MMT Library

Broadcom
Corporate Headquarters: San Jose, CA

Web: www.broadcom.com

Revision History

Revision	Date	Change Description
0.1	11/03/2017	First draft
0.2	04/30/2018	1. Subtitle support 2. Lip sync support 3. Clock recovery 4. exTSMF, TSMF and MTSIF

Table of Contents

List of Figures

Overview

In Japan, 4K and 8K broadcasting will be done only using MMT standard. MPEG Media Transport (MMT) specification is developed by MPEG-H committee (MPEG-H Part-1) for delivery of Audio/Visual information. For now, MMT is targeted only for BCM7278 based STBs.

Following figure shows simplified layer model of the audio/video data encapsulation using MMT standard for transmitting it via IP (broadband networks), Satellite and Cable Broadcast systems in Japan.

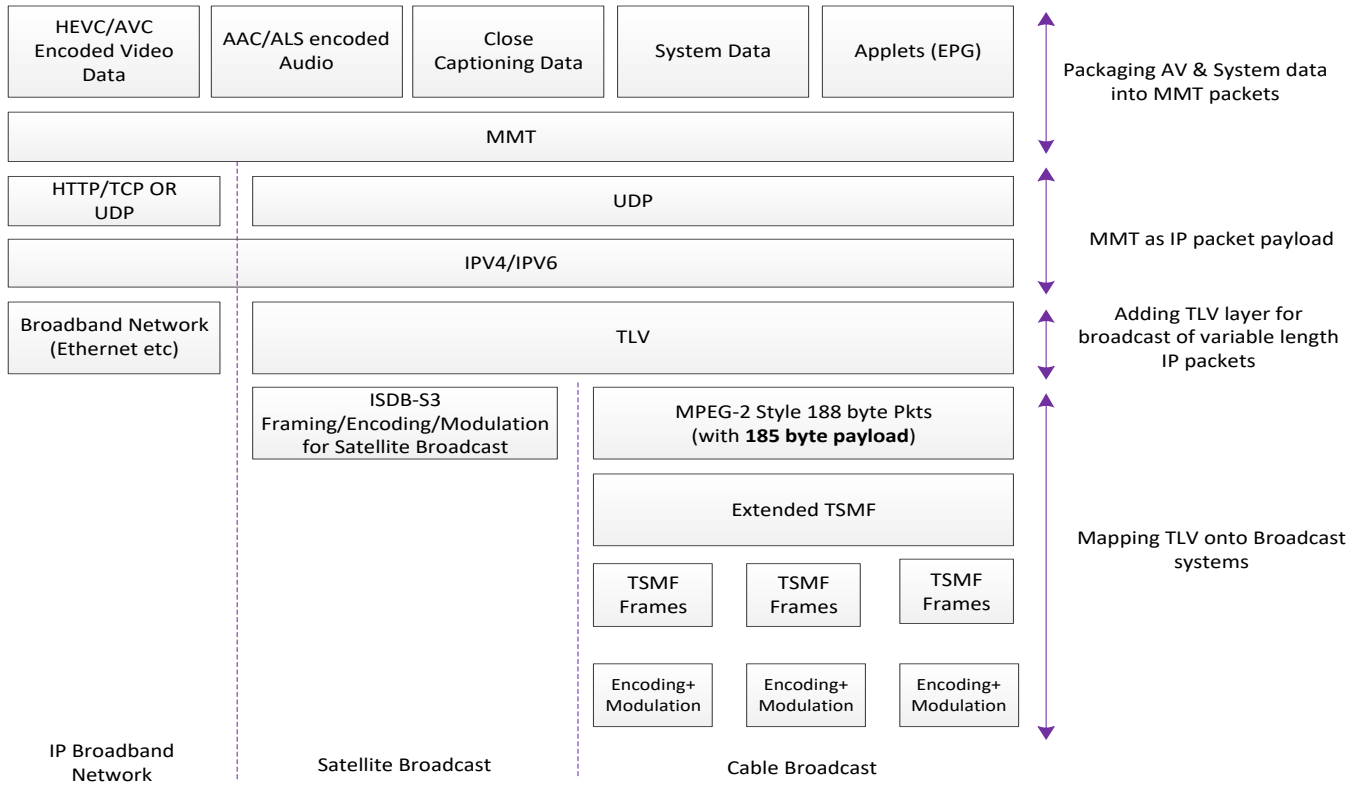


Figure 1 : MMT Layered Model for IP/Satellite/Cable systems

As shown in the above figure, TLV (Type Length & Value) layer is added while broadcasting variable length IP packets via Satellite or Cable networks.
In Satellite broadcast delivery network, high bit rate TLV streams are transmitted by using framing/encoding and modulation defined by ISDB-S3. ISDB-S3 enables satellite link speeds up to 100 Mbps and hence high bit rate requirements of 4K or 8K streams can be met using ISDB-S3.

