DELIVERABLE D10.1

IDENTIFICATION AND SPECIFICATION OF "FULL T2" PROTOTYPES TO BE BUILT

V0.6 - SEPTEMBER 15, 2011

Abstract

This deliverable presents the different prototypes to be built within the TF10 of the ENGINES project for further evaluation of a ”full T2” transmission by TF11. After a definition of the target "Full T2 features", the document gives for each prototype, the type to be developed (either a software IP block or a complete hardware and software equipment), the interfaces with other prototypes in a DVB-T2 chain, and the DVB-T2 features supported by the prototype.

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1 INTRODUCTION

Within the WP4, TF10 deals with the prototyping of "Full T2" or "NGH phase 1" compliant equipment. This prototype equipment will be used for evalutation and validation of the corresponding advanced functional features/technologies. This evaluation / validation phase will rely on both laboratory tests and field tests respectively led within TF11 and TF12. Prototyping here means either hardware or software implementation.

The developpement work within TF10 is led in two phases:

- Phase 1: prototype implementation of "Full T2" compliant equipment,
- Phase 2: prototype implementation of "NGH Phase 1" compliant equipment.

This deliverable D10.1 reports about the phase 1. A second deliverable (D10.2) will deal with the phase 2.

"Full T2" and "NGH Phase 1" compliance are defined in the TF10 description document.

This document describes the prototype equipment intended to be implemented by partners contributing to TF10 and having provided data by the edition date of this document:

Prototype Nr	Type of equipment	Provided by
1	T2 Modulator	TeamCast
2	T2 Modulator	Thomson Broadcast
3	T2 measurement demodulator	TeamCast
4	T2 Transmitter	Mier
5	T2 Gap-Filler	Mier
6	T2 Gateway	URL – La Salle
7		
8		
9		

2 DEFINITIONS

The following "full T2" features have been identified as relevant targets within the project'scope of work:

- MultiPLP (PLP number, mode, ...)
- SFN
- PAPR
- MISO
- MIMO (MISO with diversity reception)
- FEF step 1 - (empty FEF)
- TX Signalling
- Others (TBD)

3 PROTOTYPE 1: TEAMCAST DVB-T2 MODULATOR

Providing partner : TeamCast

3.1 General description

The Teamcast DVB-T2 modulator is a complete prototype board generating a DVB-T2 RF signal [1]. The modulator supports both T2-MI and MPEG2-TS inputs and will manage T2 frames and null FEFs.

3.2 Interfaces

The following figure presents the interfaces of the modulator. Two ASI inputs are dedicated to reception of a MPEG-TS stream or a T2-MI stream [2]. GPS, 10MHz, PPS and TOD inputs are dedicated to synchronization of the modulator (required for SFN processing). The DVB-T2 RF signal is given by RF output and RF monitoring output. The control of the modulator is realized through IP or RS232 interface

3.2.1 Inputs

ASI input 1 and 2
General function: MPEG-TS and T2-MI inputs (ASI format)
Data rate: 10MHz
Level range : 0 to +10dBm
Connector: SMA – 50 Ω

GPS input
General function: external 10MHz input for demodulator synchronization
Frequency: 10MHz
Level range : 0 to +10dBm
Connector: SMA – 50 Ω

PPS input
General function: external 10MHz input for demodulator synchronization
Frequency: 10MHz
Level range : 0 to +10dBm
Connector: SMA – 50 Ω

10MHz input
General function: external 10MHz input for demodulator synchronization
Frequency: 10MHz
Level range : 0 to +10dBm
Connector: SMA – 50 Ω

TOD input
General function: TOD input to synchronize the date on the modulator (absolute timestamp management)
Frequency: 10MHz
Level range : 0 to +10dBm
Connector: RS232 serial interface

3.2.2 Outputs

RF output
General function: DVB-T2 RF signal transmission

Frequency range: 300 MHz to 900 MHz
Level range : -11 dBm to +1 dBm
Supported bandwidth : 5MHz, 6MHz, 7MHz, 8MHz,
Connector: SMA – 50 Ω

RF monitoring output
General function: DVB-T2 RF signal monitoring
Frequency range: 300 MHz to 900 MHz
Level range : -31 dBm to -19 dBm
Supported bandwidth : 5MHz, 6MHz, 7MHz, 8MHz,
Connector: SMA – 50 Ω

3.2.3 Control and monitoring

The control of the modulator can be realized thanks to the *Controlcast* GUI through the IP interface. Commands may also be send to the module through teh RS232 interface.
The *Controlcast* GUI allows to set all the parameters of the modulator and monitors status information on the transmission . Concerning DVB-T2 parameters, the GUI sets the modulation parameters when considering *system A* DVB-T2 transmission but monitors the modulation parameters defined by the T2-MI tream when considering *system B* transmission.

