

Covering all bases

The popularity and demand for data-rich wireless communication is driving the deployment of radio-over-fibre technology and the success of the firms such as Zinwave, reports **Nadya Anscombe**.

Many new companies fail because of bad timing. Often the company has a great product but it is simply launched either before there is sufficient market demand or after its competitors have already taken a large share of the market. But sometimes, if you are lucky, everything falls into place at the right time. UK firm Zinwave, which launched its first product onto the market in 2007, believes its success over the past four years was largely due to having “the right product at the right time”, according to its president of international sales, Colin Abrey.

Zinwave was founded to commercialize in-building wireless technology for high-speed data communication based on radio-over-fibre (RoF) technology licensed from Cambridge University and University College London. By encoding radiofrequency (RF) signals onto light beams travelling down an optical fibre, RoF avoids the problems of loss and limited bandwidth traditionally associated with transmitting RF signals down coaxial cable.

“With the number of frequency bands being used by wireless services multiplying every year and 4G networks just around the corner, the industry needs a technology that can support all these different frequencies as well as future ones,” Abrey explained to *Nature Photonics*. “Our technology can do this.”

Zinwave claims its active distributed antenna system (DAS) is the only technology that supports all services in the frequency range of 150–2,700 MHz on a single hardware layer. “Our system is agnostic of protocol, modulation scheme and frequency,” says Abrey. “This means that on multiservice projects — projects requiring three or more services — we are very cost-effective when compared with our competitors’ systems, which require the customer to buy service-specific hardware that increases the system cost with each additional service. It also means that our technology is future-proof because you can add any service onto the existing system.”

This flexibility is enabled by the amplification and distribution architecture Zinwave has built around its RoF technology. The amplifiers and other active components must be of sufficient quality in terms of their linearity, dynamic range and



Zinwave's broadband radio-over-fibre technology is independent of frequency, modulation and protocol.

bandwidth to allow any number and type of service to be transmitted without noticeable distortion. One crucial aspect of Zinwave's system design is to keep the transmission and receiving electronics spatially and electrically separate, which eliminates the need for filters. Service and frequency discrimination is then provided not by Zinwave's system but by the base-stations that are connected to it.

Although innovative electronics is what now differentiates Zinwave from its competitors, it was innovative photonic technology that enabled the company to start up in 2002. Zinwave was founded on the idea that cheap, uncooled laser diodes were a viable alternative to the expensive cooled lasers that were in use by other RoF companies. Researchers at Cambridge University and University College London found that uncooled, directly modulated distributed feedback laser diodes could provide the linear performance required for high-quality analog RF signal transmission over modern broadband wireless services. This discovery allowed Zinwave to develop systems at considerably lower costs than its competitors.

“We have benefited from the development of uncooled laser diodes for digital modulation at 10 Gbit s⁻¹ for use with the gigabit Ethernet standard,” explains

Andy Bell, Zinwave's CTO. “We needed lasers with high linearity, large modulation bandwidth and excellent high-temperature performance, and these devices became available to us just at the right time.”

Although these types of lasers are now freely available, the key to using them correctly is choosing the correct system power. Greater laser output powers support larger coverage areas, but uncooled lasers are limited in their power capabilities. For this reason, Zinwave opted for a medium-power system with a large number of antennas (up to 64 per hub) to ensure optimum coverage. “We use 100 mW power amplifiers, and this is pushing the limits of what is possible with uncooled laser diode technology,” says Bell.

Zinwave's original research also suggested that the performance of vertical-cavity surface-emitting lasers (VCSELs) — another type of uncooled semiconductor laser — would also be sufficient for many broadband applications. Although this would further reduce the cost of Zinwave's products, Bell says the company has not yet found a commercial VCSEL with the required performance characteristics. “We want to use VCSELs but have not yet found a device with a good enough signal-to-noise range or dynamic range for our application,” said Bell. “The performance of VCSELs is not there yet, but it is moving in the right direction.”

I would like to think that in the next couple of years our products could be using VCSELs instead of distributed feedback lasers.”

The research also showed that it is possible to use multimode fibre (MMF) instead of more expensive single-mode fibre (SMF). “This not only makes our technology independent of protocol, modulation scheme and frequency, but also means we can use any type of fibre,” said Bell. “This allows our technology to be used with older MMF without the need to install new, expensive fibre.”

One case study that illustrates the benefits of RoF technology is a nuclear power station in the USA that required wireless coverage in multiple buildings totalling an area of around 500,000 square feet. As well as requiring multi-operator cellular services, paging and public safety radio services, the company also wanted to integrate a 900 MHz wireless remote dosimetry monitoring system that would continuously transmit staff exposure levels and sound an alarm if any staff were in danger.

“Every industry has different drivers, and in this case the company needed to utilize its existing MMF by using multiple patch panels and ST optical connectors, which Zinwave’s DAS supports effectively,” said Bell. “There was therefore no need for the considerable expense of installing new SMF or new angle-polished connectors, which would have been required with other candidate DAS solutions. Even we were surprised that the system worked so well, considering that the company’s MMF was installed in the 1960s.”



Zinwave’s Andy Bell.



ZINWAVE

Zinwave’s technology relies on uncooled laser diodes to achieve cost-effective operation.

Although this case study demonstrates the flexibility of Zinwave’s product, Bell and Abrey admit that it is a particularly niche application, and that most of Zinwave’s customers want to use SMF instead of MMF. “Our company was set up at a time when SMF was much more expensive than MMF and people were looking for ways to use their old MMF,” says Abrey. “The in-building market today is using an awful lot more SMF than it did ten years ago. Most of our installations are for new buildings or refurbished buildings, and our customers are happy to use SMF.”

Zinwave has now installed deployments all over the globe across markets that include healthcare, hospitality and retail. For example, the company has provided in-building coverage for the Westfield shopping centre in Sydney, Australia, where Zinwave’s 3000 DAS solution supports all major operators while also providing personal mobile radio services for all the mall staff.

This ability to carry a frequency range that includes radio is particularly attractive to the healthcare market, where staff such as paramedics and police require radio coverage inside large hospital buildings. “Deployment in hospitals is one of our fastest growing sectors,” says Abrey. “There is a growing acceptance that cellular services do not affect medical equipment as they used to and senior staff want mobile phone coverage as well as radio coverage inside a hospital.”

These are just some of the current market drivers that have enabled Zinwave to grow from humble beginnings to 25 employees spread across the UK, the USA and Australia.

Further growth will require the company to embrace new technologies. For example, using free-space optical links instead of fibre links would make installation even simpler. “It would be ideal if, to install our system, all you had to do was clip a small unit onto the ceiling of an office,” said Bell. “But to make this a reality we would need class-1 lasers with the right performance to enable a link with sufficient bandwidth and quality. We would also need to be able to target the lasers with extreme accuracy, and all this is a long way off.”

Another idea that may be closer to reality is to make the system independent of building design. “We want to eliminate the need for a site walk and RF planning,” said Bell. “All modern buildings these days have integrated structured cabling systems, and we are looking at how DAS can exploit this in a similar way to existing WiFi deployments. Specifically, we believe a rules-based approach to antenna deployment, together with a plug-and-play architecture, will allow both craft-free initial deployment and simple future expansion. This would enable wireless services to be installed at the construction phase in a similar way to a sprinkler system — an idea that we like to call the ‘fifth utility.’” □

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