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The Status of WITSML as an Intelligent Energy Real-Time Enabler

Børge Kolstad, William Chmela, Rune Skarbø, and Nicholas Gibson, Kongsberg Intellifield

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Abstract

The XML based Wellsite Information Transfer Standard Markup Language (WITSML) wellsite data exchange format provides the hydrocarbon extraction industry with a bandwidth efficient, real-time drilling data management and exchange format. Drilling data can be supplied to the data consumer within seconds, regardless of their global location.

With recent industry talk of the big demographic bulge or crew change being due within five years and ongoing difficulty in sourcing new recruits into the hydrocarbon extraction industry, the ability to take the data to the expert, rather than the expert to the data, provides both Oil and Service Companies with workflow challenges and opportunities.

This paper reviews three cases that show the WITSML data standard and associated infrastructure being used to automate or improve the distinct organizational workflows. The provision of real-time well and drilling data *via* an internet protocol based data standard and data management infrastructure brings measureable improvements within the discussed workflows.

Introduction

Large "integrated" software providers, as well as small niche software houses, are embedding the Wellsite Information Transfer Standard Markup Language (WITSML) application programming interface (API) into their latest software releases (WITSML, 2008). This API allows automatic and seamless data flow between data providers and software applications written by different and often competing companies. Software tools focused on interpretation and analysis of drilling, petrophysics, geophysics and geology data can now be used much more efficiently in real-time decision making (Saputelli *et al*, 2003).

To take full advantage of the real-time capability of these new applications, a supporting infrastructure must be put in place to gather, distribute, manage and visualize this data in real-time. This infrastructure allows automated data flows directly from the sensors in the well or on the rig directly into the supporting applications anywhere in the world. The infrastructure also allows the results of these supporting functions to be made available back on the rig site.

WITSML - a proven well data standard

In the last five years tremendous progress has been made across many industries that require a global, 24/7, decision-making environment. As early as fifty years ago, standards protocols began to evolve to allow data acquired by different vendors or service companies to be interpreted by other vendors' software products. Standard file formats such as LAS, DLIS, and SEGY enabled this capability. Originally, the workflow was manual with the supplier of the data generating tapes or disks of the data, shipping the data to the supporting engineer or geoscientist, where she or he manually loaded the data and performed an interpretation in support of the operation. The reality was that there were many lessons learned, but very little real-time support.

In the past fifteen years, the large integrated service companies began offering complete packages including data acquisition, digital data transmission using proprietary formats, and interpretation of results. Any gaps in their offerings were filled by buying small software companies and building custom links to integrate this software into the larger package. The disadvantages of this approach are:

- 1. The user is tied to one vendor for the entire workflow, even if some of the applications are not "best in class";
- 2. The operator does not have full control of the real-time data and may compromise their data security model because data is fragmented within several different off-site service company data hubs;
- 3. The integration between the applications offered by a single service company is not always seamless or efficient, potentially slowing down dataflow and making change control and upgrades complicated.

Today, standards such as XML and SOAP allow data to be automatically transferred between companies, software applications and devices with no coordination or custom programming required from either end of the data transfer transaction. Many different industries are using these standards to allow automated data management and to provide simple, intuitive web based access to data from anywhere on the internet or intranet. Workflows, applications and tools based on these standards are often referred to as Web 2.0 technologies.

The WITSML standard is built upon the shoulders of all these standards to allow automation of the gathering, distribution and management of drilling data in real-time in a truly global integrated collaboration environment.

With the WITSML data transfer standard, an oil and gas company can easily manage its own secure global infrastructure in which all data from all vendors, service companies and data providers is gathered in real-time into a single server on the rig site. The real-time data is available to anyone with the correct security logins and credentials regardless of their location, within or outside the operator's firewall, providing organizations with completely secure control of the real-time data access.

The infrastructure also allows all real-time data to be transferred to an onshore integrated collaboration environment (ICE) that supports the remote drilling operations. A WITSML server located in the integrated collaboration environment harvests the real-time data from multiple drilling rigs in real-time and is able to store this data for years.

The WITSML backbone gives instant, intuitive and simple access to all data to all professionals in the organization on the rig and in the office, including engineers, geoscientists, asset managers and executives.

In daily operation today, workflows based on a vendor-neutral WITSML platform seamlessly integrate data from vendors such as Schlumberger, Halliburton, Baker Hughes, Geoservices, MD Totco, NOV, *etc.*, with applications from Knowledge Systems, Paradigm, Smith International, Schlumberger, Landmark and many others. Workflows, quality control and real-time data management can be standardized across divisions, business units and locations, while keeping the flexibility to make local choices of drilling contractors, LWD companies, data providers and supporting software applications (or even parts of software applications).

Implementation of a WITSML backbone renders obsolete the data management services used to transfer data associated with the drilling operation (*e.g.* EDR, LWD, Mudlogging, *etc.*). The backbone replaces these legacy data transfer systems with an integrated real-time data management infrastructure.

Described below are three example workflows that have been automated and/or improved by using a vendorneutral WITSML infrastructure.

Case 1: Implementation of a global real-time data management infrastructure using WITSML

Historically, during drilling operations the domain experts have travelled to the rigsite to provide their expertise onsite whilst the operations are on-going. This requirement for the rig site presence of the domain experts demanded planning, logistics, bed space and expenditure. The expert had to go to the data.

In the example below, the WITSML infrastructure takes the required drilling data to the expert, regardless of their location.

In the displays within Figure 1 below, an executive or a supporting engineer or geoscientist is provided with an overview of all consolidated data from the operations within an area in real-time. This overview display, as shown on the left of Figure 1, gives the user a simple interface to choose a rig for futher evaluation.

