USER MANUAL

EtherMPX v3

DOCUMENT REVIEWS

Date	Version	Notes
01 Mar 2014	1.0	Initial release
20 Feb 2015	1.1	Rephrase of some sections
10 Mar 2015	1.2	Merged with SFN option User Manual

Dear customer,

After introducing our DDS-30 FM Exciter in 2010, the first in the world capable to accept Digital MPX (MPX over AES), it was time to solve another problem: there was no Digital MPX STL in the market! Also, the existing Analog MPX STLs could not meet our high standards in order to exploit the full capabilities of DDS-30.

That's why we decided to design a Digital MPX STL, which could transport Digital MPX, beside the classic analog MPX, analog L/R, and digital L/R (over AES) modes. Since we are big fans of the "everything IP" concept, we couldn't select something else than IP transmission!

In your hands, you have the EtherMPX IP STL, which is the result of our research and development. Since version 3, an LCD user interface and SFN over IP capabilities added, so you don't need GPS receivers any more!

Always with 24bit professional high-end audio performance and minimal latency, we could compare the performance of EtherMPX to a cable! Even if EtherMPX is designed to be a perfect match with our DDS-30 FM Exciter, you can use it to deliver analog MPX to any other exciter, and you will notice immediately the difference compared to any analog FM STL.

So, enjoy using your EtherMPX and thank you for selecting us for your business!
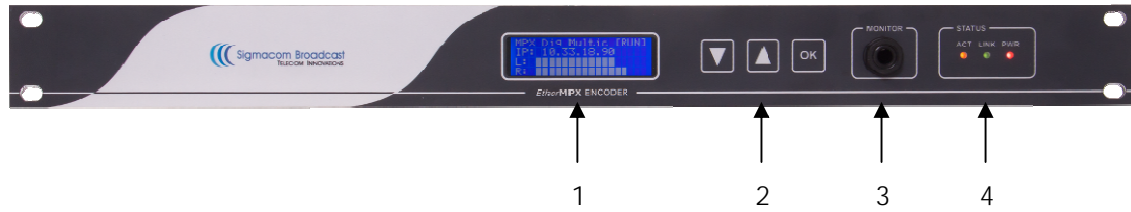

Sigmacom Broadcast
March 2014

Contents

1. Hardware description

The front panel (Encoder / Decoder):

        1   2   3   4

1. LCD Display [20x4 characters]
2. Navigation buttons [UP, DOWN, OK]
3. Monitor output [1/4" TRS Female jack]
4. Status LEDs [ACT, LINK, PWR]

The rear panel (Encoder):

1 2 3   4   5   6   7   8   9   10
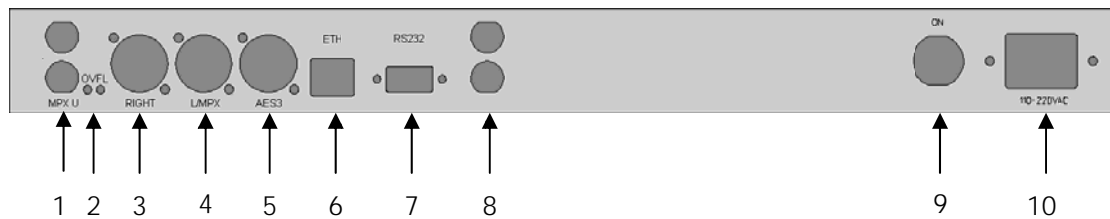
1. Unbalanced MPX input (BNC female)
2. Excessive input level alarm LEDs (L/R)
3. Right channel balanced input (XLR3 female)
4. Left channel / MPX balanced input (XLR3 female)
5. AES/EBU balanced input (XLR3 female)
6. 10/100 Ethernet port (RJ45 female)
7. RS232 port (DB9 female)
8. 10MHz input & output (BNC female – SFN option)
9. On/Off power switch
10. 100-240VAC power input connector (IEC)

