

DVB with return channel via satellite

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Introduction

Increased interactivity is a general tendency for telecommunication services today, an aspect which is also reflected in the more traditional distribution services like radio and television. Customers want to choose, sort, order, store and manipulate what they receive on their terminal, and ideally also interact from the same terminal. The distribution network becomes an asymmetric interactive network, with a possible evolution towards fully symmetric communication. This convergence between communication and broadcasting leads to an evolution from broadcasting to multicasting or point-to-multipoint communication, where the difference lies in the possibility to offer contents/services designed for individuals or groups of people with restricted access and billing. This evolution will also have consequences for satellite communications, certainly the most broadcast-oriented medium of all.

There are several ways to design a return channel for satellite multicast services, and many believe terrestrial return channels to be the most cost effective and practical. Commonly proposed terrestrial return channels are PSTN, ISDN or GSM. However, there is a large worldwide interest for a definition of a return channel via satellite, and there are several reasons for that. Firstly, as mentioned above, the "normal" consumer does not want to be bothered by technical set-ups with interconnections between TV, PC and telephone. A solution where all the technical equipment is concentrated within one box, and without having to fear blocked telephone lines etc. will certainly be appealing for many people. Another reason to choose satellite services is the increased traffic in the terrestrial networks, which often results in blocking or reduced quality of service. The instantly available capacity on a satellite link can with efficient resource allocation for instance be set to 2Mb/s. A 100Mbyte file will need about 7 minutes for transfer over satellite whereas the time required over a 64kb/s terrestrial line will be about 3½ hours. Finally, there is an advantage, both for the users and the operators, that both channels are on the same medium. This enables a better control with the QoS and the network management, the terrestrial infrastructure is often not controlled by the same operator as for satellite, and this is certainly not the case when national borders are crossed.

Standardisation procedures for DVB-RCS

Due to the recognised need for a specification of a return channel via satellite, the DVB-TM (Digital Video Broadcasting - Technical Module) created an Ad-hoc group early 1999, called the DVB-RCS (DVB- Return Channel via Satellite). The DVB project itself was launched in 1993, under the auspices of the EBU (European Broadcasting Union) [1]. The motivation was to promote a common, standard, European platform for digital TV broadcasting, and the idea was supported by all players; broadcasters, operators, standardisation bodies, media groups and industry. Today, DVB counts 220 members from more than 30 countries around the world. Due to high professionalism, the DVB has gained confidence worldwide, even if initially intended for European purposes. DVB is not a standardisation forum itself, the specifications drafted in the various technical Ad-hoc groups are, after approval in the

DVB hierarchy, sent to bodies like ETSI or ITU to obtain the formal status as a standard.

Contents of the DVB-RCS specification

As for all other project within the DVB, the work in DVB-RCS is based on the Commercial Requirements issued by CM. Three user profiles were identified in CM, the "Prosumer", the "Corporate" and the "Consumer". The main target will first be the "Prosumer", meaning "Professional consumer", which is a user with the need for broadband, high-quality services and the economical capacity to invest in relatively costly niche-market-equipment. The typical prosumers are a home offices, small media or graphical design offices, medical or educational centres. The corporate will represent a larger group of users behind one terminal, typically with a LAN connected to the RCST (RCS Terminal). The usage of the channel will tend towards more symmetrical behaviour, with the meshed network as the ultimate architecture. The consumer will probably be the last profile to feel the need and to be able to afford this kind of equipment, but a fast development in technology, together with increased needs for capacity and enhanced services makes the consumer a realistic user in the future.

In addition to defining the three user profiles, the CR also gives the reference model and many specific requirements for the system. One of the requirements is that the DVB-RCS specification [2] shall resemble the other specifications as far as possible, in particular the DVB-S (DVB-Satellite [3]). The reason for this is the wish to help a quick understanding of the specifications, to enable reuse of technology, and hence to reduce time-to-market. The specification shall be frequency-independent. It shall enable reliable network- and user security mechanisms, and incorporate an efficient transport layer. Interfaces with other infrastructures, such as PSTN, ISDN etc., shall be possible, and flexible terminals shall permit dynamic frequency allocation. The CR also describes the target bitrates, services, bit error rates, prices and availability for each type of terminal. The DVB-RCS specification only aims at defining the network independent layers, the network management and the services offered are left for the network operators and service providers to define.

