MULTIMEDIA TRANSMISSION NETWORK IMPLEMENTATION

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ABSTRACT

This paper discusses the key considerations that must be evaluated when developing implementation plans for new terrestrial digital multimedia networks. It examines the new opportunities these networks bring to broadcasters and content delivery companies when entering this new space — and the impact on infrastructure requirements. There will be a review of the various digital and mobile TV standards, analog to digital transition, new technologies, implementation, and the impact on space planning, power levels and costs. This discussion is based on Harris' experience and involvement with projects and networks around the world.

INTRODUCTION

Broadcasters and media network operators around the globe are on the verge of a brand new era in digital multimedia broadcasting — which is daunting, challenging and exciting. There are many questions still to be answered, and increasingly complicated technology with which to become familiar to ensure that the right choices are made when developing plans for network transmission infrastructure. While the path to your digital future may seem complex and confusing, understanding a few major points about the various network transmission solutions allows you to select the right path for your transition. Harris has extensive experience with a full range of solutions, and has implemented hundreds of systems using all global standards.

FLEXIBLE STANDARDS

With each passing day, it seems that a new standard is announced for the delivery of content to consumers, either in their homes or on the move. Gone are the days when you only needed to figure out which version of PAL was being used for color TV, and analog systems have remained basically the same for 20 to 30 years. Today's networks need to be able to deliver content using today's approach, with a smooth upgrade to tomorrow's. For example, many broadcasters need to upgrade aging analog networks to ensure complete nationwide coverage, but they are not ready to make a "hard cut" to digital. Transmission infrastructure must have an upgrade path from today's analog operation to deliver crystal clear content to existing users, and provide a smooth transition so broadcasters can make the switch according to their timetables with minimal upgrade costs and downtime.

In addition to the analog-to-digital transition, several digital standards that have been in place for some time are now seeing either extensions or next generations to allow for more payload capability. Examples of this can be seen in the DVB family of standards, with the extension of DVB-T to DVB-H for handheld use either by offering a separate DVB-H mux for mobile, or via hierarchical modulation techniques to use some of the bandwidth in the same transmitter as the DVB-T, or the newly announced DVB-T2, which boasts greater payload capacity targeted at offering exciting HD content. ATSC has a similar migration path for mobile with the evolution of ATSC mobile in the proposed MPH standard, and standards in Asia continue to evolve, such as China's DMB-T/H for terrestrial, and both CMMB and TMMB for mobile content. To prepare for this world of evolving standards, many of which may change several times over the typically long life of a transmission system, you need to employ a flexible, adaptable solution.

As you evaluate offers from a range of technology suppliers, it is important to include a true multimedia exciter as the cornerstone of the transmission system to ensure future compatibility. In addition to supporting multiple standards, the exciter should offer adaptive digital pre-correction to maximize transmitter operating performance, and ensure technical compliance. While some older systems offer fixed pre-correction, adaptive correction constantly monitors the performance of the transmitter and adjusts for non linearities in the amplifier and filter system, which can be affected by changes in weather and the antenna system. Multimedia exciters, like the Apex M2X™ from Harris, offer peace of mind that comes from the ability to support all of today's popular analog and digital standards. The Apex M2X™ also features exclusive Real-Time Adaptive Correction (RTAC™) for spectral mask compliance and maximum coverage. And, since the exciter is software-controlled, you are prepared for whatever standards evolve in the future.

SYSTEM POWER LEVELS

The early promise of digital transition boasted a dramatic reduction in transmitter power levels, since the digital signal offered top quality up to the point that the receive level was simply too low to decode. In actual practice, many network operators have discovered that although digital power levels are indeed lower than the equivalent analog, they are higher than originally calculated. Careful network planning is needed to ensure that the network designed provides adequate coverage for the type of reception desired. For example, many planning models assume that antennas are located on roof tops 10 meters above the ground with a certain amount of antenna gain; when in reality, many homes use indoor antennas attached to set-top boxes to receive digital signals. This signal reception scenario offers a much more challenging situation. Similar difficulties are also apparent in many mobile digital networks for TV and Radio, which employ far less optimized receive antenna systems, deploying a 10 m pole with a directional antenna connected to a handheld receiver. In fact, elevated digital radio power levels were allowed in Europe under the Geneva 2006 agreement to combat poor indoor reception from early networks. In addition to the impact on reception, many operators are now planning a greater number of higher power sites in a network to reduce ongoing operating expenses such as site rental, antenna system costs and maintenance.

