DVB-T SYNCHRONIZATION NEEDS

DVB-T Features

The Terrestrial Digital Video Broadcast (DVB-T), specified in the ETSI standard EN 300 744, is designed to allow optimum use of available frequency spectrum with structure of broadcast data flexible enough to accommodate numerous services: multiplex of up to 8 video programs in a 8 MHz bandwidth (where only one analog program was broadcast), multi-language stereo/surround channels, etc.

DVB-T gives complete freedom in terrestrial frequency planning and can be tailored to suit any geographical or frequency environment. The system allows the maximum spectrum efficiency when UHF bands are used by utilizing Single Frequency Network operation.

Moreover DVB-T ensures excellent performance in portable reception, tested successfully up to 275 km/h on highways and in trams moving through dense city centers. Such performance will allow notebook computers of the future, equipped with DVB-T receivers and omni-directional antenna, to have fast access to web content and to receive general broadcast data along with TV programs.

These features have convinced many countries to adopt the DVB-T standard, including the 15 members of the European Union, Australia and New Zealand. Numerous DVB-T broadcast services are now operational in Europe.

DVB-T Technical Overview

The DVB core system, also used on satellite or cable DVB, consists of generating data "containers" that can carry flexible combinations of MPEG-2 video, audio and other data with encoded protection scheme using Reed Solomon outer coding, outer convolutional interleaving and, where needed by the transmission environment, a punctured convolutional (Viterbi) code.

The key specific feature of the terrestrial broadcast is the use of a multi-carrier modulation system (COFDM) to overcome adjacent channel interference and reflections of the same signal (ghosting): The "Guard interval" principle is used to avoid data interference by waiting long enough between each generation of data bit so that the longest echo arrives before the next data. This implies a low bit rate on each carrier, but balanced by a high number of adjacent carriers within the useable bandwidth. This COFDM process allows the construction of Single Frequency Networks (SFN), where all the transmitters use the same frequencies, which permits "gap-filling" for optimizing coverage in difficult spots.

DVB-T Synchronization Needs

Transmission of DVB-T signals achieved through SFN requires an overall time and frequency synchronization. Indeed, for each instant of time, every transmitters must broadcast the same digital data at the same exact frequency.

The diagram of Figure 1 shows a typical DVB-T network. The video/audio signals with associated data created by the program providers are MPEG-2 encoded and multiplexed to create the "Transport Stream" (MPEG-2 TS) of a group of programs.

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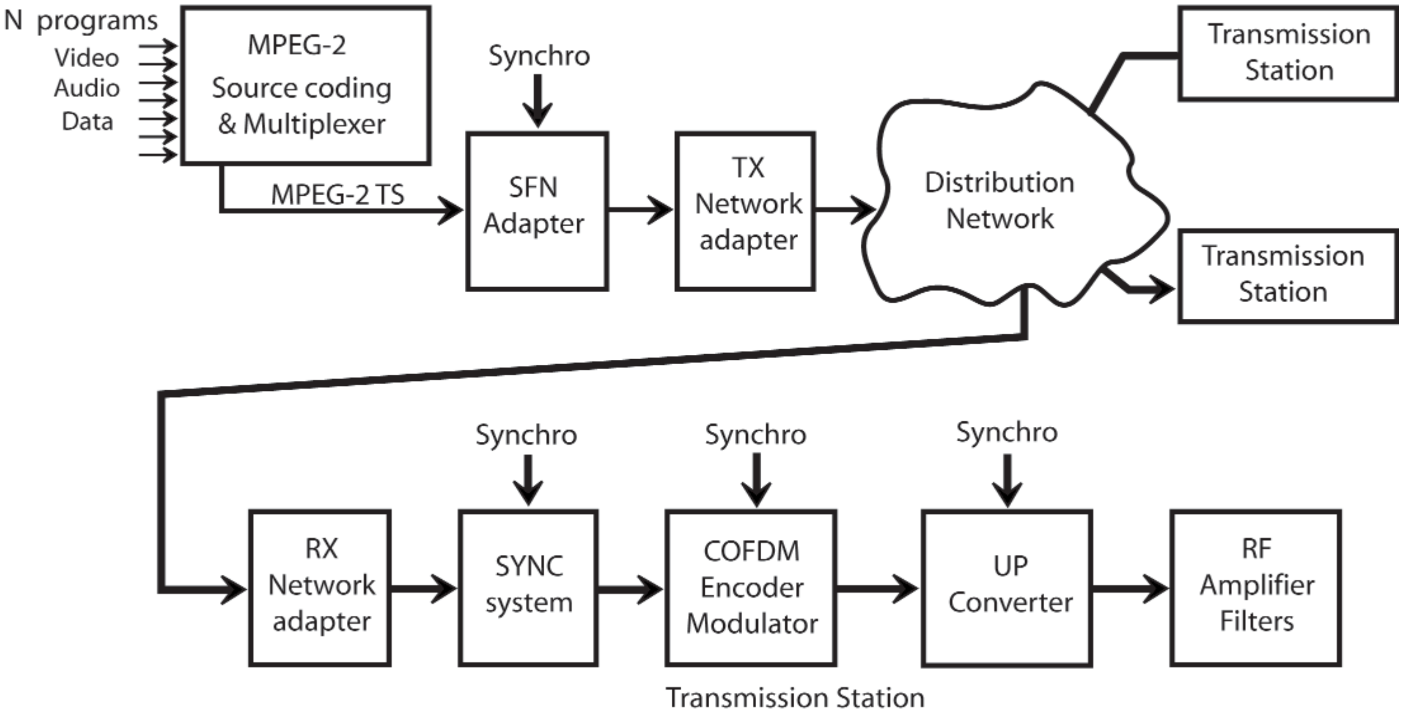