The rear panel (Decoder):
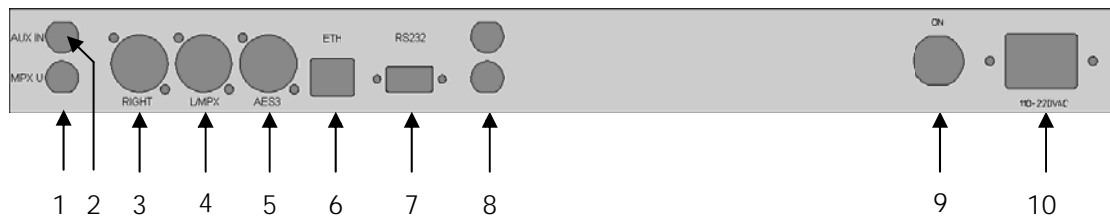
1. Unbalanced MPX output (BNC female)
2. Unbalanced AUX MPX input (BNC female)
3. Right channel balanced output (XLR3 male)
4. Left channel / MPX balanced output (XLR3 male)
5. AES/EBU balanced output (XLR3 male)
6. 10/100 Ethernet port (RJ45 female)
7. RS232 port (BD9 female)
8. 10MHz output (BNC female – SFN option)
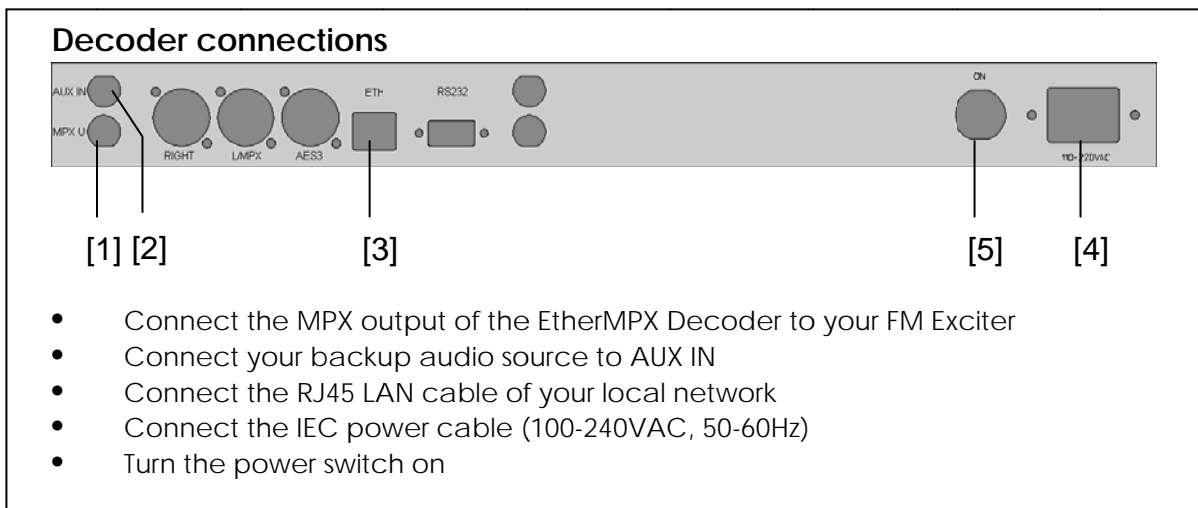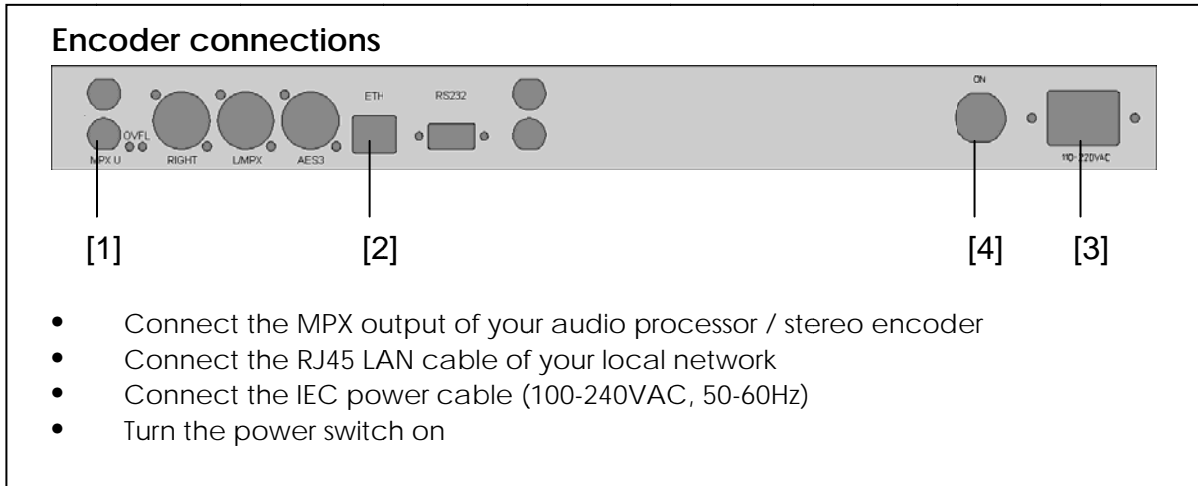9. On/Off power switch
10. 100-240 VAC power input connector (IEC)

2. Installation instructions (Encoder & Decoder):

1. Install both Encoder & Decoder in a 19″ rack.
2. Connect power and Ethernet cables as shown below:

Encoder connections

[1]   [2]   [4]   [3]

- Connect the MPX output of your audio processor / stereo encoder
- Connect the RJ45 LAN cable of your local network
- Connect the IEC power cable (100-240VAC, 50-60Hz)
- Turn the power switch on

Decoder connections

[1] [2]   [3]   [5]   [4]

- Connect the MPX output of the EtherMPX Decoder to your FM Exciter
- Connect your backup audio source to AUX IN
- Connect the RJ45 LAN cable of your local network
- Connect the IEC power cable (100-240VAC, 50-60Hz)
- Turn the power switch on

Audio levels adjustment at Encoder

Analog audio input at Encoder should not exceed +6dBu (4.37Vpp). Suggested nominal range is 0dBu (2.19Vpp) to +4dBu (3.47Vpp).
The audio outputs at the Decoder will provide the same audio level (1:1) as fed into the Encoder. Analog and digital outputs of Decoder are operating simultaneously.

