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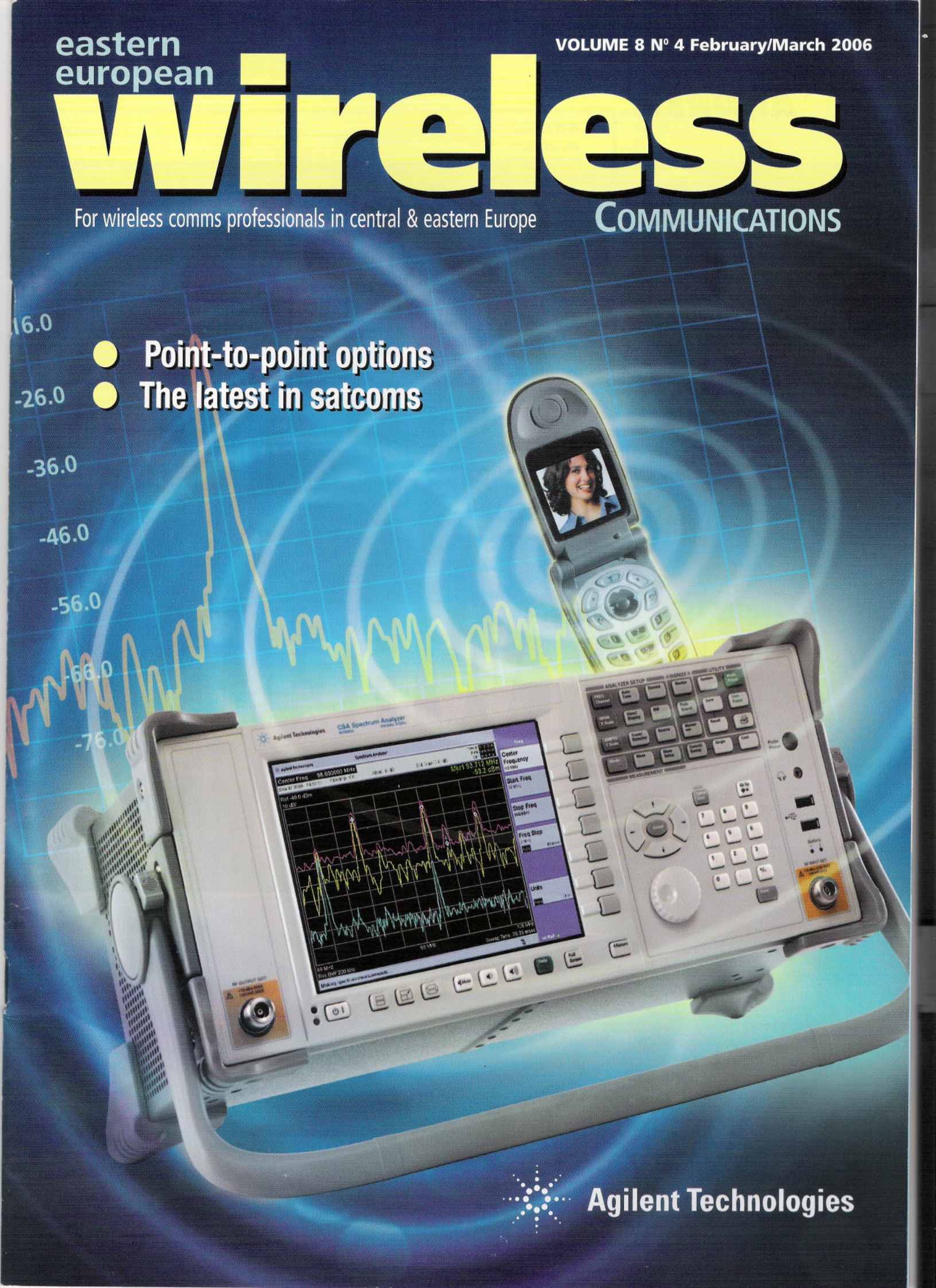
eastern european wireless COMMUNICATIONS

For wireless comms professionals in central & eastern Europe

- Point-to-point options
- The latest in satcoms



Agilent Technologies

Sharpening the point on point-to-point

The promise of wireless broadband aims to solve the rural/metropolitan ICT divide in eastern Europe. Using a pure WiMAX network is one way of achieving this – but it's not the only solution. Other point-to-point (p2p) technologies, such as free-space optics and microwave, can complement existing set-ups and even offer complete solutions in their own right. *John-Paul Kamath* examines the available p2p options for enhancing wireless networks.

