Telemetry network enhances surface control

HIGH-BANDWIDTH TELEMETRY

A REAL-TIME, bi-directional drill string telemetry network has demonstrated simultaneous upward and downward data rates of up to one megabit per second, with a mean time between failure comparable to current mud pulse telemetry technology. The network uses inductive coupling coils and armored coaxial data cables embedded within premium double-shouldered drilling tubulars to provide high bandwidth telemetry without impacting drilling operations.

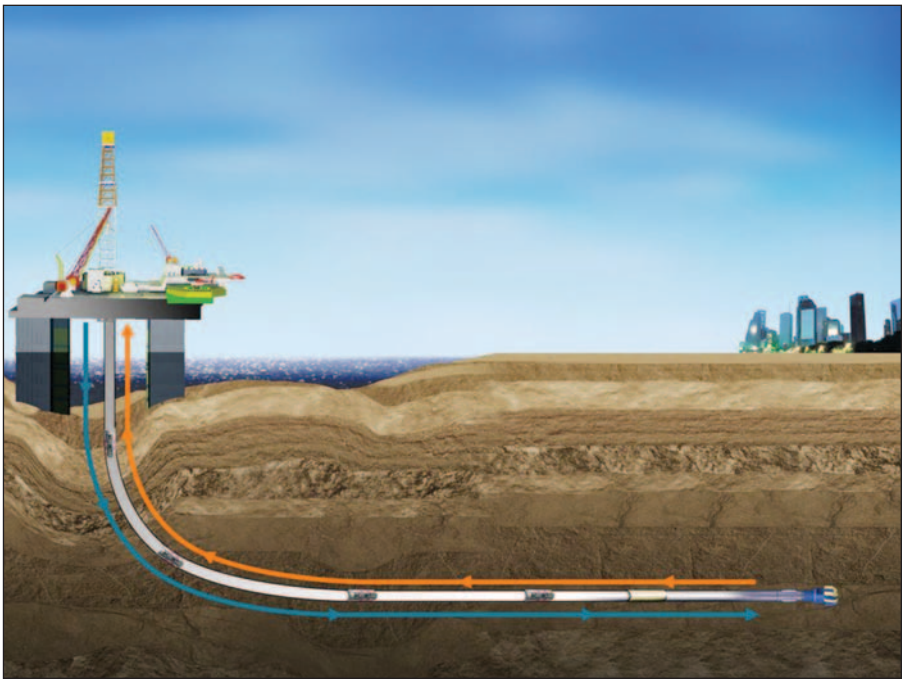
Field trials have included multiple vertical and directional gas wells drilled to depths exceeding 14,000 ft in the Arkoma region of southeastern Oklahoma. The drilling environment has involved extremely harsh vibrational conditions. During these trials, an oilfield service company has deployed many downhole measurement while drilling (MWD) tools, interfaced directly to the drill string telemetry network. This interface allows real-time surface control and interrogation of the downhole tools and transmission of high-density, low-latency drilling dynamics, formation evaluation and directional MWD data at previously impossible speeds. In a recent well, the operator elected to eliminate their usual mud pulse transmission tool, utilizing the telemetry drill string network and compatible MWD tools as the primary downhole data source.

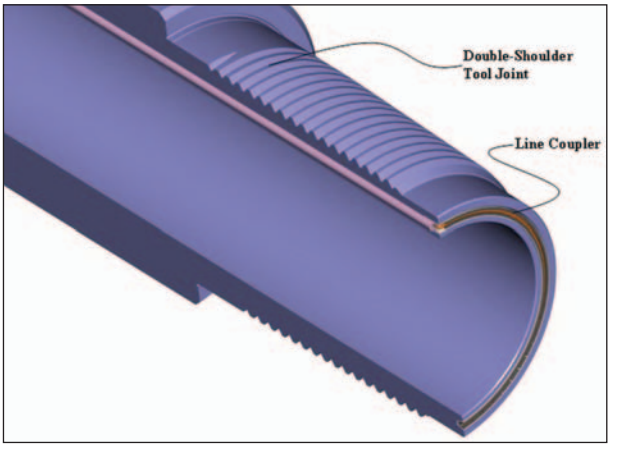
This paper provides details of the latest field trials, including specifics on the development and performance of these network-enabled MWD tools. A summary of the mechanical and electrical design considerations will be offered.

