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Importance of Antenna Size on Microwave Total Cost of Ownership

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To meet the network demands of ever-increasing LTE capacities, mobile operators are exploring ways to quickly, and cost effectively, modernize their backhaul networks. One means of achieving this is by upgrading microwave networks to high capacity Ethernet systems. However, a rapid reduction in equipment coupled with a push for higher capacities is driving higher modulations and lower resulting link budgets, which often means there is a requirement for larger antenna sizes. As a result, tower lease costs are starting to be one of the major factors in operators' total cost of ownership.

Tower lease costs also factor into the cost of ownership in another significant way, because they can often limit or delay deployments. The larger the antennas size, the more wind load and space it induces on the tower. For larger antennas, this often means many towers are not suitable; or, if they are, they may require engineering modifications or extensive engineering studies and zoning activities. Lastly, larger antennas are more expensive, as well as being more difficult and pricey to install, with some of the largest antennas requiring the use of a crane or helicopter to deploy.

For this discussion, let's focus just on the equipment and site leasing costs of microwave links. A typical microwave link costs about $5,000. In most cases, the links are installed on a 3rd party's tower or rooftop, and the mobile operator pays a monthly antenna lease fee. This fee can vary by region, but a rule of thumb is $100/month per foot of antenna. This means 5 years of antenna leasing for a 3' antenna link (2 ends) equates to $36,000, or over 7X the cost of the equipment itself. By

reducing the antenna sizes by one foot, an operator can save $12,000, over 2 times the CAPEX of the link, or 30% of the combined total cost. This makes it crucial to minimize antenna size of a link, even if it results in higher equipment costs.

The good news is there are a number of technologies being introduced to help improve link budget, which may allow for a reduction in required antenna size. The first of these technologies, used quite broadly in packet microwave systems, is adaptive modulation. Adaptive modulation operates at the highest possible link capacity, but when there is a link fade event the link will drop to a lower modulation and capacity rather than going off-line. This allows operators to engineer the antenna sizes for a link based on a lower modulation, but still operate the majority of the time at the higher modulation.

The second technology being integrated in some microwave systems is compression. Compression takes the incoming data and reduces it to a lower over the air data rate, replacing repeated bit patterns with shorter symbols. With compression, microwave systems can get anywhere from 40% to 200% more data into a given link capacity. This allows an operator to engineer a microwave link to lower capacity than required, using compression to meet the required data throughput. By engineering to a lower link capacity, a lower modulation can be used that provides more system gain and enables smaller antenna sizes, but that still meets the required link availability.

The third, and newly emerging microwave technology being used to optimize antenna size is GaN amplification. GaN is starting to emerge across a wide range of microwave bands. With the introduction of GaN, an additional 5-8 dB of transmit power can be achieved on a microwave link. This increased system gain will typical introduce a small premium on the microwave equipment. However, this will also usually result in a reduction in antenna size, providing leasing cost reductions that far exceed any CAPEX premium introduced on the equipment.

It's clear that, in cases where the mobile operator does not own their own towers, one of the largest areas for microwave link cost reduction is controlling tower lease costs. The only way to minimize these costs is through reduction of the link antenna sizes. However, operators will not consider sacrificing link availability in order to optimize these costs, as it will affect their SLAs and resulting customer revenue. This is why the three link budget improvement technologies discussed: adaptive

modulation, compression and increased transmit power are critical to reduce operators' backhaul costs. However, in order to realize these savings, it is important that operators look at the complete network operating expense, and not focus solely on equipment costs.

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