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Maximizing Satellite Transmission Efficiency with DVB-S2

White Paper

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INTRODUCTION

Cost-effective transmission of high quality content and provision of advanced and interactive services are among the primary business challenges facing broadcasters and system operators today. Using traditional standards, HDTV's high bandwidth requirements are too great to be supported by subscriber fees. Similarly, personalized and interactive services require significantly higher data rates than those supported by the DVB-S standard. New standards and technologies that maximize bandwidth usage efficiency and provide return-channel support are essential for operators to remain competitive and profitable.

THE DVB-S2 STANDARD: SUPERIOR PERFORMANCE AND LOWER COSTS

The new, bandwidth-efficient DVB-S2 (EN302307) standard, the successor of DVB-S and DVB-DSNG, is designed to address the challenges of cost-effectively transmitting high-quality video and advanced services via satellite. DVB-S2 delivers significantly higher throughput in a given satellite transponder bandwidth than the earlier standards. It is based on advanced technologies that are optimized for HDTV broadcast, news gathering, interactive services and other essential applications.

Support for DVB-S2 requires little capital investment, since it involves only two areas of the broadcast headend: The transmission system (modulator) and reception system (receiver decoder). Encoding, transrating, scrambling, and other processing tasks are not affected, and the devices that perform these tasks need not be replaced or upgraded when moving to DVB-S2. Existing satellite equipment and software likewise need not be upgraded when switching to the DVB-S2 standard.

DVB-S2 provides a backward-compatible mode that, during the transition period, enables legacy DVB-S STBs to receive the usual transmission, while new, DVB-S2-compatible STBs receive additional channels on the same broadcast. In DTH applications, where the expense of set-top box (STB) replacement is a major consideration, upgrades to DVB-S2 can be implemented incrementally.

Finally, DVB-S2 accepts any input stream format and has FEC efficiency that is extremely close to the theoretical performance limit. As a result, DVB-S2 equipment deployed today is effectively future-proof and unlikely to be superseded – or need to be replaced - for many years.

CHARACTERISTICS AND BENEFITS OF DVB-S2 SYSTEMS

DVB-S2 systems are characterized by:

- A wide range of code rates (from 1/4 up to 9/10)
- Four modulation constellations (QPSK, 8PSK, 16APSK and 32APSK), ranging in spectrum efficiency up to 5 bit/s/Hz, optimized for operation over non-linear transponders.
- A flexible input stream adapter, suitable for operation with single and multiple packetized or continuous input streams.
- A powerful FEC system based on LDPC (low-density parity check) codes concatenated with BCH codes, allowing quasi-error-free operation at about 0.7dB to 1dB from the Shannon limit.

- Variable Coding and Modulation (VCM) optimizes channel protection and modulation on a per-program basis,providing different levels of quality of service for different programs.

- Adaptive Coding and Modulation (ACM) functionality optimizes channel coding and modulation on a frame-by-frame basis for interactive applications whose bandwidth requirements vary over time.

- Backward-compatible modulation mode.

DVB-S2 characteristics translate into concrete benefits for broadcasters and network operators.

Much higher rates of channel efficiency than past standards are enabled by new channel coding schemes. Together with higher order modulation, this increases satellite transponder throughput by about 30% at a given transponder bandwidth and transmitted EIRP relative to DVB-S/DVB-DSNG.

Differential error protection and modulation for service components or transport streams (e.g. SDTV, HDTV, audio, multimedia) are made possible by Variable Coding and Modulation (VCM). This further enhances bandwidth efficiency while maintaining desired quality.

Satellite capacity for interactive and point-to-point applications may be increased by 100%-200% by combining VCM functionality with the use of a return channels to achieve closed-loop Adaptive Coding and Modulation (ACM). ACM improves channel protection and dynamic link adaptation capabilities and may potentially reduce service provisioning costs substantially.

In areas with variable receiving capabilities or conditions, DVB-S2 can improve transmission quality substantially. Adaptive Coding and Modulation (ACM) varies the level of channel protection and modulation on an individual transport stream level, with dynamic adjustment that adjusts to environmental conditions.

A wide range of formats may be simultaneously transmitted on the same transport medium. Supported input data formats include continuous bit-streams, single or multiple MPEG transport streams and IP as well as ATM packets. This represents a substantial improvement over DVB-S and DVB-DSNG, which support MPEG transport streams only.

Backward compatibility enables operators of DTH networks to migrate gradually from DVB-S to DVB-S2. DVB-S2 is available in both backward-compatible and non-backward compatible modes. The backward-compatible mode allows legacy DVB-S receivers to decode a portion of the transmitted bouquet and new DVB-S2 receivers to decode the entire bouquet. It provides somewhat lower bandwidth savings than the non-backward-compatible mode, but enables DTH operators to distribute the cost and labor associated with replacement of the installed base of set-top-boxes over a longer period. Direct transition to non-backward-compatible mode is most suitable for contribution solutions and distribution to terrestrial and cable and satellite headends.

DVB-S2 APPLICATION PROFILES

The DVB-S2 standard was designed to support four application profiles:

- Broadcast distribution services
- Digital TV Contribution and Satellite News Gathering (SNG)
- Professional services
- Interactive services

In this paper, we discuss broadcast distribution services and digital TV contribution and satellite news gathering applications, and the specific DVB-S2 features and modes that must be provided by equipment utilized for those services. Professional and interactive services are beyond the scope of this paper.

BROADCAST DISTRIBUTION SERVICES APPLICATION PROFILE

Broadcast services have a large coverage area and provide video services to receivers with a high degree of availability. Higher order modulation and advanced coding schemes benefit broadcast services by increasing data throughput at a given bandwidth, increasing availability through improved link margin, and increasing the coverage area.

