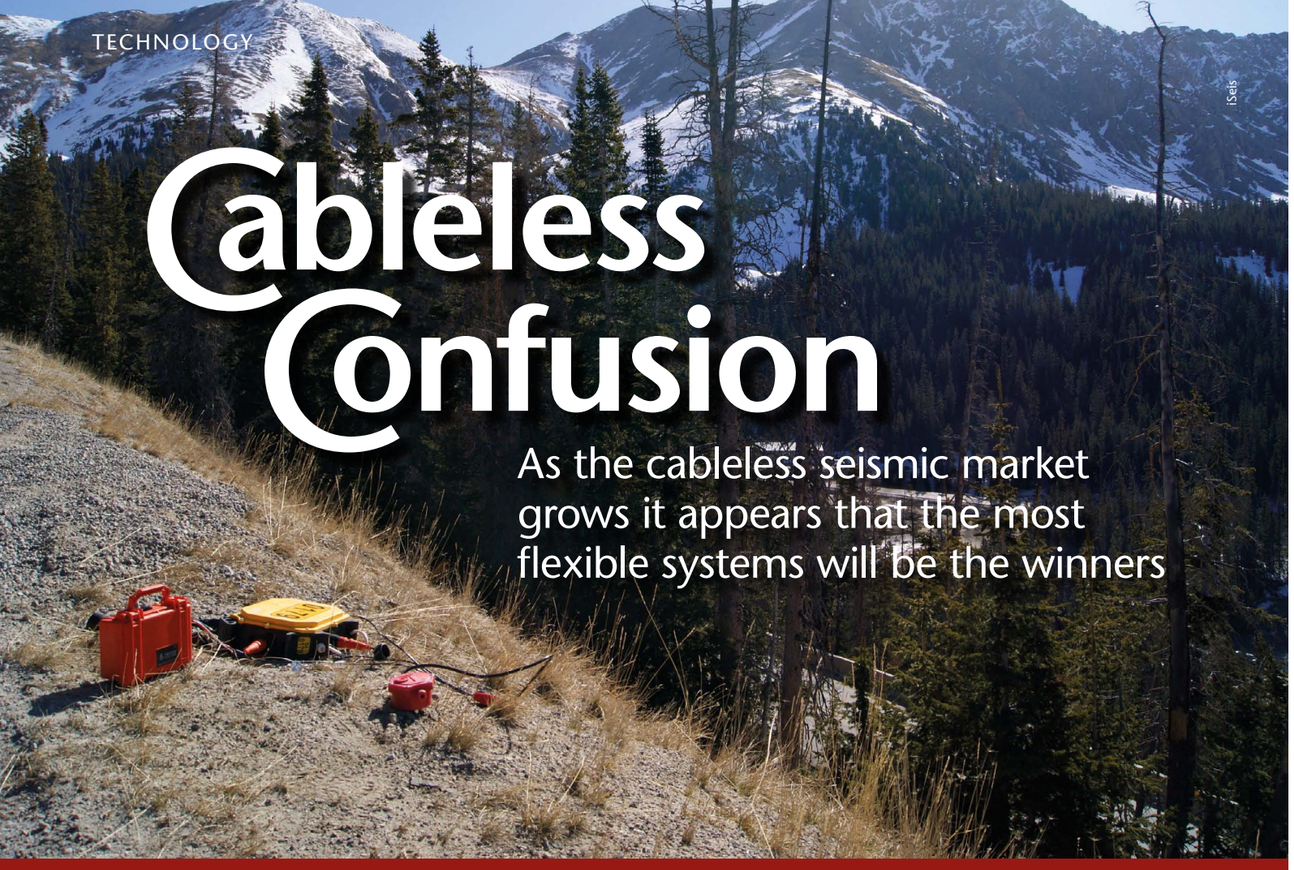

Cableless Confusion

As the cableless seismic market grows it appears that the most flexible systems will be the winners

ROBERT HEATH

After almost a decade of nearly taking off, this flexible new technology is finally making its mark. With around a quarter of a million cableless seismic channels sold in the last few years, and an ever-growing share of the land acquisition market, there is no doubt that such equipment is here to stay.

