

White Paper

Reach for New Heights
with DragonWave and
Harmony Enhanced^{MC}



DragonWave

www.dragonwaveinc.com

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Introduction

DragonWave has been delivering industry leading microwave backhaul systems to the industry for over fifteen years. DragonWave has more than 2,000 end customers in over 150 countries, and has delivered over 500,000 radios globally, and planned or installed over 20,000 links. Most recently, the company announced a large network expansion with Sprint, orders from an Argentinian mobile operator, and DragonWave radios being selected for deployment in an Australian critical communications network. These announcements demonstrate DragonWave's broad portfolio that helps address mobile network requirements, fiber extension, small cell deployments and private networks. DragonWave's solutions include the Avenue product line for small cell deployment, Harmony Enhanced, Harmony Eband, and the newest product taking the industry by storm, the Harmony Enhanced^{MC}. DragonWave's deep industry experience, global presence, professional services expertise, and broad industry-leading portfolio enable our customer networks to reach new heights.

Harmony Enhanced^{MC}

DragonWave's latest product, Harmony Enhanced^{MC}, allows operators to deploy higher wireless capacities with better economics than ever before. Harmony Enhanced^{MC} is a dual-carrier, high-capacity packet wireless microwave point-to-point backhaul system, offering double the capacity in a single ODU. Because the radio and modem are integrated into a single highly compact outdoor unit, Harmony Enhanced^{MC} is a zero footprint solution – eliminating rack congestion and minimizing collocation space.

The Harmony Enhanced^{MC} system is the industry's first to use GaN technology in the 11-23 GHz frequency bands, enabling the highest output power microwave system on the market. The ultra-high power increases the overall system gain and allows for deployment of smaller dishes, higher order modulations, or increased link availability. Equipped with DragonWave's Bandwidth Accelerator+ technology, Harmony Enhanced^{MC} achieves the highest degree of spectral efficiency (through 4096QAM, 4 x 4 MIMO and wider channels), delivering more capacity per channel with a longer reach than any other all-outdoor microwave system.

Harmony Enhanced^{MC} delivers industry leading capacities of up to 4Gbps in a single radio, and 8Gbps in a single channel with MIMO or on a single antenna with XPIC. With unmatched capacity and system gain, simple installation and operation, as well as sophisticated remote management capability, Harmony Enhanced^{MC} delivers significant lifecycle cost savings for service providers and enterprises alike. Harmony Enhanced^{MC} also includes a 10GE interface for future scalability. In addition, the Harmony Enhanced^{MC} provides full Ethernet switching capabilities, including MPLS-TP, UNI, 1588 TC, and SDN. This innovative, carrier-grade, packet microwave solution operates in licensed or unlicensed spectrum from 6 to 42 GHz.

Microwave Network Total Cost of Ownership

As mobile network equipment costs have decreased, and networks have become more automated, tower costs have become a dominant portion of the total cost of ownership. This is especially true for the case of Mobile backhaul networks. Tower costs are charged on a monthly basis, and costs increase as the antenna size on the tower increases. A typical rule of thumb is \$150 per month per 1' of antenna size. The total cost of backhaul ownership for a 7 year period is analyzed in the chart below, assuming a single microwave system with 2' (30cm) antennas.

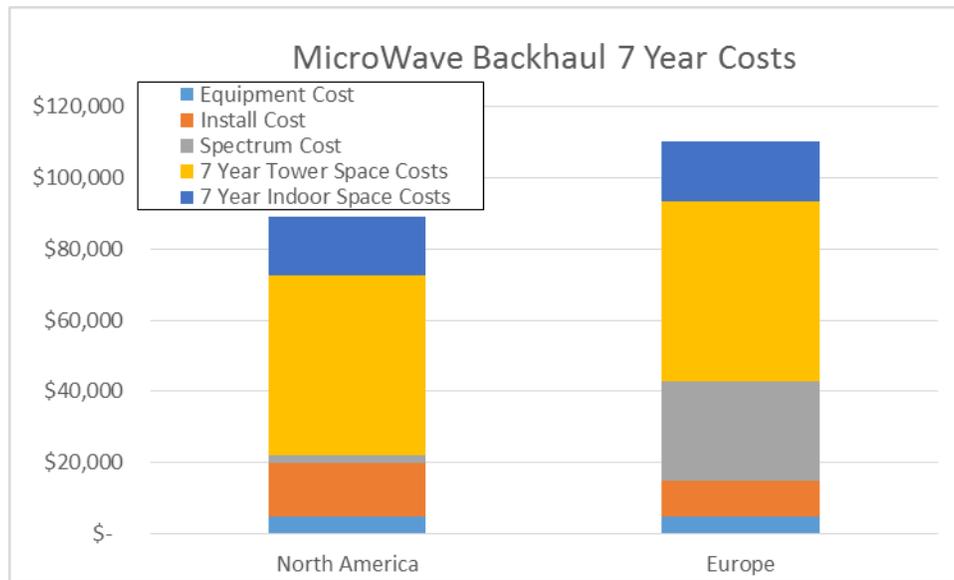


Figure 1: Microwave Backhaul 7 Year Costs

As can be seen in this chart, the dominant cost factor here is the tower lease cost. In the North American case, the tower lease costs associated with the microwave antennas represents 57% of the total costs. In the Europe case, the tower lease cost represents 46% of the total cost of ownership. The second most significant component of the total cost in the North America case is from indoor space lease costs—something that can be eliminated through the use of an all-outdoor system.