Figure 1 gives the general DVB return channel reference model. In this model, the interactive network is depicted as independent from the forward channel. Very often, however, the forward interaction channel, or forward signalling channel, is integrated in the forward transport stream (TS). This is also the case in the DVB-RCS specification, where the forward signalling is part of the DVB-S TS. Figure 2 shows a simplified diagram of a network architecture. Actually, the DVB-RCS reference model is far more complex than this, however, the wish to indicate all possible network realisations may obscure the simplicity of the concept. Usually, several RCSTs will be connected to the interactive satellite network, consisting also of the satellite, an earth station and a network control centre (NCC). In figure 2, the earth station antenna acts both as a feeder for the forward path and as a gateway for the return path. The NCC shall handle the synchronisation, give correction messages to the terminals and allocate resources.

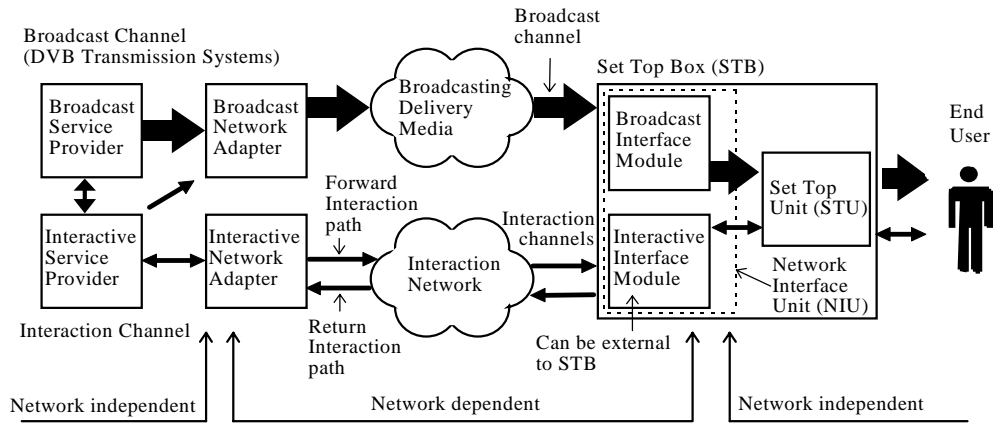


Figure 1. DVB's general reference model for interactive networks.

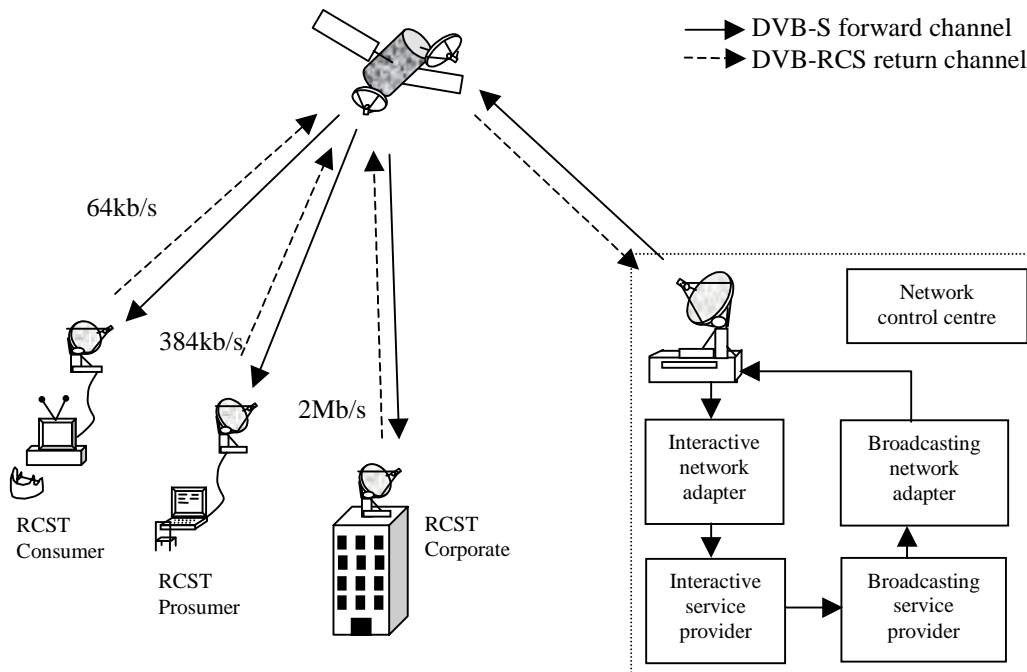


Figure 2. Simplified diagram of a network architecture for DVB-RCS systems.

