Free At Last

Shedding burdensome and restrictive cables, seismic sensors are now free to roam the land reducing cost, health, safety, and environmental concerns in obtaining quality full-wave, 3-D data.

BP's tight-sand Wamsutter gas field is the sight of the first, large-scale field trial of I/O's Firefly system. The cold, windswept, and environmentally sensitive south central Wyoming area put all aspects of the system to the test. The field station (yellow box) is connected to the receiver by a short wire. The unit is located by using an embedded GPS positioning tool.

Accessing email, searching the world-wide-web, and downloading photos can all be done from your easy chair at home, at the airport, or just about anywhere you can get a cell or WiFi signal. Operating without being connected by a cable has changed the way people and businesses interact, providing convenience, portability, and speed. Cableless seismic systems are changing the way land based seismic is acquired, bringing convenience, portability and speed to the E&P industry.

A typical 2,400-channel seismic shoot requires over 160 km of cables. It takes 10 large hi-boy trucks each carrying 13,000 to 18,000 kg to transport such a system. A cableless system, on the other hand, can be moved by 3 to 4 trucks. Eliminating the cable makes seismic systems more efficient to transport, are easier on the environment, and faster for crews laying out the shoot.

By using some of the latest wireless, GPS data, storage and power technologies, cableless systems can be integrated easily into environmentally sensitive and urban areas where geophone placement can be difficult. They also enable high-station counts, dense spatial sampling, and surveys designed with increased offsets and azimuths, techniques that improve image quality in a variety of situations, ranging from tight gas sand plays to complex fractured reservoirs. When comparing imaging quality, Paul Brettwood, Director, FireFly Solutions Delivery at I/O states, "the difference between FireFly® and traditional multi-channel seismic is like comparing the quality of a photo taken by a 10 megapixel camera to that from a 2 megapixel camera; the cableless system is capable of much more resolution and better imaging."

Old Idea-New Technology

"Wireless seismic is not a new concept, I/O had our RSR system in the market in 1995. (John Flavell Smith of Vibtech developed a wireless system about the same time.) FireFly is based on a completely different architecture than its cableless ancestors." Gregg Hofland, Director, FireFly Solutions Architecture claims. "A lot of different technologies (GPS, LiDAR, wireless communications, data storage, and power supply) have come together to enable this new generation of cableless system," Brettwood says.

Since receivers can be placed just about anywhere, accurately locating them is both key to processing the data and to recovering the equipment. To locate ground equipment, I/O has built into each field station unit locating GPS software that records the exact X and Y horizontal coordinates. For the elevation, a LiDAR survey is flown to obtain the Z coordinate (LiDAR works like radar, except ultra-violet or near-infrared laser light is used instead of radio waves). All types of wireless communications are used in this process including cellular, Bluetooth, VHF radio, and WiFi. Seismic signals are recorded on data storage devices, such as flash memory cards (like those used in digital cameras), that will soon be able to hold four gigabytes of data. Finally, a variety of power sources and batteries allow units to be on location for up to a month or longer.

Other wireless architectures available that use a combination of the above technologies include Vibtech's UnIte™ and Ascend Geo's Ultra™. However, I/O's FireFly system continues to be the only product that uses all the described technologies in its solution.

Lower Costs - Increased Productivity

Cableless systems offer greater productivity than cable-based systems. Once in place and when the source is ready, cableless systems are ready to start recording. Boot-up time is minimal.

Cables and the necessary ground support equipment account for a significant portion of the costs in obtaining today's standard seismic surveys. The initial cost of cables can be 30% of the system and this expense occurs every 2 to 3 years when the cables are normally replaced. The sheer weight of the equipment adds to the cost of transport, along with mobilization of the seismic crew. A larger crew is necessary to deploy such a cable-based system. Once in place, additional crew members spend time troubleshooting the system, with the majority of that time spent on cables and their repair. As the number of real-time channels in today's surveys continue to increase, the time and crew hours are critical to keeping fieldwork economically viable.

