DVB (Digital Video Broadcast) vs. iDirect Technology

DVB Technology

Digital Video Broadcast (DVB) is a satellite-based standard that was primarily designed to use in broadcast video applications. The standard has been widely adopted due to its simplicity, easily available chipsets, and cost. DVB based technology is widely deployed and understood by most network operators. DVB was primarily designed for one way broadcast of video and MPEG traffic. Recently a new standard DVB-RCS (Return Channel via Satellite) was completed to allow for a standard based return channel for two-way traffic. The intent of the open standard is to accelerate economies of scale, thereby generating lower-cost solutions and opening the market in a shorter timeframe than could be possible with competing proprietary solutions.

Technology

DVB standard for the forward or broadcast channel has the following technical characteristics,

- MPEG frame for transporting video and data
- RSV (Reed-Solomon Viterbi) based Forward Error Correction
- Very high bandwidth on the outbound

DVB-RCS standard has the following characteristics,

- TDMA based inroutes
- MPEG frame for transporting data
- Also supports ATM cells for transporting data

DVB standard based systems interoperate well on the outbound channel between different vendor equipment. DVB-RCS for the return channel is another story. The standard only provides for the basic interoperability between different vendors. For any enhanced services, the interoperability is lacking to say the least.

The standard does not guarantee basic interoperability (e.g. TDMA slot sizes, # of inroutes, hopping vs. static frequencies, frame sizes, code rates are all variable). In theory two vendors could design infinitely adjustable implementations of the specification. In reality, they would have to actively engage each other and support a set of interoperable modes.

Advantages of DVB based system:

- High bandwidth outbound or broadcast
- Designed and built for Video Broadcast
- Lower Cost of Remote Terminals

Disadvantages of DVB based system:

- Generally Power-Limited satellite requirement
- Very inefficient when use of transponder capacity
- Not designed for TCP/IP traffic. IP is encapsulated within MPEG
- Very high Hub equipment cost

Advantages of DVB-RCS based system:

- Potential interoperability between multiple vendors
- Potentially lower cost of modems

Disadvantages of DVB-RCS based system:

- Interoperability between multiple vendors limits functionality
- Typically implemented with RSV FEC which is not very efficient
- TDMA protocol used is typically slotted-aloha

iDirect Technology

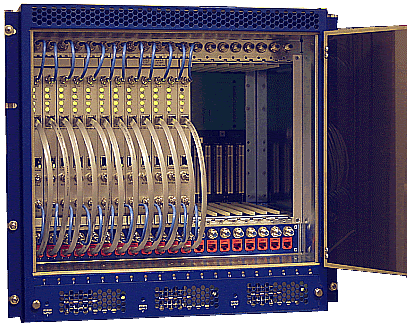
iDirect has pioneered TCP/IP over satellite technology in the industry to ensure the most efficient use of satellite bandwidth. As demand for IP over satellite continues to grow more Network Operators would want to start offering IP services over satellite. iDirect technology is designed to allow Network Operators implement these networks at a much lower cost, at the same time provide a business class service with all the TCP/IP enhancements over satellite.

Technology:

iDirect Outbound has the following technical characteristics,

- TDM Based Broadcast
- Up to 11.5 Mbps Channel Rate
- Primarily Bandwidth Limited Implementation
- Turbo Product Codes (TPC) FEC
- Lower E_b/N_o for 10^{-9} BER when compared to RSV
- iDirect Frame Format optimized for TCP/IP

iDirect Inbound or Return Channel has the following technical characteristics,



- Enhanced Dynamic TDMA Technology
- Up to 5.75 Mbps Channel Rate
- Primarily Bandwidth Limited Implementation
- Turbo Product Codes (TPC) FEC
- Lower E_b/N_o for 10^{-9} BER when compared to RSV
- iDirect Frame Format optimized for TCP/IP
- Dedicated bandwidth per VSAT
- Extremely fast dynamic allocation algorithms

Advantages of iDirect Technology

- Primarily Bandwidth limited, thus much lower service costs
- Extremely responsive TDMA channels
- Queue depth checked 5 times/sec
- All remotes have a minimum CIR
- Multiple-inroutes Network Capability
- Frequency Hopping Capability – Dynamically Assigned based on demand
- Very scalable hub equipment, with multiple network support within a chassis