One of the main challenges for the DVB-RCS group has been to specify inexpensive terminals. The CR indicates ex-factory prices on the order of 1000Euros, 3000Euros and 50.000Euros for Consumer, Prosumer and Corporate terminals respectively. Cost limitations will also imply EIRP limitations and possible use of suboptimal components such as nonlinear amplifiers. Of course, the cost is not the only limiting factor for the EIRP, regulatory rules have to be respected as well. In addition, the satellite channel is noisy, and use of Ka-band transmission for the return channel may give less known effects of multipath fading. As soon as interactive services are considered, the delay becomes a matter of concern with implications on several levels ranging from synchronisation, log-on algorithms to the delay perceived by the user after having made a request. This aspect highlights the need for efficient transport mechanisms, a need to be balanced against the contradicting need for flexibility. The NCC is in charge of the network control, which will include several RCSTs, but

maybe also several satellites, feeders, gateways and even several networks. The RCST network to manage is a multipoint-to-point structure, far more complex to administrate than the opposite, the point-to-multipoint.

The NCC is thus in charge of the control of every RCST in the network as well as the network as a whole. A terminal will log on after having received general information by "listening" to the forward link. The information given there is on the status of the network, and most important, the forward link provides the Network Clock Reference (NCR). When the RCST has obtained synchronisation with the NCR, it will use one of the designated slots (indicated in the forward channel) for log-on request in a slotted-aloha manner. If the terminal is successful with this request, the NCC will forward various tables containing general network and terminal specific information. The specific information is about necessary frequency, timing and power level corrections to be performed by the terminal before transmission start. These tables will also indicate the resources allocated for the terminal, and it is possible to ask for different services or increased capacity during transmission. The NCC has the possibility, with certain intervals, to correct the transmission parameters of the RCST, and if something goes wrong during transmission, the NCC shall also have the possibility to force the log-off of the RCST. The continuous signalling from the NCC is provided according to MPEG-2 SI [3].

The DVB-RCS specification is also restricted to the indoor unit, i.e. the signal processing between the source encoder and the IF conversion. The outdoor unit (the radio frequency part) will be specified by ETSI in [4]. The DVB-RCS physical layer contains specification of timeslots and frames organised in super-frames. The sequencing is controlled by means of the NCR, the access method is MF-TDMA (Multiple Frequency Time Division Multiple Access). Otherwise, the specification contains energy dispersion, two types of channel codes (concatenated Reed Solomon/convolutional coding and Turbo-codes), prefix emplacement, Nyquist filtering and QPSK modulation, most of which is well known from the DVB-S specification.

Conclusions

Many satellite operators have shown their interest in the return channel via satellite technology, and concrete plans for operation of such services in the near future exist. The prosumer market has been evaluated to have a potential market of some millions only in Europe, and as soon as higher volumes of terminals are produced, reasonable prices for the consumer market will be reached.

The DVB-RCS specification has been treated and approved in the TM, the CM and the Steering Board in DVB, and has been sent ETSI in March 2000.

References

- [1] <http://www.dvb.org/>
- [2] DVB Blue Book A54 rev.1.
- [3] ETS 300 421, “Digital broadcasting systems for television, sound and data services; Framing structure, channel coding and modulation for 11/12 GHz satellite services,” 1994.
- [4] ETSI, “Harmonised draft DEN SES-00xx V0.0.1, European Standard (Telecommunication series), Satellite Earth Stations and Systems (SES); Satellite Interactive Terminals (SIT) and Satellite User Terminals (SUT) transmitting towards satellites in geostationary orbit in the 29.5 GHz to 30.0 GHz frequency bands,” May 1999.

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