The implication of this movement to higher power levels in networks requires transmission systems that can support elevated power levels from the beginning, or as an upgrade path. For example, many networks have been designed for "high-power" transmitters ranging from 3-4 kW, which has been the typical maximum size of a single-cabinet UHF system offered by many suppliers. Using a traditional transmission system, you could simply "stack" enough cabinets to reach higher powers; however, the system is penalized with a larger footprint, reduced efficiencies and increased complexities. New development in RF device technology, driven by new 50-volt DC devices used in the mobile phone network industry has enabled unprecedented power levels in compact systems. Systems are available today that offer power levels double the previous benchmark for analog or digital power in a single cabinet. For example, the Maxiva™ ULX transmitter from Harris provides a record 8.7 kW in a single compact cabinet with efficient liquid cooling. In addition to the increase in power density, the new 50-volt technology provides several other key benefits including device ruggedness, thermal resistance and reliability.

LONG-TERM COSTS

When you consider the costs associated with the deployment of a new digital network, your immediate thought is the acquisition costs of the infrastructure equipment needed; however, over the life of a typical network, the upfront costs are paid many times over by the ongoing operating expenses. When planning the deployment of a multimedia transmission network, you need to carefully evaluate the long-term costs, including but not limited to power consumption, delivery and installation, building floor space, site rental charges, lifetime maintenance and repair, and eventual disposal costs. Although the topic of power consumption seems straightforward, it is often overlooked in the planning and procurement process in favor of the obvious metric, purchase price, which can lead to elevated operating costs and reduce profits over the life cycle of the product.

A recent evaluation of contemporary products for digital mobile transmission found significant power consumption differences that, in a few months, covered any price difference and, within several years, paid for the transmitter on the power savings alone. The figure below depicts a Harris DMB system with PowerSmart™ technology as compared to other systems; the comparison assumes $0.188 per kWh for electricity. When you multiply the savings per transmitter across a typical network, the results are compelling. The cost of the electricity is the direct effect of increased power efficiencies; however, there is an additional reduction to the facility cooling costs that adds to the savings realized by selecting power-efficient systems.

Harris	Power before filter	Typical Power Consumption	Efficiency	Operating cost per year	Major Supplier	Power before filter	Typical Power Consumption	Efficiency	Operating cost per year	One Year Savings with Harris	Ten Year Savings with Harris
DMB670-125	150	800	19%	€ 1,051	XX 013	150	1,400	11%	€ 1,840	**€ 788**	**€ 7,884**
DMB670-250	300	1,300	23%	€ 1,708	XX 025	300	2,500	12%	€ 3,285	**€ 1,577**	**€ 15,768**
DMB670-500	600	2,225	27%	€ 2,924	XX 050	600	4,300	14%	€ 5,650	**€ 2,727**	**€ 27,266**
DMB670-1000	1,200	4,100	29%	€ 5,387	XX 100	1,200	7,800	15%	€ 10,249	**€ 4,862**	**€ 48,618**
DMB670-2000	2,400	7,850	31%	€ 10,315	XX 200	2,400	15,500	15%	€ 20,367	**€ 10,052**	**€ 100,521**

The size of a transmitter used to be a consideration in a network only if there were sites to which transporting equipment was difficult, or where doors had limited openings. However, in today's world of shared transmission sites and multiple overlaid terrestrial media networks, the space available at each of the transmission sites is limited. This limited, increasingly costly real estate places greater emphasis on the size of the transmitter and, as previously discussed, this is exacerbated by the movement to higher power levels. When planning the network deployment, there are three main ongoing cost areas impacted by the footprint required for the transmitter: cost of floor space, availability of floor space (not the same as cost of the space), and cost of delivery. The cost of the floor space is pretty straightforward. This comes from the amount charged in a common site for the needed area for your network. You pay this every month, and most contracts have the ability to increase costs over the lifetime of your network. The availability of space, on the other hand, is another factor. Some locations may have room on the master antenna or space on the tower, but not in the building. For example, in a digital mobile network planning process, it was noted that the need for dual cabinets to make the necessary power required an addition to the building, which entailed both upfront costs of nearly $50,000 and additional monthly costs. By using a newer model of transmitter designed with a smaller footprint, the required power was delivered in one cabinet, without any additional site costs. The impact of footprint and weight also affects the costs to deploy the system to the site. Freight and delivery charges are derived from the weight and volume of the shipment. This impacts one-time costs, of course. However, not so obvious is the impact on long-term costs that parts and modules shipped from either the supplier of a centralized parts depot or an operator would have on the network. Additional costs are incurred for each item shipped; therefore, any reduction in the weight and volume of the units and components can have a sustained effect in reducing operating costs.

