



## Increase in mobile data traffic prompts operators to focus more on backhaul

Nordic operator group TeliaSonera is the latest telecoms provider to plan a large-scale overhaul of its backhaul infrastructure. The work is due to be carried out later this year.

The company relies predominantly on 2Mbps leased fixed-line connections – called E1s – to link its cell sites to radio-network controllers (RNCs). But the plan is to implement Ethernet backhaul when it receives equipment based on later releases of the 3GPP standard this year.

“We are investing in Ethernet backhaul as soon as possible,” says Johan Wickman, vice president for research and development at TeliaSonera. “It has tremendous advantage in terms of cost and increased capacity.”

TeliaSonera’s strategy mirrors those of countless mobile operators migrating backhaul to Ethernet. Vodafone is upgrading its microwave backhaul to Ethernet, as are T-Mobile, Swisscom Mobile and Telecom Italia. Vodafone, O2 and T-Mobile have announced backhaul deals with BT’s new Ethernet-based next-generation network, 21CN.

New strategies are emerging in a bid to upgrade the E1/T1s (the US equivalent of E1s), PDH and SDH/SONET microwave radios and low-capacity SDH/SONET fiber rings that are used in backhaul throughout the world today. That’s because mobile data use is changing the economics of traditional backhaul.

### Impact of HSPA

HSPA has resulted in phenomenal data growth as flat-rate tariffs and data use by iPhones and similar devices put even more pressure on networks. Vodafone saw a fourfold increase in data traffic in the 12 months to end-March, for instance. T-Mobile’s traffic reportedly tripled a month after it launched a flat-rate HSDPA service. Backhaul is also becoming more expensive, because HSPA is more bursty than voice and SMS, and operators therefore need a much greater peak backhaul capacity to be available.

So whereas one or two E1/T1s were previously adequate for voice and SMS traffic, now as many as eight per cell site are being used. Vodafone says that 32% of its costs are related to transmission, compared with 22% three years ago. “With a big increase in data volumes, we are forecasting that the cost of transmission could get out of hand if we don’t focus very tightly on increasing efficiencies in this area,” said Andy MacLeod, global networks director at Vodafone, at the company’s technology day in March.

Research firm Infonetics is predicting massive backhaul growth: US\$3.7 billion was spent on mobile backhaul equipment in 2007, but the number of cell-site backhaul connections is expected to roughly quadruple worldwide by 2011.

Most operators are looking at Ethernet for both legacy and

new connections, because it is packet-based and therefore a more efficient alternative to the voice-network-transport protocols used in today’s backhaul. For example, Vodafone says packet-based microwave can carry between three and five times the data volumes without requiring the operator to invest in more spectrum.

New operators with WiMAX networks, similarly, are looking for backhaul options. Speaking at the Mobile Broadband Congress in London last month, Gerard MacNamee, CTO of UK Broadband, an operator trialing WiMAX, said the operator had just bought the rights to a massive 1GHz of microwave spectrum specifically for backhaul.

Ethernet cost savings are dramatic, says Michael Howard, principal analyst and co-founder of Infonetics and author of a report on backhaul released last month. By 2011, service providers using PDH, ATM over PDH, or SONET/SDH for their mobile backhaul connections will be paying three to 40 times as much in service charges per connection as those using Ethernet, DSL, co-ax cable or passive optical networks (PON), he says.

As a result, the IP/Ethernet portion of worldwide mobile-backhaul-equipment revenue is set to rise considerably, with a triple-digit five-year compound annual growth rate from 2007 to 2011.

That means a whole host of vendors and boxes to manage the process – from E1 optimizers and concentrators to gateways, sold by the likes of Celtra and RAD Data Communications.

For many operators in both the US and Europe, upgrading backhaul means migrating from E1/T1 to Ethernet over fixed-line connections. Ethernet-equipment vendors – such as Cisco – have started offering multiple parallel Ethernet-based E1/T1s that act together as a single higher-bandwidth circuit. Sprint reportedly ran into problems finding large-but-cheap backhaul – DS-3s (45Mbps) – for its WiMAX network and is now understood to be using this approach, known as NxT1.

Others are looking at backhaul over DSL, particularly operators with their own DSL infrastructure. Vodafone, which has acquired DSL operations in 12 countries, is using Tele2 infrastructure bought in Spain, and T-Mobile in Germany is sending traffic over low-cost ADSL2+ lines sold by its sister fixed-line company, T-Com.

But most mobile operators are not going for a big-bang approach and ripping out their legacy infrastructure, because TDM- and ATM-based networks are still much better at handling voice than IP. For one thing, they are inherently synchronous, a property that enables users to move seamlessly from cell site to cell site without dropping a connection. Ethernet networks are asynchronous, which means that ensuring that



voice quality is maintained can be problematic.