Addressing Tower Lease Costs

Harmony Enhanced^{MC} eliminates expensive indoor lease space through its integrated all-outdoor capabilities. However, Harmony Enhanced^{MC} has an even larger network cost impact through expensive outdoor lease cost optimizations. Harmony Enhanced^{MC} delivers >10dB system gain than other microwave systems on the market. This can be combined with Adaptive Code and Modulation (ACM) to minimize the antenna size required at a tower. Typically, this system gain improvement can reduce the antenna size by 1-2 sizes, resulting in a 50% or more reduction in monthly tower lease costs. Equipment cost savings are also realized, as the smaller antennas themselves will cost less, and installation costs will often be lower with smaller, more manageable antennas.

Some operators try and reduce tower cost by using monopoles or buildings rather than telecom towers. However, many of these sites have limitations on the diameter of antenna that can be used. With Harmony Enhanced^{MC}, a significantly higher percentage of these sites can be utilized, further helping reduce monthly site costs.

Delivering Multi-Gigabits in a Microwave System

The Harmony Enhanced^{MC} system provides modulation up to 4096QAM in the 6-42 GHz frequency bands. When this high order modulation is combined with wide channels, the Harmony Enhanced^{MC} can deliver up to 1 Gbps of radio throughput in a single 100 or 112 MHz channel before any compression.

DragonWave's Harmony Enhanced^{MC} uses a compression algorithm branded 'Bandwidth Accelerator+' to deliver an increase of 20-100% of delivered user traffic, with an immediate significant saving in terms of both CAPEX (medium number of ODUs per link), and more importantly, the dominant OPEX (medium power consumption, site leasing cost, and channel license fees). Compression techniques are real time and lossless, with zero or negligible associated delay, and compress the header, the inter packet gap and the payload. Bulk compression techniques decouple performances from packet lengths and they have huge compression scores in any condition. The performances are deterministic for each traffic type and the total score depends on real time traffic mix.

Net radio throughput can be extended on the same radio by aggregating more carriers, and therefore increasing the link throughput. In the past, this has been achieved by adding multiple radios. With Harmony Enhanced^{MC}, it's now possible to achieve this through the multi-carrier feature, supporting two channels in a single radio.

Harmony Enhanced^{MC} can support two channels in the same polarization, or using its integrated OMT, can deliver a vertical and horizontal channel at the same frequency with XPIC (Cross Polarization Interference Cancellation). This dual carrier configuration is shown for a single and dual radio installation in the figure below. This configuration can deliver capacities of 4-8 Gbps, meeting the scalability requirements of next generation mobile networks. Of course, at this capacity connectivity to the base station becomes a challenge. To address this, Harmony Enhanced^{MC} is 10GE ready, with an SFP slot capable of 10GE.

