T2-MI Satellite Distribution Architecture

Architecture of the DVB-T2 Signal Distribution Network via Satellite

Block Diagram Description | Scientific Commentary | ETSI References

Standards: ETSI EN 302 755 V1.4.1 (DVB-T2) | ETSI EN 302 307-1 V1.4.1 (DVB-S2 Multistream)

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1. Introduction

T2-MI (T2 Modulator Interface) is a specialised transport protocol defined by ETSI EN 302 755 V1.4.1, which enables the distribution of a complete DVB-T2 multiplex via a satellite link (DVB-S2) or IP network to regional terrestrial transmitters. This block diagram accurately depicts the complete architectural chain of the distribution system from the source multiplex to the end viewer.

Each element of the diagram is defined by the relevant ETSI standard, and all connections, signal flow directions and labels correspond to the current technical specifications. The following text provides an accurate scientific description of each block and connection in the diagram.

2. Central DVB-T2 Multiplex

The Central DVB-T2 Multiplex represents the source point of the entire distribution chain. It contains multiple Transport Streams (TS) corresponding to individual television services (Service 1 to Service N). Each service is encoded as a standard MPEG-2 Transport Stream in accordance with ISO/IEC 13818-1.

The multiplex also contains SI/PSI tables (Service Information / Program Specific Information):

- NIT (Network Information Table) - contains information about the physical network and transponder
- PAT (Program Association Table) - maps programmes to PID values
- CAT (Conditional Access Table) - contains conditional access information

These tables are shared across all services of the multiplex and are, according to ETSI EN 302 755, carried by the Common PLP (see section 4.1).

3. T2-MI Packager / T2 Gateway

The T2-MI Packager, also referred to as T2 Gateway, is the central processing element of the entire system. This device performs two logical functions, which according to ETSI EN 302 755 are integrated into a single hardware block - they are NOT two separate devices:

- T2-MI Packager: encapsulates the complete T2 frame structure into the T2-MI protocol
- PLP Multiplexer: multiplexes all PLPs (Physical Layer Pipes) into a single stream

3.1 T2 Frame Structure (ETSI EN 302 755, Section 6)

The T2 frame is the fundamental transport unit of DVB-T2 technology. Its precise structure is defined by ETSI EN 302 755 V1.4.1, Section 6, and must be observed without exception:

T2 Frame Element	Description and Function
P1 symbol	Synchronisation symbol - DVB-T2 signal identification, Guard Interval mode
P2 symbol(s)	Carries L1-pre and L1-post signalling - metadata about the entire frame structure
Common PLP slice	FIRST data slice immediately after P2 symbols - shared SI/PSI for all services
Data PLP slices #1..N	Data slices of individual services in order #1 to #N
T2 Timestamp	Timestamp for SFN network synchronisation (EN 302 755, §5.2.3)

CRITICAL NOTE (EN 302 755 §6):
The Common PLP slice is always placed as the FIRST data slice of the T2 frame, immediately after the P2 symbols containing L1 signalling. This order is strictly defined by the standard and must not be changed.

3.2 Common PLP [MANDATORY]

The Common PLP (Common Physical Layer Pipe) is a mandatory component of every T2-MI stream. Its existence and correct position in the T2 frame are mandatory according to ETSI EN 302 755. Use of T2-MI without this block would be contrary to the standard.

Parameter	Value / Definition
Position in T2 frame	1st data slice - immediately after P2 / L1 signalling
Content	SI/PSI tables: NIT, PAT, CAT - shared for all services

Number of slices	One slice per T2 frame
ISI assignment	ISI #0 in the DVB-S2 Multistream
Normative reference	ETSI EN 302 755 V1.4.1, Section 6

3.3 Data PLPs (Physical Layer Pipes)

Data PLPs carry the data content of individual television services. Each Data PLP is allocated precisely one slice within the T2 frame - a contiguous block of data cells in the time-frequency grid of OFDM symbols.

