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Opportunities in the DTH Ground Equipment Market

by Virgil Labrador
Editor-in-Chief

From 2005 to 2008, the number of direct-to-home (DTH) satellite platforms grew over 49% from 65 to 97 platforms worldwide, according to estimates by Euroconsult. At least 10 new DTH platforms were announced in 2008. Despite this dramatic growth in DTH platforms, the industry is facing pressure to reduce costs in the current global economic environment in order to maintain and expand its subscriber base and to meet investor expectations for returns. Growth in demand for content also drives a continuous need for expansion, upgrade and extension of both space and ground segment systems for DTH providers.

High power amplifiers (HPAs) are one of the most critical selections made in designing and upgrading DTH uplinks. Amplifiers not only affect link performance and availability, but are also one of the major components in installation and operating costs. Leading manufacturers include Comtech Xicom, CPI, and Miteq/MCL.

Traditionally, DTH uplinks have used rack-mounted Klystron vacuum-tube amplifiers to achieve the high transmit powers necessary to ensure the very high availability needed for all-weather operation. However, in the last five years, TWTA (traveling wave tube amplifier) solutions have become available at power levels that meet DTH uplink requirements and offer multi-carrier operation through a single amplifier. This is a significant advance because use of TWTAs reduces the cost to purchase, install, operate and maintain the HPAs by over 75% when compared to indoor klystron power amplifiers (KPAs), according to manufacturer estimates. And because the HPA is typically the single largest element in the uplink system's power consumption, using fewer amplifiers with higher efficiency can also dramatically reduce the DTH ground segment's power needs and carbon footprint.

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"...In most cases, a single TWTA operating with multiple carriers can take the place of multiple klystron power amplifiers (KPAs), dramatically reducing upgrade costs. System reliability is enhanced and power consumption is reduced dramatically, lowering ongoing operating costs..."

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TWTAs present a unique opportunity for cost-savings and reduced system complexity for DTH operators in these economically challenging times.

Reducing System Cost and Complexity

High power outdoor TWTAs, such as Comtech Xicom's new TWTAs designed for direct-to-home, enable uplink engineers to mount the HPA at the antenna, eliminating long waveguide runs and shelter requirements while maintaining high reliability *(see sidebar article)*. In existing systems, moving from multiple (one per carrier plus switched 1-for-N redundant) indoor rack-mounted Klystrons to a 1-to-1 redundant multi-carrier outdoor TWTA solution can free up valuable rack space for capacity expansion, without expensive and time-consuming physical build-outs. It can also dramatically reduce thermal/air-conditioning requirements. This TWTA-based approach offers significant advantages compared to earlier Klystron approaches, reducing both system complexity and the cost to install, operate and upgrade a system. Here's how:

Operational Flexibility: Growing a network using TWTAs is easy when compared to a Klystron power amplifier (KPA) approach. Physical implementation of the outdoor TWTAs is much simpler than providing additional sheltered, air-conditioned rack space for new Klystrons. Carriers can be added without installing additional amplifiers as long as the system operates within the power and linearity requirements of the TWTA. This gives an earth station operation critical flexibility compared to the traditional approach of adding a new KPA for each added carrier. It also provides flexibility in the link for changes in power and linearity requirements *per channel* as transmission standards change.

Cost Savings: Multi-carrier operation with a single HPA dramatically reduces HPA installation and replacement costs. For example, a DTH provider with 4 channels to transmit can multiplex these with a 1+1 TWTA solution, requiring only 2 HPAs, compared with 4 online amplifiers and at least 1 spare for a Klystron solution.

Advantages with this kind of TWTA approach include:

- Eliminating the need for multiplexers and simplifying switching systems, thus reducing acquisition costs and improving system reliability.
- Reducing a DTH uplink's HPA power consumption by about 90% in most cases due to the reduced number of HPA's required and higher TWTA efficiency. This directly lowers recurring operating costs.
- Reducing the size and cost of the emergency backup generator (or increasing backup operation time by up to a factor of 10)
- Eliminating the need for a fast channel changer for the backup HPA since transmit frequencies are easily changed on a TWTA by modifying its input frequency; klystrons must be mechanically tuned, increasing operational manpower requirements.