The ongoing maintenance of the network can be either a source of efficiency or costly headaches. The ability to easily repair units in the field without having to ship massive assemblies back to the factory is a key driver in reducing the ongoing costs of any network. In order to facilitate field reparability, systems must employ careful, simple design techniques that support simpler RF system and module design to eliminate complex alignment procedures. This architecture replaces the previously complex and widely used approach of maximizing gain stages within an RF module. The earlier approach supported low-level signal distribution with a return to the traditional and more reliable higher-level signal distribution followed by lower gain modules. The improved method employs lower-gain RF modules that easily allow troubleshooting and repair in the field using simple test fixtures and rapid replacement pallets. Another attribute worth investigating when evaluating network options is the commonality of assemblies used in transmission systems. The more common the assemblies across the network, the lower the parts holding costs. An ideal situation has the same simple RF pallets used in both low-power air-cooled systems and high-power liquid-cooled systems. In this case, the same parts used throughout the system reduce not only the stocking of spares, but also the training of operations staff on field service. This reduced complexity helps dramatically at a time when broadcast RF engineers are not readily available in many markets, and a wider range of skills may be deployed to maintain the transmitter network.

As the world becomes more environmentally aware, governments are enacting rules to protect the environment that impact the operation of multimedia networks. The movement to RoHS (Reduction of Hazardous Substances) impacts infrastructure products due to the lead used in electronics components and assemblies, and paints used on other treatments. You should carefully evaluate the options and rules in the local country; however, the migration of required RoHS-compliant products will soon impact every country. While this may not impact ongoing network operation, it can impact the complexity and future cost of environmentally safe disposal of non-compliant components. In any network, by the very nature of the design, there will be different sites with different power levels working together to create a seamless coverage for the end user. In order to provide the needed signal levels in some areas, small gap fillers or single-frequency network transmission sites are used to provide consistent coverage. Most broadcast operators are familiar with the installation of transmitters in a building or shelter located at the base of a tall mast. However, mobile phone networks have been successfully using weatherproof outdoor enclosures to hold transmission and technical equipment to reduce operating costs, and increase the number of locations in which these lower-power fill-in systems can be deployed. Now, most notably in mobile TV deployments, broadcast networks are starting to use this approach for lower-power systems. As you plan the multimedia network, give careful consideration to this approach, because there are some solid benefits such as lower site deployment and rental costs. The units are typically weatherproof enclosures that hold rackmount transmitters and support equipment, and contain the needed heating and cooling systems. The Harris CoolPlay™ is an example of and outdoor system designed for mobile TV in DVB-H.

SELECTING TECHNOLOGY PARTNERS

With any planned purchase, many factors must be evaluated, including products, prices, features and operation costs. However, it is also important to evaluate the potential partners, not just the product. Selecting the right technology partner can make the deployment and long-term operation of the multimedia network problem-free and cost effective. Understand the financial stability of the potential partner. Will they be able to support you if problems arise? Do they have global service capabilities? Can they help commission and deploy the system? And, a critical consideration, do they have established training facilities so your staff will be trained and knowledgeable on the system you select to deploy? Probably the best example of an ill-advised decision would be those people who purchased a Delorean automobile in the 1980s (the stainless steel car featured in the popular *Back to the Future* movies). While the car had some outstanding features and it is hard to beat stainless steel for longevity, those who selected market leaders such as BMW, Audi, Toyota and General Motors still have a worldwide network of competent service professionals to back them up.

CONCLUSION

Planning a digital multimedia network and overseeing the implementation is not a simple undertaking. Diligent evaluation, careful network planning, good financial modeling and critical partner evaluations are all part of making the right choices to ensure you have a successful deployment from day one and over the long term. There are some key points to consider as “must haves” in your selection process:

- Flexible, software-defined multimedia exciter technology with adaptive correction
- Operating cost efficiency — best-in-class power consumption
- Compact footprint
- Plan for elevated power levels — high power density
- Leading technology
- Field-serviceability
- Fully compliant with regulations — technical and environmental (RoHS)
- Solid technology partner with support for the infrastructure roll-out and the long term

It is important to note that while examining many of the considerations of building a digital multimedia network, most importantly, you must understand the local market consumer trends and business model approach, and ensure that the network covers the consumers and delivers the content they desire when they want to consume it. Also, remember that no matter how cool it looks, you don’t want to buy a Delorean.

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