Rear panel LED indications at Encoder:

- OVFL LEDs (two, one for each analog input): Indicates extremely audio level that needs immediate attention, otherwise damage may occur at analog input stages of the Encoder.

Front panel LED indications (Encoder & Decoder):

- PWR LED: Indicates that power is turned on
- LINK LED: Indicates that an Ethernet connection is present.
- ACT LED: Indicates that audio transmission is active.

Note: When Encoder is configured in "Unicast" mode and powered on, it searches for the Decoder (ACT LED is blinking every second). When a connection is established, ACT LED at Encoder & Decoder stay always on. If connection is lost, Encoder will cease transmission after 10 minutes and will start the search sequence each 17 seconds.

Default settings:

- Encoder default IP: 192.168.1.90 / 24
- Decoder default IP: 192.168.1.91 / 24
- Factory setup: Analog MPX, Unicast

Network considerations:

If you have multiple EtherMPX devices in the same network (like 1 Encoder and 2 or more Decoders), you MUST change the IP addresses of the devices accordingly to avoid IP conflicts (two devices with the same IP in the same network is **never allowed**).

If you have multiple networks or other traffic reaching the EtherMPX Encoder or Decoder, you **must filter it**. A recommended practice is to make network segmentation by using VLANs.

It is strongly recommended to use transparent bridge Ethernet links with sufficient bandwidth and low jitter in order for the EtherMPX system to operate normally. The latency, delay variance and fragmentation caused by routing, **is forbidden** for real-time traffic such as EtherMPX produces.

The required bandwidth for L/R mode is roughly 2.5Mbit/s, and for MPX mode is roughly 4.8Mbit/s.

The audio buffer size at the decoder side depends on the network jitter you have in your transmission network. Select an appropriate buffer size to compensate the instability of your transmission network, otherwise you will experience audible audio artifacts ("clicks" and "pops") due to packet loss or drops.

Always consider that an increased buffer size results into additional latency to the audio delivered.

3. LCD menus:

From the LCD menus the user can view or modify some basic parameters (described below). To control all system parameters, you have to use the EtherMPX NMS (Network Management System) software.
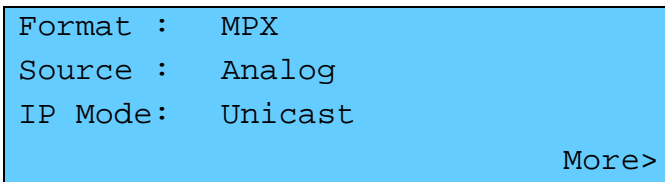
To navigate through the menus:
You can use the "UP" and "DOWN" buttons in the front panel, to navigate through the User Interface menus displayed in the LCD.

To modify a parameter:
Press once the "OK" button and a blinking cursor should appear in the screen. Use the "UP" and "DOWN" arrow buttons to move the cursor over the parameter you want to modify. When you set the cursor over the desired parameter, click once again the "OK" button. Now you can use the "UP" and "DOWN" buttons to modify the parameter.

When done, click "OK" button again. A confirmation menu appears "SAVE? Y/N" where you can select "Y" if you want to apply and save the new settings, or "N" to discard any changes you made.
If you don't push any button within 30 seconds, the system discards any changes and returns to the main menu.

1. **Menu: Operational mode**

```
Format :    MPX
Source :    Analog
IP Mode:    Unicast

                    More>
```

Format:
Enc & Dec: Select the audio format you need to transport through EtherMPX. You can select between "MPX" or "L/R".

**Source:**
Enc only: Select the source port of the Encoder. You can select between "Analog" or "Digital" (AES/EBU) input.

IP Mode:
Enc only: Select the transmission mode. If you want to feed only one EtherMPX Decoder in your network, select "Unicast". If you need to feed more than one EtherMPX Decoders simultaneously, select "Multicast" (Destination IP: 239.255.255.239).

2. Menu: Audio level

```
Input                    dBFS
A  ■  ■  ■  ■  ■  ■      -10.3
B  -
<Back                    More>
```
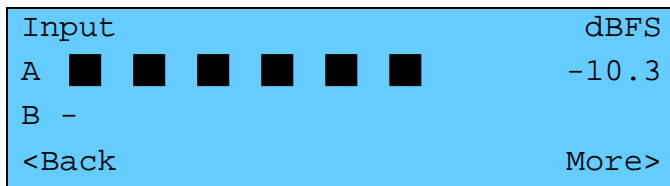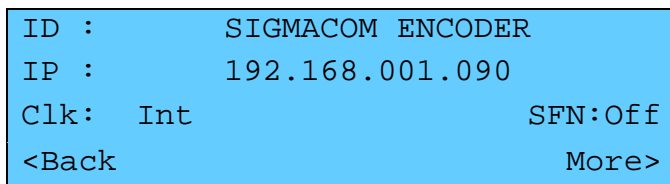
A: Displays the audio level of L/MPX channel
B: Displays the audio level of Right channel (only in L/R mode)

Audio levels are displayed as a bar graph (VU meter) and as numerical value in dBFS. Please note that this is a display only menu. You cannot modify any parameter.