A microwave p2p solution could prove ideal in lower speed applications over longer distances.

"Laying fibre optic cables is prohibitive when network traffic is low density," says Joseph Joseph, Harris Microwave Communications Director EMEA. "The physical act of digging-up roads takes time, as does gaining planning permission. This all increases the time to market for an operator and makes it longer for them to recoup costs," he adds. In most rural areas, the only way to provide telephone and internet connections, without a large-scale subsidy, is by reducing the infrastructure cost.

Joseph's comments summarise the appeal of using point-to-point (p2p) technologies for increasing the range of wireless networks. Their use in providing expanded bandwidth capacity is rising with the demand for combined voice, data and video connections, especially in eastern Europe.

Netcentrex, a provider of converged voice and video solutions, claims calls for triple play services in the region are high. It says recent deployments in Bulgaria (with Mobitel AD) and Croatia (with Optima Telekom) show an upward trend for wireless broadband.

Eastern European demand for bandwidth appears to have 'hopped' a number of traditional stages of telecommunications development, says Grant Grafton, Sales Director for Europe and North Africa at Orthogon Systems, a microwave communications provider. "The general thirst for communication is the engine driving the demand for consumer goods and services in many areas of the continent," he says.

The necessity of linking 3G masts is also creating opportunities for p2p, according to Jim Kernahan, worldwide Sales and Marketing Director at Sunflower Technologies, a provider of wireless optical solutions. 3G masts have higher bandwidth requirements than 2/2.5G ones, he says, especially where operators are aggregating bandwidth for a number of closely proximate masts via a central point.

However, providing a p2p solution, specifically to rural areas, has been expensive in the past. "The traditional backhaul solution has been to engineer longer-distance links in the 7-15GHz bands, although they frequently have far more capacity than is actually needed for a remote or rural application," says Amanda Ingalls of Skyworks Solutions, a provider of radio solutions and precision analogue semiconductors for mobile communications. She says that, together with the capital cost of radio equipment, these bands require much larger, more expensive solid dish antennas and robust mechanical mounting.

"Dual antenna configurations are also often essential to deliver the required level of availability, further increasing equipment and infrastructure costs," says Ingalls.

WiMAX is on the list of potential broadband access solutions for rural communities (see *WiMAX: The last word in last mile? EEWC* December 2005/January 2006). Equipment certified by the WiMAX Forum conforming to the IEEE802.16d standard is expected to make high performance links available to the network providers cheaply. But even though some deployments have taken place, a like-for-like financial comparison with other options has yet to be conducted. Furthermore, with the IEEE802.16e standard having yet to prove itself, the extent to which WiMAX can operate as a fully-fledged mobile solution remains to be seen.

Defining p2p

p2p technologies enhance a network in two ways: firstly, there is access, which supports site-to-site access, such as base station connectivity; and secondly, there is transport, which could connect switches between towns. But beyond all that, what exactly constitutes a p2p solution? Precise definitions are sketchy.

"A p2p solution is a wireless system that has the required capacity to transport information reliably from point A to point B."

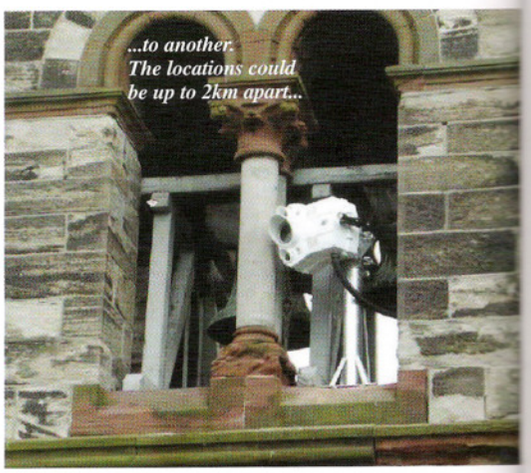
Andy Singer, President, Radio Waves

Andy Singer, President of Radio Waves, a microwave antenna manufacturer, says that a true p2p solution is one which simply transports information from point A to point B. "Although from a network operator's standpoint," he adds, "a P2P solution is a wireless system that has the required capacity to transport their information reliably from point A to point B."

