

Echo and Echo Cancellation

Source: Adaptive Digital Technologies

Overview

The vast majority of the public telephone system local loop wiring is done using two-wire connections whereby the same pair of wires carries voice signals in both directions. In the telephone company's central office or in an office PBX, a two-to-four wire conversion is done using a hybrid circuit. Hybrid circuits do not perform perfect impedance matches. The imperfection results in echo. The echo canceller's goal is to detect and remove echo as quickly and effectively, thereby minimizing any loss in voice quality due to the echo. The echo canceller must perform this function under all conditions including double-talk (when both parties are speaking at the same time) and in the presence of background noise. Furthermore, the echo canceller must not cause detriment to signaling tones (DTMF, etc.) or fax and modem transmissions.

Echo Tail

The length of time over which echo may arrive is known as the echo tail length. The impulse response of the echo path tends to be spread over a 4-8 millisecond range, but the location within the entire echo tail of this 4-8 milliseconds may not be known. This is due to a variety of sources of delay in the telephone system. With the proliferation of VoIP telephone systems, we can see large delays as a result of the delay in the packet network itself. Adaptive Digital's algorithm can operate with delays as high as 256 milliseconds.

Echo Canceler Requirements

When a call is first established, an echo canceler has no idea about the nature of the echo path. With the first utterance of speech (or other sound) and presence of its echo, the echo canceler must adapt to the echo path quickly in order to cancel the echo. The adaptation process is referred to as convergence and the amount of time required to adapt is referred to as the convergence time. Even after initial convergence, the echo canceler must monitor the echo path for potential changes in characteristics caused by events such as adding or dropping a party from a conference call, PCM slips, redundancy fail-over, etc. In addition, the canceler must be capable of detecting the presence of signaling tones as well as fax and modem signals and act appropriately.

Although compliance with the ITU G.168 recommendation is required, it is just the beginning. It is well known that a canceler can be compliant with G.168 yet still exhibit poor voice quality under many circumstances. Many cancelers may boast G.168 compliance, but only be compliant under tame hybrid conditions. Some are even tuned just to pass G.168 tests while sacrificing voice quality in the process. Adaptive Digital's canceler meets or exceeds all the G.168 tests in the presence of all 8 G.168 hybrid models while maintaining superior voice quality as the primary goal.

Voice Quality Certification

G.168 compliance is just the beginning. The true test of merit of an echo canceller is voice quality. Adaptive Digital's canceller has been tested in-house, by many customers, and independently by AT&T at their Voice Quality Test Lab. AT&T performed both G.168 objective tests and Mean Opinion Score (MOS) subjective tests. Adaptive Digital's canceller fared better than industry standard cancellers under the most important and difficult conditions: double-talk and the presence of background noise.