A direct comparison of observed mud pulse and drill string telemetry performance, highlighting operational differences, rig time impact, added value and deployment risks, will be provided.

Finally, this paper will provide details and value propositions of downhole and surface measurement and drilling applications enabled by the a reliable telemetry drill string network. Service company commentary on the likely time frame for commercial availability of these applications will be included.

High Speed Drill String Telemetry Network Enables New Real Time Drilling and Measurement Technologies (IADC/SPE 99134) ME Reeves, Grant Prideco; JD Macpherson, R Zaeper, Baker Hughes; DR Bert, BP; J Shursen, HG Intl; WK Armagost, BP; DS Pixton, IntelliServ.





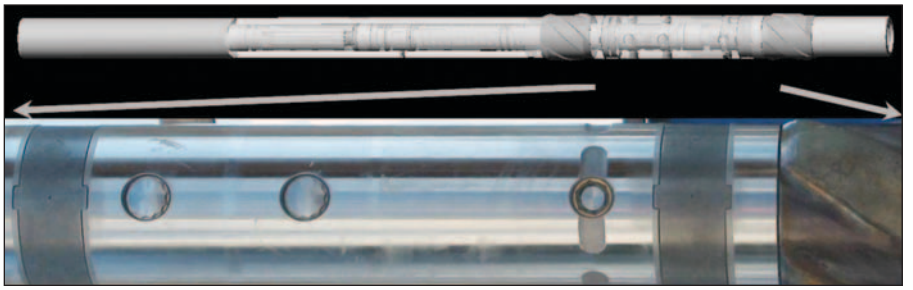
99134: A bi-directional drill string telemetry network uses unique inductive coupling coils and armored coaxial data cables to provide high-bandwidth telemetry without impacting drilling. The network has demonstrated simultaneous upward and downward data rates of up to one megabyte per second.

SWD TOOLS

Seismic While Drilling (SWD) technology provides a means to properly locate a well path with respect to depth and seismic travel time so the driller can effectively guide the bit toward a seismically defined target. SWD can also facilitate drilling decisions such as setting coring and casing points, drilling hazard avoidance and over-pressure zone identification.

Accurate and reliable SWD tools must address sensor coupling/fidelity and precision timing. This must be accomplished within the framework of the drilling environment, whose rigors impose significant constraints on the design and mounting of the seismic sensors and the accuracy of the clock.

A next-generation SWD tool has been developed that addresses coupling issues through the deployment of multiple multi-axis sensors, including ruggedized geophones, seismic accelerometers and hydrophones, in combination with a highly accurate clock and contingent surface systems. This paper investigates the performance of the new tool design and presents the



99042: A next-generation SWD tool addresses coupling issues through the deployment of multiple multi-axis sensors. Data from the tool is compared with baseline wireline VSP measurements.

results of field tests and operations in which seismic data were acquired using multiple sensors and types of sensors in various types of formations and in deviated boreholes.

The data acquired while drilling are compared with baseline commercial wireline VSP measurements to verify that the system provides accuracy comparable to that of a standard commercial wireline.

Next-Generation Multisensor Seismic While Drilling Technology (IADC/SPE 99042) RJ Deady, BE Cornish, Halliburton.

MONITORING VIBRATION

The paper describes the use of a downhole high sample rate RPM sensor and new software to provide real-time monitoring of both high frequency and low frequency torsional vibration.

The sensor is mounted around the driveshaft of a rotary steerable system and provides early warning of torsional vibration, indicating the occurrence of low frequency (stick slip) as well as high frequency events very close to the bit.