3.3 Supported T2 modes and features

The different DVB-T2 modes supported by the modulator are given in the following table:

General Frame Parameters	
DVB-T2 mode	System A (MPEG-TS only) and system B (T2MI over TS)
SFN transmission	Yes (relative and absolute)
Bandwidth	5MHz, 6MHz, 7MHz, 8MHz
Multi-PLP	Yes, up to 32 PLPs
MISO	Yes
TFS	No
FEF	Null FEFs
TX signaling	No
FFT size	1K, 2K, 4K, 8K, 16K, 32K
Extended bandwidth	Yes
Guard interval	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Pilot pattern	PP1 to PP8
PAPR	No*
L1 constellation	BPSK, QPSK, 16QAM, 64QAM
PLP parameters	
PLP type	Common, Type 1, Type 2
LDPC	16K, 64K
Coderate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Constellation	QPSK, 16QAM, 64QAM, 256QAM
Rotated constellation	Yes
Time interleaver	Disable, intra-frame, inter-frame
High efficiency mode	Yes

*The modulator does not integrate TR and ACE algorithms but is able to reserved tones dedicated to TR-PAPR management.

4 PROTOTYPE 2 : THOMSON BROADCAST DVB-T2 MODULATOR

Providing partner : Thomson Broadcast

4.1 General description

The Thomson Broadcast DVB-T2 modulator is a complete prototype board generating a DVB-T2 RF signal [1]. The modulator supports both T2-MI and MPEG2-TS inputs and manages T2 frames.

4.2 Interfaces

4.2.1 Inputs

ASI input 1 and 2
General function: MPEG-TS and T2-MI inputs (ASI format)
Data rate: up to 72MHz
Level range : ASI standard
Connector: BNC – 50 Ω

GPS input
General function: external antenna input for GPS reception
Frequency: GPS standard
Connector: TNC – 50 Ω

PPS input
General function: external 1pps input
Level range : TTL
Connector: BNC – 50 Ω

10MHz input
General function: external 10MHz input
Frequency: 10MHz
Level range : TTL
Connector: BNC – 50 Ω

4.2.2 Outputs

RF output
General function: DVB-T2 RF signal transmission
Frequency range: UHF version (470 to 862 MHz)
Level range : -15 dBm to +17 dBm
Supported bandwidth : 5MHz, 6MHz, 7MHz, 8MHz,
Connector: SMA – 50 Ω

4.2.3 Control and monitoring

The control of the modulator can be realized thanks to the web interface through the IP interface.

The web interface allows to set all the parameters of the modulator and monitors status information on the transmission.

4.3 Supported T2 modes and features

The different DVB-T2 modes supported by the modulator are given in the following table:

General Frame Parameters	
DVB-T2 mode	System A (MPEG-TS only) and system B (T2MI over TS)
SFN transmission	Yes
Bandwidth	5MHz, 6MHz, 7MHz, 8MHz
Multi-PLP	Yes
MISO	Yes
TFS	No
FEF	Null FEFs
TX signaling	No
FFT size	1K, 2K, 4K, 8K, 16K, 32K
Extended bandwidth	Yes
Guard interval	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Pilot pattern	PP1 to PP8
PAPR	Tone Reservation
L1 constellation	BPSK, QPSK, 16QAM, 64QAM
PLP parameters	
PLP type	Common, Type 1, Type 2
LDPC	16K, 64K
Coderate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Constellation	QPSK, 16QAM, 64QAM, 256QAM
Rotated constellation	Yes
High efficiency mode	Yes

5 PROTOTYPE 3 : THOMSON BROADCAST DVB-T2 TRANSMITTER

Providing partner : Thomson Broadcast

5.1 General description

The transmitter has been configured to fit in a standard 19" cabinet, providing a compact footprint and delivering transmission power of up to 1.2 kW RMS per cabinet. 125 and 250W RMS amplifier chassis offer the ability to scale output power to meet specific coverage needs. Up to six parallel chassis can be combined in a single transmitter for 1.2 kW of power.

