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Lessons learned from a decade with E-band

Extract from the Ericsson Microwave Outlook Report

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Lessons learned from a decade with E-band

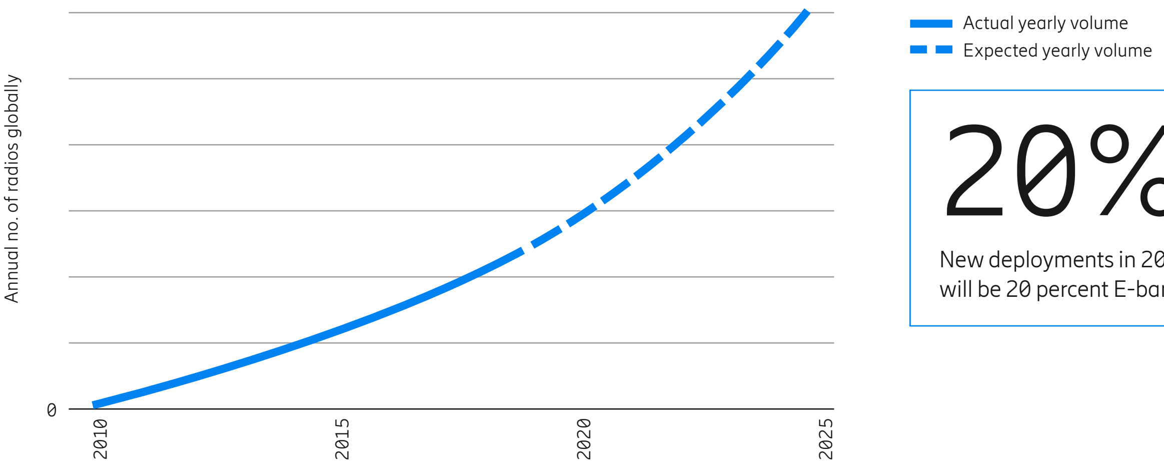
E-band is increasing in importance with the arrival of 5G and its demand for high capacity. During the recent years of commercial deployment, a number of insights have been gained that will facilitate the future use of E-band.

Many operators are facing a need to update their backhaul network to meet the capacity requirements of a 5G rollout. The RAN capacities in a 5G network, especially in urban/suburban environments, increase the need for backhaul equipment capable of handling multi-gigabit traffic in a cost-efficient way. With limited spectrum in the traditional frequency bands, the attention directed towards E-band is constantly increasing. The technology has been successfully proven in several countries for a number of years and will increasingly be needed to boost capacity in urban sites, along with multi-band booster (MBB) combinations in suburban sites. As can be seen in Figure 7, the momentum of E-band is in full swing. In 2018 there were 14 times more E-band radios sold globally compared to 2011.

As the worldwide 5G rollout drives the need for cost-efficient backhaul capacity and E-band becomes available in more countries, the curve is expected to become even steeper. With this continued growth in mind, 20 percent of new deployments are estimated to be E-band by 2025.

From a decade of both standalone and multi-band E-band deployment, there are three main lessons to be drawn.

Figure 7: Growth of E-band radios from 2010–2018 and predicted for 2019–2025



Source: Ericsson (2019)

