

2.7 Digitization/Compression of Audio Signals

Critical Band and Audio Masking

· Critical Band

human auditory system percepts the signals in form of “critical bands”

- roughly 26 overlapping bandpass filters
- bandwidth 50 ~ 100 Hz below 500 Hz
- bandwidth 5 KHz at high frequencies
- up to 24 KHz

· Audio Masking Effect

- without a masker, signal inaudible if below a “threshold in quiet”
- low-level signal (maskee) can be made inaudible by a simultaneously occurring stronger signal (masker) . Most significant in the same critical band, less significant in neighboring bands
- masking threshold (threshold of Just Noticeable Distortion, JND) can be evaluated

See Fig. 1 , p. 61, Ref [A]

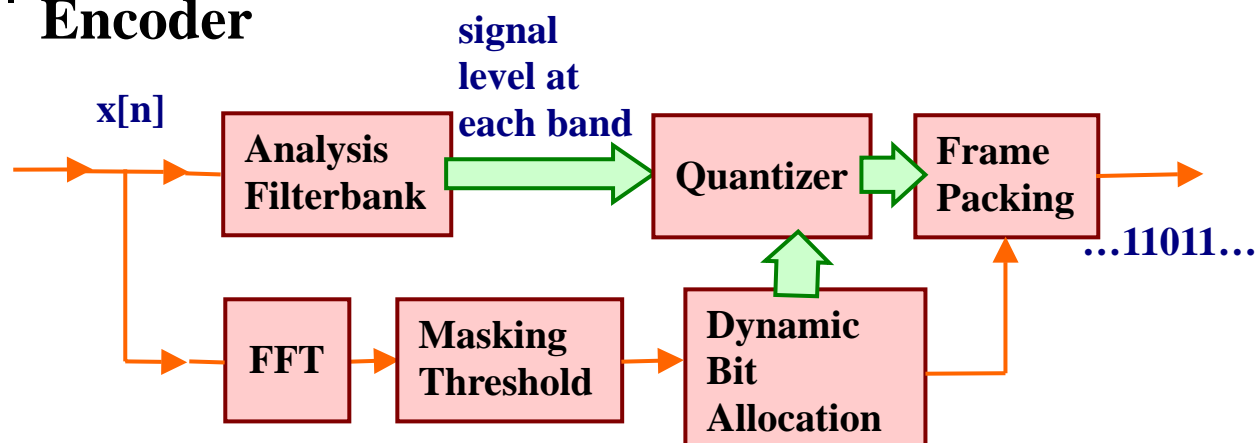
- For a given masker, signal-to-mask ratio varies across the critical band, and number of bits per sample can be chosen considering the masking effect

See Fig. 2 , p. 62 Ref [A]

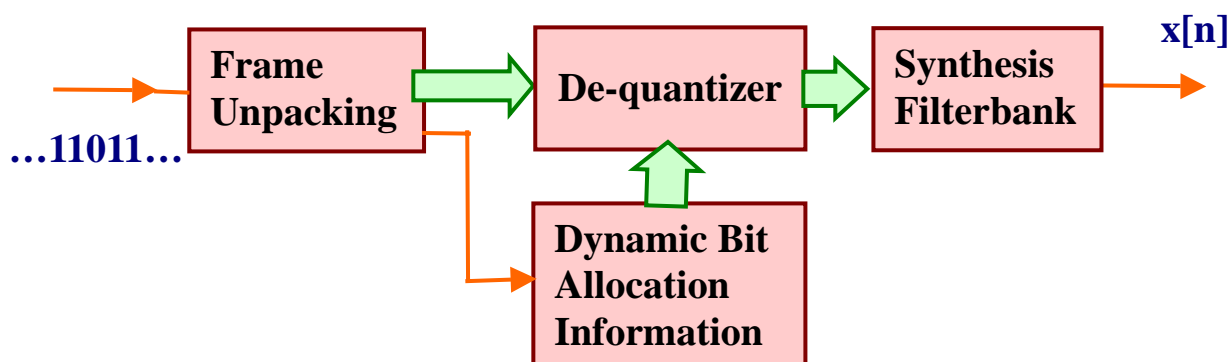
- global masking threshold obtained from many maskers

Frequency Domain Coding

Encoder



Decoder



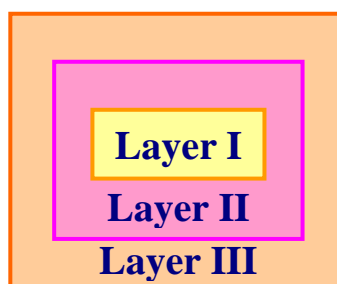
See Figs. 11 and 13 , p. 67 and 69 , Ref [A]

Removing two types of signal components

- redundant
- irrelevant for hearing

Layers of Frequency Analysis

- higher layers incorporate the main building blocks of the lower layers
- higher layers give higher performance at higher complexity



MPEG(Moving Pictures Expert Group) of ISO(International Standard Organization)

· MPEG-1 / audio coding standard

Layer I 384 Kbps

Layer II 192 Kbps

Layer III 128 Kbps

Subjective quality equivalent to Compact Disk
(CD, 16 bit PCM)

· MPEG-2 / MPEG-4

Ref : 3.17 of Haykin

*Ref [A] : “MPEG Digital Audio Coding”, IEEE
Signal Processing Magazine, Sept. 1997*