E-Band: A harmonious option for backhaul

Whether in mobile, fix or private network the millimetre wave represents a new fundamental technology tool bridging the gap between fibre high capacity systems and flexible cost effective wireless transmission.

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Mobile user habits changes

Data growth in mobile network

Smart phones and tablets are changing the paradigm of broadband access. Enabling users to be connected all the time, anywhere, the concept of sitting stationary in front of a PC to access data has become superseded. Smartphones and tablet coupled with mobile broadband connectivity enables users to access high capacity data on the go, which represents over 80% of the smartphones usage[1]. This way of accessing data and being always on is helping mobile broadband to grow exponentially year over year, so much that in 2012 mobile data traffic grew 70%.[2]

This phenomenon is driving the need for higher network capacity in both fixed and mobile networks, since 33% of mobile data traffic was offloaded to fix network in 2012, and the forecast growth of global mobile data traffic is estimated to increase 13-fold between 2012 and 2017. [2]

The backhaul network evolution

Today's mobile backhaul network features a strong predominance of microwave radio. Its deployment flexibility and capacity scalability have always been two key features that characterized this technology and its success in the mobile backhaul application.

Now with the foreseen capacity explosion new high capacity requirement are rising. Traditional licensed microwave maximum capacity per link remains within the hundreds of megabits even when using complex modulation formats. Increasing the modulation scheme level does not answer the demand for capacity. Even adopting complex modulation schemes and increasing from 1024 to 2048 QAM we obtain 10% extra capacity, while drastically increasing the equipment complexity. Although licensed microwave will still be adequate solution for the vast majority of links, a niche of high capacity in the gigabit range application is starting to take place, requiring a more tailored solution.

Although fibre is always associated as the media for providing high capacity, its limited flexibility and costs may not meet the required needs in these applications. A new technology presented itself as solution bridging the fibre high capacity offering with the high flexibility and cost effectiveness of traditional wireless transmission: millimetre wave.

[1] According to: "Our Mobile Planet: United States, Understanding the Mobile Consumer" from Google – May 2012

[2] According to: "CISCO visual networking Index: global mobile data traffic forecast update 2012-2017" – February 2013

The E-band and its applications

Millimetre wave, the E-band and the traditional microwave radio

In the millimetre wave we find the V-band operating at 60GHz and E-band operates in the 70/80 GHz frequency range. While at 60GHz a strong oxygen (O_2) peak absorption attenuation impacts the propagation behaviour with the result of particularly short links limited to a range of hundreds of meters. At 70/80GHz the attenuation falls back to less than 0.5 dB/km resulting in a more homogeneous behaviour with respect to traditional microwave frequency bands. This offers a hop length of a few kilometres similar to a 38 or 42 GHz bands as far as propagation is concerned, varying on the expected rain intensity.

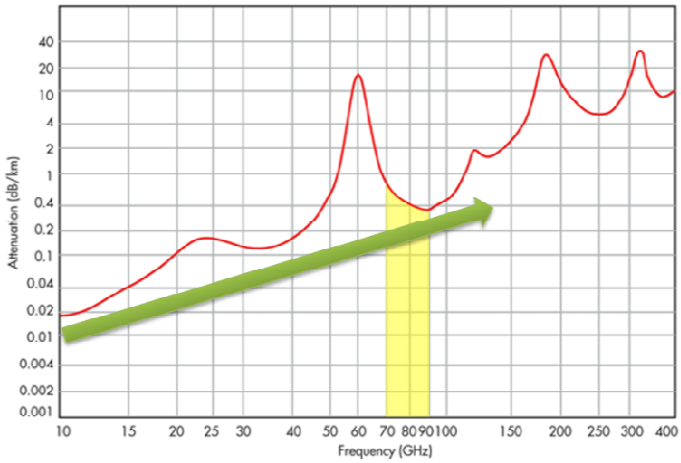


Figure 1: propagation attenuation vs frequency bands

Traditional microwave radio for short haul link operates in bands from 18 GHz up to about 50 GHz. These frequency bands offer limited amount of bandwidth, typically 2 or 3 GHz, with channel arrangements between 3,5 to 56/112 MHz. Even using high modulation scheme this implies the maximum capacity achievable to remain in the hundreds Mbps range.

