

Maximizing the potential of MWD and LWD

New service offers flexibility to switch between electromagnetic and mud pulse telemetry modes.

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Capabilities such as MWD and LWD have long proven their worth in measuring and transmitting critical formation data to the surface in real time, keeping pace as the industry seeks to expand the operational envelope in new and challenging frontiers while also pushing harder to improve ROPs. By transmitting measurements at regular intervals while drilling, MWD and LWD provide valuable information on well positioning, tool orientation, lithology indicators, reservoir content, geomechanics and drilling optimization to increase ROP, enhance wellbore stability and optimize well placement.

In recent years, advances in MWD and LWD technology have been a game changer in helping operators overcome the complexities of drilling directional wells, enabling quick and informed decision-making. As producers seek to optimize field economics by reducing the overall well construction cost while improving the quality of the borehole and wellbore positioning, services that reduce flat time, boost data transmission speeds and ensure accuracy in wellbore placement are more essential than ever.

Producers with land operations will typically choose between two methods of data transmission—mud pulse (MP) or electromagnetic (EM) telemetry—depending on the area, target formation and well conditions. EM telemetry can transmit data at very high rates of speed using EM waves, meaning that data acquisition and transmission can be completed while the pumps are off. This helps eliminate surveying wait time. MP telemetry, which transmits downhole data to the surface using pressure pulses in the mud system, is suited for deeper, more complex geologies where EM predicted signals could be weaker.

Data transmission options

As both EM and MP telemetry modes offer unique benefits, selecting a transmission option can be challenging, especially when by selecting one telemetry mode, the advantages of the alternative mode are lost. This can

result in costly trips out of hole and minutes added to the operations. To overcome these challenges and provide greater flexibility to operators, Schlumberger developed a service that streamlines surveying procedures, improves data transmission and positions the wellbore within the reservoir with greater accuracy. The xBolt accelerated drilling service was designed to maximize on-bottom drilling times so operators can deliver wells faster and stay in the sweet spot.

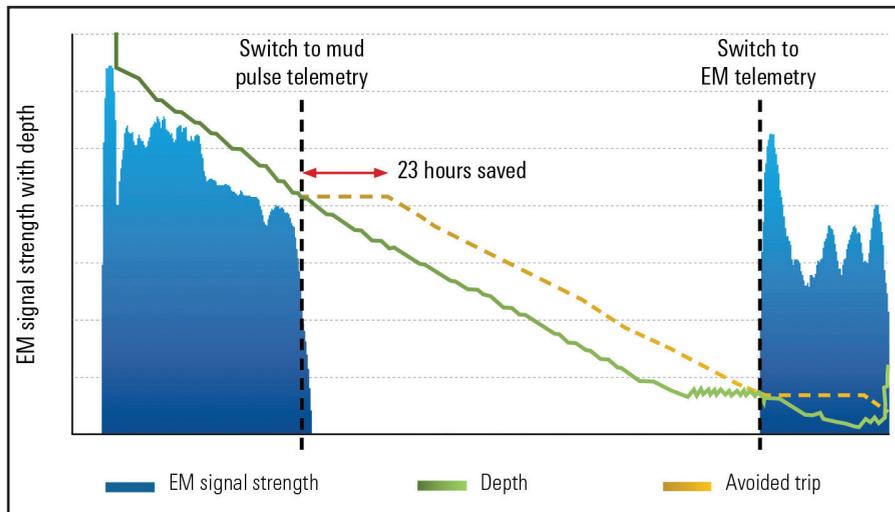
The service is available in three configurations to provide multiple data transmission options in a single tool: 1) ultrafast EM telemetry in signal-friendly zones, 2) reliable, high-speed MP telemetry for deeper, more complex intervals and 3) a flexible and redundant dual-telemetry configuration that supports either mode. Drillers can switch between modes in less than 1 minute.

Every minute counts

With the capability to use total and azimuthal-image gamma ray functionality to reveal bed crossings and boundaries at a temperature rating of 165 C (329 F), the service supports confident geosteering decisions. Improved imaging enables more accurate steering and minimizes sliding for increased ROP and reduced well porpoising, resulting in a smoother, less tortuous well profile. The service reveals formation dips while drilling to deliver a cost-effective solution for increasing total footage drilling per day and more precise well placement.

