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WIRELESS MICROWAVE TRANSPORT SOLUTIONS ACCOMMODATE DIFFERENT CHARACTERISTICS AND REQUIREMENTS TO SUIT POSSIBLE 5G SCENARIOS[14]

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Abstract: *To meet the 5G requirement for more capacity, new microwave solutions for optimizing the use of spectrum are now available. Carrier aggregation (using multiple bands on the same link), more powerful and efficient power amplifiers that enable the use of wider channels and the availability of millimeter-wave spectrum provide key functions for future network solutions.*

For example, in today's frequency bands used for RAN backhaul (6-42 GHz), several vendors can provide transceivers capable of 2.5 Gbps in a single box (thanks to 4096 QAM modulation schemes in 2 x 112 MHz frequency channels).

Beyond this, current E-Band (80 GHz) based solutions stand ready to satisfy the initial wave of 5G introductions that require up to 10 Gbps transport capacity and 20 microsecond latency in urban environments. By combining E-Band with a traditional microwave frequency band (6-42 GHz), it is possible to achieve longer distances and preserve the usual high availability for the most valuable traffic. Combined with 100 percent efficient carrier aggregation it is possible to achieve between 10 and 20 Gbps bidirectional capacity. So, in upcoming years it is expected that microwave will be able to support 100 Gbps links using new frequencies and MIMO technology.

Keywords: *5G, RAN, Backhaul, E-Band, XPIC, MIMO, Multi-band.*

INTRODUCTION

Spectrum is a finite and very valuable resource, which is why its efficient use is regularly reviewed by regulators. At the World Radiocommunication Conference 2019 (WRC-19), a global IMT (5G) identification was decided for the high bands: 26GHz (24.25–27.5GHz), 40GHz (37–43.5GHz) and 66–71GHz. As a result, usage of backhaul will eventually be transitioned from some of these bands, such as 26GHz in Europe. The timing of the transition will vary between countries, depending on the demand for 5G NR balanced against the importance of existing backhaul. The 32GHz (31.8–33.4GHz) and 80GHz (71–76 paired with 86GHz) bands were not identified for 5G and remain essential for backhaul.

Multi-band combining two or more frequency bands for one link is increasingly common in our mobile networks as we search for greater transport capacity.

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EXPOSITION

Multi-Band Booster with Hierarchical Radio Link Bondingfor bonding separately configured.

The main principle for Multi-Band Booster is to use two radio links in different frequency regions, one low-frequency region and one high-frequency region. Usually, the low-frequency region carries also the TDM traffic, and the highfrequency region carries only Ethernet.

Multi-Band Booster increases the performance of microwave backhaul and can increase network capacity. It supports flexible bonding of different carriers and frequency band combinations. Multi-Band Booster provides more efficient use of diverse backhaul spectrum assets, using higher frequencies over much wider geographical areas.

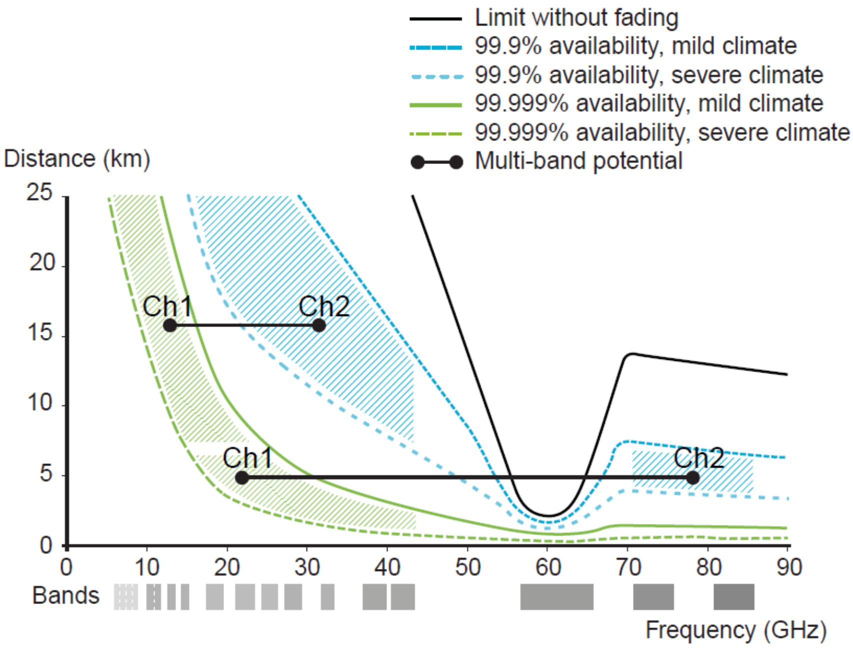
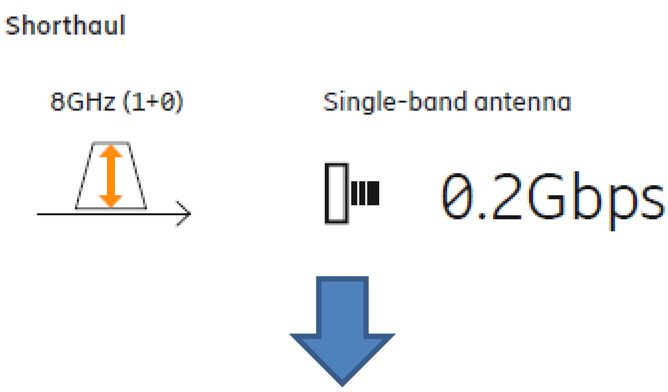


