MAYAH Communications
Application Note 34

MPEG TS

1. General description

1.1 General

The MPEG TS standard which was adopted as ISO/IEC 13818 – 1 defines ways of multiplexing more than one stream (audio, video and data) into one program. A program consists of one or more **P**rogram **E**lementary **S**treams (PES), which may or may not be MPEG encoded. The multiplexing process discerns 2 different schemes:

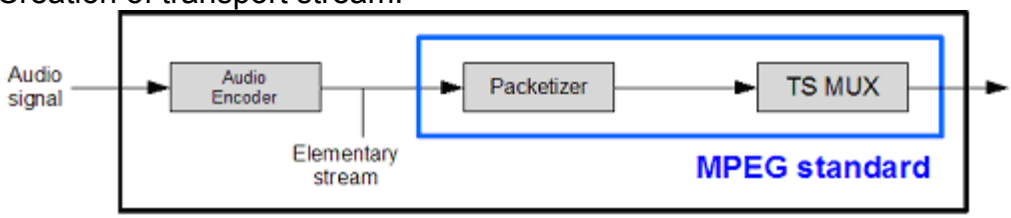
1.1.1 Transport Stream (TS)

- intended for storage and transmission in non-error-free environments
- fixed length (188 byte)
- multiple reference clocks possible
- e.g. Broadcasting, ATM

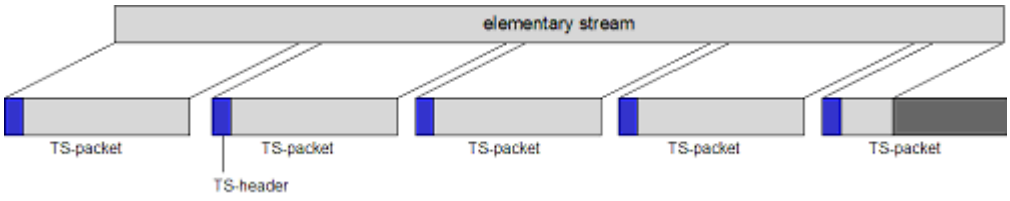
1.1.2 Program Stream (PS) – not covered in this chapter

- intended for storage and transmission in error-free environments
- large/multiple length packets
- single reference clock
- e.g. DVD

Creation of transport stream:



Packetization of an elementary stream into TS-packets:

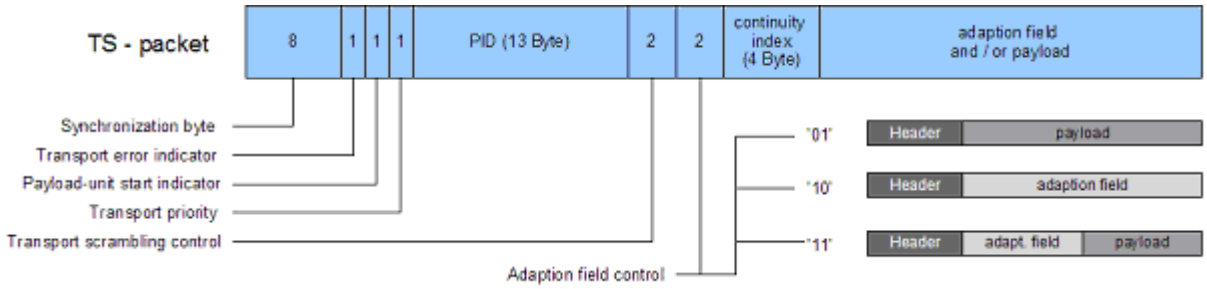


1.2 Elements of MPEG TS

1.2.1 Packet

A packet is the basic unit of the MPEG-2 Transport Stream and consists of a packet header, an optional adaption field and/or an optional payload field. A packet is a cell of 188 bytes with a header size of 4 bytes and a payload/adaption field size of 184 bytes. Stuffing of a TS-packet is possible.

TS packet header:



1.2.2 PID (Packet/Program identifier)

The PID is used to identify distinct elementary streams within the transport stream. The PID is a 13 bit value what allows the differentiation between a maximum of 8192 different PID's. TS packets with a PID of 0, 1 or 2 are special packets that include program specific information (PSI).
The PID's in the range from hexadecimal 0 to 15 are reserved by the ISO/IEC 13818-1.