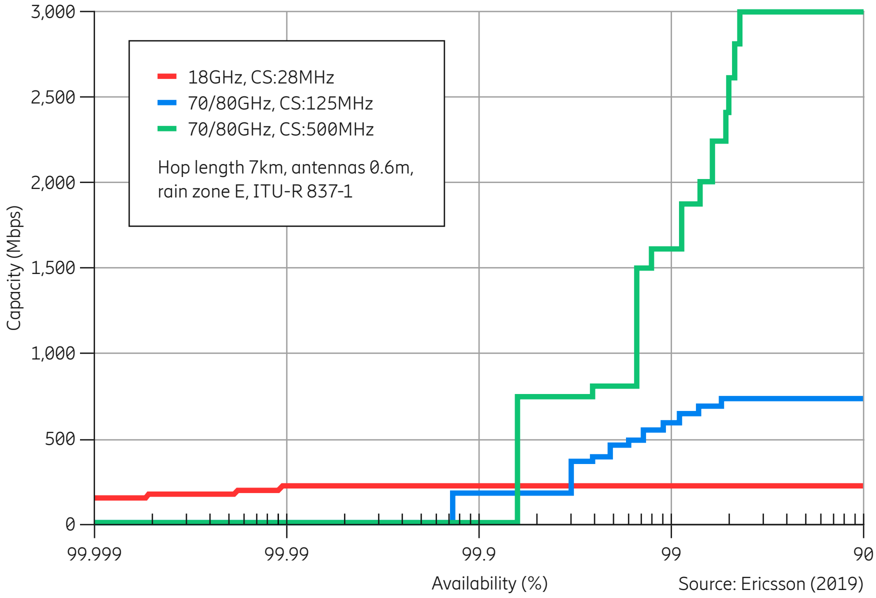
20%

New deployments in 2025 will be 20 percent E-band.

1. Reality matching predicted availability
For deployment of E-band radios in a network, the MBB concept is one of the key strategies. The obvious benefits are that it increases the capacity of an existing hop or stretches the hop length of the E-band. The trade-off in all of this is the availability of the E-band.

Figure 8 shows the availabilities for an 18GHz radio and an E-band radio, measured over 12 months in Gothenburg, Sweden (Rain zone E, ITU-R 837-1). The hop is a 7km long MBB configuration, using a combination of an 18GHz radio with a 28MHz channel and an E-band radio with a 125MHz channel. The 18GHz radio had consistent traffic during the 12-month period and the E-band radio remained at maximum modulation and capacity for more than 98 percent of the time. The E-band link contributed to the total capacity 99.93 percent of the time. When using an E-band radio with a 500MHz channel, the corresponding values for the E-band's maximum modulation are just short of 98 percent, and the E-band is contributing close to 99.83 percent of the time. From a capacity perspective, it means that the hop never drops below 175Mbps and 99.93/99.83 percent of the time the E-band kicks in and boosts the hop with up to 17 times the capacity.

Figure 8: Availability and performance for a multi-band booster hop measured over 12 months



Source: Ericsson (2019)

>99.9%

The E-band link contributed to the total capacity 99.93 percent of the time when the hop length is at 7km.

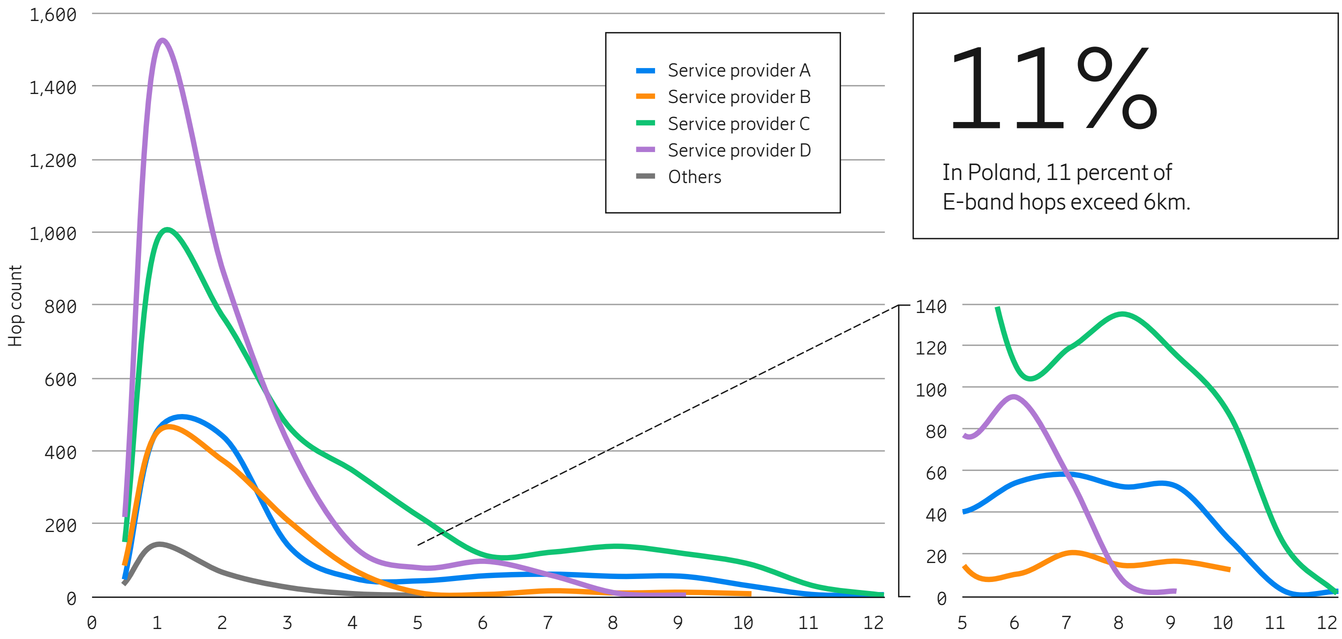
2. Longer hops win over high availability
One perceived drawback of any E-band deployment has been the idea of big limitations when it comes to hop length: that it is only applicable for one, maybe two kilometers. In Poland, where E-band penetration now exceeds 20 percent (as of May 2019), the service providers have chosen a method which allows for very long E-band hops. This distribution of hop lengths can be seen in Figure 9. Hops that are between 2 and 5km stand for 22 percent of the total, and as many as 11 percent of the hops are 6km or longer. In fact, 154 hops are 10km or even longer.