These services include distribution of standard definition (SD) and high definition (HD) digital content to terrestrial and cable headends, as well as Direct to Home (DTH) distribution. Due to the large base of DVB-S receivers already installed, DVB-S2's backward compatible mode is particularly crucial for broadcast services.

DVB-S2 enables broadcasters to transmit multi-channel and variably coded content to cable headends and terrestrial transmitters efficiently, cost-effectively and with a high level of control over quality.

BROADCAST SERVICES APPLICATION 1: DISTRIBUTION OF VARIABLY CODED CONTENT TO TERRESTRIAL HEADENDS

DVB-S2 optimizes transponder power efficiency by enabling operators and broadcasters to transmit a number of transport streams to numerous DVB-T receivers within a single carrier signal, with each stream utilizing the modulation scheme and error correction level most suitable for its content. Multiplexing is performed within the modulator rather than after modulation, minimizing both bandwidth requirements and processing.

Integrated receiver decoders and modulators for this broadcast services application provide the following essential features:

1. VCM mode – enables a number of transport streams to be transmitted within a single carrier signal
2. QPSK, 8PSK and 16APSK modulation constellations – enable higher bit-rates within standard transponder bandwidth
3. Selectable roll-off factor of 0.35, 0.25 or 0.20 – supports more efficient utilization of transponder bandwidth by reducing guardband

BROADCAST SERVICES APPLICATION 2: DISTRIBUTION OF VARIABLY CODED CONTENT TO CABLE HEADENDS

For distribution to cable headends, DVB-S2's higher bit-rates increase the number of programs that are delivered over the same bandwidth, without quality degradation. At the distribution site, the content is encoded and statistically multiplexed as it is modulated for transmission. At the cable headend, a professional decoder receives the content for transmission to customers via cable.

Integrated receiver decoders and modulators for this broadcast services distribution profile provide the following essential features:

1. CCM and VCM mode – optimizes channel protection on a per-program basis

2. QPSK, 8PSK and 16APSK modulation constellations – enable higher bit-rates within standard transponder bandwidth

3. Selectable roll-off factor of 0.35, 0.25 or 0.20 – supports more efficient utilization of transponder bandwidth by reducing guardband

DIGITAL TV CONTRIBUTION AND SATELLITE NEWS GATHERING (SNG)

DVB-S2 is ideal for both point-to-point and point-to-multipoint satellite contribution and satellite news gathering (SNG) from transportable uplink stations. Services are transported in single or multiple MPEG transport streams. DVB-S2 provides Constant Coding and Modulation (CCM) or Adaptive Coding and Modulation (ACM), which allows modulation formats and error protection levels to be changed within the data stream on a frame-by-frame basis. The limited bandwidth and high resilience associated with DVB-S2 are particularly valuable for SNG applications, where transmission costs and reliability are prime considerations.

DIGITAL TV CONTRIBUTION AND SNG APPLICATION: POINT-TO-POINT SNG

DVB-S2 L-Band/IF modulators at the broadcast site support ACM for optimum quality at lowest data rates. In point-to-multipoint contribution applications, professional decoders at the studio site inform the transmitter of the actual receiving conditions via a return channel, enabling transmission parameters to be optimized for each individual user.

Digital satellite news gathering (DSNG) encoders and integrated receiver decoders for this distribution profile must provide the following essential features:

1. CCM and ACM mode – enable transmission parameters to be optimized for reliability and transmission cost

2. QPSK, 8PSK and 16APSK modulation constellations – enable higher bit-rates within standard transponder bandwidth

3. Normal (64800 bits) and short (16200 bits) FEC frames – enable low-delay links for real-time interviews, as needed

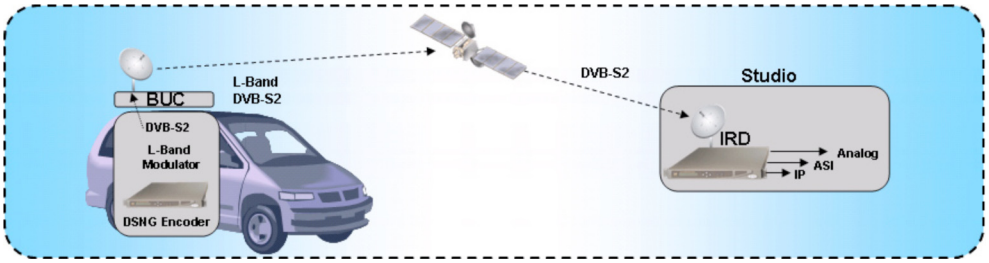
4. Selectable roll-off factor of 0.35, 0.25 or 0.20 – supports more efficient utilization of transponder bandwidth by reducing guardband

For both satellite contribution and SNG contribution applications, DVB-S2 advantages include:

- Narrower frequency slots for identical service bit-rate

- Higher bit rates for the same frequency allocation

- Point-to-point or point-to-multipoint transmission
- Increased availability
- Reduced uplink power requirements.
- Concurrent uplink of multiple sources without multiplexing
- Differential protection of transport multiplex components



CONCLUSION

Powerful new transmission and receiving solutions based on the DVB-S2 standard enable operators to significantly reduce bandwidth usage costs associated with satellite contribution, SNG and distribution to terrestrial transmitters and cable headends, and increase the range and quality of the services they provide. DVB-S2 equipment deployed today is unlikely to be superseded – or need to be replaced - for many years.

Since the standard covers a wide range of application profiles, professional products are generally designed to focus one specific application profile. As such, it is imperative that the broadcaster thoroughly understands which application profile is most relevant, and seeks products produced by vendors with the greatest expertise in that specific application profile.