The transmitter delivers a robust output signal regardless of variations in typical environmental conditions. A pioneer in DAP technology, Thomson guarantees that the transmitters provide the highest constant performance by automatically compensating and correcting for aging of components, reduction of output power, or module failure. Real-time DAP also corrects both linear and nonlinear distortions generated by output mask filters and amplifier distortions.

For monitoring, each transmitter includes an embedded Web server and SNMP agent to remotely deliver a real-time, comprehensive display of the transmitter's status as well as the identification and precise location of any fault.

5.2 Interfaces

General Specifications

Frequency range:
• UHF: 470 to 862 MHz

Signal Bandwidth

DVB-T/H: 7.61 MHz (channel 8 MHz)
DVB-T2: 7.61 MHz (channel 8 MHz) and 7.78 MHz (channel 8 MHz, extended carrier mode)

Input Characteristics

• Connector: BNC female
• Impedance: 75Ω
• Dual TS changeover without broadcast interruption: ASI MPEG-2 or MPEG-4

GPS Antenna Characteristics

• Connector: TNC female
• Impedance: 50Ω
• Frequency: 1575 MHz

External Frequency Reference

• Frequency: 10 MHz
• Impedance: 50Ω
• Format: TTL
• Connector: BNC female

External Timing Reference

• Frequency: 1 PPS
• Connector: SMB female
• Pulse width: 10 µs

Output Characteristics

Shoulder: > 36 dB
MER: ≥33 dB (average value)
Spurious: compliant with EN 302 296 V1.1.1

Power Supply Specifi cations

AC input:
• Single phase:
— 90V to 160V
— 184V to 254V
• 3-phase:
— 154V to 272V
— 312V to 432V
Power factor: 0.99 typical
Frequency: 47 to 63 MHz

Environmental Compliance

RoHS compliant

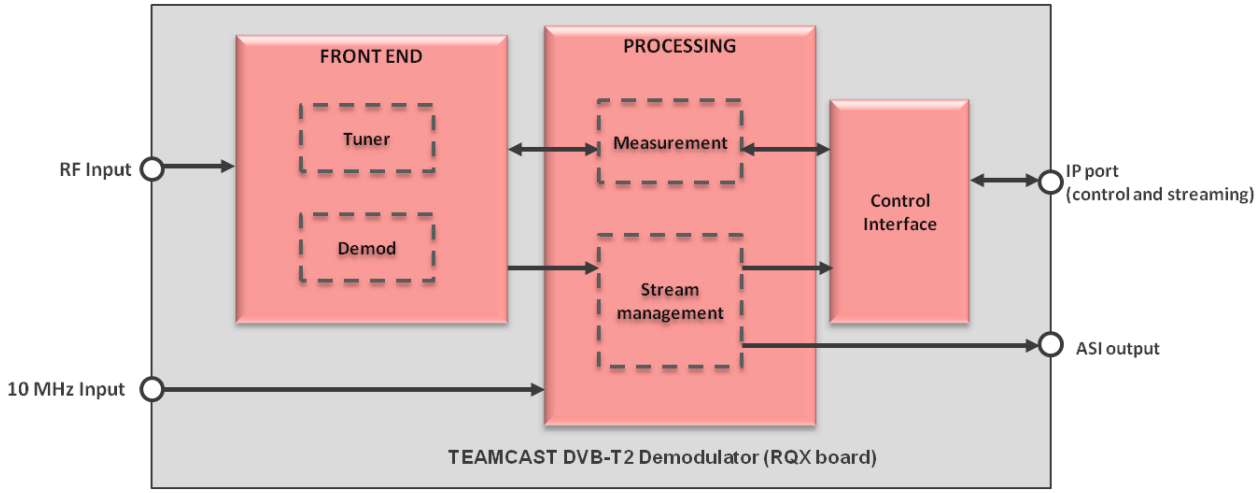
6 PROTOTYPE 3: TEAMCAST DVB-T2 DEMODULATOR

6.1 General description

The TeamCast DVB-T2 modulator is a complete prototype board demodulating a DVB-T2 RF signal. The demodulator allows recoverying one MPEG-TS and realizes signal quality measurements . The demodulator supports only DVB-T2 frames and null FEFs.

