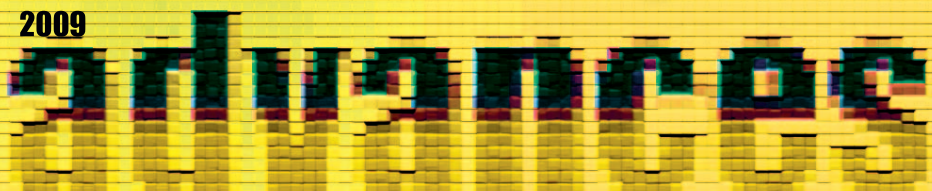


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the evolution of CABLELESS SEISMIC

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Cableless seismic systems are coming into the mainstream as their benefits become obvious.

E&P companies are testing the viability of these systems around the world in a diverse mix of climates and terrains, including acquisition settings that were previously inaccessible to conventional cable-based land seismic operations.

HSE considerations

Many cableless projects have been driven by health, safety, and environment (HSE) and access considerations. Using cableless systems, operators have been able to significantly reduce environmental impact and gain easier access to environmentally sensitive areas. Obtaining necessary permits from national and local land bureaus can often take months. Since a cableless footprint is much smaller than that required for a cable-based operation (where line-cutting through vegetation is common), oil and gas companies are able better make their case for access to the entities that oversee permitting for E&P activities and, in many cases, to gain quicker access to their areas of interest.

A second key driver of improved HSE performance comes from the difference in weight between cabled and cableless systems. Cableless systems weigh 50% (or more) less than a conventional cable-based system. Most cables are up in the 35- to 50-lb range but are also unwieldy to handle, creating unsafe carry conditions in tough terrain. Cableless node type systems are not only scalable up but scalable down to reasonable carry weights for easier deployment. This translates into smaller and more productive crews and decreased man-hour exposure. Moreover, the lower weight reduces transport costs and the carbon footprint of

support equipment such as trucks, helicopters, and ATVs that are required to transport the recording equipment to the field and shuttle them throughout the survey during acquisition operations.

Taking HSE performance to the next level

In the last several years, advancements in cableless systems have been made possible by technologies from other industries, especially the defense sector. Key technologies include Light Detection and Ranging (LiDAR) and Global Positioning Systems (GPS). When integrated into the field acquisition work flow, these technologies can help improve the HSE risk profile of the seismic operation.

LiDAR is actually a portfolio of technologies derived from the aerospace, defense, and agriculture industries in which a digital elevation model (DEM) is output with the intent of accurately mapping the topography of a given environment. The DEM becomes a significant input into a Geographic Information System (GIS), which helps integrate and display geographically referenced information in a digitized, computerized format. The DEM can be integrated with other datasets, including vegetation and urbanization models (in which landscapes, both natural and man-made, are overlaid). This creates a real-life view of the targeted acquisition area that can be visualized in three dimensions and integrated into planning and navigation tools in both the field and the office.

Using these technologies, oil and gas companies and seismic contractors are able to identify potential exclusion areas such as steeply sloping terrain, off-limits habitat areas of wildlife or vegetation, or infra-



structure such as irrigation systems or hydrocarbon pipelines. By incorporating these technologies into the land seismic operation, the E&P companies specifying them and the contractors deploying them are better able to comply with restrictions set forth by local and national land bureaus. Moreover, by identifying potential hazards upfront, contractors are able to navigate their crews more safely throughout the survey area. In fact, by integrating GPS technology into the field operation, contractors can actually track the locations of their personnel and vehicles throughout the operations zone and, with the appropriate software, take note of assets that may not have moved over some period of time, a potential sign of trouble.

ION's cableless system, FireFly, is probably the most sophisticated in terms of its reliance on a software-based command and control system. FireFly's software, Connex, is a comprehensive GIS system designed to improve field operations, crew planning, data management, and operational quality control and to support reporting and post-mortem analysis. With its integrated GPS capability, Connex enables project

A cableless system, FireFly is deployed in a heavy forest environment.

