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Ericsson Microwave Outlook

Wind impact on E-band

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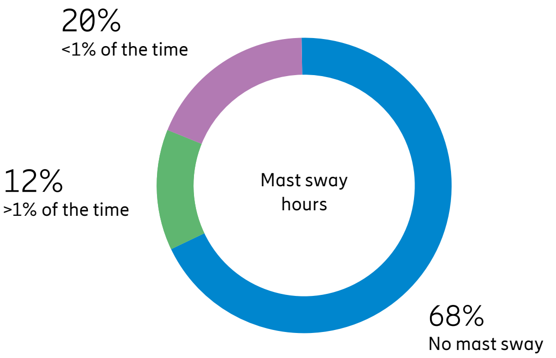
E-band radios operating at 70–80GHz offer benefits such as high capacities and high antenna gains with a small footprint. Antennas with 0.3m diameter could have up to 47dBi antenna gain, while a 0.6m diameter could have up to 51dBi resulting in beam widths of less than 1 degree, but it is a misunderstanding that E-band is unique in having narrow beams. There are antennas on any commercial microwave band, all the way down to 7GHz, that have similar antenna gains and beamwidths, but they relate to large sizes and weights, for example, a diameter of 3.7m at 7GHz or 1.8m at 23GHz. The uniqueness of the E-band is that it can offer high-gain antennas with a lightweight and compact form factor. However, narrow antenna beams require stable installations to remain focused at their targets. Early E-band installations were often installed with similar-sized radios at lower bands, and due to the narrower beamwidths, they were often, a bit unfairly, perceived as being more sensitive to mast sway and unstable installations.

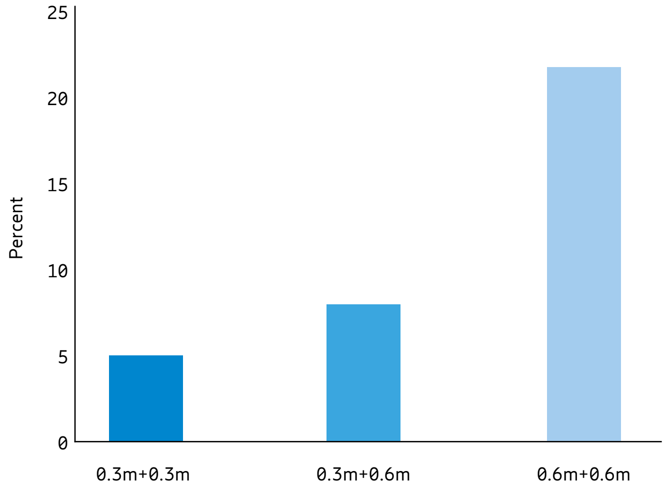
Together with a major European service provider, which has a large installed base of microwave links, we studied how E-band radios behave in a real network, with real site infrastructure and seasonal weather variations. How sensitive are the links to wind, and what is the impact from mast sway on the link availability?

Figure 3: E-band links monitored for 1.8 million hours



In total, 484 E-band links were monitored for 1.8 million hours. The worst impacted link had over 99.99 percent availability.

Figure 4: Antenna configurations for links impacted by mast sway more than 1 percent of the time



The service provider owns an E-band network consisting of more than 500 links and is currently expanding the network. In the study, we monitored 484 links over a full calendar year, tracking the mast sway in the network. The most common antenna configuration, accounting for 46 percent of the links, used 0.3m antennas on both ends, while 37 percent were equipped with 0.6m antennas and 17 percent used a 0.6m paired with a 0.3m antenna.

When deploying the radios, the service provider followed simple guidelines such as mounting on the lower half of monopoles. Data from more than 1.8 million operational hours was collected and the amount of mast sway was calculated by analyzing how the received signal varied over time. The detailed analysis was handled by AI algorithms, which automatically detected and distinguished mast sway events from other fade events such as rain, snow, multipath and line-of-sight blockage.

The results are summarized in Figures 3 and 4. Out of the 1.8 million hours, 0.4 percent (7,828 hours) showed any type of mast movement. Two-thirds of the links (68 percent) did not show any mast sway, and may be assumed to be deployed on sites with stable infrastructure and therefore are also candidates for upgrade to larger antennas if needed. However, one-third were deployed on sites where instabilities were detected, and 12 percent were deployed on sites that caused mast movements for more than 1 percent of the time. These unstable links could be candidates for a site overview at a later stage. Studying the distribution between antenna configurations impacted by mast sway (Figure 4) confirms that there is a higher probability for mast sway with large, 0.6m antennas (22 percent) compared to small 0.3m antennas (5 percent).

To estimate the impact on the link performance, we measured the error seconds caused by mast sway in the link. Figure 5 shows mast sway and link availability, i.e. percentage of time without errors compared to time with errors for all links. The color shows the antenna configuration. The lower plot shows the worst 100 links. Only 7 links had an availability that was less than 99.999 percent.