Typical Cable delivery modulators provide ability to transmit up to 40 Mbps. In order to transmit 8K content via such cable network, TLV streams are chopped and packetized into MPEG style packets

(with 185 bytes as the packet payload). The high bit rate MPEG-2 style bit stream is then distributed over multiple cable transponders using Extended TSMF layer (defined by JCTEA **STD-007-6.1**). The Extended TSMF layer makes use of the existing TSMF frame structure for providing bonding parameters of the distributed TLV streams.

Usage cases

MMT via Cable Broadcast

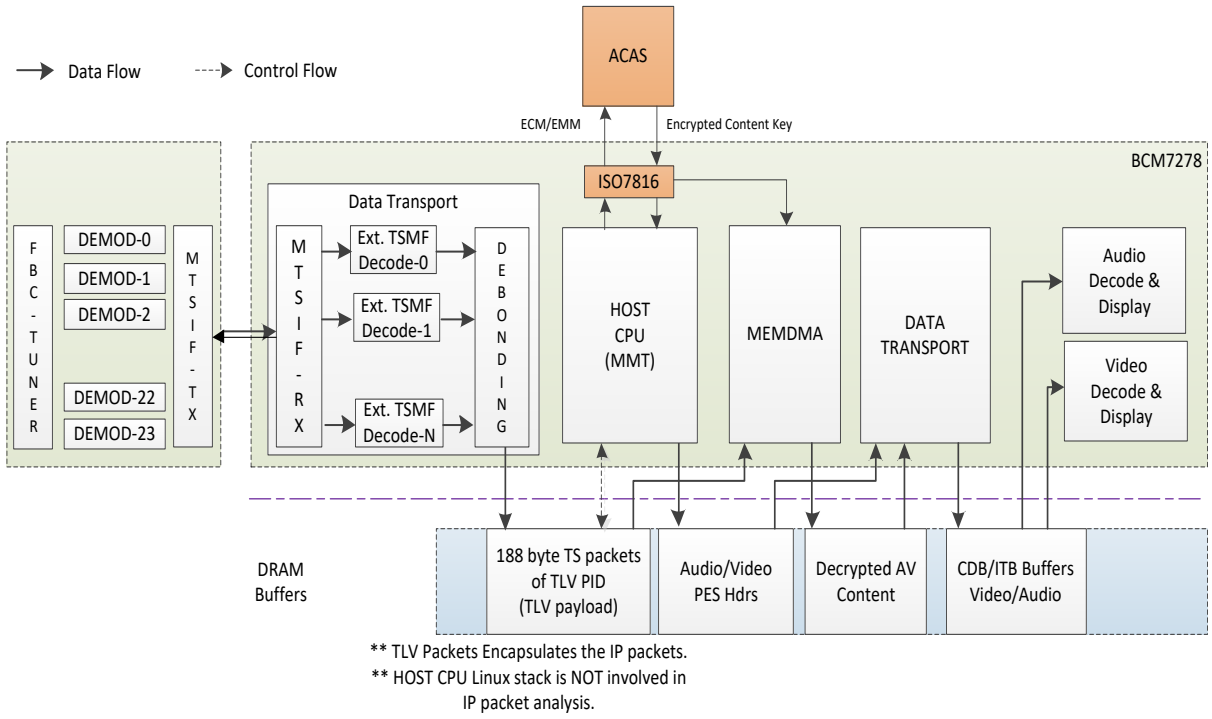


Figure 2: MMT Support over Cable Broadcast Systems

In Cable Settop Box systems, the single fat TLV stream (containing 4K or 8K content) is distributed over multiple modulators using Extended TSMF. At receiver, the stream data from multiple tuners/demodulators are required to be bonded into a single fat TLV stream before decoding. The packet re-sequencing from multiple transponders with Extended TSMF frames has to done at every 188 byte boundary. BCM7278 performs such task using Extended TSMF Decoding HW for reconstructing the distributed streams.
The MMT SW running on Host CPU extracts the TLV packets and MMTP packets (by analyzing MPEG-2 TS, TLV, IP headers) from MPEG2TS (3 bytes header + 185 bytes payload) packets read from data transport HW. MMT SW then feeds MMT payload from MMT packets to MEMDMA for descrambling. The AV data extracted from decrypted MMT payload content is then stitched by MMT SW with the PES headers and fed to Data Transport. Data transport generates CDB/ITB data for video and audio decoder & display pipe.

TSMF