Productivity over cabled systems from the initial field trials is still being evaluated by BP. They claim that a "conventional land system and approach would have been cost prohibitive" (see Reality-The Field Trials section below). BP was impressed with the shooting pace as crews averaged 500 to 600 shots per day in just a 6 hour shooting day. The peak production was 1001 shots in 5 hours. The shots accomplished in one hour (200) are about what they expect from a full day of shooting with a conventional, cable-based system.

Health, Safety, and Environmental

One of the biggest benefits of a wireless system over a cabled system is the health, safety and environmental (HSE) factors. The lighter equipment helps to minimize environmental disturbance and health and safety concerns associated with the acquisition crew. "These concerns have become nearly as important as obtaining the 3-D image," says Marty Williams, Senior Vice President, FireFly Solutions at I/O. "Wireless systems dramatically decrease the number of people and the amount of equipment on location and the consequent environmental impact."

Cableless systems can be used with smaller crews carrying lightweight backpacks, enabling deployment around steep terrain and obstacles in the field.

Since a smaller crew is necessary for wireless systems, the potential health and safety liability is decreased. Crew members are not hefting heavy loads which sometimes cross rough terrain, translating to less strains and injuries.

Finally, in areas with environmental concerns, wireless systems offer less impact whether shooting in an urban environment or a very fragile, natural area. Less crew, less troubleshooting, and the ability to place sensors around obstacles all reduce impacts to the project area.

Resolution

The oil and gas industry needs to cost-effectively identify drilling opportunities and, at the same time, reduce the dry hole risk. When designing a survey for a cable-based system, environmental, safety and logistical restrictions can force tradeoffs in data quality. Cableless systems allow surveys to be designed to get the best possible spatial and vertical resolution.

Gregg Hofland says, "cableless systems impact image quality in several ways. First, with more channels on the ground, we are able to record higher fold surveys. This gives us data with less jitter, which makes it easier to interpret. Second, we are able to process the data on a smaller bin size, which increases ▶

spatial resolution and allows improved definition of subtle geologic features. Finally, we can collect data with increased offsets and azimuths, which is often critical for accurate determination of rock properties. The result is more accurate data and images that allow interpretation of obscure and subtle targets."

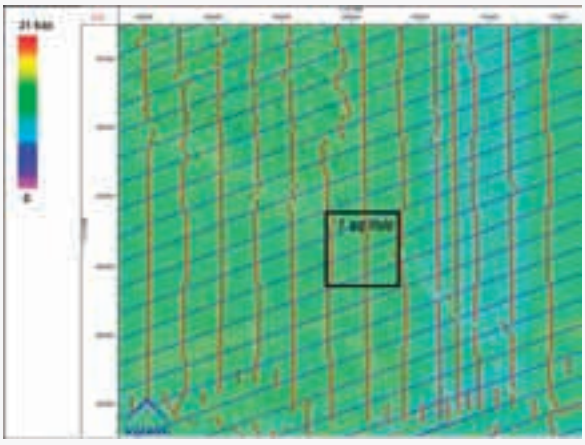
Data is transferred from field units in backpacks via an Ethernet connection while charging batteries.