Photos courtesy of ION Geophysical



managers to pre-plan daily work flows and to issue assignments, instructions, and safe route requirements to crews working in the field through pre-programmed handheld navigation devices.

Image enhancement

Traditional cable-based land seismic operations typically employ highly linear spread geometries that are more a vestige of the cable-based system architecture and conventional line-cutting and acquisition methods rather than the imaging requirements of the subsurface. Cableless systems provide the flexibility to avoid sampling gaps due to obstructions, such as lakes, steeply sloping areas, or oilfield infrastructure. Instead of allowing equipment constraints such as cables to govern the layout of the survey, cableless systems allow receivers to be deployed at various locations around the obstacle for optimal subsurface sampling and,



FireFly is laid out for commissioning prior to deployment in east central China.

where required, to over-sample or under-sample the geologic target to reach the optimal cost-benefit trade-off of the project.

Global deployments in diverse terrain

E&P companies and seismic contractors alike are recognizing the value cableless systems bring to a project, especially when HSE is a top concern. Over the last year, FireFly has been deployed in a diverse mix of terrains and acquisition environments, including the mountains of western Colorado, the dense pine forests of East Texas, the saline desert plateaus of east-central China, and within swampy terrain in Mexico. Other cableless systems have been deployed near Villahermosa in Tabasco (Mexico), Tierra del Fuego, the jungles of Belize, and swampy coastal regions of the southern US, indicating a growing interest in cableless technologies throughout the industry.

ION's FireFly survey in Colorado was acquired in a rugged, mountainous area in which lands were both privately and publicly held. Moreover, the environmental restrictions were significant, with both wildlife and irrigated ranches posing a challenge. East Resources believed that the only way to deploy the equipment safely was with a cableless recording sys-

tem given the steep mountainous terrain along the edges of the survey area. In the end, the survey was completed on time, before hunting season started, and under budget, with no major HSE incidents despite the challenging acquisition area.

In East Texas, Dawson completed a FireFly project with Vibroseis for a super-major oil and gas company in an area interspersed with farms, forests, road crossings, and active

mining operations. In a remote region of Inner Mongolia that was far from existing support infrastructure, one of the world's largest seismic contractors deployed FireFly to acquire data in a producing hydrocarbon basin that was a test of high-density multicomponent recording with a cableless system. Again, both projects were completed on time and under budget.

Looking ahead

As this article is being written, FireFly is being deployed by Comesa on the first of three seismic imaging projects for PEMEX. These surveys will be undertaken in a variety of environments ranging from swampy areas to agriculturally intensive regions. According to Adan Oviedo, managing director of Comesa, "Permitting in Mexico can often be a time-consuming process, but FireFly's cableless architecture can help both public and private landowners understand that we can conduct a seismic acquisition operation in a rapid, 'get in, get out' manner and with minimal environmental disturbance."

As cableless technology continues to evolve to handle even more diverse and challenging deployments, one might ask, "What's next?"

