

Broadcast Transmission Systems – Efficiency and Total Cost of Ownership

Martyn J. Horspool

Product Manager, TV Transmission

GatesAir, Mason, OH 45040, USA

Overview

In today's world of rapidly increasing energy costs, new carbon taxes and pressure from environmentalists and Governments to reduce energy consumption, broadcasters are searching for ways to reduce the operating costs of their equipment. TV and radio transmitters are likely to be one of the more costly items that a typical station owns, not only in its initial purchase price, but also due to their on-going operational costs.

Rising Energy Costs

The price of energy continues to rise around the World. According to the US Energy Information Administration, global energy demand is set to grow by 56% between 2010 and 2040. That very high level of demand is certain to push prices up. This ever-increasing cost of energy has created a demand for more efficient, energy-saving equipment.

Transmitter Efficiency

The electrical power efficiency of the transmitter plays an important part in the overall cost of ownership equation. Early digital TV transmitters had a power efficiency in the 15% to 18% range. This means that a 10kW transmitter consumed about 66kW of electrical energy, converting only 10kW of that energy to useful RF and 56kW as waste heat.

Not only was the cost of the electricity consumed a big expense, the cost of cooling the transmitter facility to rid it of the waste heat was also high. Many advances in transmitter efficiency have been made over the past 10 years. The recent advent of new 50 volt LDMOS RF devices and special amplifier techniques significantly improved the RF amplifier efficiency. Efficiencies for just the RF pallet can be in excess of 50%, using the latest technologies. But transmitter efficiency isn't the only factor that should be carefully examined when replacing an old system, or purchasing a new one.

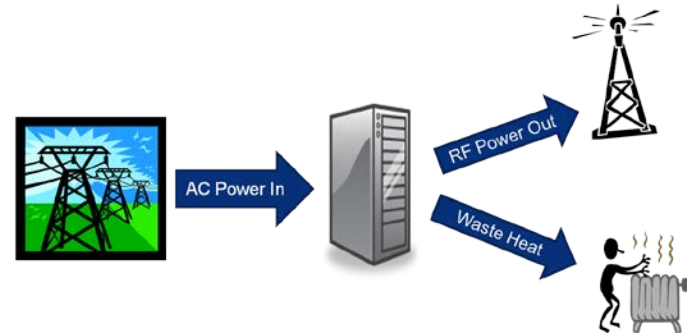


Figure 1 –Energy used by a Transmitter is converted to RF Power and waste heat

The real cost of owning the equipment over a period of time is perhaps the most important consideration. This is generally referred to as TCO, or "Total Cost of Ownership"

Total Cost of Ownership (TCO)

The TCO of a transmission facility is the actual cost to operate the system over time and includes:

- Transmitter power consumption including all items (Cooling, Control, Exciters, Drivers, PA's, etc.)
- Any AVR's or UPS systems in the AC path
- AC Isolation transformers, or Step-up/Step-Down Transformers ahead of the transmitter
- Heating, Cooling and Ventilation costs for the transmitter room (HVAC). Includes initial costs and annual maintenance costs
- Routine maintenance costs (Cost to send a technical expert to site plus any materials used)
- Equipment repair costs, including parts, shipping costs, labor and travel time to site
- The physical size and footprint of the equipment may be a factor, especially if building space is rented

The TCO will vary considerably and may depend on site location, annual temperature range, electricity costs per kW-hr, labor rates, etc.

GatesAir has developed a TCO calculator tool that enables HBC transmitters to be compared against each other as well as other brands of transmitters. This useful tool can



be used to evaluate the cost/benefit of replacing an older low efficiency transmitter with a new high efficiency design. When replacing older technology transmitters, electrical power costs can drop by 50% or more, as well as other benefits including less heat load to the room, less frequent maintenance visits, simpler and faster fault identification using built-in diagnostics – not to mention the added benefit of a higher quality and more dependable on-air signal.

High Efficiency Transmitter Designs

Newer technology has paved the way to more efficient and “green” transmitters. For digital television, several power amplifier techniques have been developed that dramatically improve the efficiency. Two methods that have been most commonly employed are Drain Modulation and Doherty.

Drain Modulation involves a process called “envelope tracking” where the DC power to the RF LDMOS device tracks the RF envelope so that the device is close to saturation at all times. While drain modulation is a really good way to increase amplifier efficiency and is fully broadband, it does involve rather complex power supply techniques and sophisticated pre-correction involving considerable circuit complexity and added cost.

Classic Doherty amplifiers use a technique first demonstrated back in the 1930’s and can provide excellent efficiency improvement, especially with modulation waveforms that exhibit a high peak to average ratio (as found in all current digital TV systems). It does however have an inherent disadvantage due to its limited bandwidth, often requiring between 4 and 7 versions of an amplifier design to cover an entire VHF or UHF frequency band.