Figure 1 - Typical DVB-T network

The SFN adapter creates a data container, known as "Mega-frame," constituted with a fixed amount of actual data to procure a bit-rate adaptation between MPEG-2 TS packets and OFDM frames ensuring that it is possible to produce identical waveforms at each transmission station. Mega-frame launching time ("time stamp") is then inserted by the SFN adapter. The network adapters provide a transparent link for the MPEG-2 TS from the central unit to the transmission stations through a primary distribution network. Delivery time computation and compensation delay are performed on the Mega-frame at the destination points by the SYNC system. When the path delay of each link is invariant only a constant delay has to be inserted. But operational networks generally use "fallback" links in order to guarantee the continuity of the distributed signal. So "dynamic delay" compensation is required to cope with re-routing path inside the distribution network. As this is performed on many sites far distant from one and other, over a country or a region, a common time reference for all the sites is necessary.

Then, the data are modulated by the COFDM, which requires perfect time synchronization in order to manage correctly the guard interval for the transmission mode chosen. Poor time synchronization will consume the "echo budget." COFDM frequency synchronization is also necessary to ensure a proper carrier spacing to avoid inter-carrier interference. The data carriers in the COFDM frame can use QPSK or different levels of QAM modulation and code rates, in order to trade bit rate against ruggedness. For instance a 64 QAM will increase 6 times the bit rate, in comparison with no QAM, but with stringent requirements on spurious phase noise which implies use of a suitable frequency reference.

Finally the frequency up-conversion performed must be realized with great control in order to master the SFN RF signal, thus avoiding mutual jamming of the transmitters.

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GPS Clocks

GPS Clocks provide both a 10 MHz frequency reference and an absolute time reference slaved on GPS signals referenced to Coordinated Universal Time (UTC). Due to the global availability of the GPS signal, aGPS Clock is the most cost effective solution to fulfill the DVB-T synchronization requirements that are disseminated on numerous locations.

Spectracom, using its expertise in time and frequency synchronization systems, has developed a full range of GPS Clocks which are specifically designed to fulfill digital broadcast requirements. From the OEM boards (Epsilon Board™) designed to be integrated inside DVB equipment to the modular rack mounted units (Epsilon CLock™) delivering a wide range of outputs required for a multi-transmitter site, Spectracom offers the right products with a complete range of associated customer services (installation, training, support, after-sales, and consultancy) that guarantees the required quality of service for the DVB-T network.

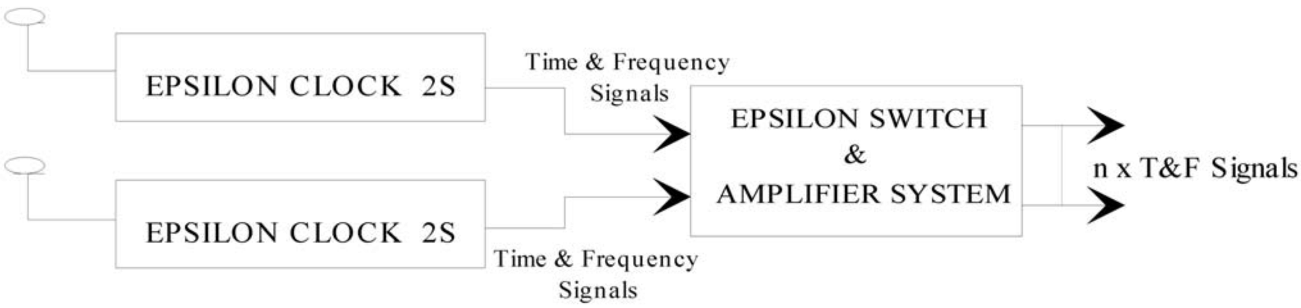
Epsilon Clock 2S

Epsilon Board OEM

High Availability Clock Systems

The mass market applications of DVB-T with large subscriber audience requires high level of service and reliable synchronization equipment.

For this, Spectracom introduced the Epsilon Switch & Amplifier System that provides a cost effective way to build a redundant clock system with high operational availability through simple use of standard and low cost Epsilon Clock series.



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