

## MAYAH Communications White Paper

### ISDN over IP issues

**April, 2010, Munich - WARNING !: Transmission problems with audio codecs - ISDN routed via IP - is that a real and serious issue?**

**Status of this document:** V 1.0  
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**Sources:** Customer complaints, Telco information, own tests  
**Problem:** loss of sync  
no service indicator 7 (important for data transmission)  
packet loss in IP with affect on ISDN  
**Target:** Hints and problem solving  
**Solution:** Use IP, Switch to IP earlier than planned  
Use only IMUX, no Bonding  
Select a telco you can trust and you have tested

*MAYAH, manufacturer of the well known CENTAURI I and II, C11 and other audio codecs reports that more than average transmission problems are raised by its customers. It seems that **a change from pure ISDN to ISDN via IP** might have caused this. MAYAH is giving hints and problem solving methods in this short white paper.*

20 years of successful audio transmissions via ISDN with MAYAH audio codecs, but now things seem to change. Technical features of ISDN which were proven and worked almost 20 years do seem to disappear here and there. Reasons for this phenomenon and methods to solve it on short and long term, can be found below in this document.

## Background

The technology we are talking about is almost 20 years old, but is now combined with the Internet and that's why an old proven technique results in a new situation. When transmitting via ISDN and using a bit rate which is higher than 64 kbps, different mechanisms are used to compensate the time shift between the different number of ISDN lines in use. Example: 256 kbps via 4 ISDN B channels is used, 3 of the lines have only small time differences of a few milliseconds and one has a shift of almost 100 ms. There are two main principles which are applied by audio codecs:

### **Principle 1: Bonding**

The sending end of the two communicating audio codecs, the encoder, does send a test pattern via all ISDN B channels and the receiving end, the decoder, does analyze the received test pattern. Based on the result, the decoder will adjust the time delay buffers in order to get all the lines synchronized.

**Advantage:** Measurement once and no further capacity of the data channels need to be occupied for the synchronisation.

**Disadvantage:** In case of any changes in the network, e.g. routing, the framing will be lost and no re-synchronisation will happen.

### **Principle 2: Inverse Multiplexing IMUX**

The sending end of the two communicating audio codecs, the encoder does split the data signal to the number of ISDN B channels and following the standard J.52, the data signals are numbered in order to allow

the receiving end, the decoder to put the data signal back to its original sequence. This is a continuous process.

**Advantage:** Measurement continuously, i.e. even in a re-routing situation the device will follow the right data signal order and be in sync, maximum with a small audio muting in between.

**Disadvantage:** Some bits of each B channel need to be occupied for the continuous synchronisation method.

The advantage of J.52 compared to other IMUX methods is that bit rates of up to 384 kbps can be transmitted via 6 ISDN B channels. None of the other IMUX schemes, which have proprietary background, such as CCSIMUX for 128 kbps Layer 2 and 3 transmissions, can go beyond 128 kbps.

## What can happen in pure ISDN synchronous networks?

1. It is important that your ISDN does show the service indicator 7 which indicates the data service of 64 kbps transparent from the sending location to the destination.
2. ISDN B channels can be routed without any change during a transmission session.
3. ISDN B channels can be re-routed during a transmission session (s. Figure 1). This will happen randomly and there are a few reactions caused to audio codecs: Either they loose framing and dont re-synchronize (BONDING) or they mute one or more frames and then re-synchronize (J.52 and other IMUX schemes).

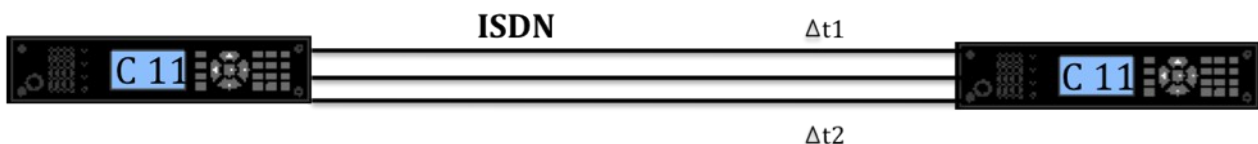


Figure 1 Two C11 Audio Codecs connected via ISDN with time delay between the B channels

## The new situation: What can happen in ISDN via IP networks?

4. ISDN connectivity is offered at both ends but will be converted to IP packets after the first switch. The IP packets can use different routes through the Internet and thus can cause similar situations as described in 2.
5. ISDN connectivity is offered at both ends but will be converted to IP packets after the first switch (see Figure 2). The IP packets can be lost due to erroneous situations in the Internet. This can cause the temporary loss of audio (muting for a while). On top of muting it may cause the loss of framing (BONDING) or a process of re-synchronisation (J.52, IMUX) as described in 2.