The ability to immediately detect the occurrence of torsional vibration has already resulted in a significant improvement in rotary steerable and LWD life because of the ability to identify, implement and continuously update the optimum drilling parameters (primarily weight on bit and rotary speed) in real time.

When used in conjunction with downhole vibration sensors in the LWD string and surface torsional vibration monitoring systems, a more complete picture of the complex downhole vibration conditions becomes possible. The beauty of this particular device is that it is already part of the rotary steerable system, so there is no additional lost in hole exposure as would be the case for a separate sub.

Real Time Downhole Torsional Vibration Monitor for Improving Tool Performance and Bit Design (IADC/SPE 99193) BC Comeaux, GT Irvine, DC Chen, B Wiecek, GM Gillespie, Halliburton.

OPTIMIZING HOLE-CLEANING

In large-diameter directional intervals, high instantaneous rates of penetration (ROP) are often sustained in order to achieve directional objectives. The combination of the large hole, high ROP and high inclination can be challenges for effective hole-cleaning. Nonproductive time (NPT) associated with pack off, lost returns and stuck pipe can result without proper balance between ROP and available hole-cleaning capacity.

Conventional practices for ensuring adequate hole-cleaning include incorporating additional circulation time prior to making connections. However, if this additional circulation time is inadequate, the risk of pack off can increase significantly. Conversely, excessive circulation time may prevent an operator from drilling at the technical limit of efficiency. Conventional practices also include the use of real-time, equivalent circulating densities (ECD) from pressure while drilling (PWD) tools to gauge hole-cleaning effectiveness and to identify pack off. Unfortunately, the abrupt nature of a pack off and the rapid increase in ECD that can ensue provide little warning. The result is often a limited ability to minimize NPT.

An expanded application of real-time pressure while drilling (PWD) measurements can be used to optimize ROP and hole-cleaning to allow consistent drilling. Based on the use of real-time equivalent mud weight (EMW) measurements, this new technique identifies hole-cleaning deficiencies earlier in their development and can allow effective management of additional circulation time.

Comparison of two similar wells drilled in the East Breaks area of the Gulf of Mexico by Kerr McGee Oil & Gas Corporation demonstrates the effectiveness of this technique.

Achieving Technical Limits: Expanded Application of Real Time Pressure While Drilling Data Helps Optimize ROP and Hole Cleaning in Large Diameter, Directional Intervals (IADC/SPE 99142) SG LaPierre, G Courville, Kerr-McGee Corp; J Song, Halliburton.

EXPANDABLE LINER HANGER

In the traditional systems that employ "cone and slip" technology, the failure rate of liner top packers, as well as the failure of system installation, has been great. In conventional systems, mechanical equipment with multiple slips are run and set. The disadvantages of these systems include multiple leak paths, reduced radial clearance, and their exposed hydraulic ports, all of which increase their potential for failures.

Liner installations are unsuccessful many times because:

1. Liner cannot be run to depth;
2. Liner hanger/packer pre-sets;
3. Setting tool fails; or
4. Liner top cement job is poor.

This paper will discuss an expandable liner system that was developed to address the shortcomings of the traditional systems. The new liner system combines expandable solid liner technology and proven cementing products and service capabilities.

The system incorporates the expandable liner hanger body with an integral packer, a tieback polished bore receptacle, a setting sleeve assembly and a crossover sub to connect the assembly to the liner. Elastomeric elements are bonded on to the hanger body. As the hanger body is expanded, the elastomeric elements are compressed in the annular space. This virtually eliminates the liner hanger/casing annulus and delivers liner top pressure integrity as well as impressive tensile and compressive load capacity.

The discussion will include the design, operating procedures and benefits of the expandable liner hanger.

Development of an Expandable Liner Hanger System To Improve Reliability of Conventional Liner Hanger System (IADC/SPE 99186) SA Walvekar, AT Jackson, Halliburton.