Quarkonics Applied Research Corporation
440 Burroughs #649, Detroit, MI 48202 Phone: (248) 761- 8378 email: info@quarkonics.com

Case Study: Compression technology – downhole data

The Problem

Many leading oil & gas drilling equipment providers have invested millions of dollars in installing custom downhole sensors that can be positioned at or near the drill bit. Downhole sensors can detect temperature, pressure, rock composition, weight on the bit (WOB), downhole RPM, and many other parameters in the downhole. With the availability of such sensors, it is now possible to detect the downhole conditions, and use that information to adjust drilling parameters to maximize drilling efficiency.

A major challenge faced by our clients is the problem of transmitting this wealth of data back to the surface, where it can be used for further analysis and

automation. Various mechanisms have been developed to transmit data from downhole to surface, such as wired pipes, wireless data transmission system, mud pulsing and drillstring acoustic based mechanisms. Unfortunately, each of these mechanisms has some intrinsic drawbacks that make them either ineffective or too expensive to transmit downhole data. Power consumption in the data acquisition system increases with the number of active sensors and the sampling rate of analog to digital converters. Sending large quantity of data at high speed requires high channel capacity and more power. Higher channel capacity and battery power are the major cost factors in optimizing drilling using downhole data. Reducing the quantity of data transmitted from downhole while maximizing the value of information transmitted is thus crucial in reducing the cost of drilling using downhole data.

The Solution

Quarkonics scientists used a combination of data compression techniques and hardware to solve this problem. This was achieved by processing the sensor data and converting it into another format before transmitting it to the surface. The raw data from downhole sensors is converted into a format that maximizes the value of information contained in it for drilling decisions, but minimizes the quantity of data to be transmitted over the channel. The data minimization is achieved by installing a microprocessor in the downhole, containing a control program. The program uses several algorithmic processes to determine which drilling control parameter values need to be transmitted at any given time to optimize drilling efficiency. It then transmits only those values over the data transmission mechanism. The receiver on the surface receives these values and feeds them to the rig controller. A separate program inside the rig controller uses this compressed information to make drilling optimization decisions and accordingly control the drilling parameters from the Top drive.

By moving the data compression logic to the drill bit, significant savings are achieved in power consumption while transmitting data to the top drive. This technology is an alternative to wired drill pipes that require a large amount of retrofitting. The microprocessor can be attached to any drill bit and can transmit data through mud pulses or any available channels, consuming far less bandwidth than sending the complete sensor data.Our tests showed that the system achieved 90% compression of downhole data.

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Key aspects of the downhole data compression technology

- Microprocessor based, for storing data compression logic right at the drill bit
- Ability to combine data from multiple sensors
- Can be extended to include newer sensors
- Works with existing data transmission channels, including mud pulses.