TWTA vs. Klystron Advantages

- ***Reduced system costs***
- ***More bandwidth per amplifier***
- ***More operational flexibility***
- ***More redundancy***
- ***Less electrical power consumption***
- ***Less space***
- ***More antenna flange power***
- ***More supplier options***

Moving the HPAs to the antenna from the transmission room provides still more benefits:

- It eliminates the need for long waveguide runs between the transmission room and antenna - and associated losses. In many cases, a single TWTA, with its higher instantaneous bandwidth, can provide *much more power* at the antenna compared to KPAs in the transmission room.
- It also reduces space requirements for the transmission room facility, saves on new installations, and frees up space needed for upgrades.
- In addition, it can reduce air conditioning costs by eliminating a

significant portion of the thermal dissipation in a transmission room.

DTH providers usually plan to operate permanent carriers for as long as possible, even for decades, over which time the tubes, a component in the amplifier, may be replaced without a need to retire the whole HPA. Using Klystrons that rely on a single tube supplier for that component puts all of a DTH uplink's "eggs in one basket." In replacing klystrons with TWTAs, DTH operators can choose a TWTA product that is compatible with multiple supply sources of tubes, reducing their long-term dependency on a single supplier for replacement parts.

Overall, the business case for outdoor TWTAs in DTH uplinks is compelling: DTH networks benefit from a reliable solution offering reduced amplifier costs, lower electricity consumption and a reduction in facilities and ancillary equipment cost. That should make both engineering and financial management happy.

Virgil Labrador is the Editor-in-Chief of ***Satellite Markets and Research*** based in Los Angeles, California. He is the author of two books on the satellite industry and has been covering the industry for various publications since 1998. Before that he worked in various capacities in the industry, including a stint as marketing director for the Asia Broadcast Center, a full-service teleport based in Singapore. He can be reached at *virgil@satellitemarkets.com*

North American Direct-to-Home Providers

HPA Upgrade Choice: TWTAs

In recent years, HPA manufacturers, antenna manufactures and North American Direct-to-Home operators have been coming to the same conclusion: system expansion using klystrons is expensive, impractical and unsustainable. With the growth of HD and local channels via spot beams, facilities became stretched to their capacity.

Klystron amplifiers have narrower bandwidths, and require indoor facilities, multiplexers, tuners, rotary joints, and other parts. Broadband amplifiers (TWTAs and SSPAs) enable rapid re-configuration, making it easy to add or change channel configurations. Major North American Direct-to-Home operators saw the fundamental superiority of migrating to a broadband, outdoor architecture, sources say. By moving amplifiers into the antenna hub, these operators have saved on facility expenses and power. A single TWTA, operating with multiple carriers, took the place of multiple klystron power amplifiers (KPAs), dramatically reducing their upgrade costs.

Comtech Xicom's amplifiers have proven to be an amplifier of choice in direct-to-home uplinks in North America. **(photo: Comtech Xicom)**

These are no doubt key reasons why TWTAs from Comtech Xicom have made big inroads with the major direct-to-home providers in North America. Comtech Xicom is a leading worldwide manufacturer of high power amplifier products for satcoms markets, including TWTAs, SSPAs and KPAs for a wide range of frequencies and applications. Xicom's 750 Watt XTD-750DBS has been the amplifier of choice in North American direct-to-home uplinks, changing how the industry operates. At Ka-band, where greater bandwidth availability enables new HD capability, Xicom's 250 Watt XTD-250Ka TWTA has set the standard, with a new 500 Watt unit now available. For DTH operators using the Ku satcom band, a new 1250 Watt XTD-1250Ku TWTA is making the case for the outdoor TWTA approach even more attractive for their DTH uplinks.