REVIEW (Terminology)

- Polar signaling
- Baud rate (symbol rate)
- Bipolar signaling (coding)
- Central office
- Circuit switching
- C-message weighting
- Common-channel signaling, Inband signaling
- Companding
- Crosstalk, far-end crosstalk (FEXT), near-end crosstalk
- dBm, dBrnC, dBrnC0
- Delta modulation, slope overload
- DTMF Signaling
- Echo, echo canceller, echo suppressor, talker echo, listener echo



REVIEW (Terminology)

- Multiplexing, FDM, TDM
- Full-duplex, half-duplex
- Gaussian noise
- HDB3
- Hybrid, two-wire circuit, four-wire circuit
- 🗆 ITU
- Line code, NRZ, RZ
- LATA
- Modem
- Multi-frequency signaling
- Nyquist rate
- Power spectral density
- PAM, PCM
- Quantization noise
- Regeneration, repeater
- Robbed bit signaling



REVIEW (Terminology)

- □ Tandem office, Trunk
- On-off signaling
- □ T1 carrier system
- DS0, DS1, DS2, DS3
- Error performance, PER, CRCER
- SQR, SNR



Decibel Questions

There are three networks in series. The first network has a gain of 19 dB, the second a loss of 23 dB, the third a gain of 11 dB. The output of the third network is +23 dBm. What is the input to the first network in mW?



Transmission

□ What are the three basic impairments (not echo or singing) we have to deal with regarding the voice channel?



Noise Power Levels

Relationships between various noise measurements Y dBrn=X dBm+90dB Y dBrnC = X dBrn-2dB

- Example: An idle-channel noise power measurement of 21 dBrn occurs at a -7 dB TLP. Express the noise power of this measurement in dBrn0 and determine what power measurement this noise would produce at another point in the circuit that is designated as a -2 dB TLP.
 - □ dBrn0=dBrn-(TLP dB) or dBrn=dBrn0+(TLP dB)



Voice Digitization

- □ SQR=10.8+20log₁₀(v/q), $v \rightarrow$ rms amplitude of the input
- □ For a sinewave input $v^2 = A^2/2$, SQR=7.78+20log₁₀(A/q)
- $\Box q=2A_{max}/2^{n} \rightarrow SQR=1.76+6.02n+20log_{10}(A/A_{max})$
- **Dynamic Range=20log**₁₀(V_{max}/V_{min})
- Example: If two bits per sample are added to a PCM bit stream, how much can the dynamic range be increased if the quantization intervals are adjusted to improve the SQR by 3dB?



PSD of Line Codes

- Example: The duobinary line coding (proposed by Lender) is also like bipolar, but requires only half the bandwidth of bipolar. In this code
 - □ A "**0**" is transmitted by no pulse,
 - \Box A "1" is transmitted by a pulse f(t) or -f(t) using the following rule:
 - A "1" is encoded by the same pulse as that used for the previous "1", if there is even number of "0"s between them.
 - It is encoded by a pulse of opposite polarity if there is an odd number of 0's between them.
 - □ The number 0 is considered an even number.
 - a) Using the half-width pulse f(t), sketch the duobinary signal y(t) for an input sequence 110100101110001
 - b) Determine R_0 for this code if "0" and "1" are equally likely.