6.2 Interfaces

The following figure presents the interfaces of the demodulator. One RF input is dedicated to the reception of the DVB-T2 input signal. PPS and 10MHz inputs allow eventually to synchronize the demodulator to an external reference. At the output, the MPEG-Ts stream may be obtained through an ASI interface or an IP interface. The control of the demodulator is realized through the IP interface.



6.2.1 Inputs

Here are described the inputs of the demodulator.

RF input
General function: DVB-T2 RF signal reception
Frequency range: 48 MHz to 862 MHz
Level range: -90 dBm to –30dBm
Supported bandwidth: 5MHz, 6MHz, 7MHz, 8MHz,
Connector: SMA – 50 Ω

10MHz input
General function: external 10MHz input for demodulator synchronization
Frequency: 10MHz
Level range: 0 to +10dBm
Connector: SMA – 50 Ω

6.2.2 Outputs

Here are described the outputs of the demodulator.

ASI output

General function: MPEG-TS stream over ASI output
Data rate: 50 Mbps maxi.
Connector: BNC Female – 75Ω

IP output

General function: MEPG-TS stream over IP output
Data rate: 100 Mbps maxi.
Connector: RJ-45

6.2.3 Control and monitoring

The control of the modulator can be realized thanks to the *Controlcast* GUI through the IP interface. Commands may also be sent to the module through teh RS232 interface.
The *Controlcast* GUI allows essentially to display the quality analysis results. Thus, the GUI gives MER and SNR figures and displays the channel impulse response and the constellation.

6.3 Supported modes

The different DVB-T2 modes supported by the demodulator are given in the following table:

General Frame Parameters	
Bandwidth	5MHz, 6MHz, 7MHz, 8MHz
Multi-PLP	Yes *
MISO	Yes
TFS	No
FEF	Yes**
TX signaling	No
FFT size	1K, 2K, 4K, 8K, 16K, 32K
Extended bandwidth	Yes
Guard interval	1/4, 19/128, 1/8, 19/256, 1/16, 1/32, 1/128
Pilot pattern	PP1 to PP8
PAPR	Yes
L1 constellation	BPSK, QPSK, 16QAM, 64QAM
PLP parameters	
PLP type	Common, Type 1, Type 2
LDPC	16K, 64K
Coderate	1/2, 3/5, 2/3, 3/4, 4/5, 5/6
Constellation	QPSK, 16QAM, 64QAM, 256QAM
Rotated constellation	Yes
Time interleaver	Disable, intra-frame, inter-frame
Stream format	MPEG-TS only
High efficiency mode	Yes
Null packet deletion	Yes
ISSY management	Yes

*The demodulator is able to manage DVB-T2 signals trasporting multiple PLP but will treat only one PLP.
** The demodulator is able to decode the DVB-T2 signal when there are FEFs but is not able to decode any FEFs.

7 PROTOTYPE 4: MIER DVB-T2 TRANSMITTER.

Providing partner: MIER Comunicaciones S.A.

7.1 General description

The transmitter prototipe is part of the range of solutions for digital terrestrial TV broadcasting , providing output powers of 20, 50, 100Wrms.

Extremely compact, flexible and reliable; it is designed to cover deployment needs on remote centers with harsh accesses and with space restrictions.

It provides an elevated efficiency and robustness, allowing an easy installation and commissioning. Its modular design allows configuring different types of redundancy architectures to improve system availability. Additionally, it includes a series of automatic parameter configuration, as well as flexible monitoring and remote control tools, providing an intuitive and simple OPEX.

Its highly compact design allows allocating a 100Wrms transmitter in a standard 19" rack unit with only 2U height.

Its modular conception provides the flexibility to configure the equipment as transmitter, transposer or on-channel repeater configurations (echo canceller is available for on-channel repeater configuration).

