BARIX

Application Note

Intercom Panel design requirements for Full Duplex AEC with Barix devices

1 Introduction

Barix provides firmware solutions for Intercom and Paging applications where often full-duplex communication is required. For those applications Acoustic Echo Cancellation (AEC) needs to be supported in order to avoid feedback coming from the analog interface (e.g. door station panel or speakerphone).

Barix Annuncicom 60, Annuncicom 100/200, PS1 and PS16, based on the IP Audio Module 102/302 have support in the DSP for AEC. The AEC function is enabled for duplex audio in G711 format in the SIP Client, SIP RAVA, IC_Paging and IP_Intercom firmwares.

In this Application Note we will outline what are the design requirements for a third party analog panel to benefit from the AEC function of the Barix unit.

2 Acoustic Echo Cancellation

In a duplex communication we will call the remote party system “Far End” and our local system “Near End”. Acoustic Echo happens when the Far End audio signal coming out of the Near End speaker is picked up by the Near End Microphone and transmitted to the Far End system.

With reference to the picture below we can identify 4 different sources of Acoustic Echo:

1. **Reflected** feedback, i.e. part of the Far End signal coming out of the Near End speaker is reflected by different surfaces in the open environment and is picked by the Near End microphone

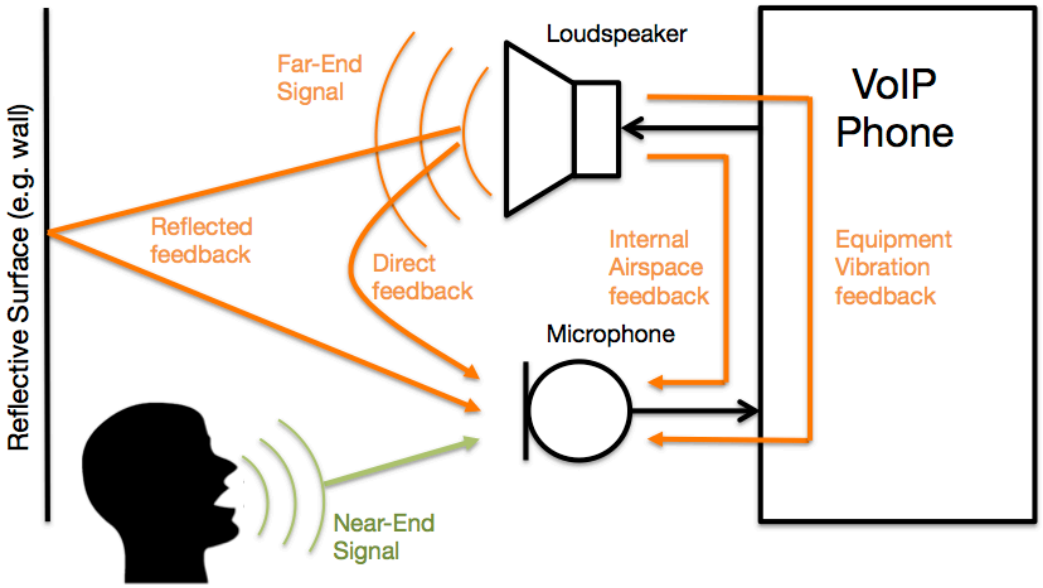
2. **Direct** feedback, i.e. part of the Far End signal coming out of the Near End speaker passes directly over the air to the Near End microphone

3. **Internal Airspace** feedback, i.e. acoustic waves propagate inside the chassis and are subject to resonances, amplifications and attenuation at different frequencies compared to the original signal.

4. **Equipment Vibration** feedback, caused by the mechanical waves propagated through the chassis and the electronic boards of the near end system.

The Acoustic Echo Cancellation algorithm aims to remove the feedback signal from the audio picked up by the Near End microphone before sending to the Far End system. This is achieved by subtracting the audio patterns that were already present in the original Far End signal, in terms of shape and time window.

In other words AEC is designed to completely remove the reflected feedback and partially remove the direct feedback, while the other feedback sources must be resolved by HW design of the door/intercom station.



3 HW Design Requirements

The following recommendations are to be considered when selecting a third party analog panel manufacturer, or designing your own HW, in respect to the mentioned sources of Echo.