Advantages of iDirect Hub Technology

- Support for multiple satellite and networks within one chassis
- Extremely scalable
- Very compact ($1/6^{th}$ the size) of comparable technologies
- Very cost competitive
- Carrier Class – Fully Redundant with Hot-Swap capability

Other iDirect Solutions Benefits

- TCP and Web Acceleration in BOTH directions
- Application QoS in the BOTH direction
- Network QoS
- Rate Limiting Capability in BOTH directions
- Committed Information Rate (Dynamic and Static) in BOTH directions
- Fast “First-Click” Response
- DHCP/NAT/Local DNS Caching Capability
- Built-in 3DES Link Encryption Capability

DVB vs. iDirect – IP Efficiency Comparison

DVB frame format uses MPEG for broadcasting video. IP over DVB has to encapsulated within an MPEG frame to be transported over DVB. IP packets must be segmented into MPEG 188 byte cells which further decreasing efficiency. This is a consequence of using a system optimized for digital video to transport IP packets. A maximum sized 1500-byte Ethernet packet has to be segmented into 8 or more MPEG cells. The iDirect solution has no such constraint. Transport cells are sized variably depending on the size of the IP packet instead of having to conform to fixed sized cells.

This provides a much better throughput efficiency over an iDirect Network. As an example, over a 500 KHz satellite capacity, with an iDirect solution one can get a TCP/IP throughput of 530 kbps. With the same satellite capacity over a DVB network, the TCP/IP throughput is 385 kbps.

Case Study:

On 8 MHz of satellite capacity, using QPSK and some guard band and RSV Coding Rate ¾ , with DVB one will get a data rate of 7.7Mbps, but the actual IP throughput of 90%, assuming MPE configuration. The **IP throughput will be around 7.0 Mbps**.

Over the same satellite capacity the iDirect solution gives an **IP throughput of 8.8 Mbps.** This is an increase of 25% IP throughput.

DVB vs. iDirect – Satellite Transponder Capacity Usage

DVB based systems use concatenated Reed Solomon and Viterbi for its FEC. iDirect uses Turbo Product Codes (TPC) FEC for its system. iDirect systems operate at E_b/N_o's approximately 1.5 dB lower than DVB based competitors to deliver 10^{-9} BER performance. This reduced requirement allows an operator to use lower power on the satellite thus reducing overall cost of the system. This allows the network operator to provide a more cost-competitive solution that provides a better TCP/IP performance over satellite.

Case Study:

BER performance of iDirect 4k TPC coder is equivalent to the Reed Solomon / Viterbi 3/4 code. (TPC is actually slightly better by about 1/4 dB). In addition, an RSV based system requires about 1.5 dB more power to maintain a BER of 10^{-9} (This is critical when having TCP/IP over satellite).

Network Size:

Channel Rate:	5 Mbps
Encoding:	QPSK (2 bits/symbol)

RSV:

RS/Viterbi ¾ Code Rate:	0.691
User Data:	5 Mbps * 0.691 = 3,455,000 bps
Satellite Capacity:	2.5 Mhz
Power Equiv. BW (+1.5 dB):	3.54 Mhz (To Provide Equivalent Quality as iDirect TPC)

TPC:

TPC Code Rate:	0.793
User Data:	5 Mbps * 0.793 = 3,965,000 bps
Satellite Capacity:	2.5 Mhz

If we consider a typical rate of $5.00 per kHz per month.

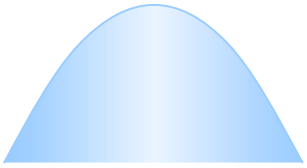
Comparison 1: Code Rate Efficiency and Usable Bit Rate

The coding efficiency of an iDirect system is significantly better than the competitors RSV based systems. From the above calculations it can be clearly shown that the iDirect system has 14.76% higher data throughput than the competitors.

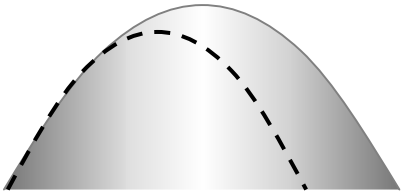
3,965,000 – 3,455,000 = 510,000 extra user bits for same transponder capacity (14.76% more)

Comparison 2: Cost of satellite segment

RSV based system requires about 1.5 dB more power, than an iDirect TPC system, to maintain a BER of 10^{-9}. This BER performance is critical for a system with TCP/IP traffic. TCP/IP is very sensitive to BER performance and throughputs will vary significantly if a low BER is not maintained. To achieve the same BER levels of an iDirect system, competitors RSV based systems need about 1.5 dB additional power. Thus the total additional bandwidth required by DVB based system is 1.04 Mhz.