The idea of a client's requirements determining the appropriateness of a given solution forms the basis for other definitions. "A true point-to-point solution should offer the highest possible bandwidth and with a significantly cheaper outlay than a leased line/dark fibre connection," says Stuart Williams, General Manager of MRV, a provider of optical transport solutions.

Meanwhile, Leigh McBain, a Project Management Director at Fsona, a free space optics vendor, says that a p2p solution is one which meets the speed-over-distance needs of the end user – not what industry pundits claim is the 'next big thing'. Choosing a technology platform to implement a p2p solution is easier than one would think. Each method serves a specific niche and, in some cases, can be used jointly to strengthen a single offering.

FSO enables transmission from one building...



...to another. The locations could be up to 2km apart...

More than microwaves

Free space optics (FSO) uses infrared to transmit data across points. "In eastern Europe, a major application of FSO is building-to-building (LAN-to-LAN) connectivity," says Kernahan. He cites one example of how the New Moscow Bank acquired a new building across the street and installed a link to stream voice and data between the two sites.

FSO p2p technology can also work as a network traffic backhaul solution. In scenarios where a multiple antenna sector approach is used by the operator to deliver broadband services, the required amount of backhaul aggregation traffic could be carried over a high capacity optical wireless link.

Peter Schoon, President of System Support Solutions, supports this type of application, saying that FSO fits better when ultra high bandwidth (FatE and GigE) is needed at relatively shorter distances of up to about two kilometres. Some microwave providers question the usefulness of this offering. "Although, FSO throughput is often greater than microwave access, we still find that 300Mbps is generally enough for most applications," says Grafton.

"Realistically, FSO has a maximum range of three to five kilometres," he adds. In comparison to RF though, the use of FSO would not require the operator to use parts of the relatively narrow band WiMAX spectrum for traffic backhaul.

While fibre still offers the highest transmission rates over media, FSO provides higher transmission than microwave. Commercially available FSO systems offer capacities in the range of 100Mbps to 2.5Gbps over several kilometres, says Skyworks' Ingalls, adding that licensed microwave communications support data rates of 2Mbps to 622Mbps over distances of 100 metres to 100 kilometres.

"While traffic capacity in free space optics systems is quite scalable from E1 (2.048Mbps) levels all the way up to Gigabit Ethernet (1.25Gbps) and beyond, microwave systems operate at lower capacity levels," says Heinz Willebrand, CTO and founder of Lightpointe, a vendor of FSO products.

However, cost can be an issue if using FSO over larger distances. Ross Lunan of Harris Communications outlines the cost-distance relationship:

"The cost, not necessarily the price, for a FSO system is virtually the same for capacities from 10m to 155m. Microwave systems are the opposite. The distance isn't the critical costing factor – bandwidth is.

There is therefore a breakpoint in price. Very high capacity short links commercially favour FSO. Long distance smaller capacity links commercially favour microwave. The longer the FSO link, the higher the cost."

How to choose a p2p solution

Different circumstances will favour one technology over another. Here are some of the key considerations Harris Communications recommends when evaluating your requirements:

Link distance and right of way issues
The longer the link, the more favourable a microwave solution would be.

Required bandwidth
Higher bandwidths over short distances tend to favour FSO.

Overall system cost (acquisition and recurring)
FSO has the system acquisition cost advantage for short links. It has advantages where there is a high recurring cost of licensing fees. Fibre optic cabling solutions are almost always more expensive, especially over greater distances or where extensive civil works are required.

Time to deploy
If this is the driver, then both FSO and microwave solutions would be better choices over fibre optic cable.


MRV engineers install an FSO transmitter in Florence, Italy.

Depending on the country however, the availability of spectrum can be an issue with microwave, as frequency shortages in built-up areas become apparent. Willebrand says that while the frequency spectrum of FSO is free for use worldwide, higher capacity microwaves need large amounts for operation and this can be expensive.

The spectrum used for FSO system operation does not require a license because of the lack of cross platform interference; provided line-of-sight is established between the two locations in question. "An FSO link can also be established, without concerns, over crossed beam paths or self-inflicted interference due to less than necessary fresnel zone allowances," says McBain. There is no licensing requirement because unlike RF, an FSO transmission does not emit any electromagnetic interference (EMI).