1.2.3 Program

A program in an MPEG-TS is defined as a collection of PID's that are related to each other (audio, video and data). Each Transport Stream comprises of one or more programs. The easiest comparison of a program might be a TV or radio channel. At the moment Centauri, C11xx, Sporty and FMII supports only one program (stereo audio channel).

1.2.4 Program Specific Information (PSI):

The PSI information is used by the decoder to 'learn' about the currently received/decoded transport stream.
The MPEG-2 TS standard defines 4 tables from which the first 2 are currently used in the Centauri, C11xx, Sporty and FMII:

Table Name	Abbreviation	PID
Program Association Table	PAT	0 x 0000
Program Map Table	PMT	Dynamically defined in PAT
Conditional Access Table	*CAT*	*0 x 0001*
Network Information Table	*NIT*	*Dynamically defined in PAT*

1.2.4.1 PAT (Program Association Table):

The PAT contains a complete list of all programs in the transport stream along with the PID (**P**rogram **I**dentifier) for the PMT (**P**rogram **M**ap **T**able) of each program. More or less PAT is a summary of the PID's of the PMT's.
PAT has got the PID = 0.

1.2.4.2 PMT (Program Map Table)

PMT contains information about individual programs. There is one PMT PID for each program. The PMT combines all relevant PID's for the particular program. You can say that the PMT provides the mapping between the program number and the program elements that comprise them.

1.3 Synchronization of elementary streams

For the reconstruction of the original program the MPEG-2 TS standard introduces mechanisms for synchronization of different streams within a program. Therefore timestamps are inserted by the encoder. These timestamps are based on the STC (**S**ystem **T**ime **C**lock; 27 MHz) which is the reference for the program and the master clock of the audio signal.
After multiplexing, the encoding system inserts a reference clock to regenerate the STC on the decoding side.

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1.3.1 PCR (Program Clock Reference)

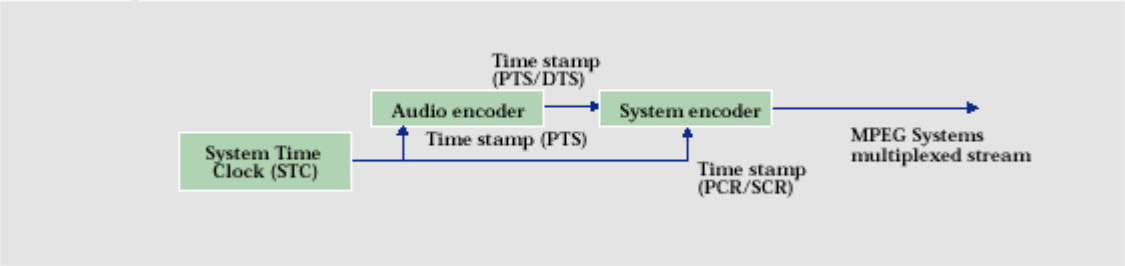
The PCR is the reference clock that is used to synchronize both encoder and decoder.
The PCR information is a 42 bit value of the adaption field which includes the PTS and DTS (see item 3.2).
The regeneration of the STC (**S**ystem **T**ime **C**lock) on the receiving side depends on transmitting PCR's through the system. PCR's are inserted at a maximum interval of 100 ms and are measured in units of one period of a 27 MHz clock.
The synchronization/regeneration of the STC on the receiving side is affected by variable delay or jitter of the link.

1.3.2 PTS (Presentation Time Stamp) and DTS (Decoding Time Stamp)

The Presentation Time stamp and the Decoding Time stamp are added to the audio frame (called **A**ccess **U**nit).

The PTS indicates when an audio frame should be removed from the receiver buffer, decoded and presented, while the DTS indicates when an audio frame should be removed from the receiver buffer and decoded.
Both PTS and DTS are entered in the bit stream at intervals not exceeding 700 ms. The timestamps are expressed in units of one period of a 90 kHz clock (retrieved from the 27 MHz system clock). In an audio-only stream the PTS is identical to the DTS.

Creation of PTS and DTS:



2. Technical description

Sessions are used to configure and execute MPEG TS connections. The following elements have to be configured.

Please note that first a profile entry must be configured for a session and than a phonebook entry which refer to the corresponding profile entry. The destination address for a session is taken from the first phonebook entry specified for the session, if there are more than one streams defined for a session.