As a result, many operators are taking a hybrid approach to mobile backhaul, leaving 2G and 3G voice on existing TDM connections but siphoning off data services – EV-DO, EDGE and HSDPA traffic – to Ethernet pipes.

Because most deployed equipment cannot distinguish between voice and data, vendors are selling smart cellular gateways to sort the traffic. New-entrant microwave vendors, such as Ceragon and DragonWave, are even producing integrated radios able to handle both types of traffic in one box.

### Pseudowire

According to migration models mapped out by vendors, operators will eventually eschew hybrid in favor of pseudowire, or circuit emulation, a technology that transports voice traffic over Ethernet services by encapsulating TDM and ATM traffic within Ethernet.

Deployed between the base station and the RNC, pseudowire conveys quality of service to traffic. Pretty much every vendor in the backhaul space is offering pseudowire – the industry body Metro Ethernet Forum even plans to introduce a vendor certification for pseudowire this month – and a small but growing minority of mobile operators, including Swisscom, T-Mobile and Telecom Italia, are thought to be some of the first operators to try it out.

However, according to Infonetics' Howard, the operators have been reluctant to send their voice services over pseudowire, preferring instead to try video, which requires a guaranteed level of service quality.

Pseudowire is not viewed as a very elegant panacea to the voice conundrum: The clocking mechanisms that introduce synchronicity within it are proprietary, for instance.

"This is a really big challenge, and there are many solutions and trials in the field," says Ariel Shuper, director of product strategy and business development at Celtro, "but as yet there is no real, clear-cut technology to synchronize networks."

But because the option to use TDM will vanish with Long Term Evolution, an all-IP network, operators are looking for ways to migrate completely to packet.

That's why a number of vendors are looking at alternatives that might be used in today's networks as well as in LTE networks; solutions to the synchronicity/clocking problem have been occupying the ITU, IEEE and IETF.

Nokia Siemens Networks (NSN), which began shipping base stations with Ethernet interfaces in October, is incorporating two newly devised synchronous standards – ITU-T's Synchronous Ethernet and IEEE 1588v2 – into equipment as diverse as base stations and DSLAMs (which produce DSL signals).

Base stations containing either standard are expected to be available in 3Q08. Both standards have advantages and disadvantages, says Dirk Lindemeier, who works in the division of NSN that develops mobile backhaul technology. For instance, the former requires a network upgrade, and the latter might suffer if the network becomes overloaded.

The industry's first packet microwave radio – Alcatel-Lu-

cent's 9500 MPR, part of its Mobile Evolution Transport Architecture – is the next generation of backhaul equipment and will address voice adequately, says Alberto Valsecchi, vice president of marketing, communications and business solutions at Alcatel-Lucent's optic division. "Our microwave-packet-radio [MPR] solution transforms existing TDM services into packets, without deteriorating the performances both at the radio link level and at the service level," he says.

Launched earlier this year, Alcatel-Lucent's MPR is able to carry several types of traffic on a single Ethernet layer, is service-aware so that it can manage the quality of service of different applications, and can manage 350Mbps of traffic – exceeding the requirements of LTE, Valsecchi says. It also integrates a new microwave that many vendors are considering – adaptive modulation – which crams even more capacity into the available spectrum.

NSN says its packet radio offering, called FlexiPacket, will be available early next year. Lindemeier says MPR will provide more-flexible traffic aggregation than is possible now, because less-costly trunk capacity will be needed, traffic aggregation is nearer to cell sites and traffic can be switched locally.

### US untapped

Despite the innovations and interest surrounding packet microwave, the technology is not expected to eat massively into the share of fixed-line backhaul connections anytime soon. Packet microwave is expected to be responsible for only 37,000 of the 265,000 new backhaul connections in 2011, Infonetics says.

That said, the US is an untapped market for microwave, says Infonetics' Howard. "There is a bigger opportunity for microwave in the US than in EMEA or Asia Pacific, because there is so much copper," he says.

That fixed will dominate is counterintuitive, given that copper is cited as the most expensive option over 10Mbps per cell site, and fiber, with its newer, faster descendant, GPON (gigabit passive optical network), is prohibitively expensive to install. But operators seem to be choosing technologies based on what they already have. Over 90% of backhaul connections in the US have traditionally been fixed-line E1/T1s or fiber, because several mobile operators have extensive fixed-infrastructure arms, which give them access to both fiber and E1s at preferential rates.

Similarly, copper appears to be a viable option for some operators, especially if they have a DSL network. For Vodafone, this technology is one-fifth as expensive as leased lines.

In contrast, microwave has been much more popular in Europe because E1s are so much more expensive than in the US. About 55% of backhaul is microwave, and operators have chosen to build and run the networks themselves rather than lease.

In emerging markets, microwave is the most popular choice, because fixed-line alternatives are scarce in so many countries. Up to 60% of the world's mobile base stations are connected with microwave, according to research firm Ovum.

TATUM ANDERSON

3GWIRELESSBROADBAND@INFORMA.COM