The transmitter is made up by two units:

- Driver unit (1U).

- Power amplifier unit (2U).

7.2 Driver unit interfaces

7.2.1 Inputs

The inputs interfaces are described below:

ASI input 1 and 2
Signal type: MPEG-TS (ASI format)
Connectors: 2×BNC female 75 Ω (back-panel)

10MHz input
Signal type: External sinusoidal signal of 10MHz for frequency synchronization
Level: from 0 to +10dBm
Connector: BNC female 50 Ω (back-panel)

1 PPS input

Signal type: External 1 PPS signal for time synchronization.
Level: TTL
Connector: BNC female 50 Ω (back-panel).

GPS antenna input
Signal type: RF signal from GPS antenna.
Connector: SMA female 50 Ω (back-panel).

GSM antenna input
Signal type: GSM signal (dual band 900MHz /1800 MHz)
Connector: SMA female 50 Ω (front-panel)

Mains input
Signal type: AC 230V
Connector: IEC-320-C14

7.2.2 Outputs

RF output
Signal type: RF signal in the UHF band.
Level: 0 dBm maximum
Connector: N female 50 Ω (back-panel).

IF output sample
Signal type: IF signal (36.16 MHz)
Level: -20 dBm
Connector: SMA female 50 Ω (front-panel)

RF output sample
Signal type: RF signal in the UHF band.
Label: -30 dB lower than the nominal output power.
Connector: SMA female 50 Ω (front-panel).

7.2.3 Control interfaces.

External IP communication
Connector: RJ-45 female (back panel)

Local communication
Connector: RJ-45 female (back panel)

Dry contacts
Phoenix contact female 10 ways (back panel)

7.3 Power unit interfaces

7.3.1 Inputs
The inputs interfaces are described below:

RF input
Signal type: RF signal in UHF band, coming from driver unit
Connectors: N female 50 Ω (back-panel)

Mains input
Signal type: AC 230V
Connector: IEC-320-C14

7.3.2 Outputs

RF output
Signal type: RF signal in the UHF band.
Level: 25Wrms, 50Wrms and 100Wrms
Connector: N female 50 Ω (back-panel).

RF output sample
Signal type: RF signal in the UHF band.
Label: -30 dB lower than the nominal output power.
Connector: SMA female 50 Ω (front-panel).

RF output sample (driver unit feedback)
Signal type: RF signal in the UHF band.
Label: -30 dB lower than the nominal output power.
Connector: SMA female 50 Ω (front-panel).

7.3.3 Control interfaces.

Local communication
Connector: RJ-45 female (back panel)

Dry contacts
Phoenix contact female 20 ways (back panel)

7.3.4 Control and monitoring.

The transmitter incorporates a Remote control module in the driver unit based on an Ethernet 10Base-T interface which allows external management.

Through this interface different services and IP protocols are implemented, easing handling and maintenance of the equipment. The module includes a GPRS/EDGE modem for backup of the communications.

SNMP

The SNMP Agent provides access and control over basic parameters of the system through the SNMP protocol. The SNMP requests will be answered depending on the entry interface, and the traps sent to one or both interfaces depending on the configuration of the corresponding object of the MIB.

SNMP agent parameters can also be accessed via a Web Browser in order to easy its use by accessibility by using common interfaces.

WEB BROWSER

Web Browser interface provides embedded web control and monitoring features. Executable from any standard Internet browser, it doesn't require any specific software.

7.4 Supported T2 modes and features.

The transmitter support the same features described in the paragraph 3.3

8 PROTOTYPE 5: MIER DVB-T2 GAPFILLER.

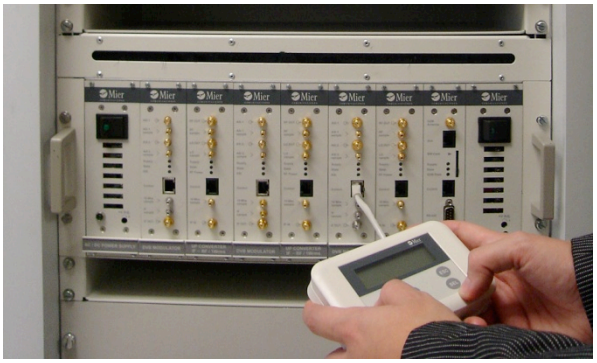
Providing partner : MIER Comunicaciones S.A.

