

**iDirect Evolution DVB-S2/ACM  
System**

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*Advancing a Connected World*



Satellite bandwidth is an expensive resource and network operators are challenged to make the best use of their limited, costly supply. The newest industry developments with DVB-S2 and Adaptive Coding and Modulation (ACM) have led to dramatically improved levels of bandwidth efficiencies. The additional bandwidth savings from these technologies can be utilized to increase data rates and expand services.

This white paper describes iDirect's implementation of the DVB-S2/ACM standard into the next-generation Evolution product line and the unique benefits and components of iDirect's Intelligent Platform™ enabling service providers to lower operating costs and increase their business opportunities.

## **Overview of the DVB-S2 Technology**

DVB-S2 uses the industry's leading forward error coding technology, Low-Density Parity-check Codes (LDPC) coupled with BCH coding. This concatenated LDPC-BCH coding scheme provides performance very close to the theoretical Shannon limit resulting in a 30-40 percent bandwidth efficiency increase over existing DVB-S systems.

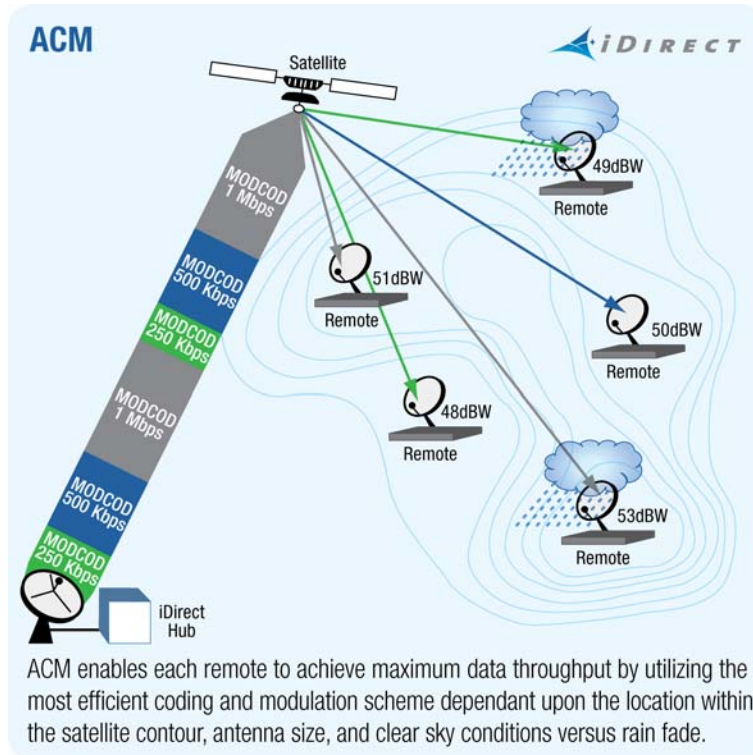
Although all VSAT operators using DVB-S2 will benefit from the coding gains provided by LDPC and BCH, there is still a wide range of efficiency between different vendors' DVB-S2 system implementations. Most system implementers continue to deploy DVB-S2 systems using the "broadcast" profile of DVB-S2, which is far from optimal for interactive VSAT systems. iDirect, on the other hand, has tuned every aspect of its DVB-S2 implementation for the efficient delivery of IP data across satellite networks, while still remaining 100 percent compliant with the DVB-S2 specification. Data packets in iDirect's Evolution platform are carried using an efficient encapsulation scheme based on the new "Generic Streams" mode of DVB-S2. In contrast to inefficient encapsulation schemes such as Multi-Protocol Encapsulation (MPE) over MPEG-2 Transport Streams, iDirect's encapsulation scheme allows for variable length IP packets to be efficiently packed into DVB-S2 frames.

The DVB-S2 standard also incorporates new modulation and FEC schemes, supporting QPSK, 8PSK and 16APSK modulations on the DVB-S2 downstream and enabling different coding and modulation schemes, including both Constant Coding and Modulation (CCM), and Adaptive Coding and Modulation (ACM). iDirect's ACM uses an adaptive, dynamic algorithm that changes the demodulation scheme and the error protection level as often as each data frame, representing a major improvement over CCM.