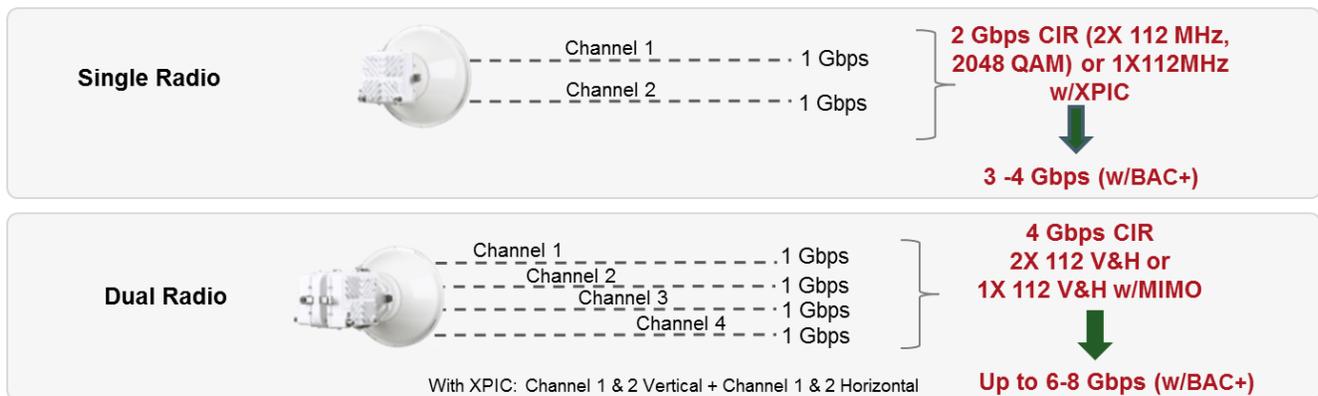


Figure 2: Single vs. Dual Carrier Configuration

Integrated All-Outdoor Next-Gen Switching

In addition to its high capacity capabilities, Harmony Enhanced^{MC} has a number of industry-leading networking features that eliminate the requirement for an additional indoor switch. This includes the introduction of the first 10GE port on a microwave system to enable connectivity to next generation base stations and routers.

Key Features of Harmony Enhanced^{MC} are:

- 4 x GE ports
 - 2 x Electrical
 - 2 x Optical SFP (1 supporting 10GE)
- Fully integrated Ethernet and MPLS switch
- SDN Ready
- Support of 256AES data encryption along with an extensive management layer encryption (RADIUS/TACAS+, SSL, SSH, SNMPv3)
- Next generation network packet synchronization:
 - 1588v2 Transparent Clock
 - SynchE with SSM management
- ELAN/ELINE service support
- WRED congestion avoidance
- 802.3ah, 802.1ag, Y1731

Harmony Enhanced^{MC} – Delivering Lowest TCO

Harmony Enhanced^{MC} brings together a number of differentiated features. Not only does it deliver the highest capacity on the market in a 6-42 GHz radio with up to 8 Gbps on a single antenna, it also delivers the lowest total cost of ownership. In addition to its all-outdoor capabilities, this is enabled through three network differentiators.

The first is reach, which enables reduced antennas resulting in lower tower leasing costs. The second is spectral efficiency, which allows the Harmony Enhanced^{MC} to operate in the minimal amount of spectrum, reducing annual spectrum charges. Finally, the dual channel capability of Harmony Enhanced^{MC} reduces equipment cost and installation cost by halving the amount of hardware required. This combination of features results in over a 50% cost savings on a 5-year basis, as shown in the graph below.

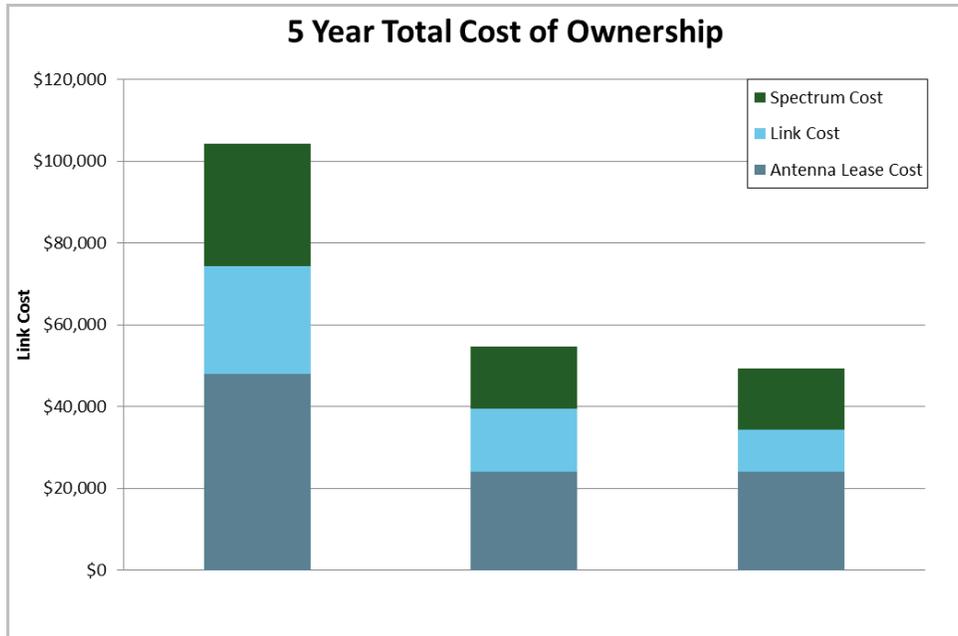


Figure 3: 5 Year Total Cost of Ownership

Reaching New Heights with Harmony Enhanced^{MC}

Harmony Enhanced^{MC} is a future-proof microwave platform. Its industry leading system gain offers unparalleled reach, and resulting optimized antenna costs. With capacities up to 8 Gbps, your network will be ready for 4G and 5G scalability. Harmony Enhanced^{MC} also brings the next generation of networking with SDN, MPLS-TP and 10GE capabilities. Synchronization needs are delivered with 1588 TC and SynchE support. Most importantly, Harmony Enhanced^{MC} ensures these services can be delivered cost effectively, so that it is leading the industry with the lowest total cost of ownership.