2.1 Session number

Here the number of the selected session is shown. It cannot be changed in this dialog. 256 sessions can be stored in Centauri, C11xx, Sporty and FMII.

2.2 Session name

The maximum length of a session name is 256 characters.

2.3 Session mode

The session mode can be selected to:

- MPEGTS (see also chapter MPEG Transport Stream)
- DMB (**D**igital **M**edia **B**roadcast)
- DVB (**D**igital **V**ideo **B**roadcast)
- ISMA (**I**nternet **S**treaming **M**edia **A**lliance)

If session mode is set to ‘none’ the session is inactive.

2.4 Sub codec

Here the sub codec is selected. The sub codec number corresponds to the destination number in the session dialog. Every sub codec is assigned to one elementary stream.

2.5 Destination

One destination can be set for every sub codec of a session. It can be set to:

- last (i.e. last IP connection)
- phone book

If phone book is selected an additional edit filed is shown which enables either

- that a phone book entry number can be typed in

or

- opening the phone book dialog by mouse double clicking to select a phone book entry

All entries becomes valid by clicking the OK-button. However, just the session part for the selected sub codec is changed. If it should be also changed for another sub codec this dialog must be open again and the other sub codec must be selected.

2.6 Provider name

Provider name can be configured for DVB service via the corresponding destination addresses of the phone book entry: "**/PRV** <*provider name*>".

2.7 Service name

Service name can be configured for DVB service via the corresponding destination addresses of the phone book entry: "**/SRV** <*service name*>".

2.8 SPTS / MPTS

Single programs transport stream (SPTS) or multiple programs transport stream (MPTS) can be configured via the following enhancement of the connection parameter in the direct command or phone book entry: "**/si <stream ID> <program ID> <program number>**". The device use its own default values, if this enhancement is not available in the connection parameter.

<stream ID>:
ID of the codec stream. Use "-1" for a random stream ID.

<program ID>:
MPEGTS program ID. Use "-1" for a random program ID.

<program number>:
MPEGTS program number.

<program ID> and **<program number>** describes a program for MPG TS, which has to be used for a stream. A program is automatic created for MPEG TS for the corresponding stream, if none of these program identifiers are already used in MPEG TS.

2.9 Constant bit rate

Constant bit rate can be configured via the following enhancement of the connection parameter in the direct command or phone book entry: "/**cbr** <bit rate>". The bit rate value is optional.

2.10 Language code

ISO 639 language code can be set for any stream by using "**/LAN** xxx" in the destination entry of a phone book. There "xxx" is the ISO 939 language code (e.g. "ger" for Germany, "dut" for Netherlands).

3. How to use on MAYAH devices

MPEG TS can be used with sessions which contains references to phonebook entries. Please refer to the Communication Reference Manual and operating manuals how to configure phonebook entries.

