June 2015

Tech Tip: Tips & Tricks for Successful AEC

Having a general understanding of the AEC module parameters prior to reading this Tech Tip is essential for success during the programming and commissioning stages of the conferencing system. All parameter definitions are covered in the SymNet Composer Help file. This Tech Tip outlines some tips and tricks to get great results fast from the Radius AEC and SymNet 4 Channel AEC Input Card. Keep in mind, room acoustics, mic and speaker placement, and gain structure are the cornerstones of getting the best results in any AEC installation.

Essential Concepts for Successful AEC

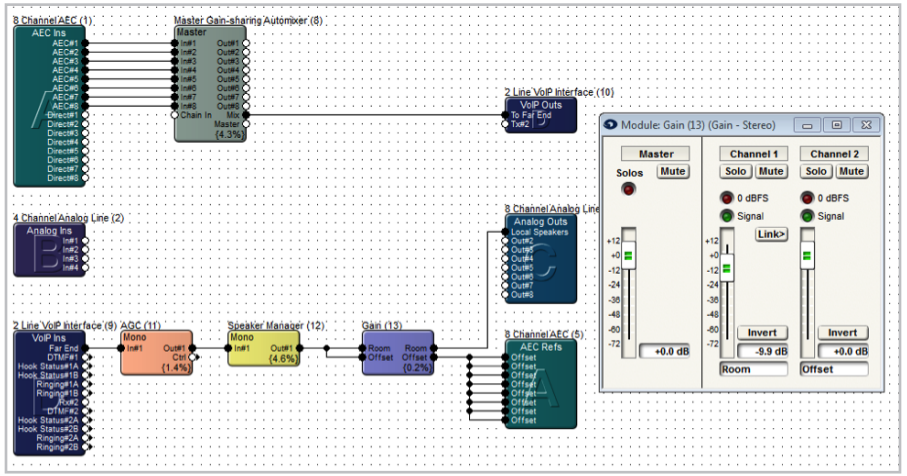
ERL: Echo Return Loss is the difference in signal level between the audio which is present at the reference input and the same audio measured in the room by the microphones. For best results the ERL should be maintained between +/- 10 dB. A 0 dB reading would indicate that the algorithm is working with optimum efficiency.

Reference: The reference should be tapped off the signal path as close as possible to the local reinforcement outputs so that any processing latency, filtering, or delay that are applied to the analog outputs are also applied to the reference input.

Reference Offset: In order for the ERL to be maintained at +/- 10 dB, it is sometimes necessary to offset the level of the audio sent to the reference input at 7-10 dB louder than the same audio entering the microphones. When the room gain is turned up, the level of the far end audio at the microphones is turned up as well. Using a two channel gain module's master fader for room gain will turn up the reference and the room gain together, maintaining the necessary offset between the reference and the same audio at the microphone input. See Example 1. If the ERL is reading more than +/-10 dB, turn down the speakers in the room or turn the reference signal slightly up using the reference offset gain module.

Example 1: AEC Basic

Notice in this example the reference is tapped off after all dynamics and filtering has been applied to the far end audio. This means the audio at the AEC reference is as acoustically close as possible to the far end audio as it enters the AEC microphones.



In a best case scenario the room volume would be set to a static operating level tuned for best AEC results. However, if the customer requires level control, you can include a gain module prior to the reference input and room outputs. Remember, the reference should be 7-10 dB louder than the same audio being picked up by the mics from the speakers. In the example above, gain module (13) gives the end user the ability to adjust the room level with the master fader. The individual input 1 and 2 faders create and maintain the 7-10 dB offset between the reference and the room volume. As the end user turns up the room volume, the reference signal also goes up with it.

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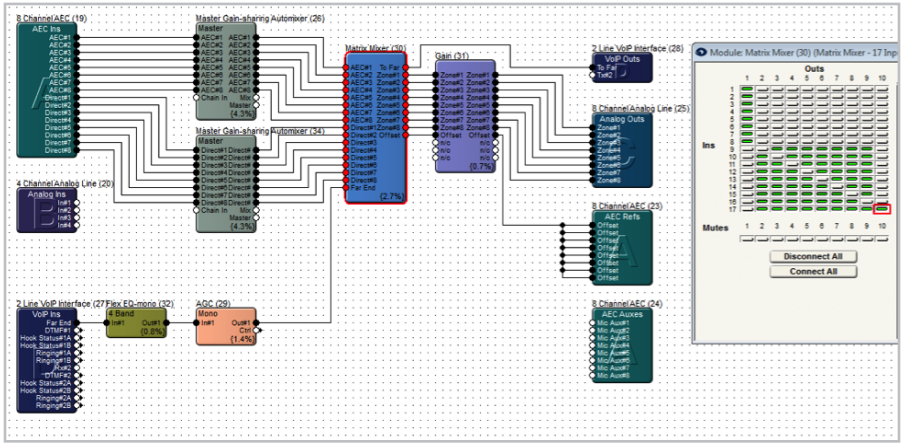
Example 2: AEC with Local Mic Reinforcement + Mix Minus

