payment of oil & gas royalties. Invariably, there are always disputes in the monies paid in a royalty transaction and it can often take many months to resolve these issues.

In this particular application there are three parties: a producer, a land owner and a royalty holder. A blockchain platform would allow these disparate interests to reach consensus on the calculation and settlement of royalties by sharing key information via a distributed ledger. Real time settlements could be executed quickly, shortening the overall process, but also dramatically reducing settlement costs.

3. CONNECTED WORKER-LONE WORKER

The pursuit and production of hydrocarbons is fraught with challenges, some of which can be extremely dangerous. Oil and gas wells are routinely drilled in harsh locations, like jungles, desserts, in mountain ranges, and in inhospitable bodies of water, like the North Sea. Energy companies are under constant pressure not only to improve efficiencies, reduce costs, and improve profits, but they are striving constantly to improve safety. If a company is known to be lax on safety, it can adversely affect the outcome of injury lawsuits, but other companies will begin to shy away from doing business with them. In days past, safety slogans like "Safety first!" were greeted with a wink and a nod. Today's energy companies no longer feign concern over safety, but take an active role insuring that safety policies are fully understood and enforced. Health, Safety & Environment (HSE) organizations now play significant roles in the management of global energy companies.

Not too many years ago, communication with mobile workers was limited. People in the field typically communicated over a radio link via a dispatcher. As the Cellular Market matured, smartphones began to appear and were ultimately adopted by the masses. In parallel, mobile broadband services matured, along with location-based services and data apps. These advances in mobile communications were the DNA of today's connected worker programs.

Connected workforce applications allow energy companies to eliminate manual processes and ensure regulatory compliance by eliminating paper-based systems, which are prone to error, and replace them with applications that help employees complete their tasks correctly and safely. Connected workforce applications improve efficiency and accuracy of data that is collected from the field. These programs also improve safety processes by streamlining data collection processes. Connected workforce applications can also help bridge the skills gap in employees.

Remote workers are hard to track and they often work by themselves. Connected worker and lone worker programs are initiatives that allow workers to request help in the event of an accident.

The latest trend in connected workforce applications is wearable technology. Employee tracking is the first tangible benefit. Should a major event happen inside a refinery or gas plant, such as a fire or explosion, having a time-stamped location of every employee is invaluable and much more reliable that a human doing a manual head count at a muster station.

Wearable devices that incorporate microphones allow for the collection of auditory information, such as the sound signature of failing mechanical equipment or a high pitched squeal of a leaking pipe that is above the frequency range of the human ear. Video cameras allow for remote expert support and collaboration between the remote worker and subject matter expert located at a central location.

4. CLOUD COMPUTING

Over the last decade, cloud computing has become a mainstream service and this paradigm shift has had enormous impacts, not only on IT organizations within energy companies, but also on bandwidth demand. Rather than own and operate racks of servers and software, companies and organizations now contract for computing services as if it were electricity provided by a utility. The strategic benefits of cloud computing are huge: 1) elasticity, allowing companies to pay for only what they consume; 2) virtually unlimited computing power when needed; 3) broadband access from practically anywhere from a wide variety of devices, such as laptops, smart phones, and tablets; 4) global access to the cloud; and 5) increased network security.

The Gartner Group forecasts that the Public Cloud Services Market will grow 17.3 percent in 2019 to a total of $206.2 Billion, up from $175.8 Billion spent in 2018 (Source: Gartner).

As the demand for cloud computing grows, there is a parallel demand for bandwidth. To successfully migrate from a private server architecture to a cloud-based solution, companies must beef up their wide area networks (WAN) to support the interaction of users with software applications that now reside in the cloud. Not only must fat pipes be ordered and installed, wide area networks must be engineered to maximize uptime. Backup circuits, alternate ingress and egress into buildings and facilities, and backup networking gear must be factored in a sound cloud strategy.

IT organizations aren't the only ones that must beef up their architectures. Large internet companies, such as Google, Amazon, Facebook, and Microsoft, are all building data centers around the world. Their goal is to put data centers as close to their consumers as possible, where they can store video content locally. A shorter data connection minimizes latency and provide end users the best possible user experience when they download content.

But as the number of private data centers grow, they must be synchronized. According to Geoff Bennett, Director of Solutions & Technology at Infinera, the large Internet companies will consume more bandwidth synchronizing their private data centers than is consumed by public Internet traffic. Think about that for a second.

This has led to several private fiber initiatives, such as the Microsoft-Facebook-Telxius subsea fiber between North Caroline and Spain. In addition, Google has invested in numerous subsea cables, providing them exclusive access, along with their investors, to needed bandwidth in certain regions.

So, as you can see, as the Cloud Computing Market grows, the demand for bandwidth will continue to increase.

5. INTERNET OF THINGS (IoT)

The Internet of Things (IoT) has become mainstream and IoT applications are being adopted by every facet of the Energy Industry, providing gains in efficiencies, and enabling big data analytics to be performed, often for the first time, on equipment in the field.