3.1 Direct Feedback

The AEC algorithm can be effective in removing the direct feedback if the positioning of the microphone and the speaker on the equipment is such that

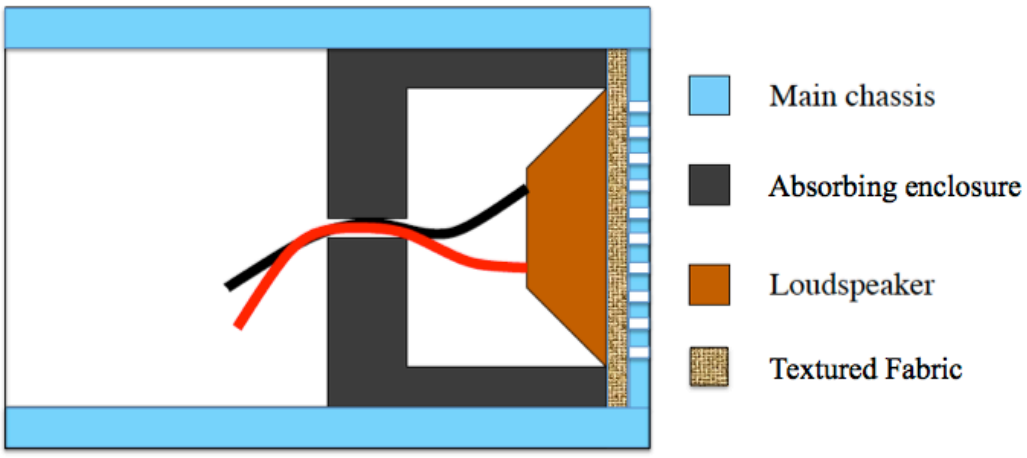
a. propagation time of the feedback over the air is long enough
b. sound pressure of the feedback is not too high

This means that the microphone and the speaker have to be positioned as far as possible from each other and more important directional separated i.e. not pointing each other.

Tip: a microphone on the front plate can be shielded from the speaker using wings to cover the hole or can be assembled recessed in respect to the surface (director cap).

3.2 Internal Airspace Feedback

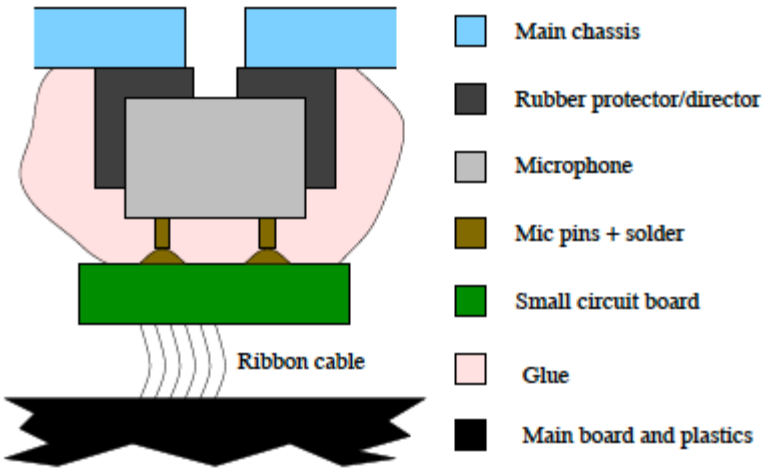
The major part of this feedback comes from the speaker back not being acoustically isolated. It is recommended to encapsulate the speaker in an absorbing enclosure without open holes.



When using metal plated door station designs, internal surface waves can be reduced by adding textured acoustic fabric between the speaker and the plate.

3.3 Equipment Vibrations

If the microphone is soldered directly to the main PCB, the chances are high that vibrations will be induced by the speaker sound propagating into it. The microphone should rather be glued to the main chassis and soft wired to the main board (as shown in the picture below).



4 AEC performance

It is to be noted that the AEC algorithm is adaptive i.e. it has to learn the environmental conditions. For that reason after rebooting the Barix unit, the first call will show improving performance in a time range of 20-30 seconds after which the best results will be achieved and persist in any following call. An attenuation of circa 60dB has been measured in a Line Level loopback test using the SIP RAVA firmware. Any audio distortions, e.g. caused by saturated volume or audio artifacts, might deteriorate the performance.

5 Conclusions

When using the AEC feature of Barix devices in Full Duplex mode it is recommended to select an analog panel or door station specifically designed for that purpose. Only when all of the above elements have been addressed will the best audio performance be achieved.

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