80GHz – TODAY’S CHOICE FOR TOMORROW’S NETWORKS
Why E-Band delivers the best capacity/$ for Backhauling

The exponential growth of Data Traffic

The rise of Tablets, Smartphones, Smart TVs, Media Centers, Home Servers and “connected devices” in general, is driving the market need for fast and reliable connections which allow to keep up with the exponentially growing traffic generated by both mobile networks (3G/4G) and fixed ones (Wi-Fi, DSL, Fiber).

Internet browsing, peer to peer file sharing, social networking and all services related to Video on Demand (e.g. Youtube, Netflix, Hulu,..) are just examples of how users generate heavy IP traffic from their homes or their Smartphones/Tablets.

If we consider traffic generated by Fixed Internet, Mobile Internet and Managed IP - which includes corporate IP WAN traffic and IP transport of TV and VoD - global IP traffic has increased more than fourfold in the past 5 years, and will increase threefold over the next 5 years.

Overall, it will grow at a compound annual growth rate (CAGR) of 23% from 2012 to 2017. [Table 1]

From Cisco VNI study, we see that the highest growth is in the Mobile data: forecast sets 2016 as the date when Traffic from wireless and mobile devices will exceed traffic from wired devices.

By 2017, wired devices will account for 45% of IP traffic, while Wi-Fi and mobile devices will account for 55%.

Just to show how the market is evolving, in 2012 wired devices accounted for the majority of IP traffic at 59%. Focusing on the mobile market, it is clearly driven by the growth of both the amount of traffic per user and the increase of the user themselves. [Chart 1]

Nowadays almost everybody owns a mobile phone – last forecasts show how the total number of Smartphones will exceed world population by 2014.

Let’s also consider the traffic generated by users: in 2012 on average, a Smartphone used 340MB of traffic per month. In 2017 it is forecast to be 2,7GB per month, almost 20 times more. [Table 2 & 3]

### Table 1

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Fixed Internet</td>
<td>31,339</td>
<td>30,295</td>
<td>47,987</td>
<td>57,609</td>
<td>68,878</td>
<td>81,818</td>
<td>21%</td>
</tr>
<tr>
<td>Managed IP</td>
<td>11,346</td>
<td>14,679</td>
<td>18,107</td>
<td>21,523</td>
<td>24,740</td>
<td>27,088</td>
<td>20%</td>
</tr>
<tr>
<td>Mobile data</td>
<td>1,578</td>
<td>2,798</td>
<td>4,704</td>
<td>7,437</td>
<td>11,157</td>
<td>66%</td>
<td></td>
</tr>
</tbody>
</table>

### Chart 1

Exabytes per Month: 66% CAGR 2012–2017

Estimation of subscriber growth

Source: Cisco VNI Mobile Forecast, 2013

Source: CDMA Development Group
The following are a few of the main promoters of growth in average usage:

1. As mobile network connection speeds increase, the average bit rate of content accessed through the mobile network will increase. High-definition video will be more prevalent, and the proportion of streamed content as compared to side-loaded content is also expected to increase with average mobile network connection speed.

2. The shift toward on-demand video will affect mobile networks as much as it will affect fixed networks. Traffic can increase dramatically even while the total amount of time spent watching video remains relatively constant.

3. As mobile network capacity improves and the number of multiple-device users grows, operators are more likely to offer mobile broadband packages comparable in price and speed to those of fixed broadband. This is encouraging mobile broadband substitution for fixed broadband, where the usage profile is substantially higher than average.

4. Mobile devices increase an individual’s contact time with the network, and it is likely that this increased contact time will lead to an increase in overall minutes of use per user. However, not all of the increase in mobile data traffic can be attributed to traffic migration to the mobile network from the fixed network. Many uniquely mobile applications continue to emerge, such as location-based services, mobile-only games, and mobile commerce applications.

At this point it will be clear that problems will arise in the access infrastructure and, directly connected to that, in the transport infrastructure.

To avoid bottlenecks and poor QoS, which can cause high churn rates, operators must invest heavily in faster backhauling technologies to keep up with the exponentially growing demand for traffic.

What they will be looking for when choosing a backhauling vendor will be:

a) High capacity to keep up with increased traffic demand
b) Low cost per bit to reduce CAPEX
c) Fast and cheap installation to reduce OPEX

Why Millimeter Wave (80 GHz)?

Better than fiber. Commercially available equipment can provide fiber-like performance at a fraction of the cost of laying fiber or leasing capacity. Today’s equipment can provide rates up to 2.5 Gbps in cost-effective, reliable architectures, with carrier class 99.999% availability at distances of 3 miles or more.