Nowadays, the industry accepts cableless with few questions, such is its desperation to get away from the disadvantages of cable. The main one of these was often said to be weight, and it was difficult to disagree. With the exception of some rather uncommon combinations of trace interval, sensor type and choice of cableless system, a cabled crew is always going to be heavier. (see "Weighing the role of cableless and cable-based systems in the future of land seismic acquisition", *First Break*, June 2010). But in these days of more complex acquisition, weight as the worst attribute of cable may be getting surpassed, as users find this old technology just too user-unfriendly to take on new types of exploration. Cable recorders were devised at a time when simple 2D or 3D CMP acquisition summed up the main types of survey being considered, so flexibility did not need to be this equipment's trademark. Today, inspired by the greater demands of this industry, novel geophysical techniques need recorders unrestricted in any way by hardware.

Despite this, cableless kit should come with a health warning for reasons which are not at first sight obvious. Just as there is little to choose between the different cable systems in terms of flexibility, so the way you might use them tends to vary little. But there is much more choice when it comes to systems which allow operations without cables and it is this variety which can cause problems. There are about ten cableless recorders available nowadays and they differ greatly from each other in features and functionality. So all of a sudden it is rather important to understand the pitfalls that each type may bring as this new way of doing acquisition moves out of adolescence.

Depending on GPS

Such pitfalls are best understood if we consider what is inherently different between a generic cable system and a cableless one, and the different ways this forces us to operate. Cables were there for a reason – three reasons in fact. The first was to emit timing to remote units, the next was to send out remote control commands and the third was to carry back along the cable QC and status information and lots of seismic data. Every cableless system manufacturer has had to consider whether to incorporate some wireless method to mimic these functions, or come up with a reason why it's no longer needed. Let's start with timing as it is the easiest, though not quite as clear cut as some would have you think.

There is a common belief that this problem is entirely solved by putting a GPS receiver inside each remote unit. Where and whenever you can pick up GPS signals – problem solved. But that is not everywhere. GPS receivers have become very sensitive – you can bury them some inches down and still pick up GPS as long as the dielectric properties of the ground permit. But a sudden rain storm can change good reception into intermittent or none at all, and GPS has also been reported lost for conditions ranging from freak weather to sand storms.

The lesson here is that the seismic environment can always find a way to outfox us, especially if hardware cuts too many corners. Making a system dependant on reliable GPS reception means you might end up with no useful data at all at times.

So, do we do nothing about this and hope for the best, or can some insurance be built in? The first thing to do is to incorporate a clock in each ground unit, which remains accurate even over long periods with no GPS signal. As this costs money and takes extra power, only a few systems bother. The next issue to cope with is when there is no GPS at all. A handful of products were devised to work without GPS timing, believing that some other form of radio-based synchronisation was always going to be a better bet. For example, a VHF frequency can naturally penetrate further through foliage than any GPS signal as it has longer wavelength and usually higher power. One system which has the best of all worlds uses GPS and a very accurate clock as the basic system, thus being able to cope with intermittency, and the option of VHF-based timing for when GPS is elusive. In all cases, given seismic data's dependence on very accurate timing, surely the most important thing is to be able to monitor when the ground units are getting no synchronisation signal. However, very strangely, few new products have made this available.

Choices in time-stamping: two Sigma units, which are receiving essential timing information via a VHF synchronisation system, used when GPS signals are unavailable.

Remote Control Commands

The next function performed by cable was sending out remote control commands. Some systems have decided not to bother with this, claiming it is not necessary to change any settings during acquisition. But this is to miss the point. Remote control in cableless recorders is to deal with power, or more strictly speaking, energy consumption. Whether batteries are a great advantage or a huge hindrance in cableless recording compared to cable depends on whether you can control how much power is used. Cabled systems come with the choice of using fewer but larger batteries which require changing rather regularly, or smaller batteries which are greater in number but last longer. Each method has pros and cons but in all cases cable systems allow users to switch off when power is not needed, and also to monitor remotely how much power remains in each battery.

