Backhauling with fibre?

Modern installation techniques and smaller, lighter cables enable more economical fibre deployment in mobile backhaul networks, writes Vanesa Diaz

Ditch Witch

Micro-trenching is particularly suited to roadways and sidewalks where utilities are already present beneath the road surface. It requires only a shallow trench, typically about 15cm deep

Since the first mobile phones were introduced in 1981, mobile networks have evolved to the point that we can now be connected anywhere and get to see, experience, explore and express ourselves with just a click from the palm of our hand. From 2G, 3G, 4G and Long Term Evolution (LTE) 4G, the maximum capacity that must be supported by each mobile cell has progressively increased in response to an exponential rise in data consumption.

But things are going to get even more demanding for mobile networks when the Internet of Things (IoT) finally takes off and all kind of sensors and tracking devices with Internet connections start to share data. By the end of this decade, analysts predict that 50 billion of these sensors will connect to mobile networks consuming 1000 times as much data as today's mobile gadgets alone. This will be challenging for mobile networks that will have to backhaul massive amounts of data.

To avoid having to purchase expensive new mobile spectrum (that might not be available anyway), the only way mobile operators can further increase the bandwidth available per user is to increase the density of cell sites. In congested urban areas this means the adoption of outdoor small-cells.

However, as these small cells will mostly aggregate to the nearby macrocell site, this strategy does not fundamentally reduce the amount of data that ultimately needs to be backhauled. In fact it is more likely to increase, especially when 5G becomes operational in the future.

Mobile operators acknowledge this capacity challenge and recognise that deploying optical fibre provides a superior technical solution compared to all other alternatives. But despite its unlimited bandwidth, reliability, low latency, and jitter, fibre penetration in the backhaul has been relatively slow compared to microwave solutions.

This situation commonly prevails because the upfront cost is the most important factor in the operator's installation decision and fibre is still regarded as an expensive option to deploy with a long pay-back period.

Behind the numbers

Based on publicly available research data, Corning has designed an economic model to compare the total cost of ownership (TCO) of some of the most common backhaul technologies (microwave, millimeter, leased fibre and new fibre deployment). The model compares the cost of backhauling a macrocell site with a tri-sectorial antenna (with each sector operating at 80 Mb/s) situated 3 km from the nearest aggregation site and connected to it via a point-to-point (P2P) link using one of the methods listed above.

When considering the first installed costs only, deploying optical fibre cable using traditional open trenching is the most capital-intensive solution. This is because open trenching is an expensive, disruptive and slow process, particularly in urban areas with prices varying from €95-157 per metre and installation speeds of only 30 to 50m a day (typical prices in the UK).

For this reason some operators have opted for leasing fibre bandwidth as a way of securing high capacity without incurring the capital cost of installing cable. However, the high leasing fees with prices varying from €40,000 to €112,000 per year for a macrocell site, make this alternative a short-term rather than a long-term solution.

A lower first-installed cost explains why wireless technologies might seem to be a more cost-effective solution than fibre. However, wireless equipment

> The breakeven point between fibre and wireless backhaul can be reduced to just 6-8 years

can incur considerable and on-going operational costs for spectrum leasing, particularly in urban areas where some of the most common frequency bands currently used are becoming congested and expensive. For example, the UK regulator Ofcom sets a license fee for a 23 GHz link using two 56 MHz channels of €2,827 per year per link.

Millimetre wireless bands can offer increased bandwidth and spectrum fees as low as €64 per ➤

year per link, but at these frequencies the equipment is more expensive and the maximum link distance is more limited, negatively impacting both deployment and maintenance costs.

Although once installed, the on-going costs of running fibre links are much lower than wireless, due to the initial cost of traditional cable installation the breakeven point for fibre relative to microwave is somewhere between 18 and 20 years, which is too long to provide an acceptable business case for the mobile operator. To allow operators to realise their preferred option of using fibre to address mobile backhaul capacity challenges, improvements to cable installation technology are necessary.

Micro-trenching, microduct and minicables

Up to 80 per cent of the total costs of deploying new fibre are due to civil works. This is because digging trenches in busy roads requires permits, traffic management and, once the ducts have been laid, reconstruction of the road by backfilling the hole and reinstating the surface. Alternative deployment techniques can notably reduce these costs and one in particular has become very popular.

Microtrenching replaces traditional open trenches with a narrow slit that is sliced or sawn into the surface of the road and into which microducts are placed. Microducts are smaller versions of the pipes through which optical fibre cable can be pulled, pushed or blown. They can be procured and installed individually or in specially-designed bundles and into which smaller and lighter minicables are blown.

