White Paper

Attacking Total Cost of Ownership through Microwave System Reach

DragonWave

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1. Overview

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. The push for higher capacities is driving higher modulations and lower resulting link budgets, which often means there is a requirement for larger antenna sizes. This has been coupled with a rapid reduction in equipment cost, resulting in tower lease costs starting to be one of the major factors in operators' total cost of ownership.

Antenna sizes 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 a difficult and pricey installation, with some of the largest antennas requiring the use of a crane or helicopter to deploy.

For this discussion, we will look at the total cost of ownership for a North American and European network, where spectrum costs vary widely. In most cases, a link is 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 2' antenna link (2 ends) equates to $24,000, or over 4X 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. The 5 year total cost of ownership of a 50OM link in 50MHz channels (US Model) and a 250M link sin a 28MHz channel (Europe model) is shown below. The models of both the US and European backhaul network reflect the impact of installation and spectrum costs. As shown below, in both cases, the antenna lease costs represent over 55-60% of the total cost.

Figure 1: Five Year Microwave Link Cost (US and Europe)

The good news is there are a number of technologies being introduced to help improve link budget, which in turn 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 with QoS monitoring, 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 modulation while maintain the

higher throughput, more system gain is achieved for equivalent performance and enables smaller antenna sizes.

The third and newly emerging microwave technology being used to optimize antenna size is high power amplification. High power amplifiers are starting to emerge across a wide range of microwave bands. With the introduction of High Power Amplifiers, an additional 5-8 dB of transmit power can be achieved on a microwave link. This increased system gain will typically introduce a small cost 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. The graph below shows the reach benefit of the higher transmit power of the Harmony Enhanced solution, which leverages High Power Amplifiers to provide up to 8 dB additional output power. This model is based on 38 mm/hr rain rate, and 15GHz, 28 MHz channel sizes. The reach improvement is 20-40%, which would equate to 1-2 antenna sizes.

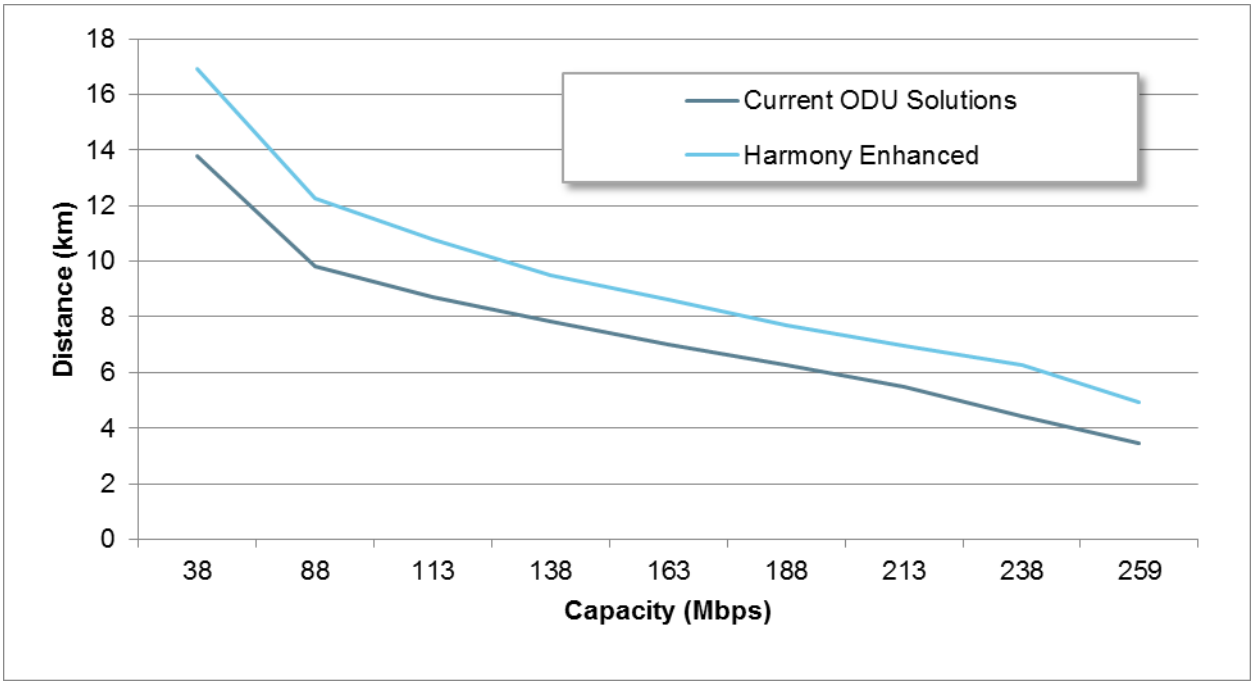

Figure 2: Reach Benefit of Higher Transmit Power (Harmony Enhanced)

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.

In the business case below, we analyze backhaul links in both the United States and in Europe. We assume that the High Power radio output power can reduce antenna size from 2 foot (60cm) to 1 foot (30cm). As a result, in both cases, the increased output power reduces total cost by 29%. This would be a further savings in a longer comparison, or if tower lease cost is more than $100/month per foot of antenna size.

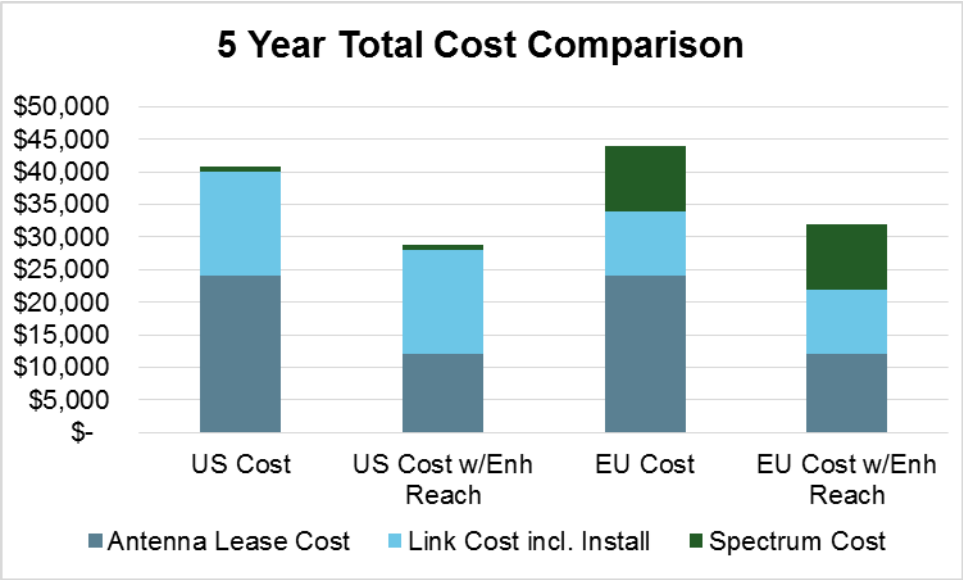

Figure 3: Five Year Total Cost Comparison

Microwave system link budget and resulting antenna costs are the largest single item for cost of ownership. Improving link budget drastically improves the business case for microwave backhauls costs. 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, not focusing solely only on equipment costs.