3.1 via Front panel

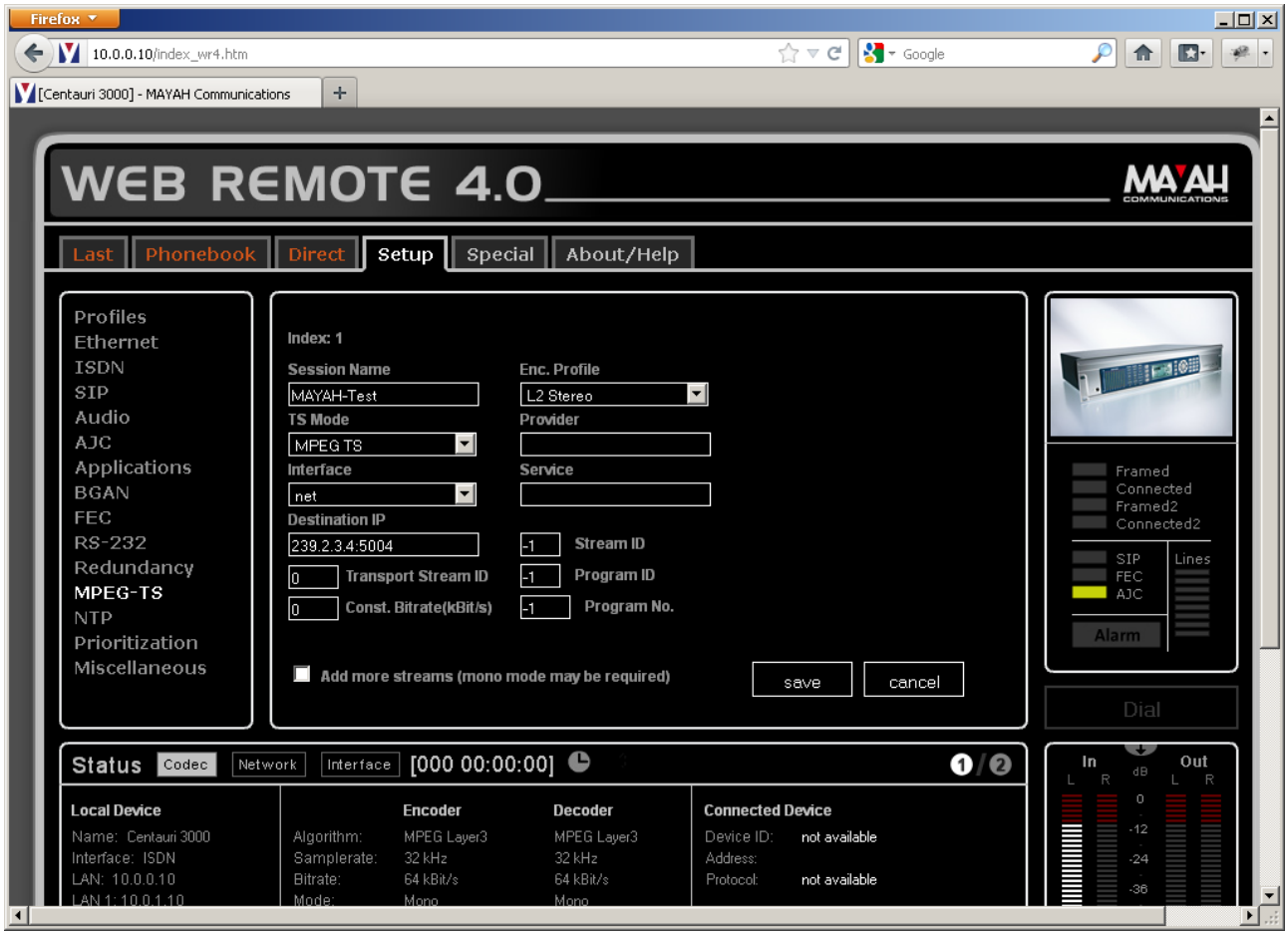
Sessions via front panel are only available on Centauri.