3. Menu: Network settings (Encoder)

```
ID :       SIGMACOM ENCODER
IP :       192.168.001.090
Clk:  Int              SFN:Off
<Back                    More>
```

ID:
Displays the device name. You cannot modify this parameter from the LCD menu, you have to use the EtherMPX NMS software.

IP:
Displays the device IP address. You can modify this parameter within the range of 1.0.0.1 to 254.255.255.254.

Clk:
Selects the reference clock source "Int" or "Ext". You cannot modify this parameter from NMS to avoid loss of communication. Only local modification is allowed. When selecting "Int", the Encoder uses the internal 10MHz TCXO reference. When selecting external, uses an external 10MHz reference connected at the rear "10MHz INPUT" female BNC connector. If the external 10MHz reference is lost, system halts.

SFN:
Displays the operational status of the SFN option (if installed). The "Off" status disables the Master Clock. When "On" the Master Clock is enabled.

Menu: Network settings (Decoder)

```
ID :        SIGMACOM DECODER
IP :        192.168.001.091
Att:  0.0                 SFN:Off
<Back                     More>
```

ID:
Displays the device name. You cannot modify this parameter from the LCD menu, you have to use the EtherMPX NMS software.

IP:
Displays the device IP address. You can modify this parameter within the range of 1.0.0.1 to 254.255.255.254.

Att:
Displays the analog output attenuation setting. A value of 0dB means no attenuation. You can modify this parameter in steps of 0.5dB within the range 0.0dB to Mute.

SFN:
Displays the operational status of the SFN option (if installed). The "Off" status means that the device is running on the internal clock. When "On" the device is synchronized to the Best Master clock elected from the network (please refer to IEEE1588v2 protocol specifications for more details on this).

4. System information

```
        Sigmacom EtherMPX v3
DSP =       v3.42
CPU =       v3.42
<Back
```
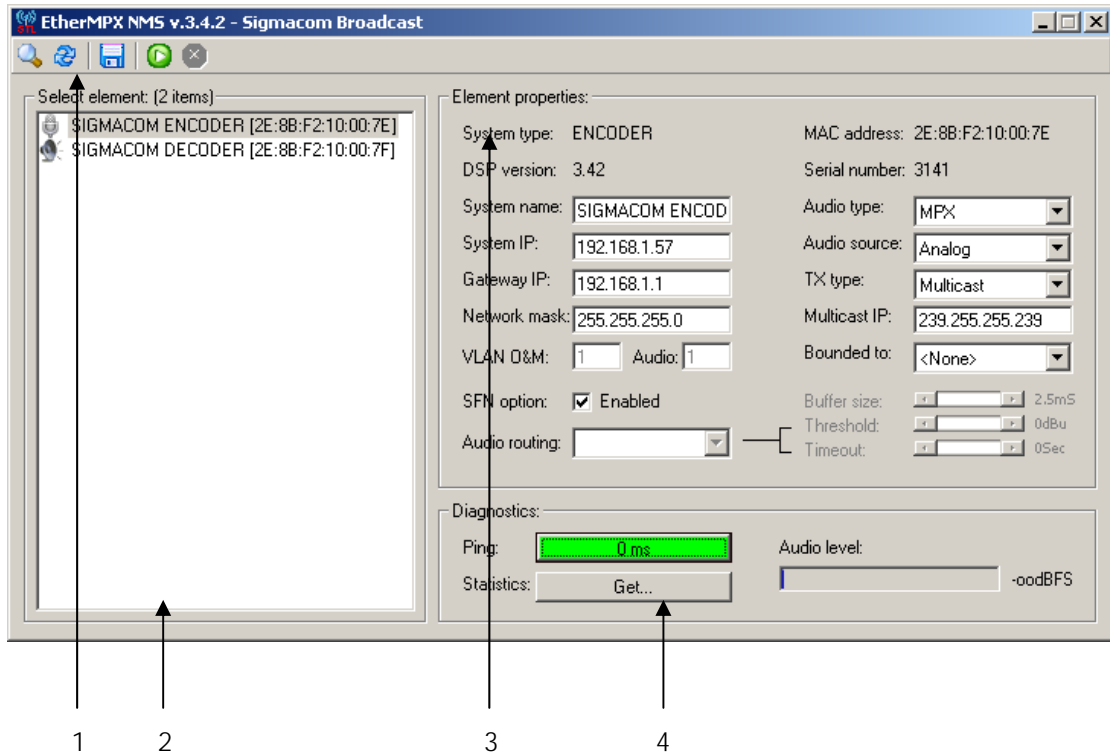
DSP:
<u>Enc & Dec</u>: Displays the firmware version running in the main processor. You cannot modify this parameter.

CPU:
<u>Enc & Dec</u>: Displays the firmware version running in the O&M (Operation & Maintenance) processor. You cannot modify this parameter.

4. NMS Software description

1. Command buttons

🔍 Discovery
Use this command to auto detect all EtherMPX devices in your network. Your computer must be in the same subnet as your devices are.

🔃 Refresh
Use this command to discard any changes made, and reload the last saved configuration stored in your computer.

💾 Save
Use this command to save locally in your computer any changes made, and simultaneously send them to the selected device (Encoder or Decoder).