TSMF is supported in some Broadcom de-modulators (like BCM33843) and optionally it's supported in most Broadcom backend chips. Many customers used TSMF functionality from Broadcom de-modulators.

Extended TSMF

Channel bonding functionality is added in extended TSMF spec. Only back end chips from Broadcom support extended TSMF. As an example BCM7278 is a first chip supporting extended TSMF capability.

MTSIF (Multiplexed Transport Stream Interface)

MTSIF is a proprietary interface between Broadcom multi de-modulator chips and back end chips like BCM7278. It carries MPEG2TS data for multiple tuners on a single interface.

MMT via Satellite Broadcast

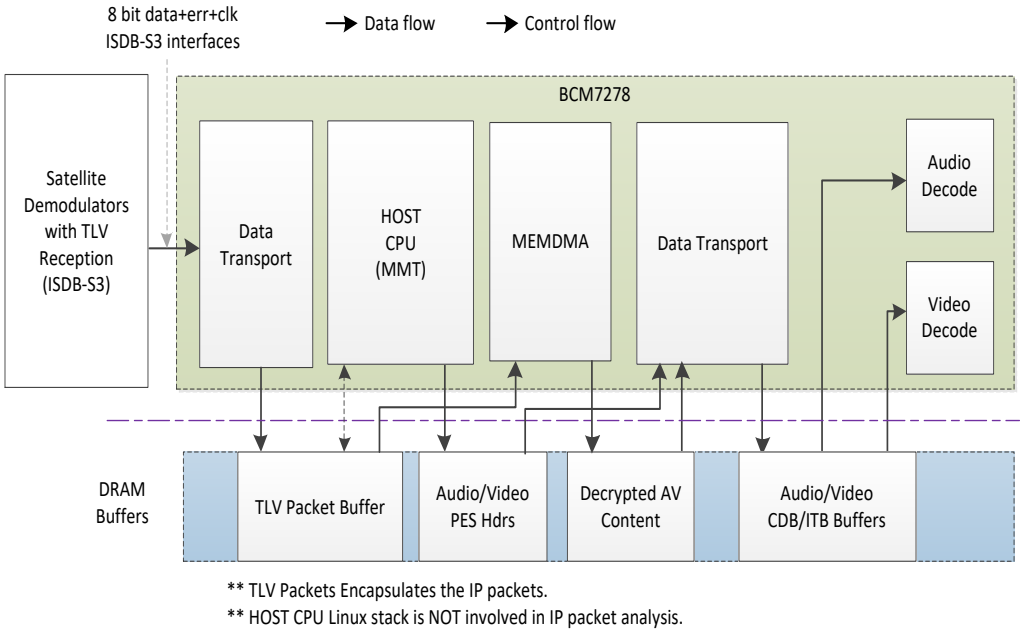


Figure 3: MMT Support in Satellite Broadcast Systems

BCM7278 supports 8 bit data/err/clk interface to ISDB-S3 TLV receivers. Data Transport module routes all the TLV packets to the TLV Packet Buffer maintained in DRAM. MMT SW on Host CPU analyzes TLV headers, IP headers and extracts MMTP packets. MMT SW then feeds MMT payload from MMT packets to MEMDMA for descrambling. The AV data extracted from decrypted MMT payload content is then stitched by MMT SW with the PES headers and fed to Data Transport. Data transport generates CDB/ITB data for video and audio decoder & display pipe.

MMT SW Library

MMT SW library is a nexus application library that uses CPU to parse mpeg2ts (3 bytes header) or TLV data stream from a file source, QAM source or ISBD-S3 source and generate control information and mpeg2ts AV streams to be used for live decoding, message extraction, recording and transcoding. Applications can mix nexus and MMT APIs to get desired functionality for MMT/TLV based products. Most of the testing is done specifically on BCM7278 based reference platforms.

