New Service Opportunities for DVB-T2 Terrestrial Broadcast

The global progress of digital terrestrial broadcasting has many sides to explore, but no recent development has made a more significant mark than the DVB-T2 standard. Its predecessor, DVB-T, certainly blazed the trail for early DTV transitions internationally, providing broadcasters and network operators with an array of options to enhance performance, distribute content and better serve audiences.

The emergence of DVB-T2, however, proved that there was room for improvement, offering higher efficiency, robustness and flexibility. Specifically, DVB-T2 introduced new modulation and coding techniques to enable highly efficient use of valuable terrestrial spectrum for the delivery of video, audio, and data services to fixed, portable and mobile devices. These new techniques make DVB-T2 at least 50% more payload-efficient than any other digital terrestrial transmission system in the world, including DVB-T.

The arrival of DVB-T2 and its powerful capabilities also signaled the birth of new broadcast models that broadcasters worldwide are beginning to enjoy. Notably, the standard enables deployment of more over-the-air programs, while laying the foundation for new or future services from mobile channels to interactive opportunities. A review of the capabilities of this digital modulation demonstrates both its higher efficiency – including better utilization of available wireless spectrum - as well as its many configurations available to the broadcaster.

The Evolution of Digital Transmission Technology

Both DVB-T and DVB-T2 (as well as other digital terrestrial standards) provide dramatic advantages over traditional analog services. The critical improvements include: Multiple programs per RF channel, improved signal quality and robustness, adaptability to Single Frequency Networks, and the capability of transmission of High Definition video and other digital signals.

The planning and developing for the DVB-T2 standard started to take shape eight years ago, with 2008 marking the release of the standard. Technically speaking, DVB-T2 provides far superior performance compared to traditional DVB-T, as well as other digital terrestrial standards such as ATSC, a standard employed in North America, Canada and Mexico; and ISDB-T, used in various configurations within Japan, Brazil and Argentina. Some of the primary technical improvements in DVB-T2 are:

- The use of the more modern and sophisticated Low Density Parity Check (LDPC) error correction, providing a 30 percent improvement over Reed-Solomon coding, an error correction technology used within the ATSC and DVB-T standards; as well as consumer technologies including Bluray, DVD and the Compact Disc
- A maximum 256 QAM mode versus 64QAM in DVB-T for higher bit-rate (8) capability. This, along with DVB-T2's extended bandwidth mode capability, allows more of the RF channel to be utilized. The result is a more efficient use of RF spectrum, providing improved overall throughput.
- Individual transmission parameters for multiple programs (Multiple PLP's). This allows for the grouping of services with optimized modulation parameters.

- Improved Time Interleaving, which enhances the robustness of transmitted information by allowing various tradeoffs in time diversity, signal latency and power reduction.
- Transmit diversity using Almouti Coding, which enables full diversity with linear processing at the transmitter. This results in an approximate 30 percent improvement for coverage across large singl-frequency networks. Also referred to as SFNs, single-frequency networks typically employ a large amount of low to medium power transmitters for the purpose of consistent coverage across large regions.
- Optional Peak-to-Average Power Reduction, which increases transmitter average power to improve operational efficiency

Converting Technical Benefits to Commercial Benefits

Because of these and other technical capabilities, DVB-T2 has the potential to generate significant benefits for the consumer, the broadcaster and government entities. The DVB-T2 standard has many "handles" or modes that can be used in many different ways. This wide array of transmission options and uses can be tailored for specific business purposes. As an example, DVB-T2 can be used to provide Single or Multiple SDTV programs, or a various combination of HDTV and SDTV programs, all simultaneously transmitted in one existing RF channel. Elsewhere in the data stream, advanced PayTV opportunities like VoD and conditional access service are made possible through its expansive bandwidth throughput.

Perhaps most enticing is the presence of multiple PLPs, which provide a convenient way to optimize different programs and applications for the best coverage/robustness combination. This includes optimized transmission for mobile and handheld services. For example, the PLP architecture can accomodate a high bit-rate program for an HD service, a medium bit-rate program for one or more SD services and a low bit-rate (very high robustness) signal for mobile/portable reception.. Such a system could use different PLP's assigned as follows:

Program Type	Code Rate	Modulation	FFT	GI	Ext. Carrier	Max BitRate
HD Program	3/5	256 QAM	32 k	1/128	Yes	36 Mb/s
SD Programs	5/6	64 QAM	16 k	1/4	No	26 Mb/s
Mobile Programs	½	QPSK	1 k	1/8	No	6.2 Mb/s

Many broadcasters must service multiple languages/cultures, difficult geographies ranging from dense cities and sparse rural areas, and do so with a limited cost structure or resources. The most immediate advantage realized by broadcasters is the ability to broadcast more than one video channel in their 8MHz spectrum. By many estimates, DVB-T2 has a practical payload capacity of 30-40Mbps. The theoretical bandwidth can be as high as 50Mbps. Assuming an 8MHz spectrum channel, a broadcaster could divide their channel as shown in figure 1.

