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A Wireless Future?

Cables Can Tangle Seismic Plans

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Photo courtesy of Chevron

... and this is now. Seismic crews in the 1930s faced remote locations that meant difficult work. Today, geophysical crews can rely on plenty of technological advances (right); however, the wave of the future (no pun intended) may be found in cable-free land nodes (above), where a single channel P-wave sensor provides continuous recording from a single point receiver station.

Photos courtesy of Fairfield Industries

It's a tough job, but somebody has to do it.

We're talking land seismic acquisition, a challenging task for the first seismic crews who ventured into the field early in the last century, and one that remains challenging today.

To conduct surveys, seismic crew members traipse around in some plenty treacherous and unwelcoming territory, e.g. dense jungles, hot deserts with their infamous sandstorms, bayous and swamps teeming with unfriendly varmints, freezing winds in mountainous areas – you get the picture.

The survey effort becomes even more daunting given the need to transport heavy cables and other equipment into such hostile areas, move this gear around during the shooting program and maintain it in working order.

Yet after the dearth of seismic data demand only a few years back – especially onshore – complaints are few and far between.

The welcome high activity level is only part of the good news.

The equipment manufacturing companies have begun to introduce more efficient, lightweight acquisition systems that are easier to operate and to maintain.

In fact, "cableless" has become the operative word, with some folks predicting the next generation systems will be even more progressive, i.e., completely cable-free – think self contained, autonomous nodes, which already have proven successful in acquiring data in deepwater environments, such as the BP-operated Atlantis Field in the Gulf of Mexico.

"Land seismic exploration today is entering a transitional period similar to 20-something years ago when recording methods began the migration from 2-D to 3-D surveys," said Scott LaBaume, director of sales and marketing at Fairfield Industries.

"We're on the cusp of a shift from orthogonal line and swath surveys to freeform nodal surveys."

Concepts vs. the Real World

LaBaume noted the modus operandi for today's seismic industry is for survey design, systems and software to accommodate grid geometries, which call for parallel lines of equally spaced receivers deployed in geometric arrays alongside another geometric array of parallel lines of equally spaced sources.

Of course, reality has a way of intruding in the best laid plans.

"Where the real world meets the artificial Euclidian geometry of the surveys, we use innovative operational techniques and intricate software routines to 'correct' the differences between our ideal survey and the real world it encounters," said Dennis Freed, technical marketing manager at Fairfield.

"What has evolved from this form of seismic acquisition is an array of available systems requiring an analog cable to connect multiple external sensors to a remote unit in order for that unit to amplify, filter and digitize the

continued on next page

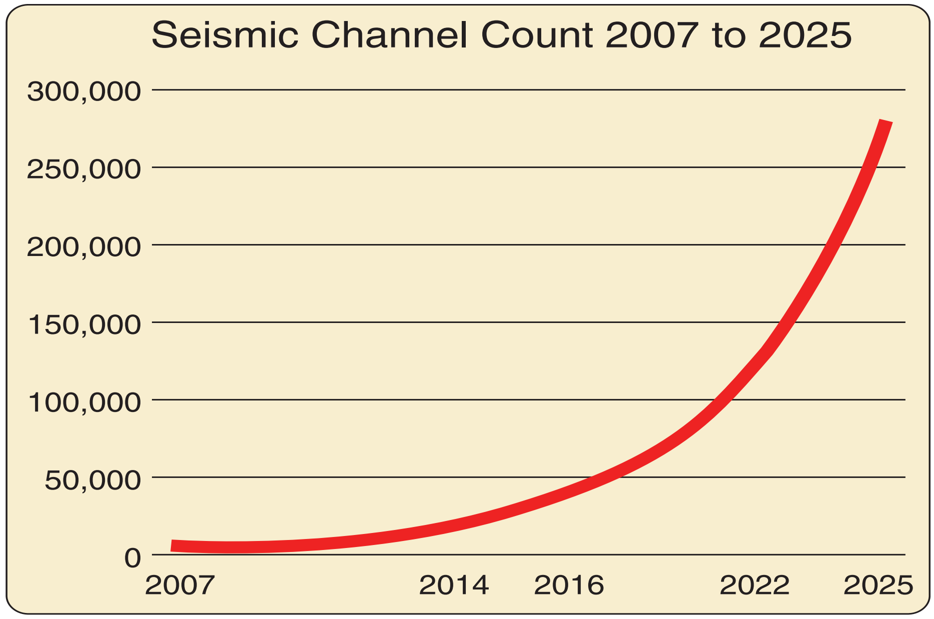
AAPG
EXPLORER

acquired analog signal," Freed said. "Then there's an external cable and often a series of connectors used to transfer the analog signals sensed by the external sensors to each remote unit.

"Many systems also require an external cable to transmit the acquired digitized seismic data to a central recorder," Freed added, "and some systems use this same external cable to provide power to the remote units."

This complex configuration can create one giant continuous headache for the seismic crew.

It's not uncommon for crew members to spend six-plus hours per day trouble shooting both the sensors and cables/connectors for leakage and continuity problems. These components can all be damaged by a variety of sources, both natural and cultural.



