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The Next Generation Backhaul Networks – E Band

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NEC
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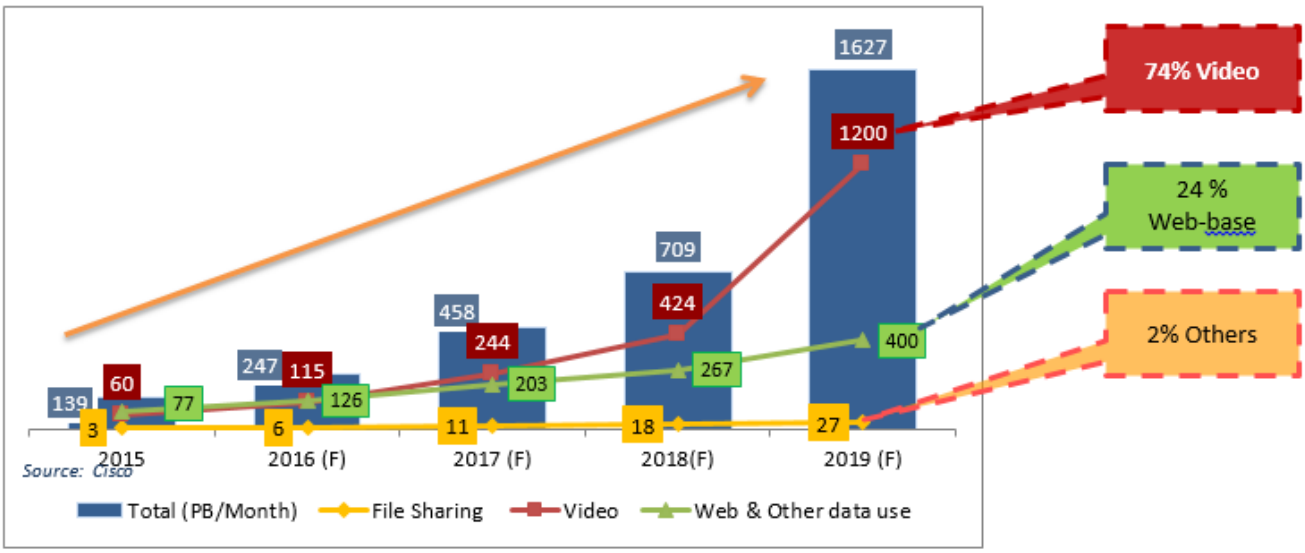
Overview:

Network demands and maturity vary around the world, and differences can even be seen within individual countries. All Networks are facing intense data growth, to meet the data requirements we need to upgrade backhaul transmission parallel to Radio technologies (2G, 3G, 4G, 5G etc). Regardless of the situation, all operators want to achieve the same goal – to provide the best possible performance and quality of experience in the most cost-efficient

The main drivers for change in Radio and Transmission technologies are the huge requirement of capacity and coverage. These drivers in urban and sub-urban environments lead to a new and revolutionary approach for mobile backhauling.

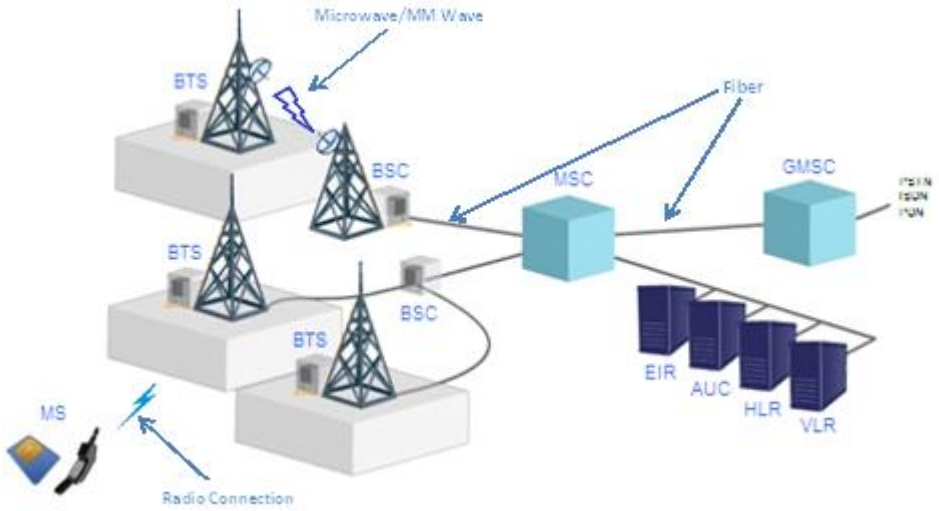


Above table shows data usage is expected to increase by 6X from current to next 3-4 years.

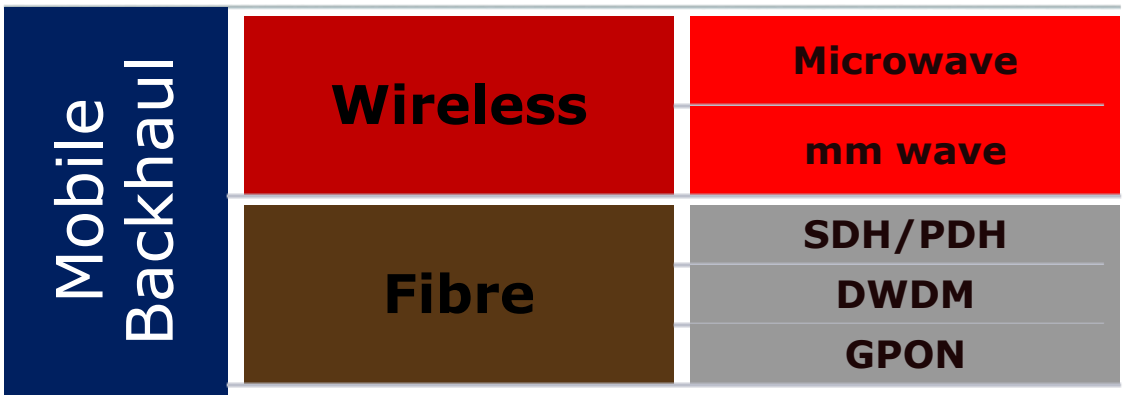
With very high capacity requirement, Backhauling needs to satisfy apparently conflicting requirements such as increase of capacity and spectrum efficiency but the consumption of power should be very low. Capacity is increasing more and more while distances decrease and base stations get nearer to subscribers.