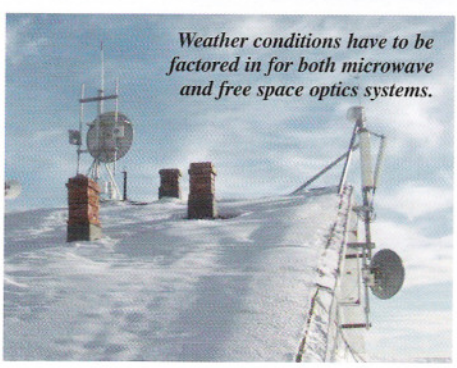
Intrusion threat

As with any communications technology, the issue of security ranks high on the list of concerns when evaluating a suitable solution. "The degree of FSO security depends on the power and frequency of the radio, the width of the beam and the type of information being transmitted," says Ingalls. With a very narrow beam far overhead, the outskirts of the beam disseminates infinitesimally low power. Tapping into that energy would be extremely difficult. Even then, tapping into the signal would require converting the RF radio signal to the format that you're sending, whether that's voice, LAN data, video or all three.

"By contrast, lower frequency radios, say in the two to six gigahertz bands, can transmit at power levels of hundreds of Watts (versus milliWatts)," she says. These can cover single-hop distances of 30-40 miles producing a beam that can fan out hundreds of feet wide (the fresnel zone), and with more detectable energy in the side lobes. Such factors raise the chances of surreptitious interception.

"Just as an example," says Willebrand, "the beam divergence angle of an FSO-based transmission system is on the order of 0.1 to 0.3 degrees. The transmission angle of a microwave antenna is in the order of 10 degrees or more."

In other words, while the FSO transmission beam has a diameter of only one to three metres after travelling one kilometre, the microwave signal will already be spread out over an area of 170m or more after the same distance, making it relatively easy to tap into.


Weather conditions have to be factored in for both microwave and free space optics systems.

Beware the fog

While the narrow spread of its beam may make FSO technically more secure, over longer distances, environmental obstacles can prove problematic for it. For FSO solutions, environmental attenuation increases with link distance and so carrier-class systems must be designed to accommodate heavy atmospheric attenuation.

"The effect of fog on FSO radiation is entirely analogous to the attenuation suffered by RF wireless systems due to rainfall. Similar to the case of rain attenuation with RF wireless, fog attenuation is not a 'show-stopper' for FSO," says fsona's McBain.

Sunflower's Kernahan advises that to mitigate against the effects of fog, the FSO link should be no longer than 600-700 metres. If it is a critical link, it should have a licence-exempt radio back-up solution installed alongside, with spanning tree installed on the common switch.

"With radio complementing FSO, availabilities to 99.999 per cent could be attained because radios operate through the fog that disables FSO links, whereas FSO links are far less vulnerable to rain cell passages that cause millimetre wave radio link outage," says Ross Lunan.

In this respect, FSO and microwave can be viewed as being complementary technologies, adds MRV's Williams.

In spite of this hybrid-installation, Orthogon still believes that over longer distances, it is microwave that makes better sense. "With FSO, you can improve your range and data rate, but at a cost that will be prohibitive for the majority of customers, thereby making an apples-to-apples comparison between FSO and other microwave technologies," says Grafton. He adds that microwave, in the 5.8/5.4GHz areas of operation, is still able to deliver data rates at up to 300Mbps over non line-of-sight paths, which equals FSO.

Upgrades

Nevertheless, both these p2p technologies are expanding their capabilities. Carriers evaluating FSO technology from the PDH/SDH transport standpoint are asking manufactures to find methods to avoid short term interruptions of network traffic.

"One of the features customers are asking for is active tracking, which actively keeps the beam right onto the target position," says Willebrand.

Calls for proven standards-based redundancy are also increasing says McBain, who adds: "A good example is our fully redundant Ethernet solution. It has been designed to provide access to backup solutions at whatever data rate the consumer may require, as well as to address a full complement of RF frequencies and even wireline carrier services."

In microwave, features that make installation and maintenance easier are a common request. Orthogon, for example, has introduced a feature allowing its links to be aligned using a 'goodness' meter displayed on a PDA which enables remote monitoring.

Using either a microwave or FSO-based technology for a p2p solution is governed by the speed-over-distance requirements. If the availability of spectrum and related licensing costs aren't prohibitive, lower speed and longer distance applications are potentially better served by using a microwave link. If high throughput (such as 100/1000Mbps Ethernet) is needed, and the distance involved is shorter (less than two kilometres, for example), an FSO based solution would appear to be a better fit.