▶ Play
This command is available only when the selected device is an Encoder device. Use this command to start audio level capture and display it in real time at the VU meter located at the down right corner of the "Diagnostics" area.

🟥 Stop
This command is available only when the VU meter is running.
Use it to stop audio level capture from Encoder.

2. **Devices list**

In this area will be displayed all the devices discovered in your
network after you used the "Discovery" command button.

🎤 icon: Indicates an Encoder device
🎤 icon: Indicates a Decoder device

Next to each icon, the device name and MAC address is displayed.

3. **Device properties**

When you click on a device in the "Devices list" area, its properties
and parameters are displayed here.

- **System type:** ENCODER or DECODER (non modifiable)
- **DSP version:** The firmware version running in the main processor
  of the selected device (non modifiable)
- **MAC address:** The MAC address of the network interface of the
  selected device (non modifiable)
- **Serial number:** The production serial number of the selected
  device (non modifiable)
- **System name:** View or modify the human friendly name of the
  selected device. Highly recommended if you have more than
  one Encoder or more than one Decoder in your network. This
  helps you to identify the proper device to manage.
- **System IP:** View or modify the IP address of the selected device.
- **Gateway IP:** View or modify the network gateway IP address of
  the selected device.
- **Network mask:** View or modify the network mask of the selected
  device.
- **VLAN:** Reserved for future releases. User cannot modify this.
- **SFN option:** Only available when SFN option is installed in the
  selected device.
- **Audio routing:** This is a Decoder only functionality. View or modify
  the audio route of the selected Decoder. Use the drop down
  menu to select between the available options:
  - Force external: Take the audio from AUX IN and pass it to
    the MPX OUT
  - Force internal: Take the audio from Ethernet and pass it to
    the MPX OUT
  - Auto detect: Enables the Silence Detector (see below).

- **Audio type:** View or modify the audio format of the selected device. Use the drop down menu to select between "MPX" or "L/R".
- **Audio source:** This is an Encoder only functionality. View or modify the input source of the Encoder. Use the drop down menu to select between "Analog" or "Digital" (AES/EBU) inputs.
- **TX type:** This is an Encoder only functionality. View or modify the audio over IP transmission mode at the Encoder. Use the drop down menu to select between "Unicast" (one Encoder to one Decoder) or "Multicast" (one Encoder to many Decoders). When in "Multicast" packets sent from Encoder, will have destination IP as defined in the "Multicast IP" field box (see below).
- **Remote / Multicast IP:** This field has a double purpose. In Encoder with TX Type = Unicast, you type the IP address of the target Decoder to transmit to. In Encoder with TX Type = Multicast you type the destination Multicast IP address in the range of 239.0.0.1 to 239.255.255.254. The Decoders participating in this group, must be also configured to "listen" to the same multicast IP address.
- **Bounded to:** Reserved for future releases, has no effect.
- **Buffer size:** This is a Decoder only functionality. View or modify the audio buffer size of the selected Decoder. Please refer to "Network considerations" section above.
- **Threshold:** This is a Decoder only functionality and it is enabled only when "Auto detect" audio routing is selected. This is a parameter of the integrated Silence Detector in the Decoder, and defines the audio level threshold to start a countdown timer before it bridges the AUX IN to the MPX OUT connector (assuming that the audio over IP is lost).
- **Timeout:** This is a Decoder only functionality and it is enabled only when "Auto detect" audio routing is selected. This is a parameter of the integrated Silence Detector in the Decoder, and defines the initial value of the countdown timer.

Silence Detector example: Threshold = -18dBu, Timeout = 20 sec. If the audio level coming from the EtherMPX encoder is below -18dBu for 20 consecutive seconds, the Silence Detector will assume that the audio over IP is lost, and will bridge the AUX IN to the MPX OUT connector.

When the audio level is restored above -18dBu for 5 consecutive seconds, the Silence Detector assumes that the audio over IP is OK and disconnects the AUX IN from the MPX OUT connector.

If your program has long periods of silence or long pauses between songs and talent, it is recommended to set the audio routing of the Decoder to "Force internal".

Note: The 5 seconds restoration timer is factory fixed and cannot be modified by the user.

4. Diagnostics

When you have selected a device in the "Devices list" area, you can use the following tools:

- **Ping response:** Click with your mouse this button, to perform an ICMP ping towards to the IP address of the selected device. The ping is originating from your computer IP address, so it must be in the same subnet as the device is.
  If there is a ping response, the button turns in green color and the response time is displayed.
  If there is no response within a second, the button turns into red color with a "Failure" caption.
- **Statistics:** Every EtherMPX device keeps statistical counters about Ethernet packets being transmitted or received. If the SFN option is installed, statistical counters about the synchronization performance are displayed. Click on the "Get" button, and a new window will appear (see below):
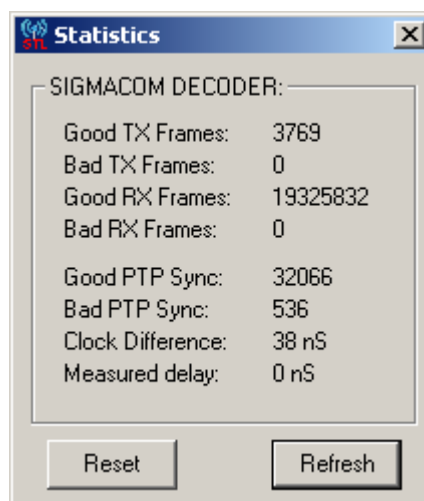
- - **Good TX Frames**: Ethernet frames transmitted OK from the device (no internal underruns / overruns, network collisions).
  - Bad TX Frames: Ethernet frames that failed to be transmitted from the device (possible causes: internal underrun /overrun, or network collisions).
  - **Good RX Frames**: Ethernet frames received OK from the device (no CRC errors, no underruns / overruns, no network collisions).
  - **Bad RX Frames**: Ethernet frames received, but dropped by the device (possible causes: CRC errors, internal underrun / overrun, network collisions).
  - **Good PTP Sync**: (Only available if SFN option is installed and enabled). Number of PTP SYNC messages received OK and took into account by

the device algorithms to calculate and calibrate on-the-fly the sync parameters.

- **Bad PTP Sync**: (Only available if SFN option is installed and enabled). Number of PTP SYNC messages received, but rejected by the device algorithms. Possible causes: Glitching Master Clock, heavy loaded network, many irrelevant Ethernet packets that must be filtered out.
- **Clock difference**: (Only available if SFN option is installed and enabled). The measured mismatch between the Master Clock and the local clock, expressed in nanoseconds (nS). This value must be as low as possible to indicate that there is a good sync with the Master Clock. Cases of >100nS difference, indicate a network problem. Possible causes: excessive latency fluctuations caused by Ethernet switches or wireless transmission.
- **Measured delay**: (Only available if SFN option is installed and enabled). The delay between local device and Master Clock device.
- **Reset Button**: Click this button to reset counters to zero. A confirmation dialog appears to verify this operation.
- **Refresh Button**: Click this button to update the counters (fetch from device).

- **Audio level:** This is an Encoder only functionality. This is a real time VU meter, which displays the audio level of the selected Encoder. To start monitoring the audio level, select the Encoder device you want, and click the "Play" button on the top strip. To stop the audio monitoring, just click the "Stop" button next, or select some other device from the "Devices list". Keep in mind that audio monitoring causes a reverse direction IP traffic of about 100-200kbit/s.

5. SFN Option

This section refers to the SFN Option, wherever is installed and enabled.

- **Operation principals:** To construct a Single Frequency Network (SFN), a.k.a. isofrequency network, all devices must have a common reference clock in order to be synchronized. A common practice is to use GPSDO, or external GPS reference clocks, with a 10MHz output (in some cases, with an additional 1PPS signal output also).

  With the EtherMPX SFN Option, you can have that 10MHz reference clock, provided by each Decoder. To accomplish this, we have implemented a PTP mechanism (IEEE1588v2) which synchronizes each Decoder to the clock of the Encoder, which acts as a Master Clock.

  The accuracy and stability of this method, heavily depends on the intermediate network elements, such as Ethernet switches, wireless IP links etc. Special network devices with PTP support are already available in the market, but for small scale implementations, ordinary devices can be utilized with a small impact to the overall performance.

  In cases where excessive latency fluctuations occur (like WiFi links), the PTP algorithms cannot handle it, and synchronization is extremely poor. We are constantly trying to improve our PTP algorithms, so please consult our support team for further information.

  The overall performance & accuracy, also depends on the quality of the Master Clock. The Encoder Master Clock is based on a TCXO with an accuracy of 2.5ppm, so in cases where more accuracy is required, it is suggested to use an external 10MHz clock (Rubidium atomic clock, or GPS 10MHz reference).

- **Encoder:** To select the internal 10MHz reference, switch the "CLK" to "Int" from the front panel menu (LCD display and buttons). If you want to use an external 10MHz reference, please connect it first to the rear female BNC connector marked as "10MHz INPUT" and then switch the "CLK" to "Ext" from the front panel menu.

  When switching from "Int" to "Ext" and vice versa, user must perform a full power reset of the Encoder, in order to trigger a re-sync state to all Decoders participating in the network.

The rear female BNC connector marked as "10MHz output" provides 10MHz 3.3Vpp CMOS signal (AC coupled) to drive any other device needed.

In case you are using an external 10MHz reference and it is lost, the system switches into a st-by mode (no audio or SYNC packets are transmitted). As a protection measure, you cannot modify "Int" / "Ext clock selection from the NMS software – only local modifications are allowed.

To turn on the PTP operation, switch the "SFN" selection to "On" (this can be modified from the front panel menu or the NMS, see previous sections). When enabled, the PTP mechanism is sending every 2 seconds a UDP port 319 SYNC message with a destination multicast IP of 224.0.1.129. The time stamping engine is capable of 8nS discrimination.

- **Decoder:** To turn on the PTP operation, switch the "SFN" selection to "On" (this can be modified from the front panel menu or the NMS - see previous sections).