Fig. 1. Distances and Frequency Bands Relevant for Multi-Band Booster

The old truth of antennas

The silicon revolution over the past 50 years has moved from high-quality mechanical and analog solutions towards DSP-based algorithms with better performance. Today, most challenges are solved in the modern DSPs on modems containing equalizers and advanced XPIC solutions, enabling even better performance through antennas with worse return loss and cross-polarization discrimination (XPD) values. For the modern digital link, it is more about having a good enough antenna to reach the maximum performance of the microwave link, as the solution is no longer in the analog circuits.



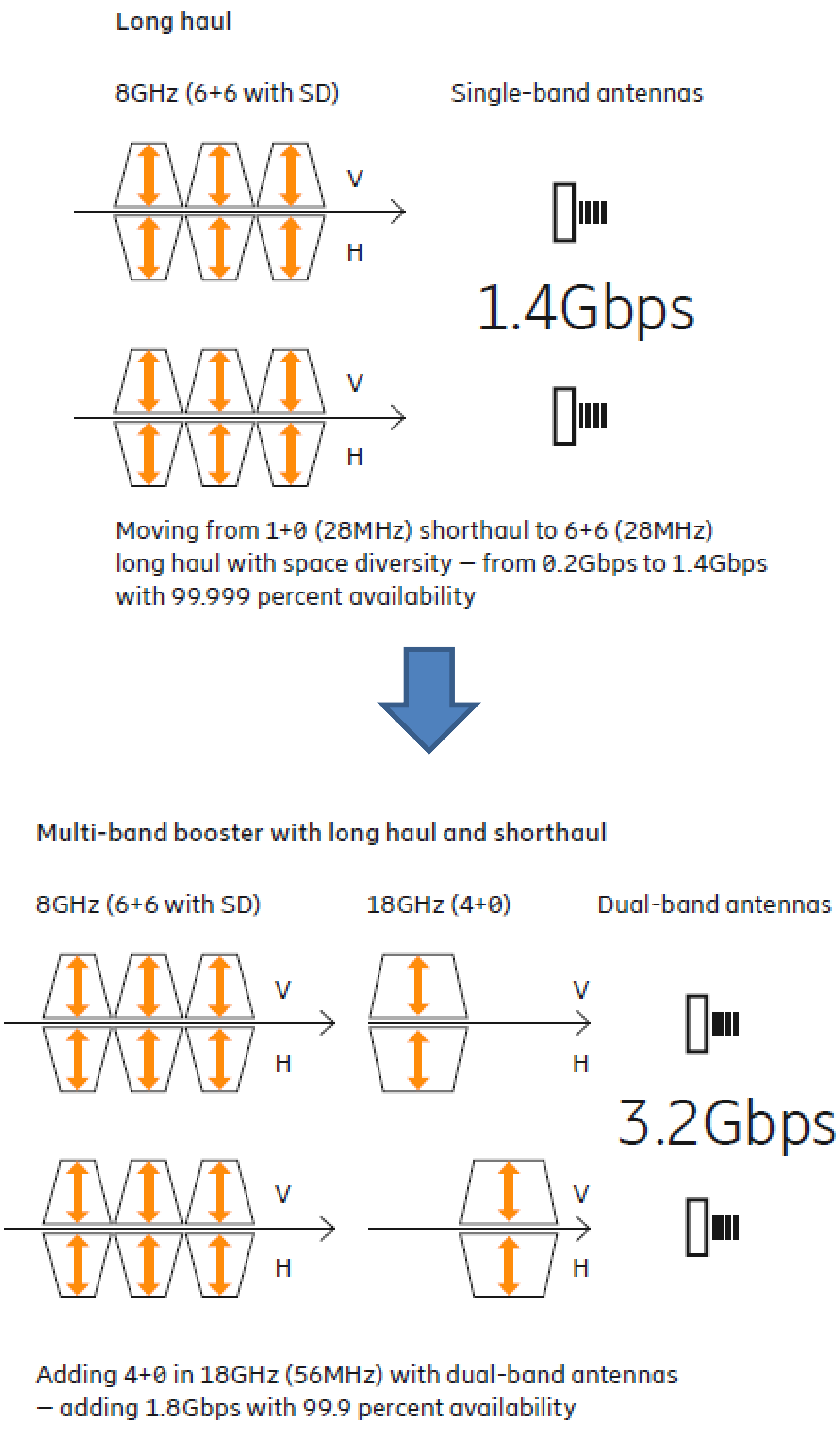


Fig. 2. Example from a real hop, 13km

Figure 2 describes a real customer case. They were running a single 28MHz channel, providing 0.2Gbps capacity. As they plan to evolve to 5G, they wanted a path towards 2–3Gbps. At most, they could get three frequency channels in the current 8GHz band. A first option was to migrate to long-haul technology and add a space diversity antenna for better availability at high modulations, resulting in 1.4Gbps capacity, a 7x capacity increase with five-nines availability over 6 channels.

It is harder to produce a dual-frequency support antenna in a single feeder if the two frequency bands are too close, but not close enough to be considered wideband support. Here, they will interfere with each other. Dual-band support is easier if there is some distance between the frequency bands, but then the propagation characteristics will be different; Figure 2.

The two frequency bands used in the combined dual-band antenna will have different availability figures. Using the 18GHz band enables easy access to 4 channels, 2 frequency channels in CCDP, since space diversity is not needed at 18GHz and, therefore, the radios placed on the original SD antenna can be used as normal radios in this band. This part of the total 3.2Gbps capacity will have a three-nines availability, so you cannot reach full capacity for 8–9 hours per year. This valuable additional doubling of capacity to the original service performance in the low long-haul bands will greatly

After both upgrades, the capacity has increased 16 times.

Microwave related resilience features that will help make the link more robust:

Adaptive modulation

