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Ericsson Microwave Outlook

E-band fits the bill

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E-band fits the bill

With the roll-out of 5G, E-band has become a commonplace mobile backhaul around the world. What is the current situation and what does the future look like?

The E-band world today

The ever-expanding list of countries opening up for E-band deployments shows that another 20 countries have allowed usage of E-band since 2021. Today, the global E-band map covers most of the world´s countries and inhabitants. This very much aligns with global 5G RAN preparations and deployment.

The major differences in E-band approvals compared to 2021 have been China ratifying the usage of E-band in late spring of 2023, and India opening up for E-band in 2022. Service providers in India immediately started to use the E-band frequency to backhaul their massive 5G RAN roll-out and this has had a major impact on the number of E-band radios deployed globally.

A look into the future

We know that E-band can deliver high backhaul capacities in 5G networks thanks to its large amount of spectrum, which provides wide channels. We also know that some countries are early adopters of E-band, while other countries have only recently opened up their spectrum for deployment. But will E-band be able to provide the backhaul capacities required to meet future traffic demands as 5G networks evolve and become increasingly capable and densified? How soon will new technologies such as W- and D-band be needed to complement E-band? These are all questions into which we can provide some interesting insights by examining results from a recent simulation of urban E-band networks in three real European cities.

These cities have different sizes and network topologies, and the total number of links in each city ranges from 300 to 1,000. In each network, it is assumed that 10 x 500 MHz channels are available, effectively a total of 5 GHz of spectrum in each direction of a backhaul link. Network channel planning is conducted by allocating as many as possible of the available 500 MHz channels to each link, while a maximum interference over noise (I/N) requirement of -6 dB is fulfilled. In other words, the planning aims to maximize the total bandwidth of each link in the network while fulfilling the I/N requirement.

Figure 3: Global E-band deployment status

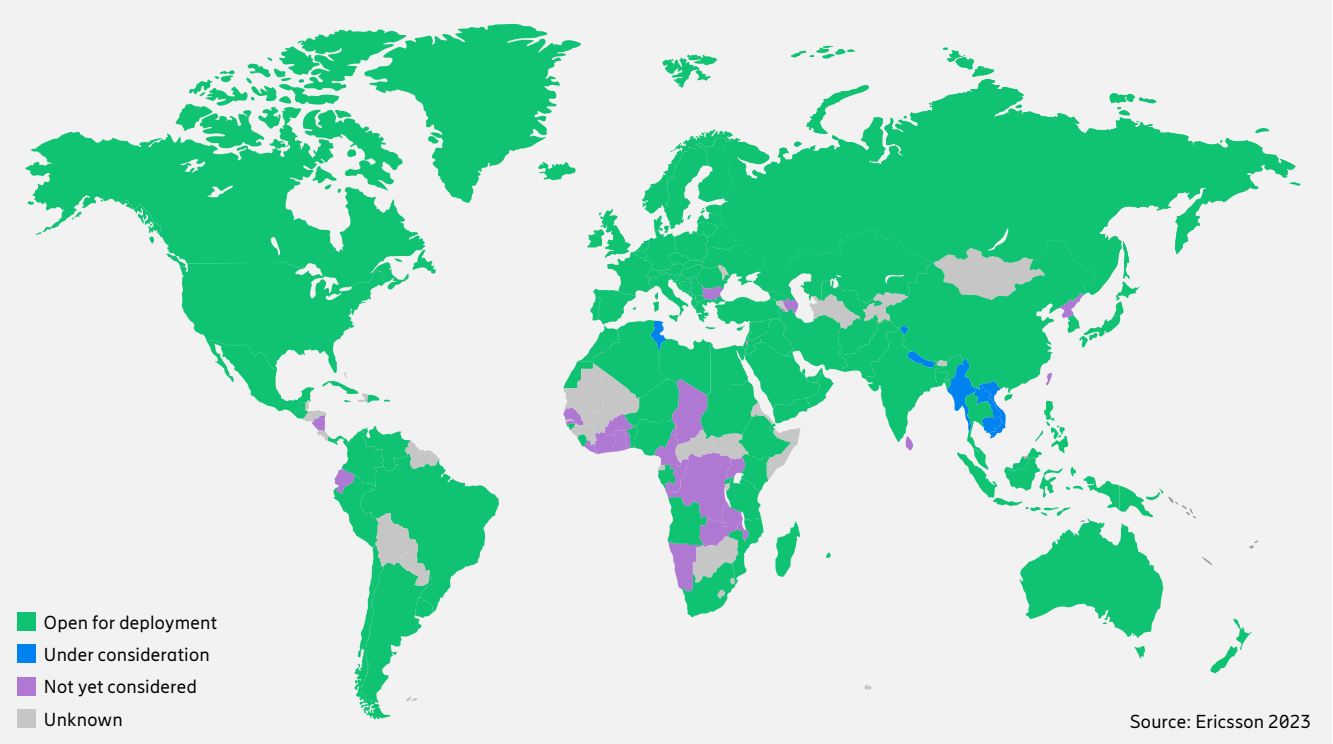
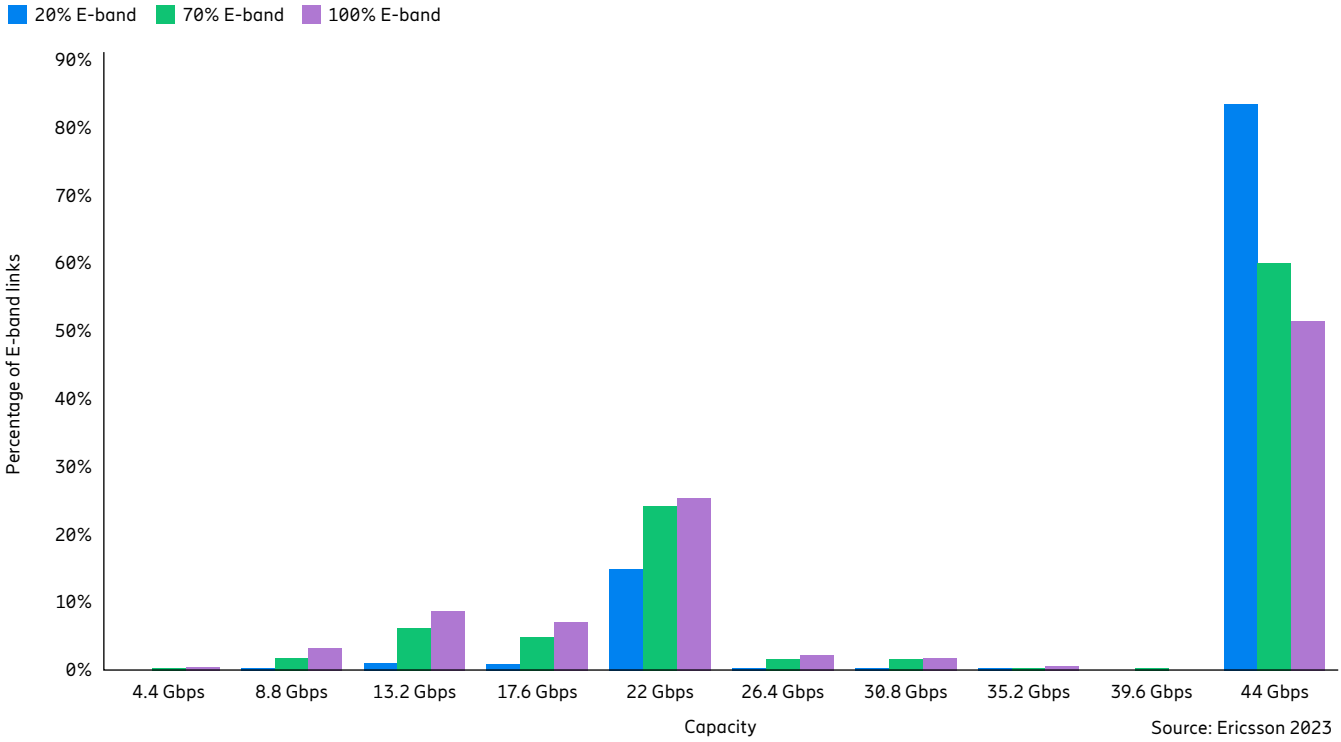