  When enabled, the device captures SYNC messages and the PTP algorithms process them on-the-fly and apply corrections to the local clock. After a short (15-30 minutes) to a medium (30-60 minutes) period of time, the averaging errors should be minimized and the 10MHz output of the Decoder will be in close sync to the Master Clock (Encoder).
 The accuracy and stability of the synchronization, heavily depends on the intermediate network elements, such as Ethernet switches, wireless IP links etc. The environment temperature can also affect the accuracy and stability of synchronization.

  If after 1 hour of operation, the "Clock Difference" counter (see "Statistics" section above) is over 100nS, then you need to investigate what causes this instability in your network.
  Also, an excess of 10:1 ratio between "Good PTP Sync" and "Bad PTP Sync", also indicates a network issue that disturbs the operation of the PTP mechanism.

In cases where excessive latency fluctuations occur (like WiFi links), the PTP algorithms cannot handle it, and synchronization is extremely poor. We are constantly trying to improve our PTP algorithms, so please consult our support team for further information.
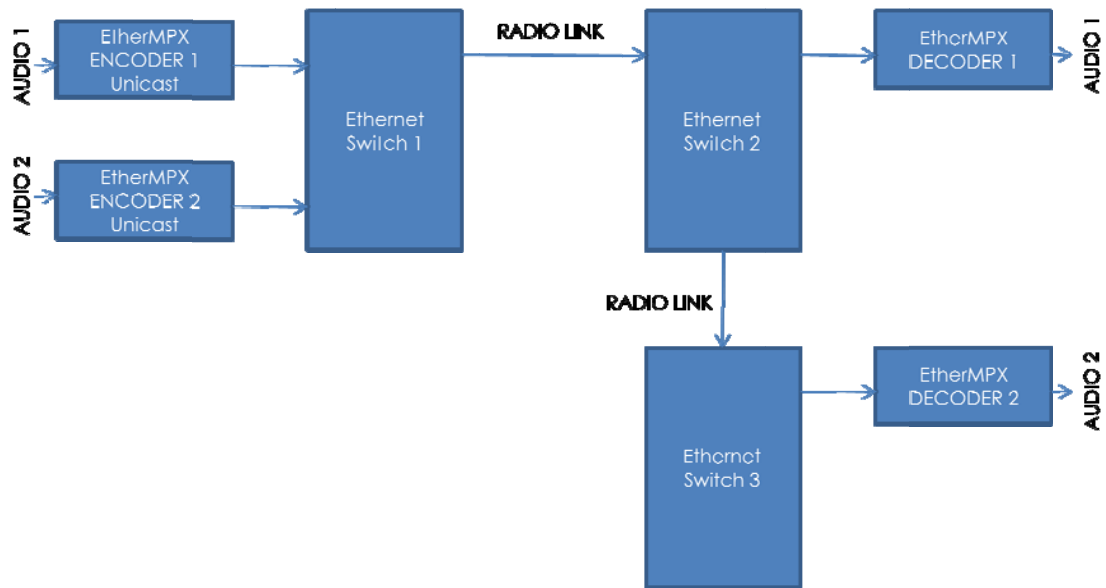
6. Implementation examples
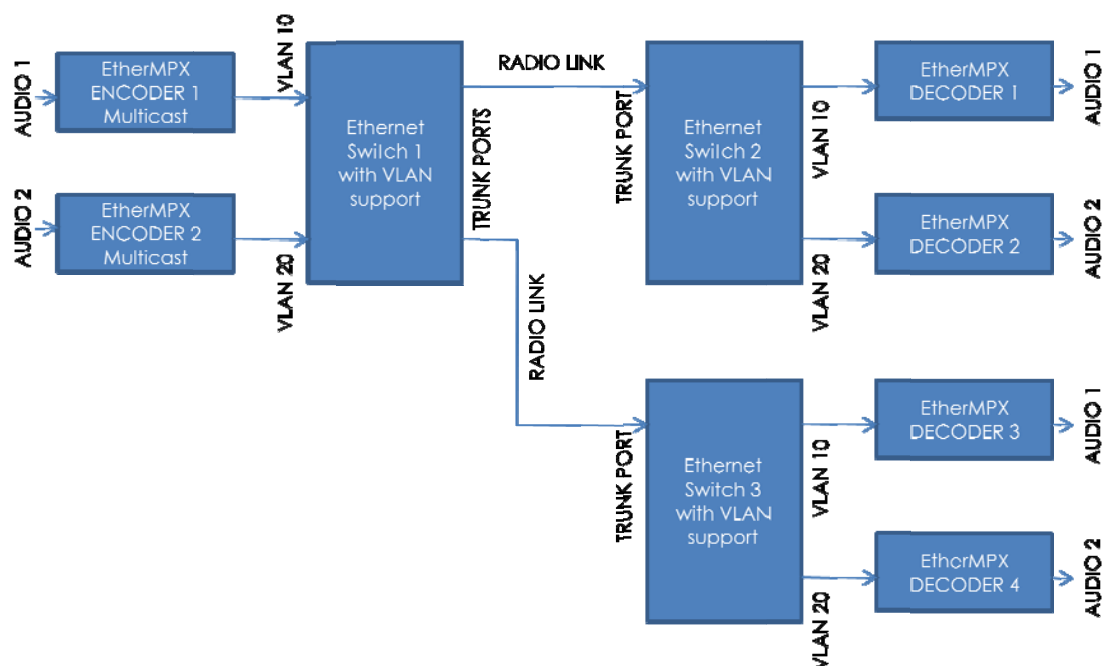
Example 1:

Two different radio programs must be transported to two different TX sites over single IP radio links. We need both programs at each TX site.

