FESAus – New Technology Forum

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Baker Hughes Drilling & Evaluation

aXcelerate™ - High-Speed Telemetry

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Mud Pulse Telemetry (MPT)

**Principle**

- Pressure builds by reducing flow cross-section
  - *Mud pulse travels to surface*
  - *Propagation speed approx. 1200 - 1500 m/sec*

- Pressure fluctuation detected on surface
  - *transducer installed in standpipe*
MPT Challenges: Interfering Noise

Drilling Vibration Spectrum
MPT Challenges: Signal Attenuation

Pulse Attenuation according to Lamb (extended reach example)

- 10Hz Water
- 40Hz Water
- 10Hz OBM
- 40Hz OBM

Depth (m)

$P_{\text{surface}} / P_{\text{downhole}}$
MPT Challenges: Signal Reflection

signal generated downhole

transmission channel

signal received on surface

transmitted pressure

channel response

received pressure

attenuation

reflection
Mud-Pulse Telemetry – Noise removal

- Pump noise cancellation
- De-modulation

PULSER → MUD CHANNEL → PUMPS

- SARA II
- Dual pressure transducer
- HSTDecode

Advancing Reservoir Performance
Mud-Pulse Telemetry - Receiver

SARA II and Advantage v2.x/HSTDecode
Improved signal resolution and processing (DSP)
Supports all pulser modulation and encoding schemes at Baker Hughes

Includes BCPM2/NRZ support (Bi-directional Communication and Power Module)
  Improved algorithms for more robust decoding
  Improved synchronization with new coding schemes
  Improved error detection/correction capabilities (protect bits from channel noise)
  Telemetry data base for statistical analysis, problem tracking and problem solving
    (correlation with drilling parameters,...)

Networked – BEACON
Baker Hughes Overall Approach to MPT

- **Surface**
  - New dual pressure processing
  - Advanced signal reconstruction techniques
  - New acquisition system

- **Downhole**
  - Next generation pulser
  - Adjustable to channel conditions
  - 4 ¾”, 6 ¾”

Data rates up to 40 bps
Baker Hughes Approach to MPT (BCPM 1)

- Action: Poppet Valve reciprocating
- Data rates up to 10bps (offshore Australia, commonly 4-6bps is expected without decoding issues)
- Parameters fully adjustable via downlinks
- Telemetry system limitation is the Poppet Valve (relaxation time of the MVA body)
Baker Hughes Approach to MPT (BCPM 2)

Oscillating Shear Valve

Highlights
- Data rates of up to 40 bps
- High pulse pressure for ultra-deep wells
- All parameters fully adjustable via downlinks
- Fully open valve for LCM operations
Realtime Data Density v’s ROP

Estimated for an LWD suite to include Gamma, Resistivity, Density, Neutron data
**BCPM2: 15bps**

AutoTrak® X-treme™ / LithoTrak™ / CoPilot™

4 Sector Gamma Imaging + High resolution CoPilot data

11,000 ft – 17000 ft MD
Telemetry Example – 20bps

BCPM2: 20bps
AutoTrak® / LithoTrak™ / StarTrak™
4 Sector Density Imaging + High resolution STK data
+ 3 curve Resistivity
10,000 ft MD
BCPM2 Summary

- Increased RT data density allowing for either:
  i. Increased ROP
  ii. More data RT
- Reduced drilling risk due to a clearer picture of down-hole dynamics
- Improved tolerance against LCM plugging – less NPT
- Greater flexibility on decoding issues
**aXcelerate Achievements**

*aXcelerate Mud-pulse Telemetry*

- 30 bps from 9,865 ft, onshore North America
- 27 bps from 11,394 ft, offshore Brazil  
  (40 bps off bottom)
- 20 bps from 20,991 ft, offshore Norway
- 10 bps from 28,372 ft, onshore Middle East  
  (4 3/4” tool)
- 3.5 bps from 34,570 ft, Sakhalin*  
  3.0 bps from 38,320 ft, Sakhalin*  
  * Not a technical limitation
- **Australia** – first run at 15bps  
  (40bps off-bottom on clean-up run), looking to 25 bps next well.
Questions?