3.2 via Webremote

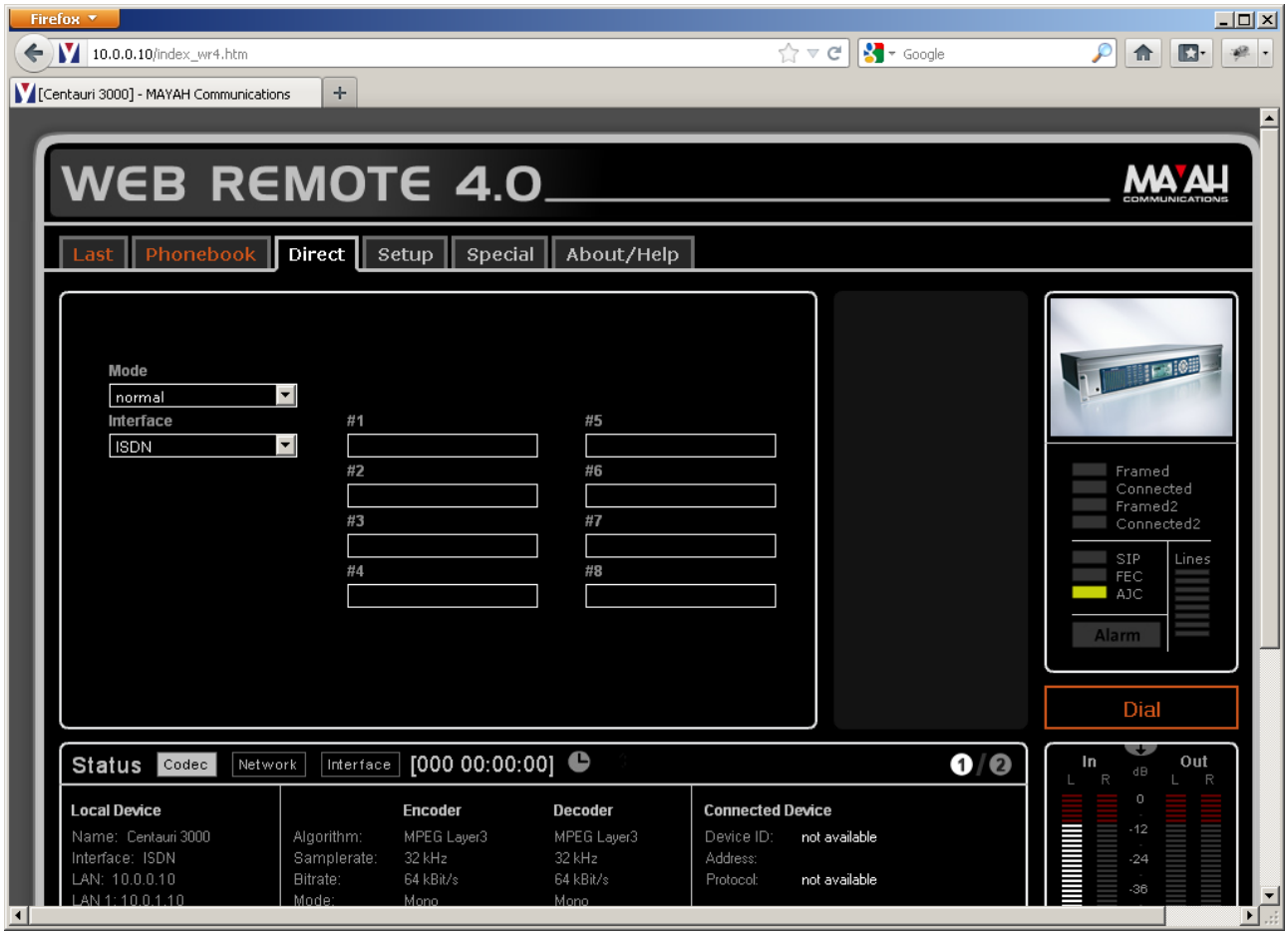
3.2.1 Define sessions

3.2.1.1 Navigate on http://10.0.0.10/index_wr4.htm to SETUP | MPEG-TS

3.2.1.2 Create e new MPEG-TS session or edit an existing one

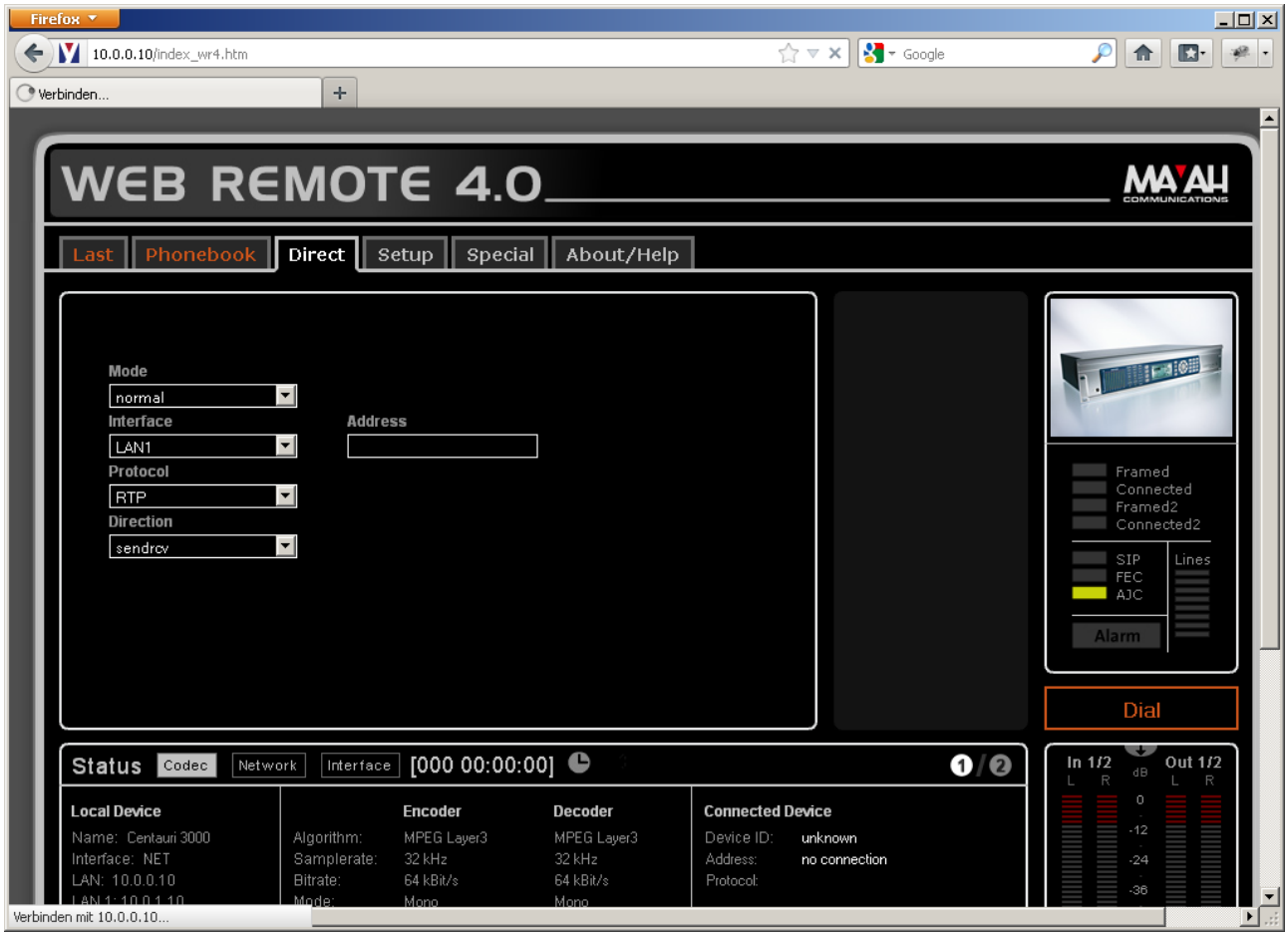


3.2.1.3 Configure your settings for MPEG-TS session and save the session

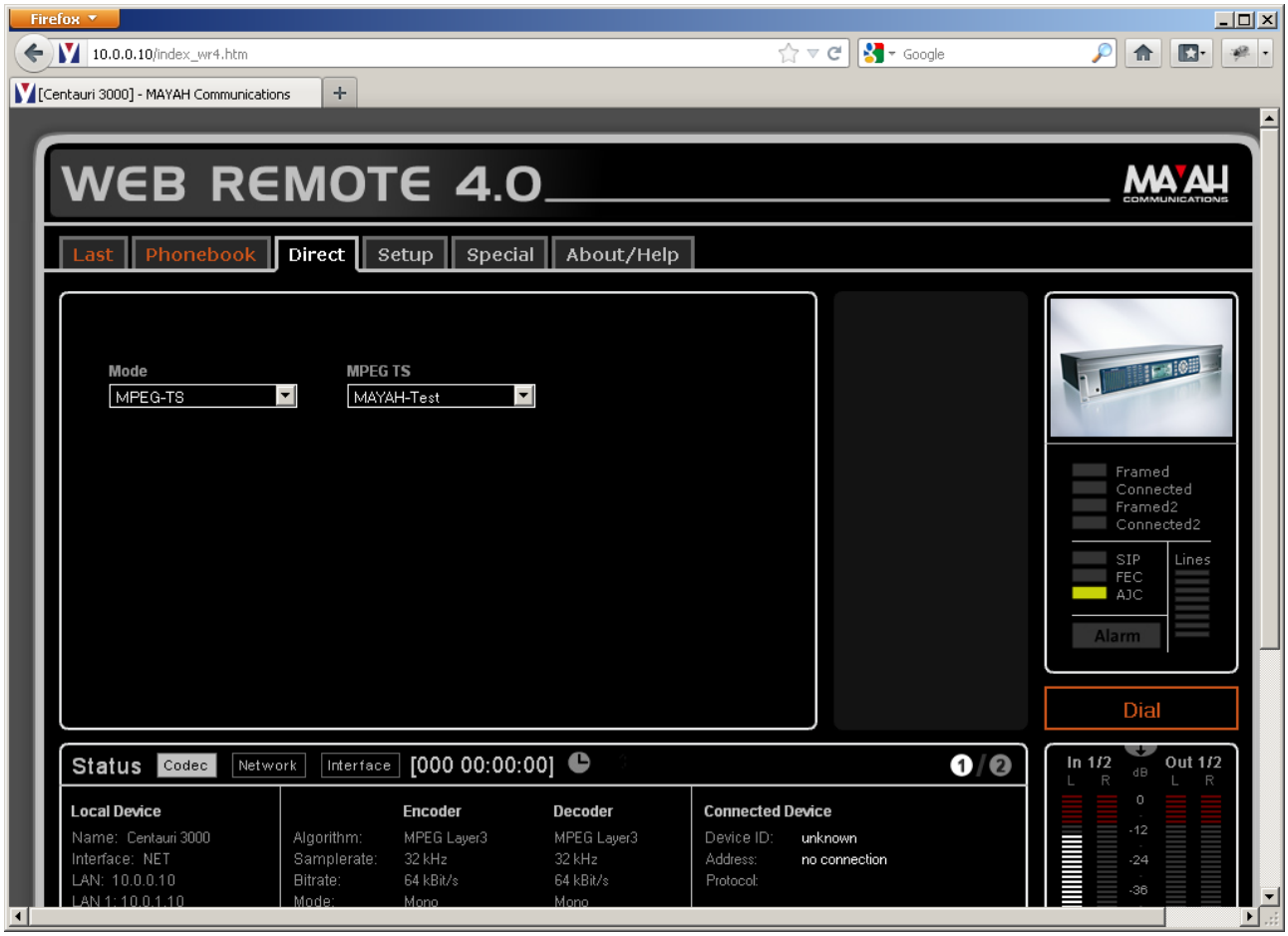


3.2.2 Use MPEG-TS sessions

3.2.2.1 Navigate to DIRECT and change the interface to NET if any other interface is currently active



3.2.2.2 Change the mode to MPEG-TS and select the MPEG-TS session for the requested MPEG-TS connection



3.2.2.3 Use now DIAL button for starting the MPEG-TS encoder

3.3 with Direct Commands

3.3.1 Define sessions

Use the following in the corresponding order session commands to configure a session. These commands are defined in the Communication Reference Manual.

3.3.1.1 Set session to use

“se_idx 1” address a session index 1 which could be modified with the following commands. There up to 256 sessions available.