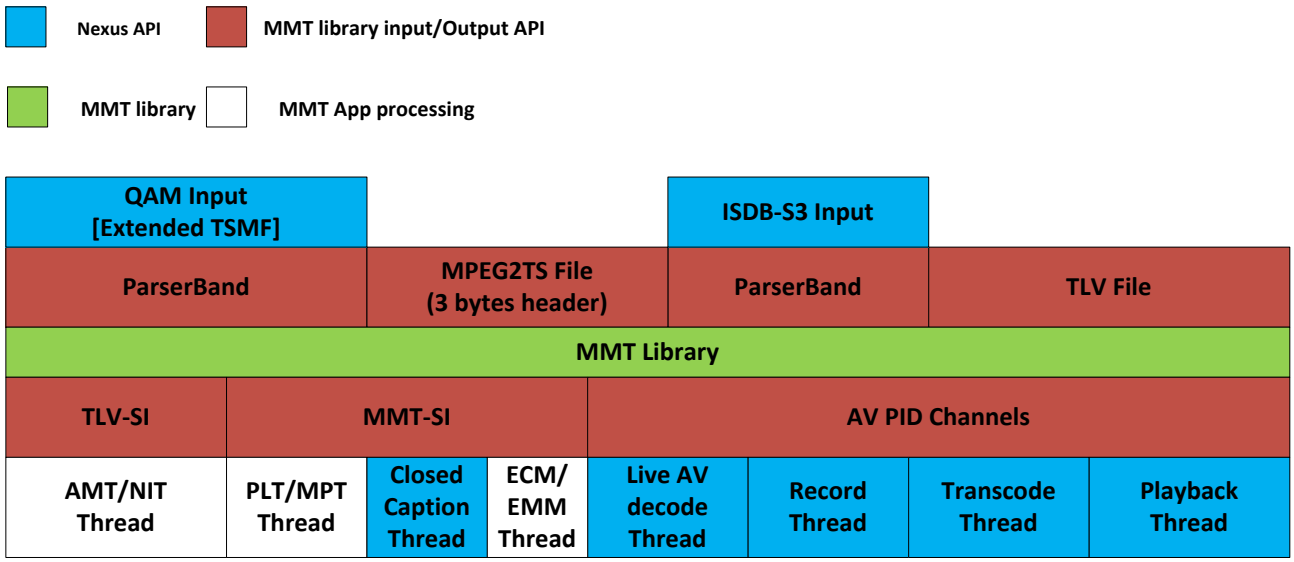


Figure 4: nexus app with MMT library

As of now, the following is supported

- Live non bonded mpeg2ts (3 bytes header) AV decode

- Live Extended TSMF based bonded mpeg2ts (3 bytes header) AV decode
- Message extraction from live and playback
- TTML Subtitle extraction
- Playback of TLV and mpeg2ts (3 bytes header) files
- Recording of TLV file/mpeg2ts (3 bytes header) file as an mpeg2ts (4 bytes header) stream
- Recording of live mpeg2ts (3 bytes header) as an mpeg2ts (4 bytes header) stream

SI extraction

There are 2 many descriptors and tables defined by the ARIB spec so Broadcom library provides hooks to get the required raw message buffer which applications can use to extract the necessary tables based on their product specification. Refer to mmt_message_from_playback.c example app for usage of SI APIs.

There are 2 types of SI

- MMT-SI - APIs are available to get the raw MMT-SI message buffers which applications can use to further extract descriptors and tables. MMT example application facilitates extraction of only PLT and MPT tables as an example.

- TLV-SI: APIs are available to get the raw TLV-SI message buffers which applications can use to further extract different descriptors and tables. MMT example application facilitates extraction of AMT table as an example.

Subtitles

MMT library converts the subtitle data into PES packets and feeds them into data transport HW. Nexus message APIs can be used to extract the PES packet based subtitle data just like DVB subtitle data. mmt_subtitle_from_playback.c example app shows how to get the TTML format subtitle data from an MMT stream.

Lip sync

Broadcom back end chips support MPEG2TS PTS based lip sync and PCR based clock recovery.