Several other technologies exist to provide gigabit services [Chart 2], the advantage of 70/80GHz microwave backhaul is the only solution that offers carrier-class reliability at any significant distance at a cost that can transform backhaul and access business models.
Wider Spectrum.
Many frequencies, licensed and unlicensed, between 2GHz and 40GHz, are congested or becoming so resulting in poor quality or interrupted services. Moreover, in order to deliver higher data speeds, more radio frequency bandwidth is needed. In recognition of this many administrations have released or are releasing mmW frequencies for PTP use. Traditional PTP technologies use channel widths up to 56MHz restricting raw Ethernet throughput to around 360Mbps. Users requiring Gigabit speeds would need 156MHz of spectrum. This amount of spectrum is simply not available in the traditional Licensed Microwave Bands. The currently released mmW bands at 60, 70, 80 and 90GHz unlock 19GHz of spectrum making them ideal for high throughput data communications [Chart 3]. In comparison there is less than 0.5GHz of spectrum available for PTP and other license exempt use between 2 and 6GHz. The Licensed Microwave Bands are now so full in urban areas that acquiring even a 7MHz channel are proving challenging. In the E-band, the available 5+5GHz portions of spectrum allow use of larger channel bandwidths to deliver one Gigabit throughput per link, with low modulation formats. Second generation equipment using four levels of modulation can deliver two Gigabits or more transport capacity over a single channel.

Cost Effective, typically 3km hop length. In today’s fiber-rich world, the “last mile” urban fiber stretch is the most expensive part. Millimetre wave (mmW) communications is designed to serve urban range connections (3km) offering an advantageous alternative solution to the deployment of fiber, with a fiber-like performances.

Interference fail safe. These small high gain antennas have very narrow beam widths providing enhanced frequency re-use and interference immunity and make interception and eavesdropping very difficult. These narrow beams combined with proprietary over the air protocols and data compression make mmW PTP links very secure when compared to standards based implementations such as 802.11 where interception devices are easy to implement.
a) Remote Storage Access

The main features of microwave backhauling: ALFOplus80HD, are the following:

- Packet header compression performance: 10% to 20% additional gain, depending on protocols stacks and frames size.
- Modulation scheme: hitless modulation and code selection from BPSK to 64QAM with adaptive code modulation (ACM)

SIAE ALFOplus80HD

SIAE MICROELETTRONICA was among the first movers into this new transmission technology. Know for the innovative R&D department, together with the 60 years expertise in Microwave, SIAE MICROELETTRONICA is probably one of today’s best partners for implementing a high quality, fast and reliable network, with low prices which are a direct consequence of the all in-house production (engineering, design and manufacturing). That is why SIAE MICROELETTRONICA is one of the main providers for Global Operators around the world.

In its second release the ALFOplus80HD reached 2.5Gbps offering fiber like capacity. This field proven solution takes millimeter wave backhauling a step further, with a fraction of the cost.

The main features of ALFOplus80HD, are the following:

- Packet header compression performance: 10% to 20% additional gain, depending on protocols stacks and frames size.
- Modulation scheme: hitless modulation and code selection from BPSK to 64QAM with adaptive code modulation (ACM)

Table 4

<table>
<thead>
<tr>
<th>Data Rates</th>
<th>80 GHz</th>
<th>Metro Fiber</th>
<th>Microwave 38/42 GHz</th>
<th>60 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Link Distances (99.999% Availability)</td>
<td>&gt; 2 Gbps</td>
<td>2 to 10 Gbps</td>
<td>&gt;500Mbps</td>
<td>1 Gbps</td>
</tr>
<tr>
<td>Relative Product Complexity</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Relative Cost of Installation and Ownership</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Very Low</td>
</tr>
<tr>
<td>Installation Time</td>
<td>Hours</td>
<td>Months</td>
<td>Hours</td>
<td>Hours</td>
</tr>
<tr>
<td>Regulatory Protection</td>
<td>No/Lightly Licensed</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

In particular, ALFOplus80HD QoS feature provides an improved and more predictable network service, as follows:

1) Improving loss characteristics based over Hierarchical QoS
2) Avoiding and managing network congestion
3) Prioritizing services to different kinds of network traffic
4) Optimizing packet delay variation (PDV)
5) Setting traffic priorities and end-to-end quality management
6) Lowering latency transmission media (better than fiber)

All the above characteristics will lead SIAE customer’s networks into MEF 2.0 compliancy.

Conclusion

During this brief market overview Chart 6 we saw how the market is demanding for effective and cost saving solutions for their infrastructures, especially in the mobile market where the traffic growth is exponential year on year.

February - 2014
Considering the price to Mbps, on a short/medium range the advantage of 80GHz solution is extremely clear, over fiber and also over other traditional microwave backhauling solutions.

SIAE MICROELETTRONICA has been leading MW innovation for more than 60 years and is now able to provide the most advanced solution on the market for millimeter wave backhauling, offering a product - the ALFOplus80HD - which is the result of full in-house development and the significant experience acquired with years as global mobile operator’s supplier.

SIAE MICROELETTRONICA offers a complete backhauling solution shaped on today’s full Ethernet networks’ needs, including the joint development with CISCO of the Microwave Adaptive Bandwidth (MAB) feature providing optimized performance for both ring and non-ring based topologies while using adaptive modulation (ACM).

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