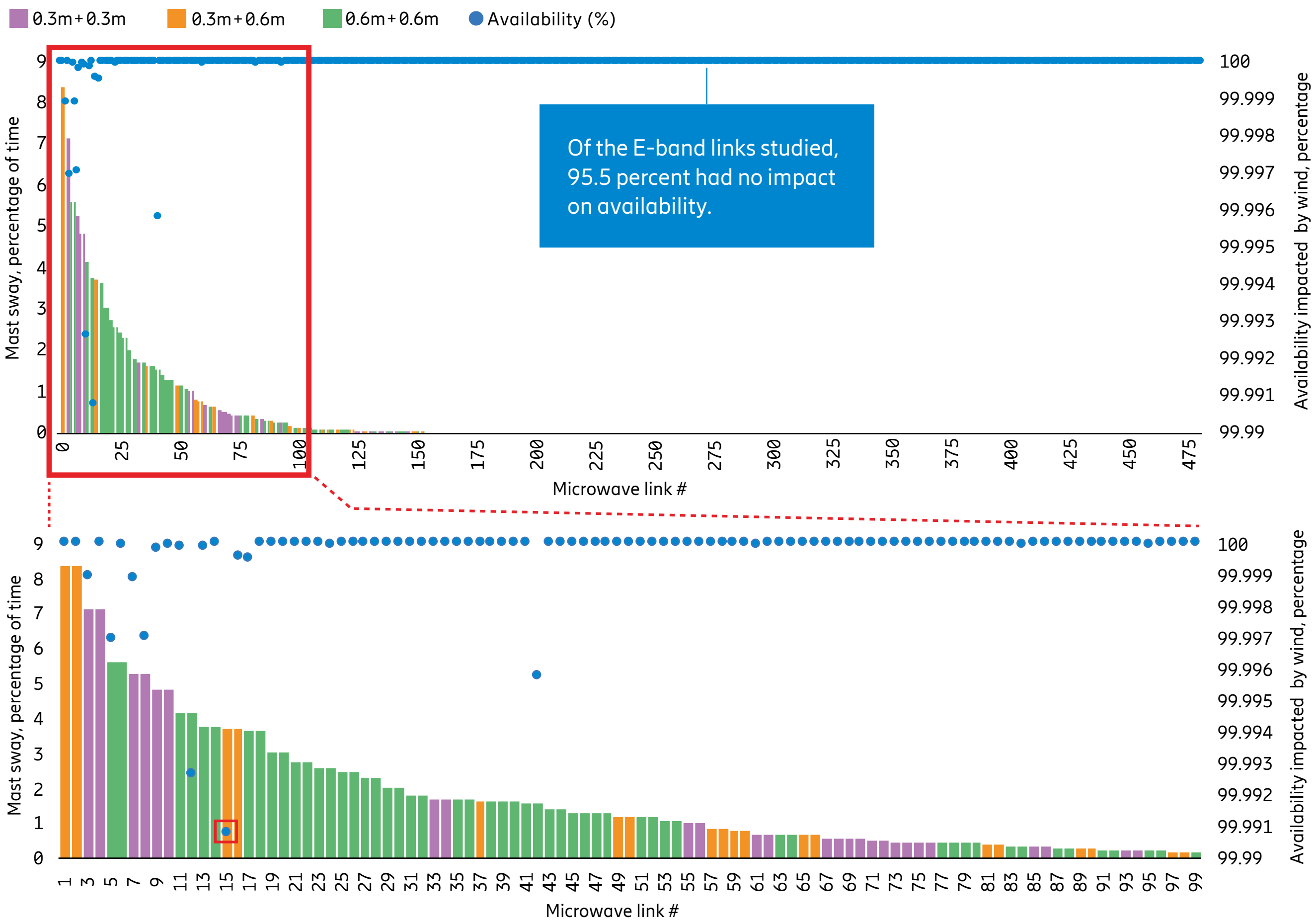
Wind had no impact on availability for 93 percent of the links equipped with 0.6m antennas.

93%

The worst availability (99.991 percent) was observed for link #15.

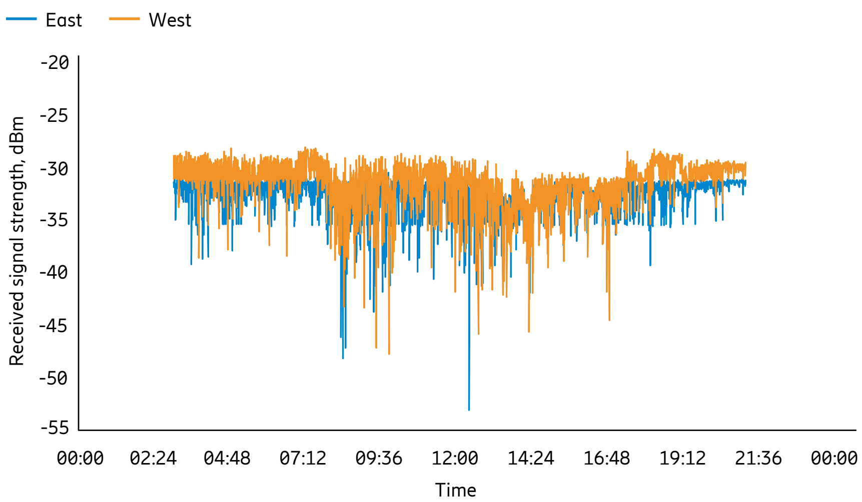
Figure 6 shows the site for link #15. The plot shows how fast and deep the received signal could fade for this link during a windy day in June 2020. The mounted E-band radio is indicated in the red square. It was mounted above the 50 percent height of the monopole, which was not according to the deployment guidelines from the service provider. However, there are often acceptable reasons for deviating from guidelines – in this case, it was difficult to find a clear line-of-sight below tree height.

Figure 5: Availability and mast sway of the monitored links



In conclusion, the one-year study shows that mast sway in E-band backhaul networks is an effect that should be considered, but with tools for careful planning and monitoring it is often possible to control and mitigate the effect. More than two-thirds of the sites in the study showed no mast sway, and only a few showed any impact on link performance with the worst impacted site still having over 99.99 percent availability. More than half of the sites equipped with 0.6m antennas detected no mast sway at all and 93 percent of the sites with 0.6m antennas were error free with respect to mast sway.

Figure 6: Mast sway impacted by placement of link



Received signal strength of the worst impacted link, during a windy day

On the most impacted link in the study, the antenna was placed higher than recommended.

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