8.1 General description.

The gapfiller prototype is part of the modular serie which allows to build flexible configurations (several transmitters/repeaters/gapfillers in the frame, including optional modules like GPS, UPS, monitoring, ...).

The nominal output powers are 1Wrms, 2Wrms and 5Wrms.

This modular serie allows up to four 1W/2Wrms channels or three 5W channels per frame with two additional slots for service modules.



Each channel is made up of two different modules:

- Down-converter: It moves an UHF channel to IF.
- Up-converter: It moves the IF signal to an UHF channel and amplifies it to reach the nominal output power.

8.2 Down-converter interfaces.

8.2.1 Inputs.

RF IN
Signal type: RF signal in the UHF band, coming from the receiving antenna.
Level range: from -75 dBm to -20 dBm
Connectors: N female 50 Ω (module front-panel).

LO input
Signal type: LO sample coming from the up-converter and used for the down-conversion mixer.
Level: -5 dBm
Connectors: N female 50 Ω (module front-panel).

8.2.2 Outputs

RF sample
Signal type: Input signal sample (UHF band) for monitoring.
Connectors: SMB male 50 Ω (module front-panel).

IF sample
Signal type: IF signal sample for monitoring.
Level: -20 dBm
Connectors: SMB male 50 Ω (module front-panel).

IF output
Signal type: IF signal output to the up-converter.
Level: 0 dBm
Connectors: SMA female 50 Ω (module front-panel).

8.2.3 Control interfaces.

Easy check (RS-232) connector
Interface to connect handheld terminal for local monitoring.
Connector: RJ-45

8.3 Up-converter interfaces.

8.3.1 Inputs.

IF IN
Signal type: IF signal, coming from the down-converter.
Level: 0 dBm
Connectors: SMA female 50 Ω (module front-panel).

8.3.2 Outputs

RF output
Signal type: RF signal in the UHF band, going to transmitting antenna.
Level: 1, 2 and 5Wrms
Connectors: SMA female 50 Ω (module front-panel).

RF Sample
Signal type: RF output signal sample (UHF band) for monitoring.
Level: 20 dB lower than RF output level.
Connectors: SMB male 50 Ω (module front-panel).

LO OUT
Signal type: LO signal sample for mixing process in the down-converter module.
Level: -5 dBm.
Connectors: SMB male 50 Ω (module front-panel).

LO Sample
Signal type: LO signal sample for monitoring.
Level: -20 dBm
Connectors: SMB male 50 Ω (module front-panel).

10 MHz Sample
Signal type: 10 MHz reference signal sample for monitoring.
Level: 7 dBm.
Connectors: SMB male 50 Ω (module front-panel).

8.3.3 Control interfaces.

Easy check (RS-232) connector
Interface to connect handheld terminal for local monitoring.
Connector: RJ-45

8.3.4 Control and monitoring

LOCAL INTERFACES
Easy-Check

- 6 button + LCD display device
- To adjust and check the operation of each of module.

Once plugged to a specific module it will browse all possible configuration, monitoring and status information of the module.

mTDT Toolkit

- Proprietary software Local Graphical User Interface
- Offers the most intuitive and friendly user way to manage the system by means of a laptop.
- When connected to a serial port, it allows automatic profile loading, exhaustive monitoring of the equipment, firmware updates and complete configuration.

REMOTE INTERFACES.

SNMP

- The SNMP Agent provides access and control over basic parameters of the system through the open architecture SNMPv2 protocol.
- Embedded on the SMU (System Management Unit) module.
- It includes a GPRS/EDGE modem as a backup of the communications
- 10Base-T interface to manage the equipment remotely over the Control module.

Web-browser

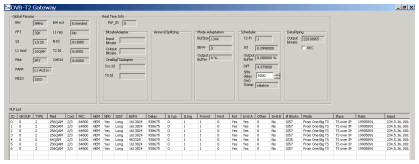
- Executable from any standard Internet browser, it doesn't require any specific software
- Allows saving on proprietary programs
- Easy remote and local control and monitoring capabilities *depending* on user privileges.
- Embedded on the SMU (System Management Unit) module.