## **Adaptive Coding and Modulation (ACM)**

iDirect's Adaptive Coding and Modulation (ACM) enables each remote to operate at its most efficient coding and modulation scheme, at any moment in time, depending on location within the satellite contour, antenna size, and atmospheric conditions. iDirect's implementation of ACM evaluates current channel conditions and throughput requirements through a return channel to determine the ideal modulation and FEC rate for each individual DVB-S2 frame and makes adjustments in real time. ACM not only optimizes the bandwidth efficiency for maximum throughput on a remote-by-remote basis, it also avoids network operators having to determine in advance which modulation and coding should be used. Network design couldn't be made any easier or closer to reality. In order to ensure uninterrupted service, even in regions prone to deep and sudden rain fade, with ACM the links will automatically

adjust for the size of each antenna within different parts of the footprint, localizing the impact of edge-of-footprint remotes.



Through iVantage™, iDirect's award-winning Network Management System, network operators can easily configure and deploy DVB-S2 carriers and analyze:

- ◆ The modulation and coding usage across the network
- ◆ ACM gains achieved on the outbound carrier as well as individual remotes
- ◆ The signal-to-noise ratio being experienced by remotes.

These are not the only characteristics that make iDirect's implementation of DVB-S2 and ACM unique. iDirect has taken additional steps to ensure further efficiency gains through:

- ◆ Implementation of an efficient encapsulation scheme optimized for ACM – iDirect's encapsulation scheme has been designed in conjunction with the requirements to support ACM. The hub can transmit data packets to remotes using any number of modulation and coding combinations, with no need to assign a remote to a particular modulation and coding or stream. This minimizes the amount of signaling overhead in the system, and reduces data latency.
- ◆ Deployment of an efficient packing algorithm used to match variable length IP packets into fixed-length DVB frames.

- ◆ Use of a framing format optimized for ACM interactive IP data recognizing the different requirements of interactive and bulk traffic.

With ACM, network operators can dramatically conserve space segment, more than 50% in most cases, and use the additional bandwidth to increase data rates and expand services.

With this efficient implementation of DVB-S2/ACM, the iDirect Evolution product line complements its patented D-TDMA return channel technology and takes advantages of the many built-in features that are specially designed to increase bandwidth efficiency and simplify network operation.

### **D-TDMA Upstream Transmission**

On the inbound or upstream, the Evolution Product line leverages iDirect's Multi-Frequency (MF), Deterministic TDMA (D-TDMA) technology, which allows multiple remote sites to share the same inbound capacity. This industry leading D-TDMA protocol guarantees fast response times and is known for the deterministic nature in which a network can be designed to meet a variety of service level agreements (SLAs). The iDirect system allocates bandwidth to each site based on traffic demand and network operator imposed QoS restrictions.

The system constantly analyzes demand at all satellite routers and allocates bandwidth as frequently as eight times per second. This type of architecture is ideal for enterprise networks that have bursty TCP/IP traffic and also support real-time traffic such as VoIP, video conferencing and mission critical applications.

The iDirect system allows remotes to hop between inroute channels based on traffic demand. iDirect's MF-TDMA provides fast frequency hopping on a burst-by-burst basis and provides the highest efficiency in capacity usage and allocation.

iDirect was one of the pioneers of Turbo Product Coding (TPC), a forward error correction (FEC) scheme for the inbound / return channel that improves link performance and reduces latency. TPC FEC is based on an iterative decoding technique, which recycles partially decoded messages back through the process. For the remote, this translates into a reduced need for retransmission, and allows more efficient use of satellite bandwidth. As a follow-on iDirect will introduce a new coding scheme to which it has exclusive rights. This will offer an improvement of up to 2dB in the Eb/No performance over TPC and add alternative block sizes, reinforcing iDirect's position as industry leader for inbound / return channel efficiency. Additional adaptability will also be added to the inbound / return channel, beyond the uplink power control that is standard in the Evolution remotes.

### **TCP & HTTP Acceleration**

iDirect TCP acceleration, built into the Hub and Remote routers, mitigates the effects of satellite latency and guarantees packet delivery in the event of data corruption or loss. TCP acceleration performs this task by buffering packets in the outbound and inbound direction. By itself, this cannot provide improved web performance over a satellite link, but iDirect's acceleration delivers the functionality required to support a highly responsive network for Web applications. The service provider benefits through an improved end user experience and more cost-effective solution due to the lower latency associated with accelerated IP packets.