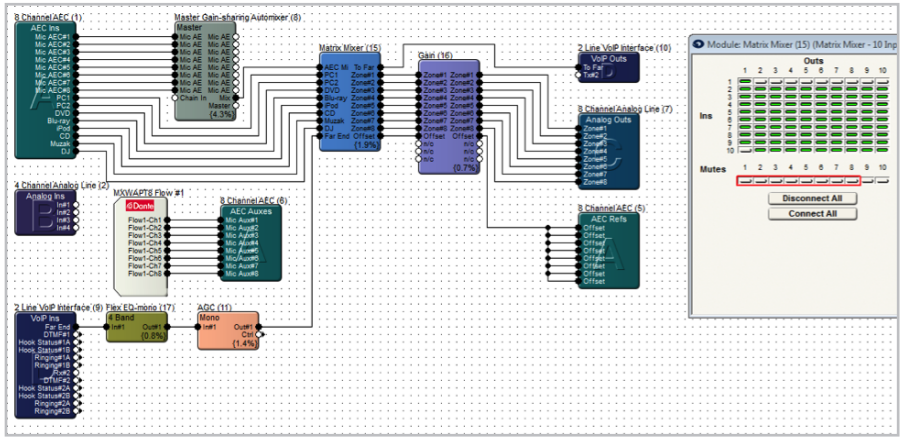
The AEC algorithm adds 11 ms of latency which would be distracting if used for the local sound reinforcement. For local reinforcement use the direct outputs of the 4 channel AEC input card instead of the AEC outputs. Each set of outputs should be feeding their own Gain-Sharing Automixer before passing through a matrix mixer, which provides the mix minus capabilities and routing to the local sound and far end.



Again, the AEC reference point and local speaker outputs need to be tapped after all processing, and right before the outputs.

Example 3: AEC Dante Flow to Aux inputs (using Shure Dante MXWAPT8 mics)

The Radius AEC and/or SymNet 4 Channel AEC Input card can apply the AEC algorithm to either the analog inputs or any source routed to the AEC Auxes.



In this example, the AEC is applied to Shure Dante MXWAPT8 mics whose audio enters the SymNet DSP through the Dante bus, while the physical inputs on the AEC Ins module are utilized for additional non-AEC sources via the direct inputs, such as PC audio.

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Gain Structure

Follow these steps to set up an AEC Conferencing system with proper gain structure.

1. Start with the power amps turned down all the way.
2. In the AEC module, adjust the mics input gains so that the meters are showing about -20 dBFS during normal talking level into the mics. Start with the level, and then use the fine trim control.
3. Adjust the rest of the gain structure through the entire system for unity gain (-20 dBFS).
4. Then establish a connection to the far end, and then slowly bring up the level on the amplifiers, until the appropriate loudness is obtained.
5. Adjust the near end mics levels and far end transmit receive levels as required.
6. Check the ERL (Echo Return Loss) values. ERL is a measure of how loudly the far end signal is coming out of the near end speaker, and entering the near end mics. This is a visual indication of how hard the AEC process must work to remove echo. ERL will normally be negative; if it is positive or too negative, it may indicate a gain structure problem.
7. Once operational, make minor level changes as required, but do not change the level of the amplifiers.
8. Engage NLP (Nonlinear Processing) if in a particularly troublesome environment and you still hear echo. Nonlinear processing is useful for removing the secondary indirect echo, often heard as reverb NLP can be very useful and transparent to the participants; however, use of heavy NLP in troublesome environments can reduce double-talk performance and clarity.
9. Engage Noise Cancellation if needed to control steady state background noises such as computer fans and HVAC systems.
10. Engage AGC (Automatic Gain Control) to compensate for varying distances between the near end participants and their mics. It attempts to maintain a consistent level for better intelligibility.

Routing

Here's a quick reference routing checklist for the site file listing where items should be routed.

1. Direct mic inputs are routed to local speakers only.
2. AEC mic inputs are routed to the far end only (ATI, VoIP, Codec, etc.).
3. Far end inputs are routed to local speakers and refs.
4. Audio sources, PC, BGM inputs are routed everywhere (local speakers, far end, and refs).

Troubleshooting

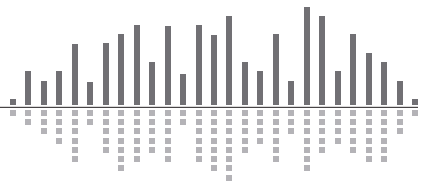
These troubleshooting techniques can be used when implementing an AEC design.

Top reasons for bad AEC result:

1. Bad gain structure
2. Incorrect mic and speaker placement
3. Bad room acoustics
4. Local reinforcement is too loud
5. ERL showing more than +/-10 dB
6. The reference signal tapped off prior to dynamics, filtering, or delay processing

Troubleshooting Residual Echo:

1. Verify that the routing to the AEC reference is correct.
2. Meter the signal feeding the AEC reference and make sure it is within the recommended range (average -20 dBFS).
3. Adjust NLP settings from off to low. If echo is still being heard, switch to high.



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4. If customer is using an analog phone line. Try removing the Radius AEC from the equation. The use of a "Butt Set" or standard analog phone can help to quickly determine if the echo is being caused with the AEC or on the actual phone system itself. If an analog line is an extension of an IP phone system, the system itself can have an echo. Simply unplug the phone line from the Radius and connect it to the "Butt Set" or standard analog phone. Make a call into the system and out from the system. If you still have an echo, the problem is not within the AEC. If the echo goes away, the problem is within AEC.

Troubleshooting Positive ERL Values:

1. Amplifier is turned up too high.
2. Mics may be too close to the speakers, or pointed directly towards the speakers.
3. Input gain on the mics could be set too high.
4. Not a high enough signal is being fed to the AEC reference.
5. Gain structure is not optimized.

ERL	Possible Problem	Result	Solution
Positive Values: 0dB and above	Amp Volume is too high AEC Ref is too low Bad Mic/Speaker placement	Not so good results – AEC may not converge well, echo may be apparent	Lower amp volume Adjust input gains Increase signal level to Ref input vs. the room (use gain module to offset)
Negative Values: -18dBFS to 0dBFS	No problem	Good!	No changes needed
REALLY Negative Values: -18dBFS and below	Bad gain structure Mic gain too low AEC Ref too high	Decent to bad results Echo may be heard	Look at gain structure Adjust mic input gain Lower signal to AEC Ref

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