The Internet of Things (IoT) is an outgrowth of SCADA (Supervisor Control and Data Acquisition) systems which have been used for over 50 years to control pipelines, electric utilities, and water/waste water systems. In the early 1990s, lightweight SCADA services began appearing, with the market segment known as Machine-to-Machine (M2M). These early services often focused on the delivery of a single service, such as measuring the fluid level in a tank. Kevin Ashton, founder of MIT's Auto ID Lab first used the term Internet of Things (IoT) in a presentation in 1999 and IoT became fashionable.

IoT is an all-encompassing term that includes a wide range of industries, technologies, and service offerings. It should be noted that distinctions can be made between IoT services aimed at consumers and services aimed at energy companies, and other industrial users. Manufacturers of everything from refrigerators to air conditioners can be connected to the Internet. Google paid over $1 Billion to acquire Nest, the manufacturer of Internet-enabled thermostats.

From a bandwidth perspective, it should be noted that the consumer market for IoT services is different than the market for Industrial Internet of Things (IIoT). Consumer IoT services generally piggyback on existing Internet connections, like the one in your home. As such, consumer-oriented IoT services in developed countries don't drive much demand for new bandwidth. IIoT applications, on the other hand, which are used to monitor and control industrial assets, typically require new Internet connections, hence driving new demand for bandwidth.

Traditional SCADA applications are very low bandwidth connections, so one may question how much bandwidth IIoT connections will drive? It is interesting to note that audio, video, and data are now being integrated into IIoT applications, creating a much larger demand for bandwidth. In the past, video would never have been considered in SCADA applications due to costs but with the advancements of IP-based cameras with integrated analytics, video is now a robust part of many IIoT applications.

6. RIG AUTOMATION

Drilling rigs are amazing marvels of engineering capable of drilling vertical and horizontal holes into the Earth's surface that are many miles in length. Drilling rigs, drill bits, drill pipe, crews, and support services are all secured on short term contracts, typically a daily rental. The day rate for a land rig ranges between $8,000 - $40,000 per day, depending on the rig size and region. Day rates for offshore rigs average 15 -20 times higher, with the largest offshore rigs equipped to drill in deep water renting for $250,000 - $400,000 per day. Day rates include the drilling crew but don't include additional contractors, or support vessels that may be needed. It is common for loaded costs of a deep water rig to range from $750,000 - $1,000,000 per day. There are serious savings if an oil company can shave a few days off the time it takes to complete a well.

Robotics and rig automation have greatly increased the safety and efficiency of drilling operations, as well as driving operational costs down. Robotic tools now assemble and disassemble pipe joints, a dangerous task done previously by rig hands wielding large hydraulic tongs. Rig manufacturers have

automated as much of the surface operations as possible, creating a "manless drilling floor". The development of automated drilling systems gets people out of harm's way and dramatically increases operational safety.

Drilling companies have been developing expert systems over the last decade to further improve efficiencies. In addition to capturing and cataloging best drilling practices from retiring drillers, broadband networks have been deployed to allow the interaction of the driller onboard a rig with a centralized control center in Houston. A drilling manager in Houston can oversee four or five individual drillers, proving oversight and expertise when needed. These collaborative systems continue to improve, thereby increasing the hunger for bandwidth.

7. 4D SEISMIC

4D seismic, or time lapsed seismic, is an improved method of modeling oil and gas in a reservoir. Seismic data is gathered using a series of hydrophones embedded in the earth's surface to gather sonic waves that are reflected off different strata below. When the seismic data is processed, a 3D image is created allowing geophysicists to map the subsurface of the earth, showing the stratification of an underground reservoir and its contents.

After a well has been stimulated in order to increase production, a production engineer will order a seismic survey to look at the geologic structures around the well(s) and the movement of oil to see if the stimulation was successful.

In offshore applications, large ships tow large arrays of hydrophones and capture the reflected sound waves bounced off the oil formation. Due to the cost and time delays of securing the services of a seismic vessel, seismic surveys are done only when economically justified.

Instead of towing the hydrophones behind a ship, which provides the production engineer a snapshot in time, 4D seismic systems utilize a network of hydrophones that are permanently embedded in the seafloor and connected by fiber optic cables. Since the seismic array is permanently installed, it can gather data on an ongoing basis, providing valuable and historic data that the engineering can use to increase production. The raw seismic data from the 4D hydrophones would be connected via a subsea fiber optic cable run back to the beach or to a branching unit of an existing subsea cable system.

4D Seismic systems provide continuous feedback on the status of a well, rather than snapshots in time. It is estimated by geophysicists that this near real-time data could increase yields as much as 8% over the well's lifetime. As this technology gains wide spread adoption on deep-water wells, look for an ever increasing network of subsea fiber optic cables crisscrossing the world's offshore oil basins.

8. CONCLUSION

The Energy Market has been an early adopter of information technology, including: mainframes, supercomputers, work stations, cloud computing, global WANs, and dark fiber. Look for exciting new trends in the Energy Industry to continue the demand for more bandwidth in the future.