Figure 2 Two C11 Audio Codecs connected via ISDN, but ISDN is routed via IP incl. packet losses

## Practical examples and what can be done:

### CENTAURI / C11 – CENTAURI / C11

CENTAURI and C11 are continuously (IMUX) controlling the synchronisation of ISDN B-channels which means that when talking to each other they are pretty good prepared for re-routing and packet losses. Audio muting may appear but then framing will come back based on the used IMUX procedure, such as J.52 and others (s. Figure 4).

#### Framing scheme

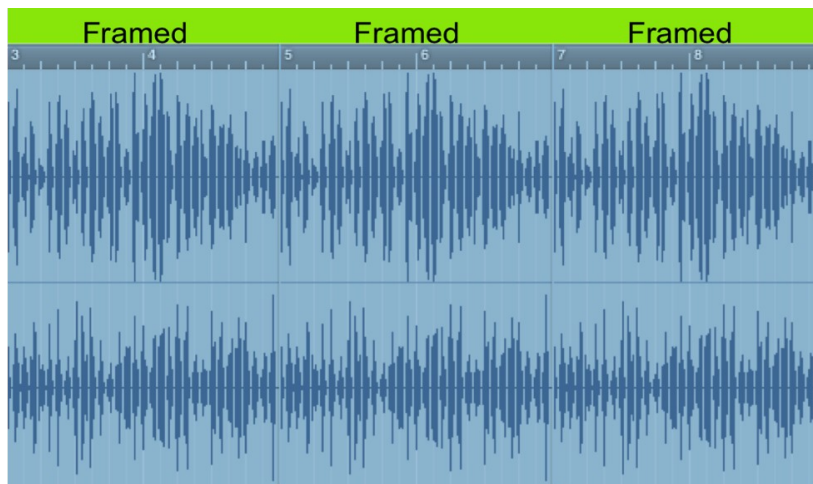


Figure 3 Framing situation in an error free ISDN or IP situation, continuous framing

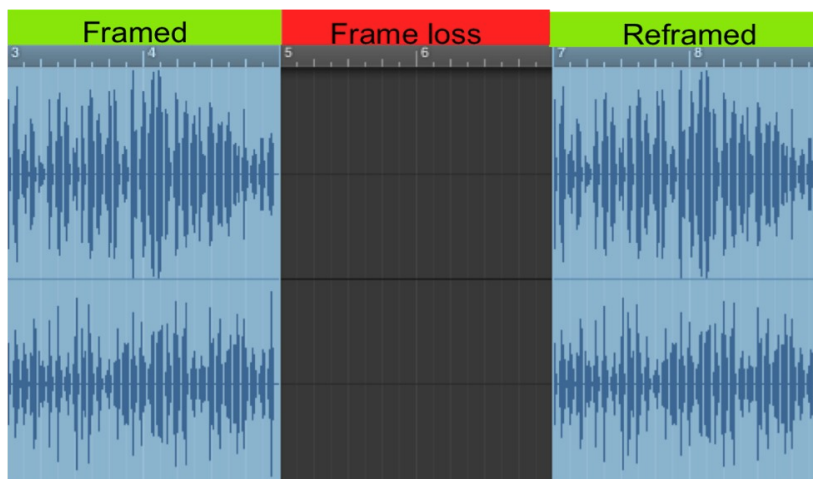


Figure 4 Framing situation in an erroneous ISDN via IP situation, Reframing due to IMUX

### CENTAURI / C11 - Musiktaxi (Opticodec)

The typical settings when talking to a Musiktaxi is BONDING - that's default on the Musiktaxi side (s. Figure 5). With BONDING we have learned that there will not be a re-synchronisation in case of packet losses. Audio will not come back as a result of this (s. Figure 6). A good idea here is to change the setting of the Musiktaxi from Bonding to CCSMUX or TELOSMUX. In that case a 2 B channel transmission with Layer 2 or

Layer 3 will use an IMUX procedure and consequently will better be prepared for faults. Both CENTAURI and C11 do understand both of those procedures and will thus be able to communicate with the Musiktaxi.

### ISDN over IP



Figure 5 C11 and Musiktaxi via "ISDN via IP" with Bonding

### Framing Scheme



Figure 6 Framing situation in an erroneous ISDN via IP situation, no Reframing due to BONDING

## Conclusions

There are five main results given by this analysis:

- A) IP is coming faster than some did expect. It is recommended to consider audio-via-IP connections rather than emulating ISDN via IP.
- B) If ISDN via IP can not be avoided for a period of time it is important to select a Telco operator of your confidence and which has been testes positive. Due to legal impacts we can not give any recommendations here.
- C) If ISDN via IP can not be avoided it is important that the ISDN line shows service indicator 7 for transparent 64 kbps data services.
- D) If ISDN via IP can not be avoided the audio codecs need to be operated with an IMUX scheme and not with BONDING.
- E) ISDN might be available for many years to come, but may not be the same reliable synchronous network that has been used during the last 20 years.