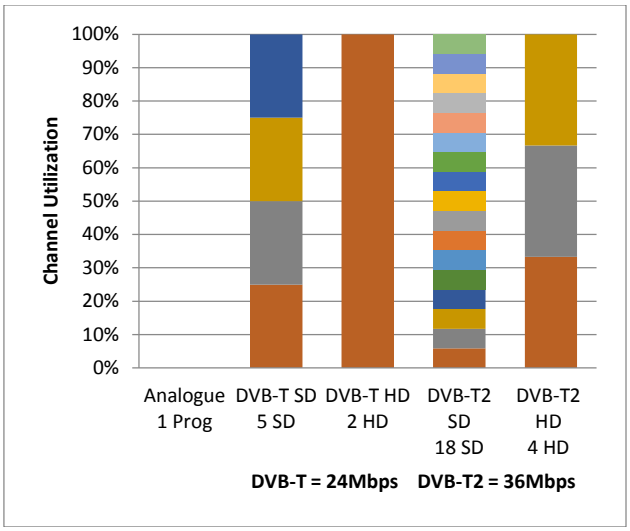

Figure 1 – Channel Utilization Examples

Certainly the advances in video compression work in concert with the modulation to allow 18 SD channels where just prior, in analogue, there was one program in the 8MHz spectrum channel. This is a straightforward implementation of fixed reception DVB-T2 and the fastest way to provide a wide variety of content to viewers.

Typically as audiences become accustomed to digital services and purchase higher capability HDTV's, demand rises for improved signal quality and more viewing options. Broadcasters can then add HD channels by either dropping some SD channels or adding a second frequency spectrum and using that for HD services. The implementation of these services is a matter of developing the desired MPEG Transport Stream and distributing to the DVB-T2 transmitters.

At this point, the broadcaster may consider the use of Multiple PLPs to create customized services. The capability to create groups or individual services with the optimized transmission parameters can be a power and flexible tool for the broadcaster. Among the many options a broadcaster can consider are Conditional Access or pay TV services, 3D TV, mobile TV, audio services, and data delivery.

For Conditional Access Systems (CAS), a broadcaster can choose all or a portion of their T2 channel to be encrypted so that only users with authorized devices can receive content. Perhaps a SD channel is free but the same channel in HD is a pay service. Or certain premium content can be part of a CAS PLP.

Other potential applications in DVB-T2 are the provisioning of audio data services. Data services hold enormous potential to deliver content, advertising, emergency notifications, and other information to users. Business models, user devices with storage memory, and broadcaster equipment are in early stages and will be available for future implementations.

Mobile Services and the Dawn of T2 Lite

One of the more commonly cited use of multiple PLPs is to use the capability to optimize the modulation parameters for mobile TV. By increasing error correction for high robustness and selecting modulation and coverage planning for either indoor or low antenna height coverage, a PLP can be constructed to deliver a suite of mobile services within an RF channel containing other services. The broadcaster can even choose to implement CAS if the market will accept mobile as a paid service.

Perhaps the biggest benefit for broadcasters choosing the DVB-T2 standard is its inclusion of Future Extension Frames (FEFs) – a feature not present in the DVB-T standard. FEFs exist almost solely to enable a path to advanced modulations as they appear. Using these frames, a DVB-T2 broadcaster can essentially transmit over-the-air content based on another standard within the DVB-T2 framework.

Importantly, this includes several options to support mobile broadcasting. Therefore, broadcasters transitioning to DVB-T2 can take advantage of FEFs to launch digital terrestrial services and mobile services simultaneously, taking two steps at once – a clear "greenfield" opportunity to establish multiple DTV services out of the gate through implementation of the DVB-T2 standard.

DVB-T2 Lite – or T2 Lite - represents one of these options. T2 Lite is actually a subset of DVB-T2, and can be deployed in two ways: as a T2-Lite transmission only; or as a mix of T2 Base and T2 Lite. Within the DVB-T2 Base multiplex, T2 Lite signals can be taken advantage of within FEFs. This is an ideal way to take advantage of T2 Lite's mobile broadcasting benefits, as T2 Lite includes specific coding parameters to enhance mobile performance.

These coding rates, identified as 1/3 and 2/5, also contribute to T2 Lite's efficiency advantage. Several other features, including low bitrates (peaking at 4Mbps) and short forward error correction frames (16k), co-exist with these coding rates to collectively offer a sharp reduction in receiver power use. The end use benefits are longer battery life and lower receiver costs, making T2 Lite-driven mobile broadcasting within the DVB-T2 standard a more attractive proposition than launching mobile services with DVB-T2 alone.

The significance of T2 Lite for broadcasters is that its profiles remove the hurdles to commercial success with Mobile DTV broadcasting upon widespread availability of consumer receivers. It represents a robust hybrid broadcast for both standard and mobile services without compromising either one, while reducing complexity and power in handheld receivers. It can also be accomplished with minimal additional infrastructure equipment and at a far cost than building a dedicated network for each service.

Comprehensively, the DVB-T2 standard provides the broadcaster with a powerful suite of tools which include a combination of advanced error correction schemes, modulation formats and other unique features that enable the broadcaster to optimize transmission capability and performance. As future needs and commercial requirements evolve, the parameters chosen initially can easily be updated later. This enables broadcasters to be prepared for future services, be able to meet the widest audiences, and add revenue increasing programs and capabilities as needed.

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July 18, 2014

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