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18-899 Special Topics in Signal Processing



Multimedia Communications:
Coding, Systems, and Networking

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Lecture 9



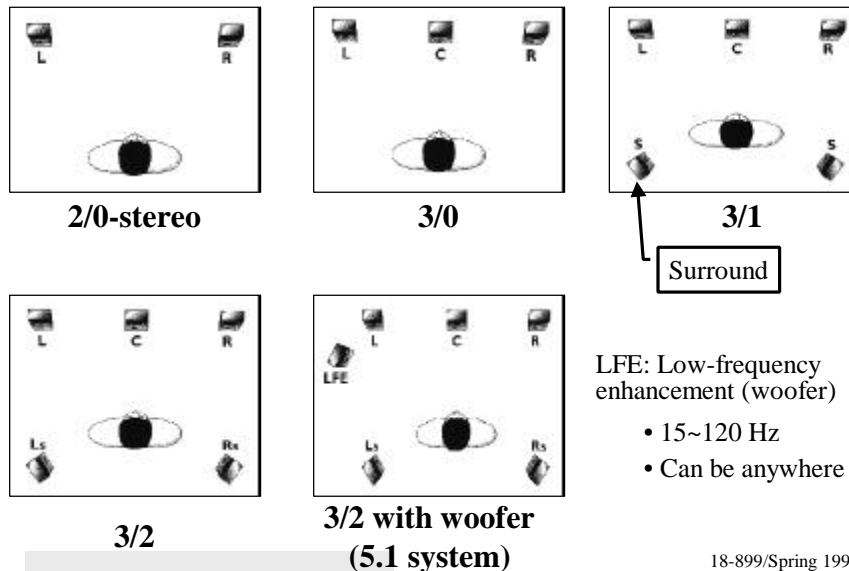
MPEG-2 Audio

MPEG-2 Audio

- Allows lower sampling rates
 - 16, 22.05, and 24 kHz (half of MPEG-1)
 - From wideband speech to mediumband audio
 - Higher frequency resolution
 - Layers I, II, and III
- Multichannel coding
 - Surround sound, multilingual, for visual/hearing-impaired
- Backward compatible (BC) and non-backward compatible (NBC) coding

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Multichannel Audio



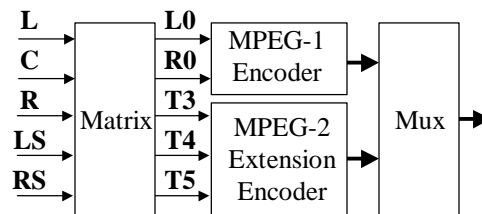
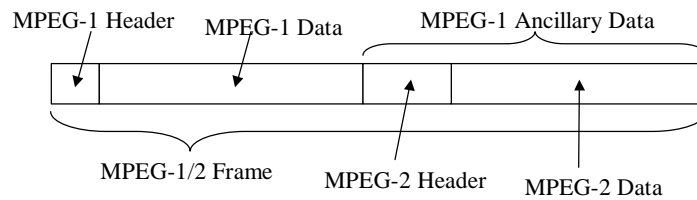
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Compatibility

- Forward compatibility
 - A new decoder can decode an old bitstream
 - Usually simple to achieve
- Backward compatibility
 - An old decoder can decode a new bitstream, at least partially
 - Usually limits the coding efficiency

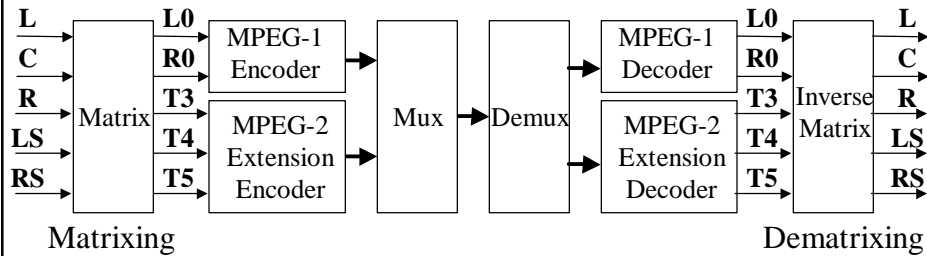
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MPEG-2 Backward Compatible Audio Coding



$$\begin{cases} L0 = a(L + b \cdot C + d \cdot LS) \\ R0 = a(R + b \cdot C + d \cdot RS) \end{cases} \quad a = \frac{1}{1+\sqrt{2}}; b = d = \frac{1}{\sqrt{2}} \text{ or } a = 1; b = d = 0$$

Backward Compatible Audio Coding (cont.)