MMT streams carries MPU time stamps (NTP formatted) so MMT library converts MPU timestamps extracted from MPT table into PTS. The PTS and MMT MPU payload are used to make PES packets. Those PES packets are then fed into data transport HW which then directs AV ES data to AV decoders. PTS from AV PES packets are used for lip sync just like a regular MPEG2TS playback.

Clock Recovery (TODO)

In Broadcom back end chips, to match system clock with encoder clock, PCR based clock recovery is used. As MMT streams don't have PCR time stamps, MMT library treats MMT stream as IP broadcast input. For IP broadcast, MMT library will monitor AV buffer depth and adjust the system clock frequency every 100ms. Note, MMT library doesn't used NTP time stamps as defined by ARIB spec.

Security (TODO)

MMT APIs for security are yet to be defined.

Playback/Live

Applications shall use the MMT message buffer APIs to get security related descriptors and extract the keys and algorithm type and provide them as input to MMT library. MMT library will use the keys and algorithm type from app along with IV created in the MMT library to decrypt the MMT payload based on the scrambling control bits provided in the MMTP header. IV is created from packet ID and packet sequence number in the MMTP header. Decryption would be done in DMA HW.

Recording

Like in live/playback case, rather than feeding the PES packets from data transport HW to AV decoders, PES packets are routed to record data transport HW. Record data transport HW adds TS headers and generates a usual MPEG2TS stream which can be playback using usual nexus playback app. To support encrypted recording, applications can encrypt the recording like any MPEG2TS recording i.e. application can choose an algorithm and keys and use the nexus security APIs to encrypt the recording.

Software build & test instructions

In URSR releases, MMT library sources are located at BSEAV/lib/mmt. Sample apps are located at BSEAV/app/mmt. Set environment variables as mentioned in the URSR release notes for BCM7278 based platform.