A key objective in drilling longer, more deviated laterals is the need to maximize efficiency by reducing flat time, a result of survey wait times when making frequent and necessary connections roughly every 27 m (90 ft). Although wait times might only be 5 to 8 minutes per connection, those minutes count. A 3,048-m (10,000-ft) lateral usually requires 100 or more connections, resulting in several hours of flat time.

Engineered with the latest in both EM and MP technology, the accelerated drilling service's dual-telemetry configuration offers a single, flexible system. Superior demodulation rates eliminate survey times when using the EM configuration, achieving data transmission rates up to 16 bits per second. The EM mode takes and trans-



An operator was able to avoid a 23-hour trip to switch between EM and MP telemetry tools by using the xBolt service. (Source: Schlumberger)

mits surveys offline while making connections. It also can withstand high concentrations of lost-circulation material without jamming, because the tool has no moving parts, and therefore the risk of component failure is significantly reduced.

For deeper and more complex intervals, the MP telemetry mode uses powerful Quadrature Phase Shift Keying (QPSK) technology, which transmits more data in the same unit of time to increase signal strength and neutralize drilling noise.

Algorithms move the MP signal into a wider-frequency spectrum to avoid low-frequency noise and overcome insufficient data transmission due to low-frequency demodulation. By delivering LWD/MWD data at transmission rates as high as 4 bits per second, compared to the industry standard of 0.5 bits per second, the MP telemetry configuration results in surveying times up to four times faster than conventional methods to achieve a significant increase in on-bottom drilling times.

Operators in the long-producing and geologically diverse Midcontinent Basin have successfully implemented the accelerated drilling service to significantly reduce survey time and costs and increase on-bottom drilling time.

Multiple options in one tool

In one application the service improved drilling efficiency across an eight-well pad where laterals reached 3,048 m. A key objective was to reduce survey time using EM telemetry, which would enable sending survey data while making connections instead of relying on the standard protocol of waiting for the mud pumps to turn on after a connection is made.

However, the formation layers above the wellbore and extended laterals prevented receipt of the EM telemetry signal. The operator deployed the accelerated drilling service, activating the dual-telemetry configuration. This enabled the driller to efficiently and quickly switch to high-speed MP telemetry when needed so as to produce and receive signals faster than traditional MP technology. The dual-telemetry tool responded to a downlink and effectively switched to the MP telemetry mode, minimizing the time to troubleshoot for signal quality. Toward the end of the run, the tool was switched back to EM telemetry mode to maximize on-bottom time.

By implementing the accelerated drilling service, the operator saved 53 hours of survey time across the eightwell pad, reducing connection time by 7.5 hours per 3,048 m of lateral and avoiding an estimated 23-hour trip.

Increasing on-bottom drilling time

In another Midcontinent application, the accelerated drilling service, using QPSK MP telemetry technology to boost bit rates and eliminate drilling noise, was implemented to improve drilling productivity by minimizing lost time due to poor survey data and slow transmission speeds. A key challenge involved overcoming low-frequency drilling noise, especially in unfavorable conditions, which prevented data captured by conventional tools from being demodulated at the surface. This forced the operator to relog every stand of drillpipe, and even retake entire surveys, to obtain accurate formation evaluation and drilling optimization data while drilling, resulting in hours of nonproductive time per well.

By deploying the accelerated drilling service, the operator was able to increase data transmission speed and deliver a continuous MWD signal, significantly increasing transmission reliability and eliminating the need for relogging and repeat surveys. System algorithms guided the MP signal to change frequencies onto a cleaner area within the spectrum to negate the drilling noise. The result was a 25% increase in on-bottom drilling time, from 62% to 78%. The service delivered a 2-bits-per-second transmission rate while drilling compared with 0.5 bits per second from standard high-volume, probe-based MP telemetry, ultimately reducing survey time by 2 minutes per connection. **ESP**