Definition of the term SLICE according to ETSI EN 302 755 §6: A slice is a contiguous, time-bounded block of data cells in the data OFDM symbols of a T2 frame, allocated to one specific PLP and forming an uninterrupted region in the time-frequency grid.

Data PLP Parameter	Definition
Slice	Contiguous data block allocated to one PLP in the T2 frame
ISI (Input Stream ID)	Unique PLP identifier in DVB-S2 Multistream (EN 302 307-1)
Mapping	Each Data PLP = one ISI in the DVB-S2 Multistream
Count	1 to N Data PLPs as required by the multiplex
Normative reference	ETSI EN 302 755 V1.4.1, Section 6

3.4 Two Output Paths from the T2-MI Packager

The T2-MI Packager has two independent and equivalent output paths for distributing the T2-MI stream. Both paths are mutually alternative and independent:

Output	Description
Output #1 - DVB-S2	Satellite uplink via DVB-S2 Multistream - described in section 4
Output #2 - IP/UDP	Direct distribution of T2-MI stream via IP network - described in section 7

CRITICAL NOTE - IP path:
The IP distribution path originates DIRECTLY from the T2-MI Packager as Output #2. It is NOT a satellite downlink signal. This is a frequent error in block diagrams - IP and Satellite are two independent output paths from the Packager, not two paths from the satellite.

4. DVB-S2 Multistream Uplink

The DVB-S2 Multistream Uplink represents the first of the two output paths of the T2-MI Packager. The T2-MI stream is encapsulated into satellite carrier signals according to ETSI EN 302 307-1 V1.4.1 and transmitted to the satellite.

DVB-S2 Parameter	Value / Specification
Standard	ETSI EN 302 307-1 V1.4.1
Modulation	DVB-S2
Coding	CCM - Constant Coding & Modulation (mandatory)
FEC	BCH outer code + LDPC inner code
Encapsulation	BBFRAME (BaseBand FRAME)
Streaming mode	MIS - Multi Input Stream (Multistream)
ISI #0	Carries Common PLP
ISI #1..N	Carries Data PLPs #1 to #N

CCM (Constant Coding and Modulation) is mandated by ETSI EN 302 307-1 for T2-MI distribution via DVB-S2 Multistream. CCM ensures a stable and predictable transmission channel, which is essential for SFN synchronisation via the T2 Timestamp.

ISI (Input Stream Identifier) is an 8-bit identifier defined in ETSI EN 302 307-1 that uniquely identifies each input stream within a DVB-S2 Multistream transmission. In the T2-MI context, each PLP is assigned a unique ISI: ISI #0 for the Common PLP, ISI #1 to #N for individual Data PLPs.

5. Satellite Link and Satellite Receive Station (SRS)

The satellite Eutelsat 3B located at geostationary orbit position 3.1° East serves as the relay point for T2-MI distribution to Africa, Europe and adjacent regions. The satellite supports DVB-S2 Multistream transmission in Ku, C and Ka bands with up to 51 transponders in total.

The Satellite Receive Station (SRS) is a professional facility equipped with a satellite dish and DVB-S2 demodulator. It performs the following signal processing chain according to ETSI EN 302 307-1:

- DVB-S2 demodulation of the satellite carrier signal
- FEC decoding: BCH outer + LDPC inner code
- CCM decoding
- ISI demultiplexing - splitting the Multistream into individual T2-MI streams

- BBFRAME de-encapsulation
- T2-MI stream extraction for further processing

6. Regional DVB-T2 Transmitter

The Regional DVB-T2 Transmitter receives the T2-MI stream from the Satellite Receive Station and converts it back into a terrestrial DVB-T2 radio frequency signal that can be received by standard home receivers (STB).