Data from Robert Heath, "Let It Flow, Flow of Ideas, Hydrocarbons and Business"

The information age on steroids: Seismic channel count growth projected into the future – from 5,000+ channels to nearly 300,000 channels. Some forecasters have even predicted 1,000,000 channel count crews.

Paying the Price

The bottom line is that cables, sensors and such can eat a big hole in the budget for a seismic shoot – directly in terms of actual dollar outlay and indirectly via inefficiency.

Freed presented some estimated costs for a sample survey where a 4,000 channel land crew might easily spend as much as $1.75 million for new cables and sensors and then incur annual estimated maintenance costs between $200,000 and $400,000 to maintain these components in operational condition.

Over a three-year period that includes initial costs along with maintenance and replacement costs, crew expenditures could reach amounts that range from $4.1 to $4.7 million for cables, connectors and sensors alone.

After three or so years of use, the cables and sensors likely would have to be replaced. Even if they're not damaged by the forces of nature or by critters (including the human kind), pinhole leaks can develop over time creating leakage and degrading the seismic signal.

The spread cables alone for fielding a 4,050 channel crew with a station spacing of 110 feet (plus 10 percent) would stretch out 490,050 feet, or 92 miles, according to Freed. He noted this doesn't include any cross line cables that many systems would require.

It is noteworthy that survey costs are governed in large part by survey location, as well as by any unusual or unique aspects of a shoot.

Who Needs Cables?

The quest to eliminate or, at the very least, reduce the number of cables used in land surveys already has resulted in availability of an increasing array of cableless systems, e.g., Ultra from Ascend Geo, FireFly from I-O, UnITE from Sercel.

These cableless systems do not require cables to interconnect the individual acquisition modules. However, they do have cables to interconnect one piece of equipment to another and/or use a string of geophones as their sensors, according to Freed.

Autonomous nodes, on the other hand, are self-contained sensors (the sensing element typically is a geophone) with batteries and a highly accurate clock, making these systems entirely cable-free.

"We've tried to get away from cables on land a number of times," said Mark Foster, land seismic R&D program manager at BP. "Today, there are a number of minimal-cable systems out there, and they all have their place. I think the technology is reliable enough today, we can get rid of cables."

Dave Monk, director of geophysics at Apache, concurs.

"The wave of the future is cableless systems, whether minimal cables like some of the systems available today, or no cables."

A major driving force in the move away from cables centers on the ever-increasing number of recording channels used in seismic surveys.

"If you look at how many recording channels we typically use on a land acquisition system, the trend is it's doubled every three and a half years," Monk said. "On a land program today, you may have 20,000 channels, so in six to seven years you're looking at

continued on next page

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100,000 channels – the trend line is solid.

"I don't believe we're going to have 100,000 channels connected with cable," Monk added. "It won't be manageable.

"Most systems out there now will be capable of operating with 100,000 channels," Monk added, "but no one has built 100,000 channels of any system yet."

Reducing or eliminating cable spreads leads to reduced equipment weight, resulting in more flexibility to place the detectors – especially important in rugged terrain, environmental hot spots and urban locales – plus the lighter gear will be much easier to move around.

Quality Control

Taking the relatively simple and inexpensive cable-free node-type route to acquisition creates a step change not only in the number of units that can be deployed but also in the quality of the data acquired, according to Foster.

For those folks who may balk at the idea of deploying a node-type system because they must wait to see the data after retrieval of the unit rather than viewing it in real time – such as with some of the high tech cableless systems on the market – Foster has some reassuring words.

"The wave of the future is cableless systems, whether minimal cables like some of the systems available today, or no cables."

"When you have a small, lightweight set of equipment that's very flexible and inexpensive (compared to cable), you can deploy the units in such large numbers," he said. "I believe we're getting to a state where the level of technology is such that these systems can be reliable enough and deployed in such quantity that even if you get a small percentage of failures the redundancy makes up for that.

"The advantage of going to this relatively inexpensive, almost disposable type of cable-free system is that each channel will be relatively low cost," Foster noted. "We want to be able to deploy huge numbers of these that allow us to either go in to an exploration type environment very efficiently," he said, "or acquire very high density – both in offset and azimuth – in the production environment."

A big issue with node systems centers on how long the nodes can be live, according to Foster. He noted this is a combination of battery life and managing the power the systems draw on the battery.

Freed succinctly summarized Fairfield's view of the next generation land seismic data acquisition system:

✓ Fully self-contained node units (free from any external connectors or cables).

✓ Must meet or exceed the analog specifications of current systems.

✓ Capable of remaining independently on site where initially deployed until time to be retrieved by crew – troubleshooting would be a chore of the past.

✓ Must be capable of not less than 288 continuous hours of independent autonomous operation.

✓ Must have highest possible reliability with a failure rate of equal to or less than 1.5 percent during a single deployment (for a 10,000 channel system, this would require a reliability rate of less than six unit failures per day.)

✓ Coupling of the node to the earth must meet or exceed the coupling capabilities of a current geophone. ❏