iDirect
Bandwidth: 2.5 MHz
Channel Rate: 5 Mbps
Data Rate: 3.965 Mbps



DVB
Bandwidth: 2.5 MHz
Channel Rate: 5 Mbps
Data Rate: 3.455 Mbps
Power Equiv. BW(+1.5dB): 3.54

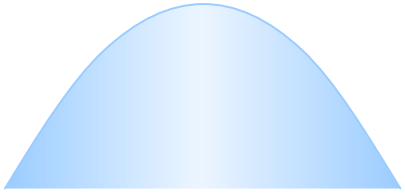
Additional cost per month for a DVB based system is $5,200.00 / Month or $62,400.00 / Year

Comparison 3: Data on equivalent bandwidth

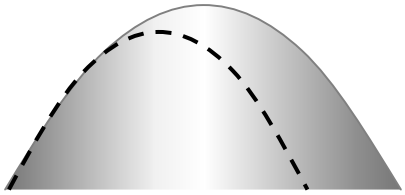
Another way of looking at this is, how much more data bits will one get when using the transponder capacity required by an RSV based system, by implementing an iDirect TPC system.

From the above example if one had 3.54 MHz of satellite capacity, using the iDirect system one will get 5,600,000 bps of user data rate.

This equals (5,600,000-3,455,000/3,455,000) = 2,145,000 bps or **62% more data.**



iDirect
Bandwidth: 3.54 MHz
Channel Rate: 7.08 Mbps
Data Rate: 5.6 Mbps

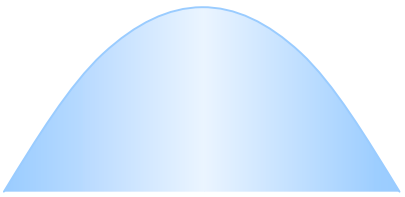


DVB
Bandwidth: 2.5 MHz
Channel Rate: 5 Mbps
Data Rate: 3.455 Mbps
Power Equiv. BW(+1.5dB): 3.54 MHz

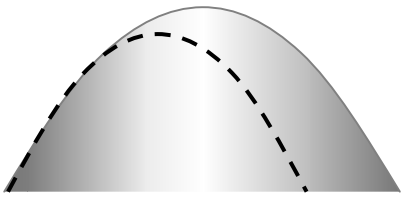
Comparison 4: Actual IP Throughput on Equivalent Bandwidth

IP throughputs over a DVB based system are typically about 80% of the user data rate. In the above example, the actual IP throughput over the DVB based system, with MPE enabled, is 3,455,000*0.90 = 3,109,500 bps.

IP throughputs through the iDirect system are close to 95% of the data rate. For the above example, the IP throughput through an iDirect system would be 5,333,000. When compared to the DVB solution, the total increase in data through the systems is an **additional 70%** or a difference of **2,223,500 bps of IP data**.



iDirect
Bandwidth: 3.54 MHz
Channel Rate: 7.08 Mbps
Data Rate: 5.6 Mbps
IP Throughput: 5.33 Mbps



DVB
Bandwidth: 2.5 MHz
Channel Rate: 5 Mbps
Data Rate: 3.455 Mbps
Power Equiv. BW(+1.5dB): 3.54 MHz
IP Throughput: 3.1 Mbps

Conclusion:

Based on the above case studies, the difference in cost for implementing a network using an iDirect solution when compared to DVB based system is significant. This allows a Network Operator to lower their service costs and provide a more efficient system. An iDirect solution not only uses the transponder capacity more efficiently, it also increases the actual throughput of TCP/IP dramatically. More importantly, an iDirect network provides a much better performance, which increases customer satisfaction and customer retention.

In addition, most TDMA systems use Slotted-Aloha protocol over the return channel. Throughput performance of slotted ALOHA is efficient until the channel utilization exceeds 36.8% at which point the number of collisions increases dramatically and there is a snowball effect where none of the users get good throughput on the channel. Most real implementations of slotted-aloha have an efficiency of about 25%, in the best case.

The iDirect Deterministic-TDMA (D-TDMA) system provides guaranteed bandwidth to every user in the system according to the Quality of Service parameters allocated to the user. iDirect's advanced Demand Assignment algorithm ensures that data gets through with minimal latency even when the channel utilization is approaching 100%.