Description of the DVB-RCS VSAT System

1. DVB-RCS NETWORK OVERVIEW

A DVB-RCS network is a satellite-based communications system that provides interconnection between users who are exchanging real time applications based on several data types (e.g. text, voice, images, video etc…). There are two transmission paths, the Forward Channel from a centralized Hub location to the remote location and a Return Channel from the remote location to the central Hub.

The DVB-RCS system standard underwent final standardization by the European Telecommunications Standards Institute in 2000. The standard calls for a forward link based on a DVB/MPEG-2 data format and a return link using Multi-Frequency – Time Division Multiple Access (MF-TDMA) scheme, allowing a two-way exchange of data. The DVB/MPEG-2 format carries up to 80 Mbps in the forward link and the MF-TDMA scheme allows up to 8 Mbps per carrier in the return direction.

The network consists of a central earth station Hub station, one or more satellites in the forward direction, a Satellite Interactive Terminal (SIT) at the remote location, and a satellite in the return direction.

Figure 1 gives an overview of the system architecture for a DVB-RCS network. The range of users includes governments, small/medium-sized businesses, universities, hospitals and residential users. Forward traffic to the users at the remote stations (SITs) is multiplexed into a conventional DVB/MPEG-2 broadcast stream at the Hub and broadcast via the satellite to the SITs. This broadcast stream is transmitted using QPSK modulation and concatenated convolutional and Reed-Solomon coding (providing a maximum forward data rate of approximately 80 Mbps) in each transponder used. The return link uses MF-TDMA and in order to provide seamless internetworking with other networks, industry standards are used for carrying data from the SITs to the Hub Station, in particular Internet Protocol (IP) and Asynchronous Transfer Mode (ATM), or MPEG.

The forward path of the system is based on the relevant ETSI/DVB standards that are shared with the current direct-to-home (DTH) delivery of broadcast television and radio. This makes these two services ideally suited for pairing on a common carrier.

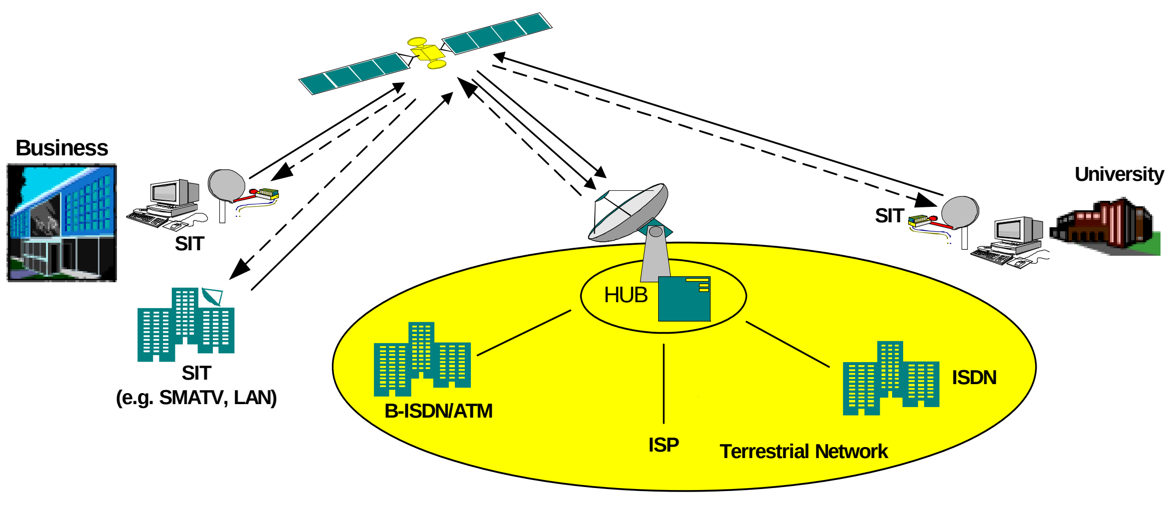

FIGURE 1: SYSTEM ARCHITECTURE OF DVB-RCS SYSTEM

A return path from the individual user is provided from a Satellite Interactive Terminal (SIT) with fixed, small antenna (0.5 to 1.2m in Ka-band in Europe, for example) and multi-media PC or digital Integrated Receiver Decoder (IRD) to an Interactive Server at a Hub Station using a multiple-access scheme. In a Cable or SMATV environment, such a terminal provides a return path for a group of connected users. This return link may consist of the multiplexing of several components (e.g. video, data, fax, and audio) that originate from the particular home or office. Similarly, in the DVB-RCS system the SIT acts as a router / multiplexer for different traffic sources. The individual components are routed via the Hub to their final destination.

The SIT employs a scheduled MF-TDMA scheme to access the network and participate in bi-directional communications. MF-TDMA allows a group of SITs to communicate with a hub using a set of carrier frequencies, each of which is divided into time-slots. The hub allocates to each active SIT a series of bursts; each defined by a frequency, bandwidth, start time and duration. This collection of carrier frequencies and time-slots is referred to as a frame. Each time/frequency slot contains exactly one packet (the packet content being either portions of IP packets or concatenated ATM cells). Frequency-agile SITs access a pattern of time/frequency slots within these frames. Having established knowledge of the MF-TDMA structure via forward link tables, the SIT accesses the network using a slotted ALOHA burst. Thereafter, traffic capacity is allocated dynamically, allowing the SIT to operate in a contention-less mode. A SIT can only transmit once the SIT has forward channel reception. Moreover the SIT must have synchronized itself to the forward link, logged in and have been allocated capacity (in terms of MF-TDMA slots).