The distances where standalone E-band is used and where MBB hops begin to be introduced varies between service providers. Some start to deploy MBB at 3.5km and some wait until the distance is as long as 5km. The way to do this is to adjust the availability requirements of the E-band, in both standalone and MBB configurations.

Figure 10 shows 7 lengthy live hops, ranging from 4.1 to 12km in length (note: all are in different locations in Poland with different rain intensity and vendor equipment) and the corresponding availability figures achieved for each modulation. By stepping away from the historical requirement of ‘five nines’, these impressive lengths have been achieved.

It is evident that E-band is a more viable solution for longer hops than previously expected and that Polish service providers have started to move towards a more packet-based approach to network planning, thus expanding the use of E-band radios.

Figure 9: E-band microwave hops deployed in Poland, split by distance

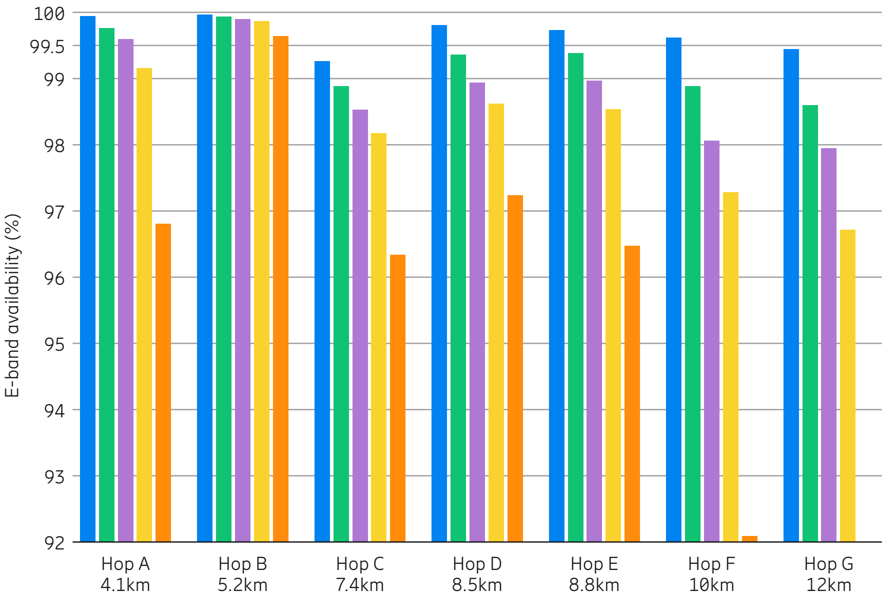


11%

In Poland, 11 percent of E-band hops exceed 6km.