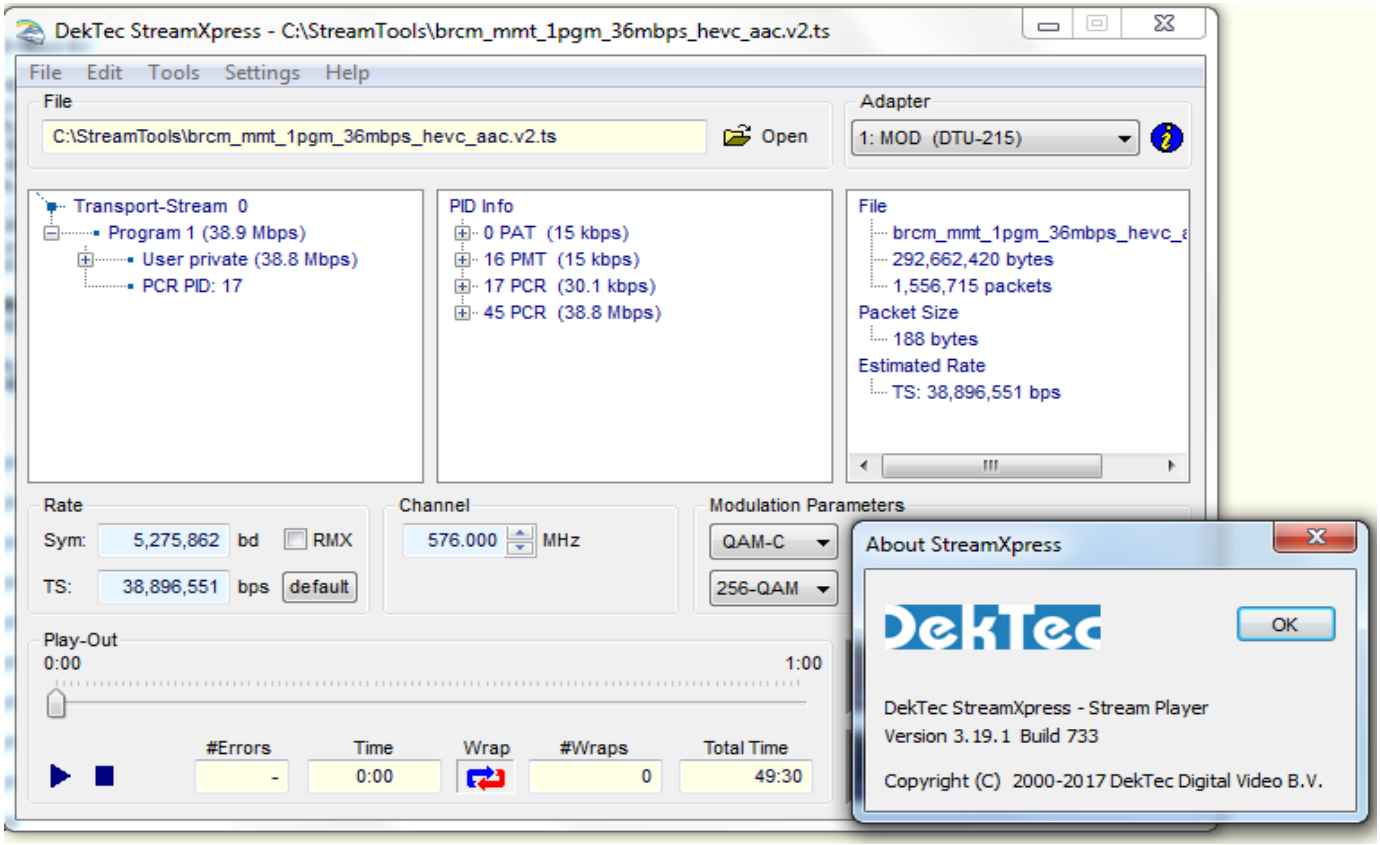
Build

 # cd nexus/build
 # make

 # cd BSEAV/app/mmt
 # make
All mmt sample apps should be copied over to obj.$(NEXUS_PLATFORM)/nexus/bin

Non exTsmf MMT Live testing

DekTec StreamXpress is used to stream mpeg2ts (3 byte header) stream from a windows PC to BCM3158 on BCM7278 based reference platform. StreamXpress version and modulation parameters are shown in the picture below. No Extended TSMF bonding/de-bonding tested using this method.



mmt_live app extracts MMT SI and TLV SI info using MMT library for live AV decode.

#./nexus mmt_live –freq 576 –tlv_pid 0x2d

exTsmf MMT Live testing

In the absence of exTsmf modulator, Broadcom tested exTsmf live mmt using Broadcom proprietary setup which requires an MTSIF feeder FPGA board that feeds exTsmf mmt stream in

.mtsif format to BCM7278 reference board. For further details, please contact your FAE. Below is the app used to test exTsmf mmt live using Broadcom setup.

#./nexus tsmf_mmt_live

Playback testing

#./nexus mmt_playback -input_format 1 -tlv_pid 0x2d APAB_4K_all.ts
 # ./nexus mmt_playback -input_format 2 Capture_20161206180200_20161206180500-bsc.tlv
#./nexus mmt_playback -input_format 1 -tlv_pid 0x2d APAB_4K_SONY_JUMBO_20170407_143421.ts
 # ./nexus mmt_playback -input_format 1 -tlv_pid 0x2d APAB_4K_WHITEBOX_20170407_143233.ts

Record Testing

 # ./nexus mmt_record -freq 576 -tlv_pid 0x2d /opt/mmt/record_live.ts
 # ./nexus playback /opt/mmt/record_live.ts

Miscellaneous Testing

#./nexus mmt_message_from_playback -input_format 1 -tlv_pid 0x2d APAB_4K_WHITEBOX_20170407_143233.ts
#./nexus mmt_subtitle_from_playback -input_format 2 *Capture_20170221182645_20170221183215-bsc.tlv*

Tested Streams

Below is a list of streams that were used for testing.

APAB Streams

These streams need to be directly requested from APAB

mpeg2ts streams (3 bytes header)

- APAB_4K_all.ts
- APAB_4K_SONY_JUMBO_20170407_143421.ts
- APAB_4K_WHITEBOX_20170407_143233.ts

TLV streams

- Capture_20161206180200_20161206180500-bsc.tlv
- Capture_20161213180745_20161213181315-bsc.tlv
- *Capture_20170221182645_20170221183215-bsc.tlv*

Broadcom Streams

These streams can be requested from Broadcom.

- brcm_mmt_1pgm_36mbps_hevc_aac.v2.ts (mpeg2ts [3 bytes header] stream)
- mmt_apab_40Mbps_4bands.mtsif (exTsmf mmt stream in .mtsif format)

TODO Items

1. Security (live/playback/recording)
2. Clock recovery
3.Transcode