- T2 frame reconstruction - restoration of the precise time and frequency structure
- Restoration of all PLP slices in the correct order (Common PLP first)
- OFDM modulation - generation of the terrestrial DVB-T2 RF signal
- SFN (Single Frequency Network) support - synchronisation via T2 Timestamp
- MFN (Multi Frequency Network) support

IMPORTANT NOTE for portal visitors:
A standard home DVB-T2 receiver (STB) NEVER receives a T2-MI signal directly. The home viewer only receives the final terrestrial DVB-T2 RF signal from the antenna, generated by the Regional DVB-T2 Transmitter. T2-MI is a professional transport format intended exclusively for distribution between professional devices.

7. IP Distribution Path (Output #2 from T2-MI Packager)

The IP distribution path is the second, alternative distribution path for the T2-MI stream. Unlike the satellite uplink, the IP path leads DIRECTLY from the T2-MI Packager into the IP network - with no relationship to the satellite whatsoever.

IP Path Parameter	Value / Specification
Source	Direct Output #2 from T2-MI Packager
Protocol	UDP/IP encapsulation of T2-MI stream
Stream preservation	T2-MI stream is carried unchanged
Use	Distribution to terrestrial SFN/MFN headend stations
Relation to satellite	NONE - IP path is independent of the satellite link

The T2-MI stream distributed via the IP network is received by a professional headend device equipped with a T2-MI hardware or software decoder. This device is NOT intended for home viewers - it is professional equipment used in television studios, retransmission centres and similar professional facilities.

8. Professional DVB-T2 Receiver with T2-MI Decoder

A professional DVB-T2 receiver with T2-MI decoder is a specialised measurement and monitoring device intended EXCLUSIVELY for professional use - signal measurement, parameter analysis, quality monitoring. This device is NOT intended for home viewers.

- Requires a DVB-S2 demodulator as the input frontend
- Contains a T2-MI software decoder
- Enables selection of a specific ISI (PLP) from the Multistream
- Used exclusively for professional signal analysis and monitoring

CRITICAL NOTE - Home viewer vs. Professional:
A standard home viewer NEVER requires a T2-MI decoder. The home receiver (STB) receives only the terrestrial DVB-T2 RF signal from the antenna. A T2-MI decoder is required only in professional devices (transmitters, headend stations, monitoring systems) that work directly with the T2-MI protocol.

9. Summary - Complete Signal Flow

The following table summarises the complete signal flow in the T2-MI distribution architecture from source to end viewer:

Step	Block / Device	Process Description / Standard
1	**Central DVB-T2 Multiplex**	Source point - TS service streams + SI/PSI tables
2	**T2-MI Packager / T2 Gateway**	T2-MI encapsulation, T2 frame creation, PLP Mux (EN 302 755)
3a	**DVB-S2 Uplink (Output #1)**	DVB-S2 Multistream encapsulation, CCM, ISI, BBFRAME (EN 302 307-1)
3b	**IP Network (Output #2)**	Direct T2-MI/UDP distribution - alternative to satellite
4	**Satellite Eutelsat 3B @ 3.1°E**	Passive relay point - geostationary orbit, DVB-S2 MIS
5	**Satellite Receive Station (SRS)**	DVB-S2 demodulation, ISI demux, T2-MI extraction (EN 302 307-1)
6	**Regional DVB-T2 Transmitter**	T2-MI to DVB-T2 conversion, OFDM modulation, SFN/MFN (EN 302 755)
7	**DVB-T2 STB (home receiver)**	Standard terrestrial DVB-T2 reception - end user

10. Normative References

All technical data in this document have been verified against the following standards:

Standard	Title and Relevant Sections
ETSI EN 302 755 V1.4.1	DVB-T2: Frame structure, channel coding and modulation. Sections 5, 6 (T2 frame, PLP, Common PLP, Slice, T2 Timestamp)
ETSI EN 302 307-1 V1.4.1	DVB-S2: Framing structure, channel coding and modulation. CCM, Multistream, ISI, BBFRAME, MIS
ISO/IEC 13818-1	MPEG-2 Systems: Transport Stream specification

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