3.3.1.2 Set session name

“se_name MPEGTS” set the name of the session to MPEGTS.

3.3.1.3 Set session type to use

“se_mode mpegts” set the type of the session to mpegts. Other types are defined in the Communication Reference Manual.

3.3.1.4 Set sub codec to use

“se_didx 1” address the sub codec for the following phone book entry. The maximum value for this parameter depends on the used product. Please refer to the Communication Reference Manual for further information.

3.3.1.5 Set phone book to use

“se_dest <phone book index> + 2” defines which phone book entry should be used for this session. Please refer to the Communication Reference Manual for further information.

3.3.2 Use sessions

Use the following session commands to establish a connection and disconnect a session. These commands are defined in the Communication Reference Manual.

3.3.2.1 Connect

“se_connect 1” start a session with session index 1.

3.3.2.2 Disconnect

“se_disconnect 1” stop a session with session index 1.

3.3.3 Example

3.3.3.1 Single program transport stream (SPTS)

se_idx 1	Number of session
se_name mySPTS	Name of session
se_mode mpegts	MPEGT mode
se_didx 1	First sub codec of session
se_dest 2	use phone book index 0 (+2)
se_connect 1	start SPTS connection

3.3.3.2 Multiple program transport stream (MPTS)

se_idx 2	Number of session
se_name myMPTS	Name of session
se_mode mpegts	MPEGT mode
se_didx 1	First sub codec of session
se_dest 4	use phone book index 2 (+2)
se_didx 2	Second sub codec of session
se_dest 5	use phone book index 3 (+2)
se_connect 2	start MPTS connection

Please note that the used phone book entries no. 2 and no. 3 have the following enhancement in the connection parameter in our example.
phone book entry 2: *10.0.0.10* **/si 25 28 29 /prv My Provider 1 /srv My Service 1**
phone book entry 3: *10.0.0.10* **/si 35 38 39 /prv My Provider 1 /srv My Service 2**
Both last parameters in the “/si” enhancement must be different to the previous phone book entry to generate an additional program (MPTS) in MPEG TS.