2. SYSTEM ELEMENTS

2.1 DVB-RCS Hub

Within the Hub station are located the Return Link Subsystem, the Forward Link Subsystem, and the Network Management & IP Subsystem.

The ***key features*** to look for in the DVB-RCS Hub are:

- Based on the open standard (ETSI EN 301 790) to ensure interoperability with DVB-RCS compliant terminal suppliers.
- Bandwidth-on-demand access, as per the scheme incorporated within the DVB-RCS standard, provides maximum efficiency and flexibility with minimum overhead.
- Designed-in modularity, scalability and flexibility. Each customer's specific needs must be successfully addressed in a cost-effective package that can grow in the future as the customer's client base expands.
- Industry-leading performance: the network can be designed to provide forward link rates of up to 80 Mbps and return link rates of up to 8 Mbps for several thousands simultaneously logged-in terminals.
- Multi-carrier demodulation: demodulate MF-TDMA frequency carriers in parallel to a support a wide variety of transmission rates simultaneously.

2.2 DVB-RCS Terminal (SIT)

SITs are available for C, Ku and Ka frequency bands, as well as X band. The DVB-RCS SIT fits perfectly in a network solution that has the following requirements:

- Always-on, broadband connectivity for all locations
- Cost-effective distribution and sharing of content

- Rapid deployment
- Reliability and quality of service
- Single platform solution for all needs
- Flexibility and scalability

The ***key features*** to look for in the DVB-RCS SIT are:

- Support of the open standard DVB-RCS using DVB-S and DVB-S2 on the forward link
- Support of forward and return links
- Return link up to 8 Mbps
- Forward link up to 80 Mbps
- Rain Fade Counter Measures (RFCM) for the Return Link: uplink power control and rate adaptation
- Return link IP traffic supported via encapsulation in ATM cells or MPEG packets
- Forward link IP traffic supported via encapsulation in MPEG packets
- The SIT end-user interface uses IP on an Ethernet connection, thereby allowing seamless connection to terrestrial equipment and offering extensive IP and TCP/UDP/RTP/IP capabilities such as QoS, VoIP, multicast, TCP acceleration, IPSec, etc.
- Up to 36 Mbps can be delivered to the end-user's Ethernet connection.

2.3 System Performance

Overall system performance can be measured in several ways. At the highest level, the DVB-RCS network solution balances tradeoffs between bandwidth efficiency, power efficiency, network scalability, and lifetime equipment costs.

Perhaps the most relevant of these measures is bandwidth efficiency. Since bits/Hz drive data transmission costs over satellite, and today's satellite bandwidth costs can represent over 20% of direct costs for service to end users, it is in this area that service providers and satellite operators often first focus their evaluation of a DVB-RCS system vs. that of other access systems.

Different issues need to be considered in bandwidth efficiency on the forward link vs. the return link. On the forward link, the adoption of DVB-S in the DVB-RCS standard was driven primarily by economics. Low-cost, off-the-shelf DVB-S and DVB-S2 components exist for the forward link, and while more efficient schemes might be possible, they would impose a significant cost penalties and development lead times for both hubs and terminals. On the return link the question of bandwidth efficiency must be addressed in detail. In satellite communications, bandwidth efficiency must be considered in the context of the ever-present trade-off against power efficiency. Some schemes will offer excellent bits/Hz performance, but ignore the fact that the resulting user terminal will need to be too large to make economic sense. With this global trade-off in context, bandwidth efficiency comparisons can then be made along several dimensions:

The DVB-RCS system can offer a number of state-of-the art system performance advantages compared to competitors' proprietary systems.

The ***key performance advantages*** to look for in a DVB-RCS System are:

- DVB-RCS Interoperability

- DVB-S2
- 1 MSym/s Operation
- Quality of Service
- Throughput / Speed
- Adaptive rain fade countermeasures
- Bandwidth Efficiency
- Scalability
- Initial System capacity
- Simplicity in pricing
- Credibility
- World-class after-sales support

3. DVB-RCS INTEROPERABILITY

Any credible DVB-RCS equipment manufacturer guarantees that its product is designed for interoperability, and it will continue to actively support interoperability efforts within recognized standards bodies internationally. Advantech Satellite Networks is offering an unrestricted license to use any third-party DVB-RCS terminal on the hub offered within this proposal – ***an option not available on any other two-way satellite system***.

We have based our business strategy on the DVB-RCS open standard, and as such, and we have been a leading proponent of DVB-RCS interoperability for several years.

- We have participated in the world's first DVB-RCS interoperability effort, proving that a SatNet terminal and a Raytheon terminal could seamlessly interoperate on SES-Astra's BBI hub in 2002.
- We have led ESA's interoperability demonstration effort between SatNet, Nera and Newtec.
- We have been actively courting our competitors' hub customers to encourage them to purchase SatNet terminals. We have performed several rounds of DVB-RCS interoperability testing on a customer's Nera hub.

SatLabs Group

Advantech Satellite Networks has received Satlabs DVB-RCS interoperability certification in October 2005. We will continue to offer terminals to customers who wish to operate on our competitors' hubs, and we will continue to support our competitors' terminals operating on our hubs.