Telecom standard is more than just a checkmark

Aaron Ramsey, Voice Processing application engineer at Zarlink Semiconductor explains minimum echo cancellation and why compliance to the G168 standard is essential for network performance

The explosive growth in international communications, a multitude of service providers, and ever evolving technologies places increased importance on telecommunications standards. However, what is not always clear is how these performance targets directly relate to real system operation.

Voice echo cancellers are one of the key elements ensuring network quality. The ITU-T G.168 Recommendation defines minimum echo canceller operating requirements for manufacturers, and compliance should provide network operators with a reasonable level of confidence in the performance of the devices.

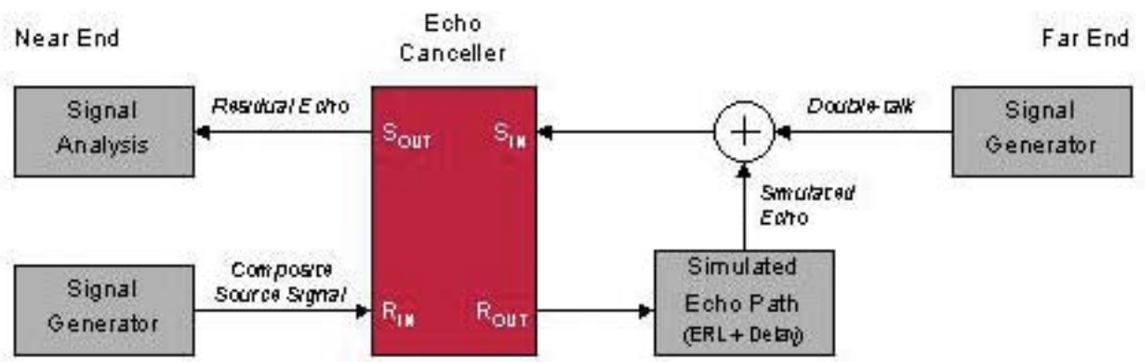
Meeting the G.168 Recommendation is a checkmark when choosing a voice echo canceller, but it is equally important to understand exactly what compliance means in terms of overall system operation.

As general principles of G.168 tests, echo cancellers are expected to ensure satisfactory performance with respect to: rapid convergence; sufficient echo attenuation during single-talk; minimal divergence during double-talk; and proper operation during facsimile and voice-band data transmissions.

The G.168 testing isolates these performance aspects, comparing results to a base level of operation.

In a typical test, the simulated echo path is configured, a Composite Source Signal is applied to the RIN port of the echo canceller (near end), and the returned echo signal after echo cancellation is measured at the

Fig 1 - The G.168 test architecture



echo canceller SOUT port (near end). A double-talk signal is applied at the far end and mixed with the simulated echo for further testing.

While the G.168 standard outlines performance measures that echo cancellers must meet or exceed, it does not specify how many tests must be completed. One vendor may be very diligent, with 1,000 tests within a defined performance range. Another vendor may only complete 100 tests within the same range. Devices from both vendors may meet G.128 demands; however, when reviewing results it is important to keep in mind that with fewer tests, weaknesses may not be exposed.

Simulated Echo Path

The ITU-T G.168 standard specifies eight echo paths for testing, based on hybrids frequently seen in analog phone circuits. The most common is hybrid 5.

While full compliance on hybrid 5 is important, an echo canceller should perform well on any of the eight hybrids. Some echo cancellers have been tuned specifically to target hybrid 5 for standards testing, at the expense of poor performance on other echo paths.

Some G.168 echo canceller tests have more relevance to real-world conditions, including convergence, double talk, narrow band signal, and comfort noise tests.

The fundamental requirements for an echo canceller are to converge rapidly and achieve good steady-state rejection of the echo signal. It is important that the steady-state cancellation is sufficient to produce a residual echo level low enough to permit the use of non-linear processing (NLP) without undue dependence on it. With better cancellation performance, less reliance needs to be placed on NLP. Steady-state attenuation isn't useful if it takes a long time to get there. In general, the convergence should be fast enough to transparently handle changes in the echo path.

The G.168 standard targets these characteristics, by testing convergence time, steady-state cancellation, and both convergence time and overall attenuation in a high noise environment.

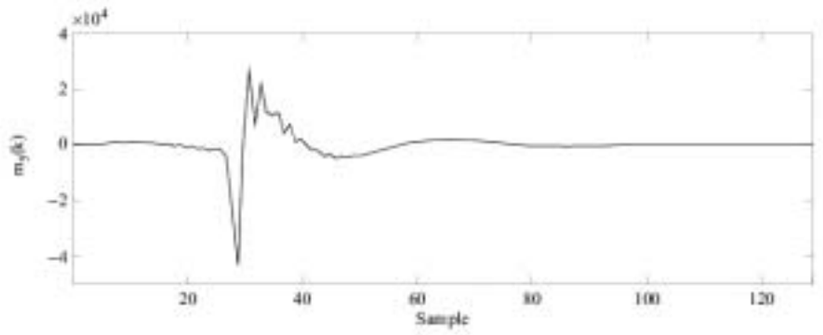


Fig 2 – Impulse respond of echo path model 5

Double-talk

Double-talk occurs when both parties on a telephone call speak at the same time. When this happens, an echo canceller has difficulty distinguishing the returned echo from the far-end speaker's voice. G.168 testing verifies that an echo canceller continues converging despite low-level and high-level double-talk, and does not produce undesirable artifacts during or after periods of double-talk. Passing these double-talk tests can be difficult for some vendors.

Specific testing verifies that the echo canceller remains converged for subscriber-originated narrowband signals that are converged on a wideband signal. With the proliferation of auto attendant systems that respond to DTMF tones, an echo canceller should not allow these tones to affect its convergence. These tones appear as a very loud burst of sound that can cause divergence if the echo canceller is not designed with this in mind.

Eliminating residual echo can result in an unnaturally silent phone line. This test ensures the echo canceller introduces a comfort-noise signal level that closely resembles the actual noise in the system. Higher quality echo cancellers inject spectrally matched comfort noise, while lower end units simply inject coloured or even white noise.

Compliance with ITU-T G.168 Echo Cancellation is an important step towards ensuring echo performance that meets the expectations of modern-day customers.

However, simply passing G.168 does not a guarantee adequate echo cancellation performance outside of a laboratory/testing environment. It is just a starting point for echo canceller evaluation, and it is equally important to subjectively test an echo canceller under live conditions to confirm that performance meets all expectations.