With the use of minicables, microducts, microtrenching can allow less disruptive and much quicker fibre deployments with speeds between 150 to 200m per day, reducing civil costs dramatically – as much as 76 per cent in one reported example in the US city of Linda Loma. In Corning's economic analysis, the large savings in deployment enabled by the use of microtrenching and minicable/microduct technologies can reduce the breakeven point between deployed fibre and wireless solutions to 6-8 years.

There are several additional potential benefits of using minicable and microduct technologies in backhaul network deployment:

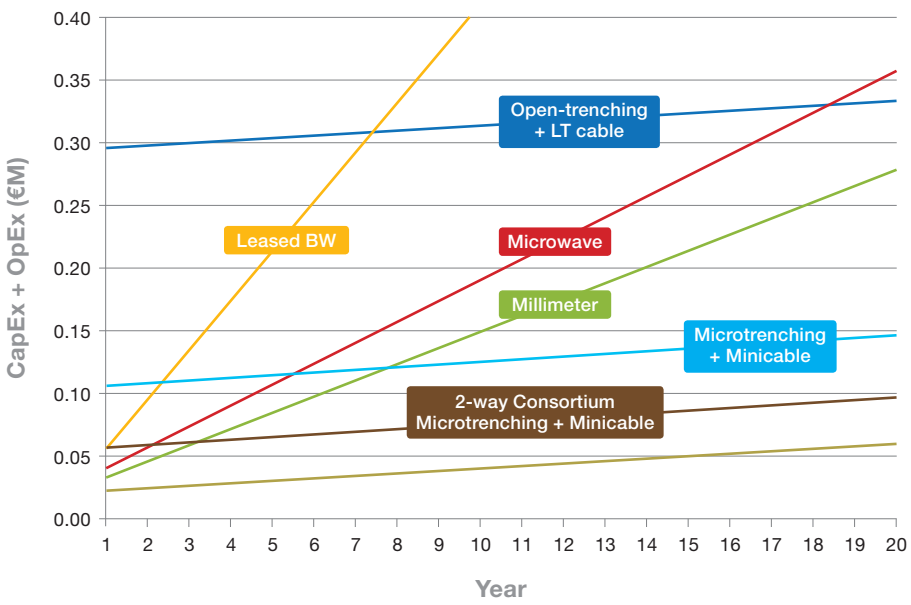
Infrastructure sharing. Interest is growing among operators in sharing backhaul infrastructure as a means of lowering overall network costs. Sharing masts for hosting microwave antennas is a common arrangement between mobile operators. For example, Telefónica, O2 and Vodafone have a 10-year network sharing agreement in selected European markets. There are also examples of operators sharing mobile spectrum and even network construction costs, e.g. in 2009, Tele2 and Telenor in Sweden formed a joint venture to build a nationwide 4G network and share spectrum.

Because microducts sub-divide the internal duct into multiple smaller compartments this technology is particularly well suited to allowing the efficient sharing of duct-space amongst several operators along a route. In Corning's economic analysis, two operators working in a consortium could share the costs of deploying a microduct bundle using microtrenching technology moving again the pay-back period relative to wireless solutions down to 2-3 years.

Duct space reutilisation. In brownfield deployments, once a standard loose-tube cable is deployed in a large duct, installing new cables in the same space is not recommended as it could damage both existing and new cables. However, by overlying microducts in the large duct first, minicables can be air-blown in later at no risk, allowing carriers to reutilise crowded ducts that would otherwise have been considered full. This approach allows operators the opportunity to increase network capacity at relatively low cost.

Duct and dark fibre leasing. Leasing bandwidth, dark fibre or duct access is a common practice in Europe. In September 2010, the European Commission (EC) issued a Recommendation with the aim of regulating wholesale products in Next Generation Access Networks (NGA). For example, the cost of renting duct space in Telecom Portugal's network in Lisbon is 10.60 euros/month/km/cm^2 and options to lease dark fibre and bandwidth are also commercially available. By leasing either some of the microducts or the fibres contained therein, an operator who deploys cable using microduct technology can open new revenue streams that could completely change the business case for fibre deployment.

Total cost of ownership comparison of installing various types of mobile backhaul



Conclusion

Mobile operators need to install backhaul networks that are capable of supporting the expected growth in data carrying capacity. Although microwave and millimeter technologies are more limited in terms of data capacity, these technologies are often regarded as the low-cost alternatives and still lead the market, whereas fibre has been perceived as a long-term investment and has often been discarded due to its high initial cost of deployment.

However, the use of advanced installation techniques and microcable can greatly reduce the initial level of investment of new fibre builds, particularly if operators form a consortium to share costs. Operators may also open new revenue streams by leasing infrastructure to competitors making the business case for fibre more attractive than ever before.

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Further reading

Paolini, M. (2011). Crucial Economics for Mobile Data Backhaul. Retrieved from **http://www.senza-fili.com/Resources/WhitePapers.aspx**