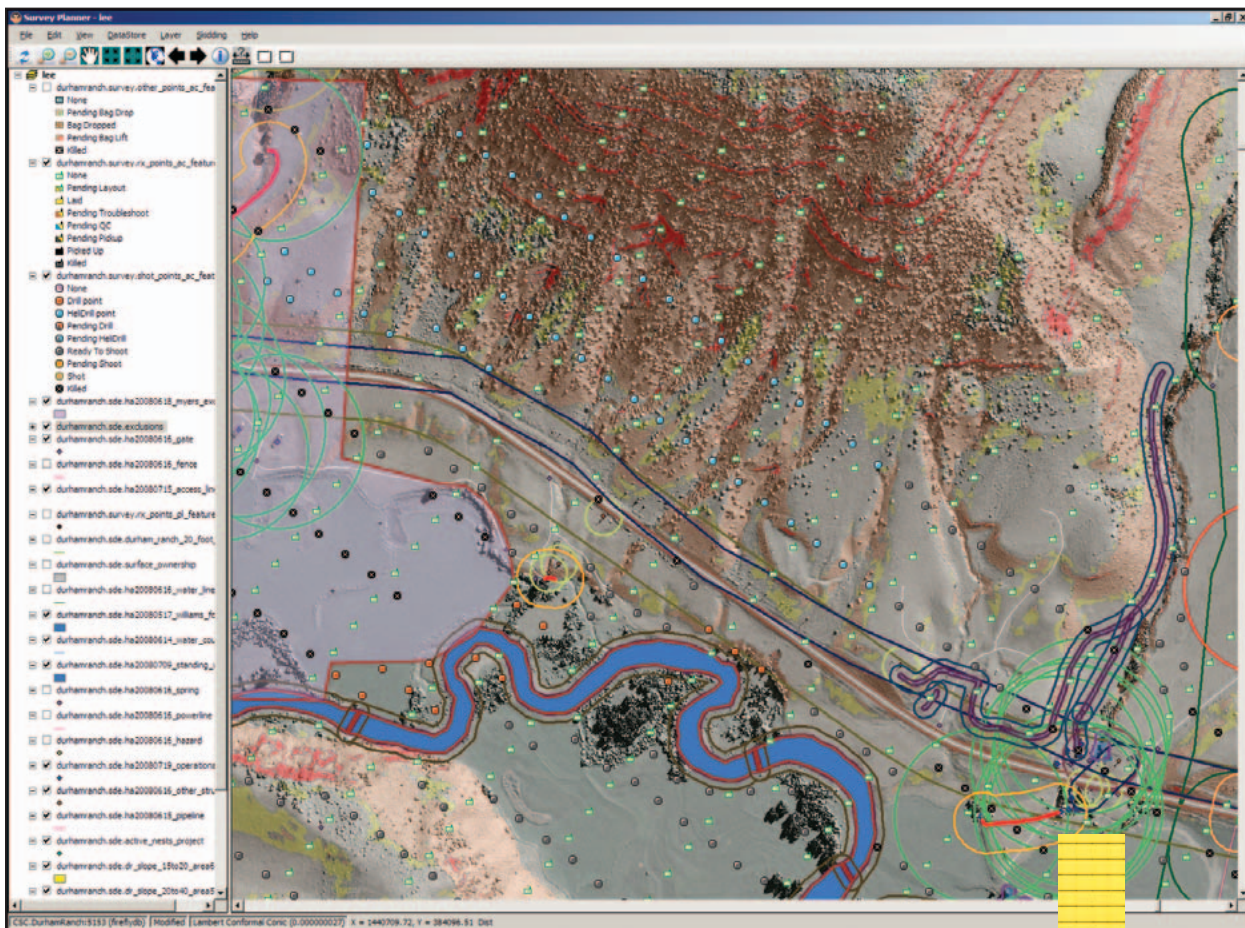
Cableless technology will likely evolve along different paths, given the number of players involved and the capabilities and strategic interests of each. Nonetheless, a few themes are likely to emerge.

One is that cabled and cableless systems are likely to be more tightly integrated so that the choice of an architecture does not become an either/or decision for a contractor, but an option in which a combination of cabled and cableless systems work together seamlessly on a single survey. Similarly, we are likely to see options emerge related to sensor technology, with cableless systems supporting both traditional geophone receivers and the more advanced multi-component (3-C) digital sensors.

A second is that, while it might be some time before data communications technology evolves enough to allow all data from high density multi-

thousand channel spreads to be transmitted wirelessly in real time, we are likely to see ever-increasing quantities of seismic attributes returned to a command center in the field on a near real-time basis. There is a place for autonomous node systems in the industry, but the true growth of cableless is likely to come from technology providers adding more functionality to a flexible all-in-one platform, not less.

As a result, the third trend is likely to be driven by the command and control software systems or field monitoring systems that the vendors provide to plan surveys and manage the seismic operations. These systems are going to deliver the productivity and HSE benefits that take cableless seismic technology into the mainstream and open up acquisition and imaging possibilities that, until now, we could only dream about. ■



More sophisticated land seismic contractors are adapting their survey planning and field acquisition methods to take advantage of the benefits that LiDAR and GPS make possible operationally and in HSE performance. FireFly's Connex software is shown here.