Figure 4: Potential E-band capacity averaged over three different European cities



Source: Ericsson 2023

Figure 5: Crowded hub site if 100 percent E-band

Source: Ericsson 2023

The Y-axis in Figure 4 shows the percentage of E-band links (averaged statistically over all networks) that can achieve the capacity given by the X-axis with at least 99.9 percent availability (assuming 64 QAM and XPIC). Three different E-band penetration percentages are assumed, with the blue color corresponding to the 20 percent (sparse E-band) of all links in the network using E-band while the remaining 80 percent is using alternative microwave frequencies or fiber. Green and purple respectively correspond to 70 percent (dense E-band) and 100 percent (extreme E-band).

The different percentages thus represent different choices and strategies when deploying backhaul networks where some networks may aggressively use a lot of E-band while others are more selective. It is interesting to note that more than 80 percent of all the E-band links can achieve 44 Gbps (corresponding to using all 10 of the 500 MHz channels) for a sparse network that has 20 percent of its links using E-band. An extreme network that uses E-band for all links can achieve 44 Gbps for more than 50 percent of its links. We also note that there are very few links that only achieve the lowest capacity of 4.4 Gbps (which corresponds to a single 500 MHz channel), and these are identified as links in extremely dense deployments, for example, dense hub sites that strictly limit the number of channels that can be used due to the I/N requirement. Figure 5 shows examples of crowded hub sites from one of the real networks used within the simulations, where links can only use a limited number of channels without causing too much interference to each other. It is in these crowded hub sites with many dense links that more advanced solutions are required to achieve higher capacities. For example, super high-performance ETSI Class 4 antennas (only 0.3 m and 0.6 m ETSI Class 3 antennas are used in the simulation), and future W- and D-band spectrum and related technologies will be needed to reach higher capacities in very dense hubs. It is difficult to predict capacity requirements far into the future with accuracy. However, predicted backhaul capacity figures for the most advanced urban distributed RAN sites by 2027[2] are around 25 Gbps – but these extreme capacities would only be needed by a few advanced sites. Therefore, it can be seen as an indication that E-band with 44 Gbps will be more than sufficient for 5G and 5G Advanced backhaul in most deployments by 2030 and beyond.

In conclusion, our simulation of backhaul networks from three real European cities with different densities of E-band links shows that E-band can provide sufficient backhaul capacity for many years to come. This is, of course, based on the proviso that sufficient E-band spectrum is made available by national spectrum regulators. Some extreme deployments, like dense hubs, can experience congestion, and will therefore be the first to need alternative backhaul solutions as the demand for capacity grows.

What will happen beyond 2030 and after the introduction of 6G is difficult to predict with accuracy. But we can certainly conclude that E-band will provide an effective backhaul solution for most 5G and 5G Advanced deployments toward 2030 and beyond.

[2] Ericsson Microwave Outlook Report 2022

About Ericsson

Ericsson enables communications service providers and enterprises to capture the full value of connectivity. The company's portfolio spans the following business areas: Networks, Cloud Software and Services, Enterprise Wireless Solutions, Global Communications Platform, and Technologies and New Businesses. It is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people globally. Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York.

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