9 PROTOTYPE 6: LA SALLE DVB-T2 GATEWAY

Providing partner : Ramon Llull University – La Salle.

9.1 General description

La Salle DVB-T2 Gateway supports both Single and Multiple PLP and it has the ability to re-use existing DVB-T Multiplexers with its special feature of 'OneBigTS Adaptation'. Its input/output interfaces are ASI, TS/UDP/IP and Files.
It is a SW application running on a PC with PCI boards for ASI input/output interfaces. The configuration is currently done via .ini files



9.2 Features

- Multi format input: IP, DVB-ASI.
- Multi format output: IP, DVB-ASI.
- Single and Multiple PLP support
- SFN, DVB-T2 timestamp generation
- OneBigTS format: common extraction and 'AnnexD' implementation for PSI/SI
- Different hardware options available

9.3 Supported modes

9.3.1 Single PLP – VV500

La Salle DVB-T2 Gateway supports configurations similar to VV500 with Single PLP.

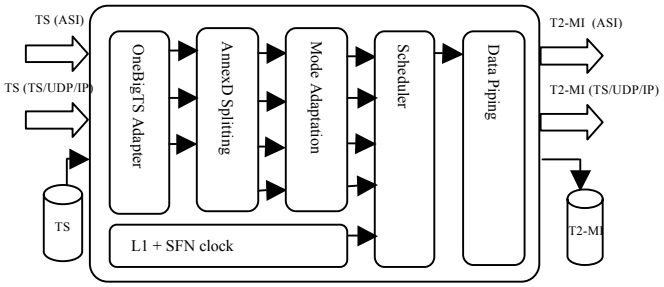
9.3.2 Multiple PLP – VV413

La Salle DVB-T2 Gateway supports configurations similar to VV413 with Multiple PLP in static multiplexing. In this mode, the allocation of BB frames is statically assigned according to the initial configuration.

9.3.3 Multiple PLP – VV400

La Salle DVB-T2 Gateway supports configurations similar to VV400 with Multiple PLP in dynamic multiplexing. In this mode, the allocation of BB frames is dynamically assigned per PLP according to the instantaneous bitrate of each PLP.
It supports 'OneBigTS' mode with a single input Transport Stream generated by a standard multiplexer. Then the DVB-T2 GW generates independent Transport Streams per each PLP (normally one PLP per service) and automatically distributes common service components and PSI/SI between Data PLPs and Common PLP.

9.4 Interfaces



9.4.1 Inputs

TS(ASI)
Standard DVB-ASI signal via 75-Ω BNC.

TS(TS/UDP/IP)
TS/UDP/IP on multicast or unicast streams.

TS(FILE)
Input TS Files.

9.4.2 Outputs

T2-MI(ASI)
Standard DVB-ASI signal via 75-Ω BNC with T2-MI signal.

T2-MI(TS/UDP/IP)
TS/UDP/IP on multicast or unicast streams.

T2-MI(FILE)
Input TS Files.

The input/output interfaces can be combined in any form.

9.5 HW specifications

ASI Connector	75-Ω BNC
Input Return Loss	> 15 dB
Error Free Cable	300 m max
ASY Physical Layer	EN50083-9
Bit Rate	0...214 Mbps
Packet Size	188 or 204
Power supply	Redundant
IP Interfaces	Dual-port Gigabit
Dimensions (H/W/D) (mm)	43/437/597 (1 RU, width 19”)
Weight	16.5kg
Environmental spec	Operating Temperature: 10° to 35°C (50° to 95°F) Non-operating Temperature: -40° to 70°C (-40° to 158°F) Operating Relative Humidity: 8% to 90% (non-condensing) Non-operating Relative Humidity: 5 to 95% (non-condensing)

10 REFERENCES

[1] *Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)* – DVB BlueBook A133 – ETSI EN 302 755 V1.2.1.

[2] *Modulator Interface (T2-MI) for a second generation digital terrestrial television broadcasting system (DVB-T2)* – DVB BlueBook A136 - ETSI TS 102 773 V1.2.1

[3] *Engines - Workpackage 4 - Task Force 10 description form*. V5 April 7, 2011.