

DVB-T Single Frequency Network Architecture

Introduction

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 broadcasted), 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 (SFN) operation.

This application note presents the architecture of such DVB-T network and the key equipment involved: program coder, multiplexer, SFN network adapter, COFDM modulator, up converter and transmitter.

You can refer as well as to the:

- Application Note: "DVB-T synchronization Needs" and associated GPS clock and redundant system solutions.
- Application Note: "Redundant GPS Clock with Distribution for Terrestrial DVB".

Single Frequency Network

A Single Frequency Network (SFN) is a network consisting of several transmitters operating at the same frequency.

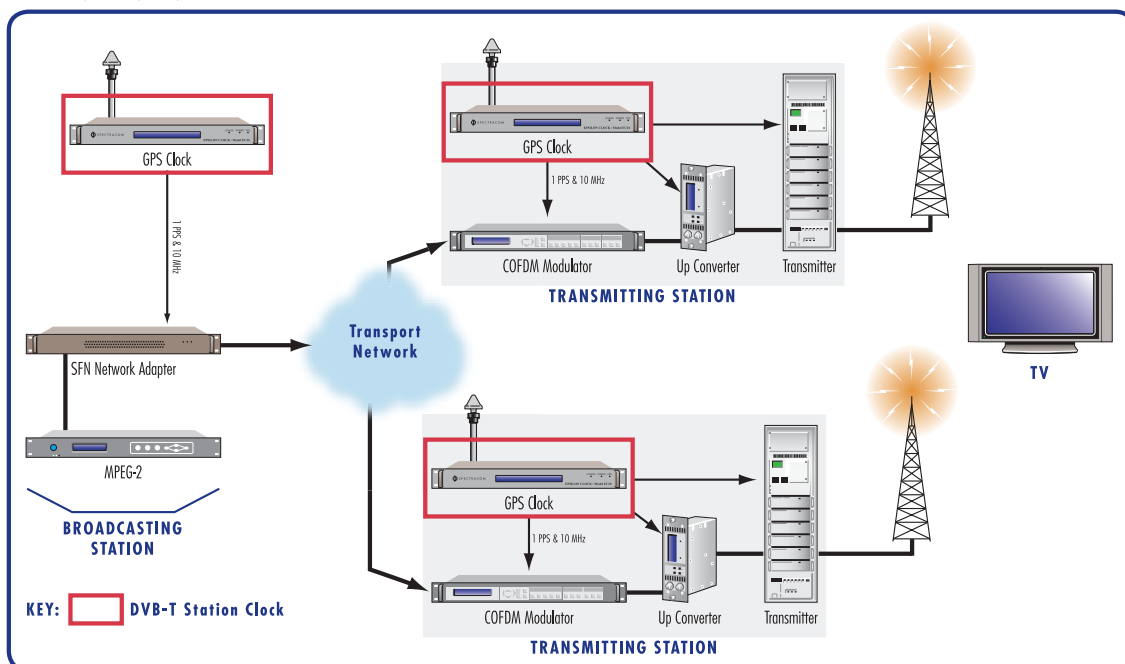
Due to the properties of the Coded Orthogonal Frequency Division Multi-Plex (COFDM) modulation used in the DVB-T system, coupled with careful synchronization of the transmitters, non-destructive interference can be introduced between signals received from several different transmitters.

The transmitter synchronization (in terms of both time and frequency) is achieved by injecting specific timing information at the head-end of the network and by providing an automatic alignment system in each transmitter.

Common time and frequency reference (GPS reference, for example) is used on each concerned site.

The benefits derived from this system are improved coverage and better utilization of the available spectrum. SFNs are already in operation in several European countries.

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continued on the back →

DVB-T SFN Adapter

The DVB-T SFN adapter allows synchronizing DVB-T transmitters organized in a single frequency network (SFN). When used at the head-end of the network, at the multiplexer output, the SFN adapter inserts time markers into the MPEG-2 Transport Stream, which are then used by the transmitters to synchronize the network. Common Time Reference used by the SFN network adapter and by each of the network transmitters to be synchronized is the 1 PPS signal supplied by GPS clocks.

The SFN adapter receives a 1 PPS time reference and a 10 MHz clock reference from a GPS clock and computes time and control information to build the Megaframe Initialization Packet (MIP). It inserts this packet into the MPEG-2 Transport Stream and recomputes the Program Clock Reference (PCR) information of each program. The SFN adapter is also able to insert, in the MIP packet, the definition of all parameters for setting the DVB-T COFDM modes (Transmission Parameter Signal information + MIP private functions). The SFN adapter receives the MPEG-2 packets as a MPEG-2 TS data stream and generates a new MPEG-2 TS data stream.

The SFN Network Adapter is compact equipment offering one MPEG-2 TS input and output. It can be installed at the output of the multiplexer or at the output of the DVB trans-multiplexer which produces the DVB-T multiplex assembly.

Example:

V-SFN product from Harris/ITIS, packaged in a 1U rack.



ITIS V-SFN adapters, integrating Spectracom's GPS Epsilon Board to provide 1 PPS & 10 MHz, have been chosen for the deployment of the first commercial DVB-T network in Spain. ITIS is to supply 8 SFN adapters and their management software and also training for the set-up of the SFN network. These 8 adapters will be placed at the head-ends of the national networks and will allow the synchronization of 176 DVB-T transmitters in the first phase of the project.

DVB-T COFDM Modulator

The COFDM modulator is a DVB-T modulator supporting generally 2K and/or 8K operations. This equipment performs channel encoding and OFDM modulation of a MPEG-2 Transport Stream for different bit rates. It also includes a digital linear quadrature modulator and a transposer with an intermediate frequency output. One single unit allows to feed a TV transmitter with a fully modulated DVB-T channel. Additionally to its basic functions, the DVB-T modulator may offer external frequency synchronization allowing to lock the COFDM modulation on a stable external reference (10 MHz).

Example 1:

"V-CAST" COFDM product from Harris/IT IS



(1 PPS and 10 MHz inputs for time and frequency references)
The V-CAST is a coder/modulator COFDM for digital television.

Example 2:

"Carry Coder" COFDM product from Broadcast Microwave Services BarcoNet
(1 PPS and 10 MHz inputs for time and frequency references)



Example 3:

"COSMOS" COFDM product from BarcoNet
(1 PPS and 10 MHz inputs for time and frequency references)



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DVB-T Up Converter

Example:

"Sirius" Up converter product from BarcoNet
(10 MHz input for frequency reference)



DVB-T Transmitters

Example:

VHF Solid-State TV Transmitters NM/NW 7000 Liquid-cooled
transmitters for DVB-T (Rhode & Schwarz)