### **Quality of Service (QoS)**

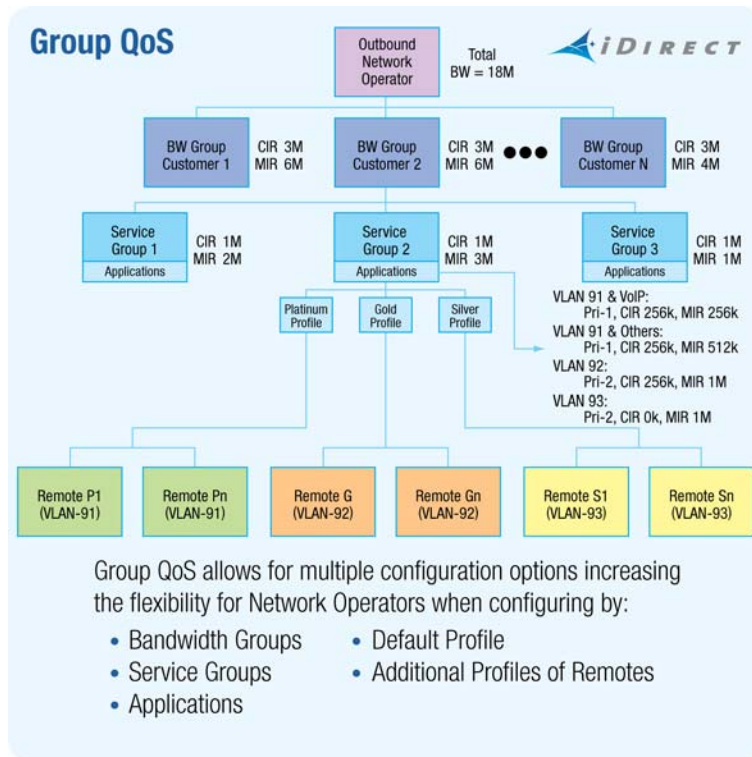
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iDirect's traffic engineering options are key to creating and maintaining networks with maximum throughput and bandwidth efficiency. The iDirect system has numerous features allowing network operators to implement a network that is properly engineered to meet customer needs and to provide application assurance. Group QoS, iDirect's award-winning bandwidth allocation algorithm, allows for countless possibilities of quality of service levels, bandwidth management and traffic prioritization.

GQoS utilizes a hierarchical bandwidth methodology whereby each bandwidth, service, and application group can be configured by:

- ◆ Priority
- ◆ Bandwidth Cost
- ◆ Committed Information Rate (CIR)
- ◆ Maximum Information Rate (MIR)



QoS properties configured at each level of the GQoS tree determine how bandwidth is distributed when demand exceeds availability.

GQoS enables the construction of very sophisticated allocation models and allows network operators to create network subgroups with various levels of service on the same outbound carrier or inbound group. It allows bandwidth to be subdivided among customers or service providers, while also allowing oversubscription of one group's configured capacity when bandwidth belonging to another group is available.

Combining GQoS with DVB-S2/ACM not only allows network operators to increase DVB-S2 efficiency gains by combining multiple small networks into a single, larger carrier, but service providers can limit the possibility of remotes or applications monopolizing bandwidth during worst-case rain fade conditions. This can maintain a fair usage policy across the network while simultaneously supporting end-user SLAs.

### **iDirect's Intelligent Platform™**

The advantages of iDirect's Evolution product line are amplified through additional benefits of the iDirect Intelligent Platform™:

- ◆ Advanced IP routing capabilities that enable service providers to support critical business applications and seamlessly integrate terrestrial and satellite networks.
- ◆ End-to-end VLAN support that permits a remote router to have multiple VLANs associated with it.
- ◆ A single VLAN map to multiple remotes that allows QoS classifications to increase the network operator's flexibility.
- ◆ Advanced security capabilities such as AES 256-bit encryption, TRANSEC and FIPS 140-2, all of which meet military and commercial security needs.
- ◆ Unequaled mobility support for land, sea, and air COTM: spread spectrum, automatic beam switching, and central management through iVantage™ Global NMS.
- ◆ Virtual Network Operator functionality, which helps hub owners expand business through hosting capabilities, and lowers cost of ownership for service providers entering new markets.

With iDirect's Evolution product line, service providers gain critical new advantages in bandwidth efficiency and availability gains. They can lower operating costs, expand into new markets and win new customers, all while protecting their current investment. Network operators can start new hub operation or easily upgrade to DVB-S2/ACM through their existing hub investment, adding new Evolution line cards and remote routers along with new iDX software taking full advantage of all the benefits the iDirect platform has to offer.