Source: Ericsson (2019)

Figure 10: Live data for multi-band booster E-band hops in Poland, availability for various modulations



The hops are in different locations with different rain intensity and vendor equipment.

12km

Leaving the 'five nines' era allows for long E-band hops.

Source: Ericsson (2019)

3. Accurate alignment is growing in importance

Point-to-point microwave links use high-gain antennas in the 30 to 50dBi range, corresponding to a half-power beamwidth (HPBW) of 5 and 0.5deg respectively. The lower gain limit is set by interference and frequency reuse, while the upper limit is set by practical limitations on alignment and stability. The gain distribution in different frequency ranges can be found in Figure 11. In the traditional bands (between 6 and 42GHz) the average gain distribution is in the 37 to 41dBi range, with the bulk well below 45dBi. Millions of such antennas have been installed. Only a small percentage of the installations have used very high gain antennas close to the upper 50dBi limit. It is understood that extra attention and skilled installers have been needed on a few links.

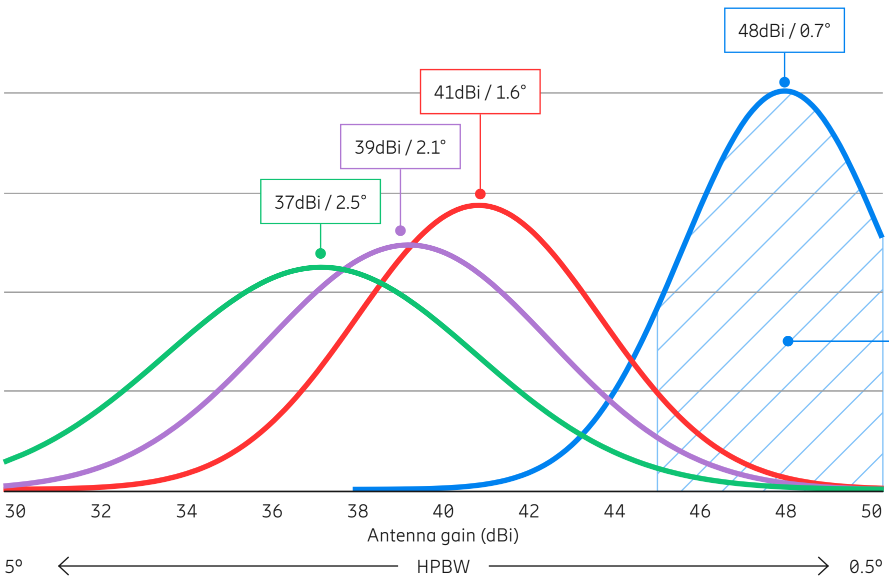
With the introduction of E-band, the distribution looks very different, with most links having an antenna gain above 45dBi (HPBW 1deg) and with an average as high as 48dBi. This means alignment skills are needed on many more links and the importance of stable masts also becomes more apparent.

The main reasons for the high share of very high gain antennas in E-band are:

- Many E-band links deployed so far have replaced an existing link in a traditional band to save spectrum cost. With a pre-defined hop length, the gain needs to be maximized in order to minimize the impact on availability at the higher frequency.
- The same gain can be achieved with half the antenna diameter when the frequency is doubled. With an antenna as small as 0.6m in diameter a gain of 50dBi can be achieved at E-band. This is the most popular size in traditional bands, and is consequently being selected also for E-band.
- The regulations in some markets require a relatively high minimum gain.

In a future with denser networks and shorter hops, along with increased radio output power, the E-band average gain will go down. This will simplify those types of installations. On the other hand, E-band will also be used for even longer hops than today. If the gain increases beyond 50dBi then self-alignment and mast sway compensation will be mandatory.

Figure 11: Antenna gain distribution per frequency range, deployments 2014–2018



E-band deployments: High end gain requires accurate antenna alignment

Source: Ericsson (2019)

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