What is Mobile Backhaul?

The mobile backhaul network provides connectivity between the radio base station site and the switch site at the edge of a transport network. It starts at the cell site, and ends up in the mobile core. So everything in between BTS/NodeB/eNodeB to Core network is considered as Mobile backhaul.



Mobile Backhaul has two subdivisions one is fiber and other is Wireless. Wireless backhaul is further divided in to Microwave and MM wave. Microwave/MM wave are a vital network ingredient for operators to inter connect various Nodes. So it will continue to be the dominant backhaul technology in the future.



MM wave has two main technologies E-Band and V-Band. Our focus area in this document will be E-Band backhaul details and applications.

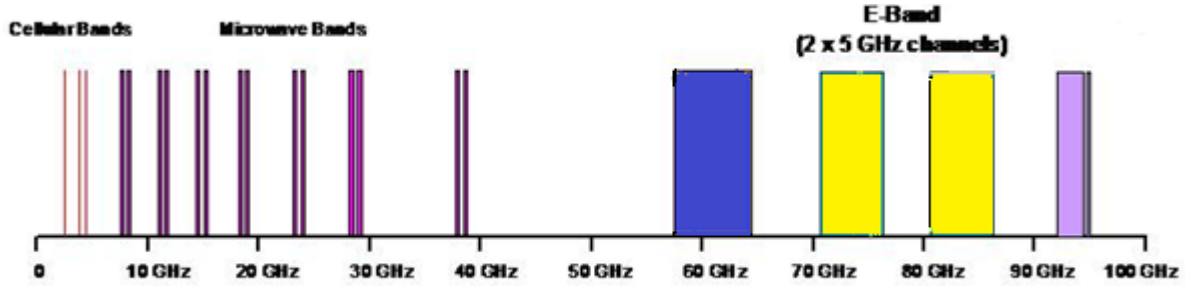
E-Band spectrum characteristics and nature:

E-Band: since 2000, regulators have made available high frequency bands at 71-76 GHz and 81-86 GHz. E-Band enables gigabit-per-second data rates given the huge amount of available spectrum (10 GHz) without any oxygen absorption.
Given the different nature of the two frequencies, different scenarios might be foreseen for each of them, including macro and small cell backhaul, front-haul applications, Line of Sight (LoS) today and most probably future near Line of Sight (nLoS) or No Line of Sight (NLoS). Nonetheless, regulations for these two frequency bands aren't always already decided, opened and planned and, especially for the V-Band case, the related portions of the spectrum differ from country to country making it very fragmented.

Bandwidth of E-Band:

E-Band is intended to cover 71-76 GHz and 81-86 GHz.

Current traditional frequencies below 50 GHz are already very very crowded and exploited, hence the need to use higher frequency bands in future-proof networks. Due to technology evolution and availability of wide channel bandwidths, the use of frequency in the E-Band appears to be of interest for the current and future needs for backhaul networks.



Following are the typical specification to use E-Band in network:

Specifications:

Frequency Range	71-76, 81-86 GHz
Antenna Port to "V" or "H" Radio Port - Maximum	<1dB
Antenna Port to "V" or "H" Radio Port - Typical	~0.8 dB
Port-to-Port Isolation	> 30 dB
Return Loss - each port	> 20 dB
Polarization Adjustment Range	±5º
E-Link System Gain	~190 dB
Free Space Loss	(2.1 mi/3.2 km) -141 dB
Rain Rate (ITU-R Region E)	22 mm/hr (0.86 in/hr)

(Region E: Denver, Stockholm, Moscow, Beijing)

The option to subdivide a 250MHz channel into 4x62,5MHz or 2x125MHz, not reported here, is foreseen in ECC/REC(05)07 only.

Advantages of E-Band:

- The 71-76 and 81-86 GHz bands are used for ultra-high capacity point-to-point communications.
- The advantages of E-band are its wide spectrum i.e.10 GHz and channels that enable very high capacities similar to fiber-like bandwidth in Gbps.
- E-band offers the highest data rates of any wireless technology, with systems available that offer 1Gbps and above full-duplex throughput.
- Improvement in modulation from 512 QAM to 4096QAM has improved the Spectrum efficiency by 30% in the traditional band
- Adoption of E-band for high throughput in Urban areas having high data demand

Applications of E-Band:

- Due to High capacity, E-band compliment Fibre by providing high throughput 2.5 Gbps (With Polarization techniques it can go up to 5Gbps).

- Mobile backhaul, with advent 3G /4G demand for backhaul ,demand cannot be supplied by traditional backhaul , hence E-Band supplement the high data demands

- E-band Solve the spectrum Congestion problem in Urban/sub urban areas, where spectrum is running out.

- It also can be used for small cell backhaul

Summary:

E-Band can provide Gigabit Ethernet data rates of more than 1 Gbps irrespective of weather conditions over several miles ensuring cost effective radio architectures. Moreover Technology has been proved to be very helpful in connecting small cells in urban area where installation of fiber is difficult. Considering all these factors E-band technology seems to be very favorable to cope with high Data demand in all areas worldwide.