In the E-band, the regulation foresees availability of 10 GHz spectrum, divided into 5 + 5 GHz portions, from 71 to 76 GHz and from 81 to 86 GHz. In this spectrum it is possible to address larger channel bandwidths (e.g. 250 MHz/750 MHz) with the consequence of delivering one Gigabit throughput with low modulation formats or using four levels of modulation up to two Gigabits over a single channel.

This difference in the channel allocation offers four times the capacity versus a traditional microwave solution, opening a multitude of new scenarios and applications that can be addressed with this solution.

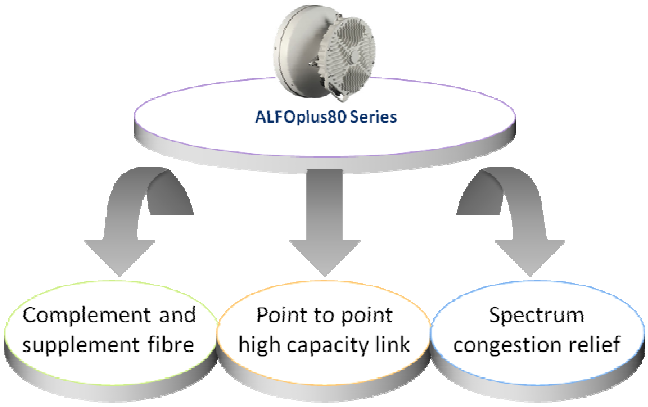


Figure 2: 80GHz applications

Complement and Supplement fibre

The characteristics of the E-band perfectly fits with the need of multi-Gigabit connections, in particular where optical fibre is not available or unfeasible for cost, deployment issues or for time constraints. Millimetre wave can be easily employed to expand fibre links as a last mile connection, for instance in the deployment of new switch cabinet to expand copper DSL, or fibre to the home FTTH/FTTB. New cabinet can be placed in new positions closer to the residential are to b served and connected to the fibre point of presence with a 80GHz link. It can also provide fibre protection where old or degraded fibre is present or even challenge new fibre installations. The low deployment costs and immediate time to service offer fast connectivity and speeds up network deployment. Furthermore the flexibility of deployment typical of wireless transport technology allows higher freedom in network topology than offered by urban fibre.

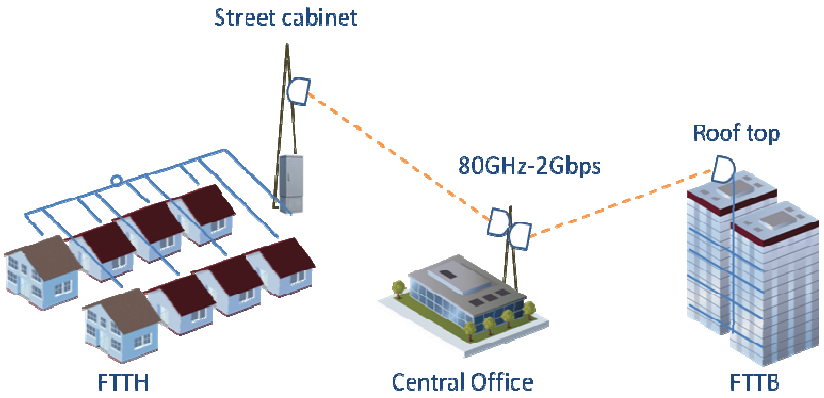


Figure 3: 80GHz FTTB/FTTH application

Point to point high capacity link

Millimetre wave solution have become part of microwave vendor's portfolio enhancing their offering. 80 GHz specifically has high versatility in traditional wireless point to point applications.