Because two Encoders are operating in "Multicast" mode (this is needed in order to feed more than one Decoder), these two streams must be logically separated inside the network.

To achieve this, you need Ethernet switches that support VLANs.

You will need to define separate VLANs - one for each radio program (VLAN 10 for radio program 1, and VLAN 20 for radio program 2 in our example). Even if you have isolated network segments, you should define unique IP addresses to each device.

Note that the ports connected to IP radio links, must be configured as trunk ports to allow all VLANs to pass through. The ports connected to Encoders & Decoders, must add the appropriate VLAN tags to ingress traffic, and discard VLAN tags on egress traffic.

Example 2:

Two different radio programs must be transported to two different TX sites over single IP radio links. We need only one program at each TX site.

To achieve this, you can use ordinary plain Ethernet switches.

Because two Encoders are operating in "Unicast" mode (each one is paired to only one Decoder), they can co-exist in the same network without the need of VLANs. Of course each device must also have a unique IP address.

Note:

These are only two mere examples. The flexibility and the possibilities of using EtherMPX over an IP network are endless.
If you need any assistance on designing your own transmission network, please do not hesitate to consult us!

7. Technical specifications

GENERAL	
Model name	*Ether***MPX** v3
Dimensions	19" 1U chassis
Power supply	230VAC 50Hz, 12W
Operating temp	-20 to +60 Celsius
Transport protocol	Proprietary UDP Unicast or Multicast
QoS management	IETF RFC2474 compliant
Audio compression	None (Linear PCM)
Audio resolution	8 – 24bit for Digital L/R & MPX input 24bit for Digital L/R & MPX output 24bit for Analog L/R & MPX output
Audio sample rate	8 – 192kHz input for Digital L/R input 174-192kHz input for Digital MPX input 48kHz internal for Analog L/R input 192kHz internal for Analog MPX input
Audio latency	L/R mode: 5mS (up to 40mS on busy net) MPX mode: 2,5mS (up to 20mS on busy)
Network usage	L/R mode: 2,37 Mbit/s typ MPX mode: 4,74 Mbit/s typ
Audio monitor	Stereo ¼" Female jack in front panel

ENCODER	
Input name	Port A
Input type	Digital electrical interface
Connector	XLR-3 female
Impedance	110 Ohm balanced - transformer isolated
Supported formats	AES3, IEC60958, S/PDIF
Maximum data rate	12.288 Mbit/s
Audio sample rate	32 - 192 kHz (174-192kHz for D-MPX)
Audio sample resolution	24 bit

Input name	Port B
Input type	Analog electrical interface - 2 inputs
Connector	2 x XLR-3 female (balanced R, L/MPX) 1 x BNC female (unbalanced MPX only)
Impedance	1 kOhm
ADC resolution	24 bit
ADC sample rate	48kHz for L/R input, 192kHz for A-MPX
ADC THD+N	-106dB (0.0005%)
ADC Dynamic range	121 dB (no weighting)
Channel separation	135 dB
Reference input	3.47Vpp (+4dBu) for 0 dBFS
Input BW @ 48kHz SR	-0.1dB @ 20 kHz
Input BW @ 192kHz SR	-0.1dB @ 80 kHz

DECODER	
Output name	Port A
Output type	Digital electrical interface
Connector	XLR-3 male
Impedance	110 Ohm balanced, transformer isolated
Format	AES3
Maximum data rate	12.288 Mbit/s
Audio sample rate	48kHz for L/R output, 192kHz for D-MPX
Audio sample resolution	24 bit

Output name	Port B
Output type	Analog electrical interface - 2 outputs
Connector	2 x XLR-3 male (balanced R, L/MPX) 1 x BNC (female unbalanced MPX only)
Impedance	1 kOhm
DAC resolution	24 bit
DAC sample rate	48kHz for L/R output, 192kHz for A-MPX
DAC THD+N	-108dB (0.0004%) at 48kHz L/R out -96dB (0.0015%) at 192kHz A-MPX out
DAC SNR	129dB at 48 or 192kHz
DAC Dynamic range	129 dB (A weighted) at 48 or 192kHz
Channel separation	124 dB at 48kHz L/R output Infinite at 192kHz A-MPX output
Reference output	3.47Vpp (+4dBu) for 0 dBFS
Out BW @ 48kHz SR	-0.1dB @ 21.8 kHz
Out BW @ 192kHz SR	-0.1dB @ 87.2 kHz

SFN Operation	
Ouputs	1x10MHz
Connector	BNC Female
Impedance	50 Ohms
Delay compensation	Auto up to 20mS (basic version)
Synchronization	PTP (IEEE-1588), <8nS accuracy

NOTE: Technical specifications are subject to change without notice. Please contact us if you have questions, or to get latest information and updates.

Sigmacom Broadcast support:
support@sigmacom.gr - or call +302312209905.