TCO Example

As an example of a TCO comparison, figure 1 compares a recent model DVB-T2 transmitter (GatesAir Maxiva ULX series) with and a new design, the Maxiva™ ULXT with PowerSmart® 3D technology, which incorporates many energy saving techniques. The total operating costs savings over a 10 year period is 38.3%.

This example clearly shows that the power cost savings can be significant and in many cases can save more than the capital equipment cost over time. Additional savings that can be realized by deploying the new Maxiva ULXT include:

- The reduction in waste heat reduces the cooling requirements for the room

- Utilization of new rugged 50V LDMOS devices improves system reliability, reducing downtime and costly emergency repairs
- Improved modularity in the new system further improves the on-air reliability as well as reducing the frequency of site visits.
- Reduction of Carbon Taxes:
 - Some countries have imposed energy taxes based partly on carbon content
 - In Australia, the carbon tax in 2012 was at \$23 per tonne of CO2 emissions
 - Broadcast Australia (a major broadcaster in Australia) has estimated that the first year of the new carbon tax cost them almost \$3M.

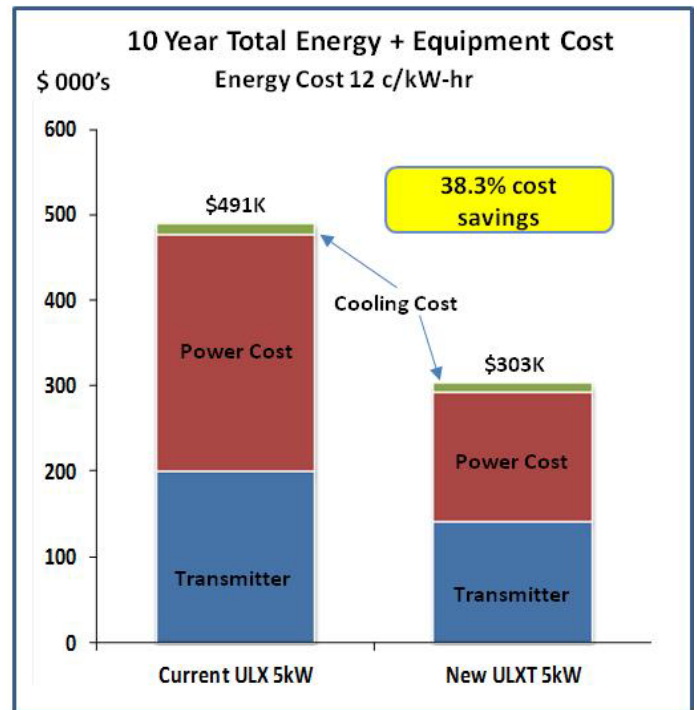


Figure 2 – Efficiency Comparison - Current versus New Technology DVB-T2 Transmitters

GatesAir “PowerSmart 3D” Technology

Over the past 30 years, GatesAir has a rich history of developing energy-efficient broadcast solutions. PowerSmart® is the on-going GatesAir design initiative to create the most efficient transmitter designs and products. GatesAir leverages the most sophisticated tools to develop cost, energy, and space efficient solutions.



For radio, the GatesAir Flexiva family of FM transmitters can offer operating efficiencies up to a remarkable 72%. The Flexiva line was the first FM design to use 50V LDMOS devices, and consequently has the smallest footprint on the market for transmitters of 10kW and higher power.

For television transmission, the GatesAir Maxiva family is the flagship product line. These transmitters now incorporate the latest developments, known as PowerSmart 3D. Benefits include:

- Unique GatesAir patent-pending amplifier technology
- Over 50% pallet level efficiency (VHF)
- Broadband operation
- Switch mode AC-DC converters – 96% efficient
- Superior system efficiency leading to lower total cost of ownership (TCO)

For TV transmission, two new products, the Maxiva VAX (Band III VHF) and the Maxiva ULXT (UHF), both with PowerSmart® 3D technology have been recently introduced.



Figure 3 – New High Efficiency FM and TV Transmitters

Other Ways to Improve Efficiency and Save Money

Many broadcasters have found that sharing facilities (transmitter building/site, tower and antenna) is a good way to save money and makes for a more efficient operation (spares consolidation, for example).

Utilizing new digital modulations can also save money, by allowing more efficient transmission. For example, with DVB-T2, it is possible to transmit multiple programs simultaneously, using a single transmitter. Each program can be transmitted with its own modulation scheme, which allows tailoring of service area and type of service, whether it is for fixed rooftop reception, portable indoor reception, or to mobile devices. Continued efforts to improve video and audio compression allow more programs to be carried within a specific maximum bit-rate

In summary, it is clear that the broadcast manufacturing industry is taking important steps and investing in new technologies to improve efficiency and reduce the TCO for TV and radio transmission systems. As newer and more efficient solid state RF devices become available, they allow designers to integrate them with other energy saving techniques to further improve overall efficiency. Today, advanced PA technology along with more efficient power supplies, optimized cooling systems and other techniques are combined for optimized solutions. In the near future, on-going development will lead to even higher efficiency transmission systems.

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