To go cableless, requiring many more batteries than almost any cabled configuration, while not being able to control or monitor power, is asking for trouble. Some say the problem is made even worse by the use of lithium-based batteries. The extra power density of lithium is often cited as a way to overcome the power wastage if it is not possible to remotely switch off the ground unit, but reliance on this battery chemistry is risky, since it tends to be fussier about operating temperature and the way it is charged. It is also much more expensive, and there are reports of lithium batteries exploding, so some airfreight companies will not carry them. The worst of all worlds is probably the use of an internal lithium battery, which seems to be just asking for trouble given its predilection for erupting.

Sending Back Data

Next is the issue of sending back QC, noise, status and seismic data. In the cable world, this can be considered as more or less one function but it would be a mistake to think this when coming to cableless, because the amount of data involved in sending QC, noise and status back from the spread to the observer is tiny in comparison to seismic data volumes. This is an essential distinction because wireless technology handles low bandwidth rather well whereas even today, high bandwidth

Cableless systems offer greater flexibility

A USB (bottom of picture) actively harvesting data from a Sigma unit

transmission in the seismic environment comes with many hurdles.

Nevertheless, some systems force the operator to live without any QC, status or data at all, so-called shoot-blind operations. This had some advantages when the deployment of such ground units was simpler than deploying those where some form of complex radio communication had to be established. But nowadays some manufacturers recommend that their shoot-blind units are buried to avoid theft, which removes any advantage of rapid deployment. Systems now exist with mesh radio networking technology built in, which are just as easy to deploy as any shoot-blind equipment, do not come with any recommendation to be buried and take away the risk of theft, and of recording bad data while not knowing about it. Such mesh radios can be used to send back all sorts of information including GPS reception strength, as well as have the benefit of allowing remote control of ground units, thus simultaneously solving the battery usage problem too.

When it comes to real-time transmission of seismic data, there are various approaches on offer, all of which have some level of drawback. Perhaps most capable is that demonstrated by iSeis's Sigma system which can be used for both passive and active recording. In fact, it is currently being used to provide real-time transmission from a passive spread of 750 km^2 for over two years, 24/7 – probably a world record.

But if you choose hardware which either does not offer real-time data return, or you use it in a non real-time way, then sooner or later you have to retrieve data from the ground units. Here, there are two broad choices: systems where the units must be collected and taken to a central location, where they are attached to some sort of rack and the data sucked out; or those where you go to the unit and copy the data while the box is still recording. Some obvious benefits of the latter approach are that it is much faster and that less equipment is needed. If you do not have to pick up boxes just to get your hands on the data they can stay doing the job they were purchased for.

'Harvesting' Data

Then comes the issue of how to get the data out, something which is usually referred to as harvesting. As almost all cableless recorders are continuous record systems, it is useful to have the option only to take out data relating to reflection seismic files, and to ignore all the stuff in between. On impulsive crews, this saves a significant amount of harvesting time and so may affect the choice of technology used in actually transferring data from the internal memory of the ground unit.

So what is the ideal way to transfer data? The answer is that there is no single best way but to have only one method has been found to be a severe limitation when operating in different environments. A very useful option is the ability to record not just to internal memory but to some detachable external memory simultaneously. This enables data harvesting to be instant, which is especially useful when birddogs want to get their hands on data for QC, and it also overcomes the occasional problems of using Wi-Fi for harvesting. The iSeis company has just recently added this feature to its Sigma system.

As we see, there is great choice in cableless, with some manufacturers having decided to offer much more versatility than others. If the future of a seismic contractor is in being able to get the greatest use out of one set of equipment, it seems that the most flexible systems are going to be the winners. ■

Cableless seismic operations in Quito, Equador. 'Cableless' and 'cablefree' are not synonymous. The 'cable' refers to digital telemetry cable, which cableless systems do not have, but they all have other bits of cable, to connect batteries and geophones.