Figure 1: A real-time drilling operations management system demonstrating granularity within the well and drilling data views.



If particular well sites require attention, the expert or their support infrastructure can "drill down" into the data. Rigs with problems are highlighted based on user defined warning or alarm settings. The second or central screen in Figure 1 gives another view of the operations showing key information from all rigs such as current drilling state (determined automatically from real-time data), current bit depth, pit levels, hook load, *etc.*. From this second screen, the user can drill down into the data on the rig in more detail, as shown upon the third or right screen in Figure 1.

The major differentiator between this and legacy systems for rig site support is that all data from all vendors is available from a single interface. Data from the drilling instrumentation, the LWD, the mudloggers and more can be displayed in a single screen. Both real-time data and historical data from different vendors can be displayed in real-time, whilst domain experts make the drilling decisions.

Taking the data to the expert allows people with regional or workflow specific knowledge and experience to provide advice, feedback or corrective action to remote drilling operations. For example, a driller currently located upon a rig located in the South China Sea can assist colleagues with their current Gulf of Mexico drilling operations by reviewing the real-time data within the corporation's global real-time data management

infrastructure.

Figure 2 below illustrates an example backbone that makes drilling data available to any expert in any location. The corporate infrastructure provides WITSML-based links to third party datasets, software and service providers. These links can be provided both within and outside the corporate firewall.





Case 2 : Population of a master well repository with raw real-time data using WITSML

The WITSML data standard can be used as a mechanism or protocol to directly populate corporate master well repository systems with the raw real-time well and drilling data as it is created. Such WITSML-enabled corporate master well repository systems can either be commercially available software applications or alternatively bespoke well databases. In turn, these commercially available enterprise software applications or bespoke enterprise well databases can then be made Open*Spirit* compliant, allowing near real-time access to the well and drilling data in other third party software applications (Open*Spirit*, 2008).

This first data management step provides the data consumers with the well data as it is acquired and allows them to compare the data and information with pre-stored well data or geological analogues. WITSML-enabled third party geotechnical, petrophysical and drilling software toolsets can then source, upload, and use this real-time data. The real-time data is now available within the software and visualisation canvas that the domain expert is accustomed to using, rather than asking the domain expert to master another technology or software.

Having the latest version of the drilling data immediately available to the domain experts within the organization provides real business value. The WITSML format well and drilling data arriving within the geoscientist's and engineer's toolset of choice within seconds of being generated allows these data consumers to focus on value-added work.

Instead of managing data transfer between software applications and learning new drilling operation specific software systems, domain experts can concentrate upon the required analysis and interpretation to determine what the real-time data reveals about the drilling program and the reservoir rock properties.

An oil and gas company's data management administration team will be able to guarantee a high level of service to the domain experts. Automatic loading of the corporate master well repository with the real-time data provides organizations with the fundamental well and drilling data that help promote high quality data management standards and procedures.

Case 3: Providing real-time pore pressure analysis to remote drilling operations using WITSML.

Several major studies have suggested that abnormal pore pressure and associated wellbore instability can result in between 30% and 50% non-productive time (NPT) (Schmidt *et al*, 2004).

WITSML has been used as a tool to provide drilling and petrophysical data to pore pressure analysis experts in real-time (*e.g.* Brady, 2007; Standifird and Matthews, 2005; Standifird *et al*, 2006). On occasions, the experts were located away from the wellsite due to personnel on board (POB) limits at the rig. The WITSML data format also allows, for example, change out of a service company at the rig site without any disruption of the real-time data links.

The WITSML data enabled the pore pressure analysis experts to update the pre-drill lithology and pore pressure models in real-time, providing a continual update of pore pressure and wellbore stability at the bit. These were then fed into the predictive model to reduce the window of uncertainty for the pore pressure ahead of bit to planned depth of the well. The pore pressure analysis results were fed back from the experts' remote location to the wellsite and were used as a basis for proactive operational decisions in real-time.

Figure 3. Illustration of actual pore pressure change from the projected pore pressure profile versus borehole depth for a sample borehole pore pressure profile, along with ± 2 standard deviations of the mean pore pressure profile values resulting in the projected "window of uncertainty". Image courtesy of Knowledge Systems (www.knowsys.com)



pp deviation (prediction - final)

This real-time data enabled the analysts to improve the geomodel results and reduce the pre-spud uncertainties in the pore pressure, thus reducing uncertainty around key geotechnical and petrophysical parameters whilst drilling. The continual reduction in the uncertainty of the predrill program reduced the level of NPT and resulted in higher quality boreholes.

Conclusions

The WITSML format is a proven standard that allows oil and gas companies to easily manage their own, secure and seamless data management and transfer infrastructure to support and promote the management of a full suite of drilling operations in real-time. The real-time drilling and logging data can be provided to domain experts located around the globe, regardless of their location, as long as they can gain access to the internet. The XML based WITSML data schema makes efficient use of the available data transmission bandwidth, important for development of hydrocarbon fields where communications infrastructure is limited.

Rather than taking the expert to the data, the data is taken to the expert in real-time. The WITSML data standard and data management infrastructure gives domain expert stakeholders the facility to provide analysis, feedback and support to remote drilling operations as they progress, regardless of the rig locations. Historic drilling and logging data can be reviewed alongside the current borehole operations providing end users with a drilling knowledge management system with contextual data displays.

Given the high cost of current drilling and logging operations, oil and gas companies can immediately realize value from adopting a WITSML-based data management infrastructure. Real-time acquisition and storage of petrotechnical and engineering data using WITSML will reduce cycle times for monitoring, surveillance and decision support of current drilling projects, as well as facilitate further interpretation and analysis of the data. Within seconds of its capture, domain experts can use the real-time data in their standard drilling and petrotechnical software applications.

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