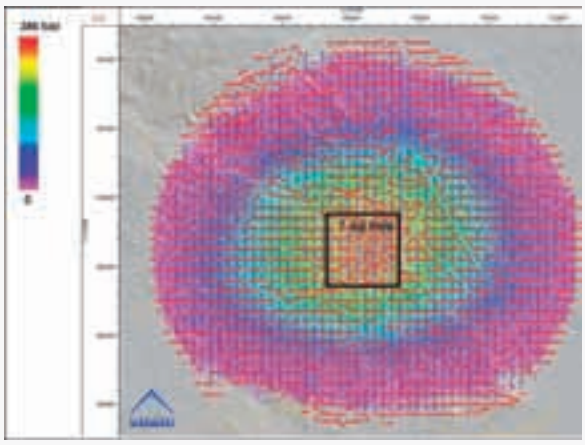
Reality-The Field Trials

The first large field survey to test I/O's cableless system was over a portion of BP's giant Wamsutter gas field located in south-central Wyoming. "The field is one of the largest tight gas resources in North America, with more than 50 Tcf (1.4 Tm³) gas initially in place," says Craig Cooper, BP's seismic project coordinator for North America. "Most of the production facilities sit at 8,000 feet (2400 m) above sea level in the environmentally sensitive Red Desert area. Our desire to protect the region is compelling us to investigate technologies and methods that could deliver a substantial impact on our operations."

Part of their multi-faceted investment in the field was to use FireFly to record densely sampled 3D3C seismic data. The survey recorded approximately 7,200 shot points over a 72 km² area. "To optimize our investment program at Wamsutter, we need to maximize the productivity and reserves capture from every well that we drill. To target potential fractures and hit other subtle 'sweet spots' in the reservoir we need seismic data that is substantially better than what we currently possess. The most likely way to do that is to increase the source/sensor density and utilize a survey design that enables multi-azimuth, single-sensor acquisition. Accomplishing these things with a conventional land system and approach would have been cost prohibitive. It also would have imposed risks on us from an HSE standpoint which would result in sub-optimizing the program. With FireFly, we can deploy as many sensors as necessary without being forced to make these compromises."

Because of the unique architecture and flexibility, cableless surveys (lower map on the right) can be laid out in a tighter grid to enable full sampling and a much higher actual fold. Image of the topography in the background is taken from the LiDAR survey.





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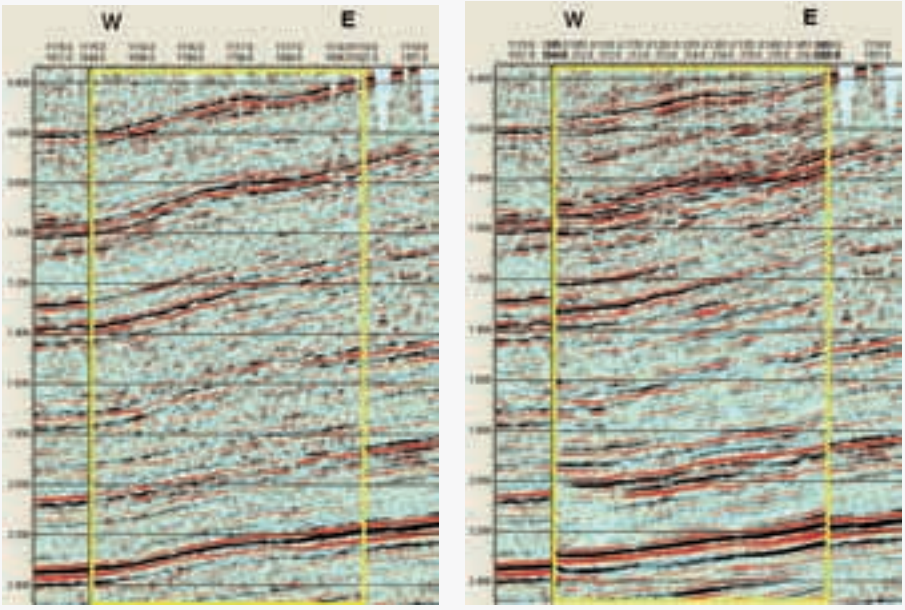
Summing up the first large field trial of FireFly, Craig Cooper explains "We expect to have a final P-wave volume early in the third quarter. This will allow us to make some critical business decisions related to our drilling program beginning in 2008 and about whether re-shooting the Wamsutter field area is warranted. We've been pleased with data quality results from the initial processing stages so are looking forward to delivery of the final volumes. We have the opportunity to use this technology to fundamentally change the way we perform. If we stay committed and deploy the technology quickly, BP can really stay ahead of the pack."



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Proof of the success is in the image quality. (Recently processed Firefly line on the right.)