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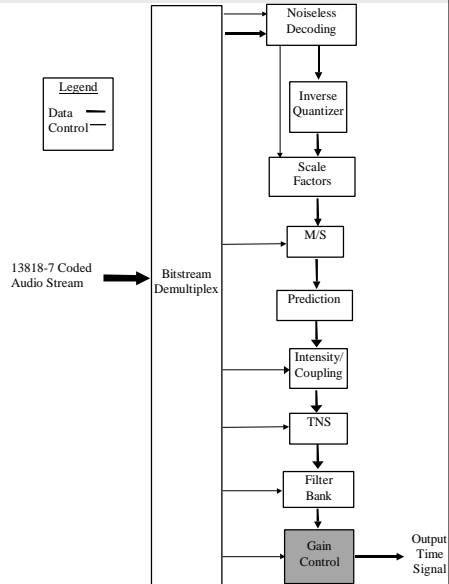
Non Backward Compatible (NBC) Coding

- MPEG-2 Advanced Audio Coding (AAC)
 - ISO/IEC 13818-7 (April 1997)
 - 320~384 kbits/s for 5 channels, 64kbits/channel
 - NBC at 320 kbits/s as good as BC coding at 640 kbits/s
 - 1~48 audio channels, 0~16 LFEs, 0~16 data streams
 - Same framework (perceptual subband coding) as MPEG-1, with some enhancements

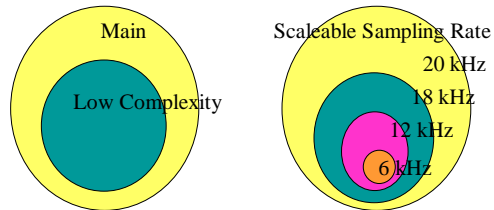
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MPEG-2 AAC

- Encoder Enhancements
 - Preprocessing
 - High resolution filterbanks
 - 1024-line MDCT
 - Temporal noise shaping (TNS): time-dependent quantization
 - Coupling channel
 - Backward adaptive prediction in subbands
 - M/S stereo coding (intensity multichannel coding)
 - Noiseless coding (entropy coding): Huffman coding



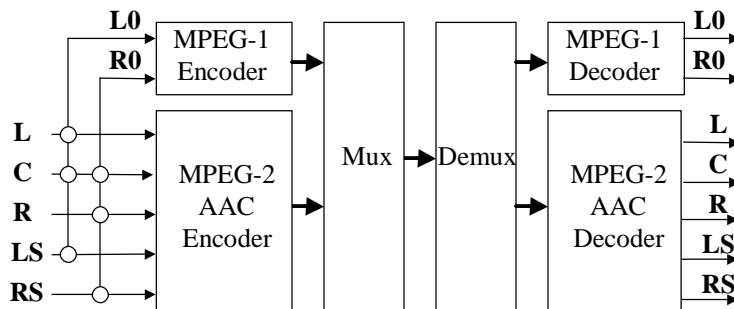
MPEG-2 AAC Profiles



- Main profile
 - Best quality, highest complexity
 - 1024 or 128 MDCT
- Low-complexity profile
 - No temporal noise shaping, no prediction
- Scalable sampling-rate profile
 - Scalable output sampling rates and complexity
 - Uses hybrid filterbanks (like MPEG-1 Layer III)
 - No prediction, no coupling channel

Simcast

- To achieve backward compatibility at the cost of higher bitrate



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References

- Peter Noll, “MPEG digital audio coding,” *IEEE Signal Processing Magazine*, Sept. 1997, pp. 59-81
- <http://www.cseit.it/mpeg/faq/faq-audio.htm>
- <http://www.tnt.uni-hannover.de/project/mpeg/audio/>

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