Traditional static modulation was of the type on/off – it either worked or not. The adaptive modulation will offer whatever capacity is possible at all times. This means more capacity when everything is fine, but more importantly, continued connectivity also when the traditional solutions stopped working. Misaligned antennas may reduce the system gain below the planned availability target, but you may still have some connectivity left with adaptive modulation. Adaptive modulation will increase the robustness of the link.

Radio-link bonding

When you have more than one link available, all the capacity is pooled into one common resource. Based on QoS settings, the high priority traffic takes precedence in whatever capacity is available. Therefore, a modern 2+0 link with adaptive modulation and radio-link bonding can be much more resilient than a traditional 1+1 link ever was.

Traffic-Aware Power Saving

When there is a major network problem, it is not unusual that it may also be a problem with the power supply and that the battery backup needs to function as long as possible. That is where TAPS helps – power usage is dependent on traffic needs instead of using the same power all the time. This can reduce used power and prolong the battery backup time, thus increasing the chance that power comes back in time to charge the batteries.

Emergency unlock

Modern products are more often than not based on SW licensing that defines their capacity and capability. In a network scenario with fire on some sites and cut off connections on other sites, using what is left to the maximum may be necessary. That is when the Emergency unlock function comes into play. All capability and capacity get unlocked with one command for a limited time until the issue is permanently solved.

Remote management

When the reorganization of the network is needed due to an emergency, you do not want to plan for a series of site visits. Therefore, it is vital to have a safe and secure DCN connection over which all changes can be made.

CONCLUSION

5G is continuing to grow at an impressive rate. By the end of 2021 more than 210 communications service providers had launched commercial 5G services, and the 5G share of mobile network traffic is expected to be 60 percent by 2027. Backhaul networks will need to be able to cater for high bandwidths to support 5G, but also to be flexible to serve the large variations in different markets and deployment types.

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