Technical Explanation of the Comrex Turbo G.722 Encoding Algorithm

G.722, an international standard, defines the algorithm for compressing 7 KHz audio into 48, 56 or 64 KB/s channels. The method used is Sub-Band Adaptive Differential Pulse Code Modulation (SB-ADPCM). Under most circumstances, 56 and 64 KB/s channels are of interest, since these are commonly available on the public switched telephone network. G.722 has the distinct advantage of being an international telephone standard which is supported by many manufacturers worldwide. Different manufacturers' systems usually have no trouble interconnecting in G.722 mode.

G.722 works by splitting audio sampled at 16KHz with quadrature mirror filters (QMF). This results in two separate audio bands, 0-4KHz, and 4KHz- 7.5KHz. In G.722, each of these bands is independently applied to an ADPCM encoder and decoder. The results are applied to an inverse QMF where the wideband audio is restored.

SB-ADPCM is also the basis of another popular wideband coding scheme, APT-X. The main difference with APT-X coding is the number of subbands used. While G.722 divides the audio spectrum in half, APT-X divides the spectrum into four subbands, each of which is processed independently. Both provide equivalent bandwidth at a data rate of 56 or 64 KB/s.

With the advent of ISDN, higher capacity data channels can be easily achieved. By summing the "B" channels of a BRI ISDN, a composite 112 or 128 KB/s link is possible. SB-ADPCM coding can exploit this higher data capacity because the QMF filters "scale" with the sampling rate. For example, in APT-X if the lowest subband encompasses 0-2000 Hz at a sampling frequency of 16KHz, the lower band will become 0-4000Hz at a sampling frequency of 32KHz. Likewise, each of the two subbands in G.722 will scale, from 4KHz to 8KHz bandwidth, in this case. In essence, using SB-ADPCM, by doubling the data rate, you can easily double your audio bandwidth, given that enough processing power is supplied, and that the hardware supports it.

Comrex implemented a G.722 doubling algorithm in 1994, calling it "Turbo" G.722 and later, simply "Turbo". The modification allows complete connectivity to G.722 standard devices at 56 or 64 KB/s, but enhanced bandwidth (15KHz) when connected to a "turbo" system at 112 or 128 KB/s. In both standard and Turbo, the coding delay remains approximately 6 mS.

All Comrex codecs designed for ISDN or other digital circuits incorporate both G.722 and Turbo.The U.S. broadcast industry has received Turbo well, since it provides the advantage of wideband audio with very low coding delay.

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