In mobile backhaul from deployment in aggregation links to high capacity rings, with a current capacity of 2 Gbps and future expected 10 Gbps. Also in Cloud RAN (C-RAN) architecture for CPRI or OBSAI backhaul the high capacity low latency requirements are met.

In private network as short-haul hops in urban environment to link adjacent or nearby builds like hospitals, university campus or private enterprise premises.

Furthermore due to its extremely low latency the 80GHz solution is applicable for deployment in banking and trading networks.

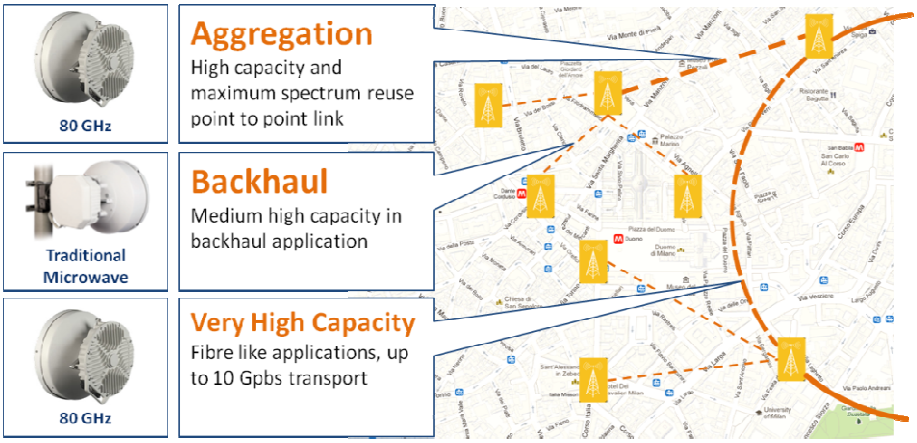


Figure 4: 80GHz mobile application

Spectrum congestion relief

Mobile backhaul represents the biggest application for microwave radio. For this reason part of traditional microwave radio spectrum in many country is close to congestion due to deployment density driven by constant mobile access network extensions.

Several factor are contributing in pushing higher microwave radio deployments in urban environment:

- New cells, either expansion or new technology deployment
- Cell radius reduction and consequently reducing the hop length between cell sites,

The wide spectrum availability and its lightly licensed regulation makes the use of 80 GHz in urban environment a perfect candidate to migrate to solve the congestion issue. The use of this frequency band would allow operators to free up spectrum in traditional

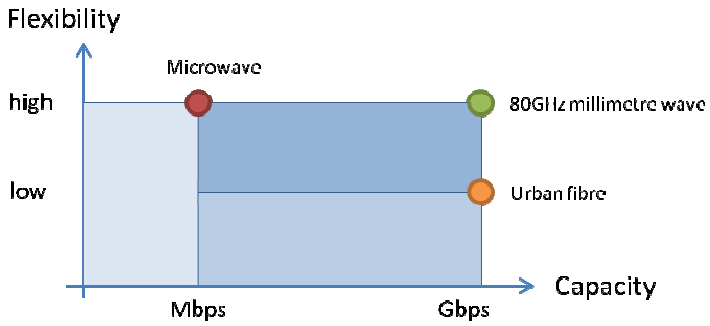
microwave bands consequently improving network flexibility to optimize the current network as well as offering wider choice of options for future deployments.

Furthermore if we consider highly dense urban areas the high directivity gain antennae employed in 80 GHz allows operator to maximise reuse of the frequency and channels.

Conclusions

The inclusion of millimetre wave operating in the E-band 80GHz gives mobile operators a new tool at their disposal to enhance their transport network.

This technology offers great deployment flexibility when compared to fibre, while offering similar capacity level at a much lower costs. Also it offers great capacity reach when compared to traditional microwave radios, while retaining common operational and deployment mode. This homogeneous operational behaviour as traditional microwave allows operators to fully liaise with existing knowledge and skills, minimizing the introduction costs.



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