

HY-330

fall semester 2024

Introduction to telecommunication systems theory

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Compression

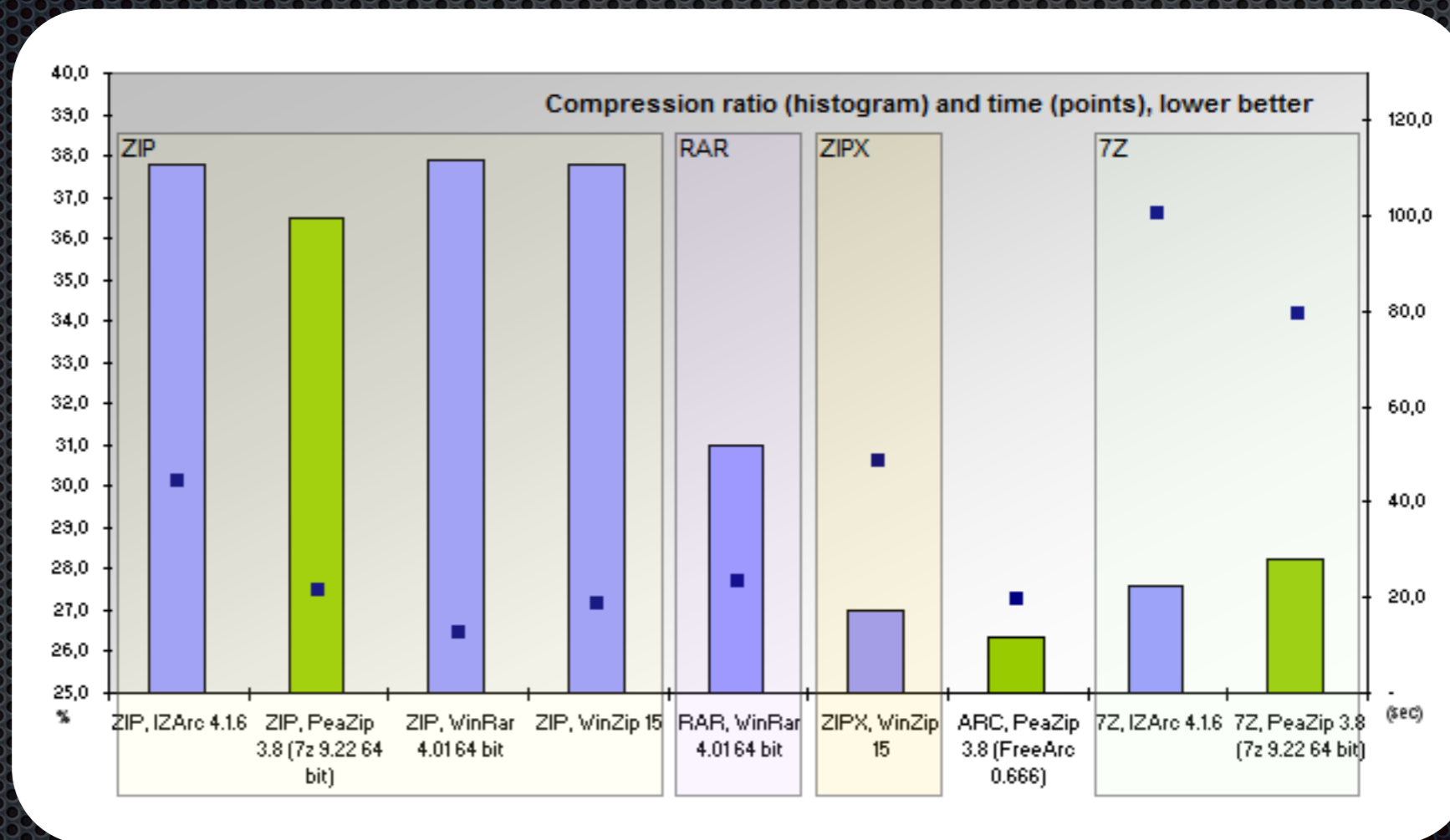
- ✦ Why?
- ✦ Lossless
- ✦ Lossy

Data Compression

- ✦ Encoding in order to reduce size
 - ✦ Storage
 - ✦ Transmission time / Bandwidth
- ✦ Methods
 - ✦ Redundancy reduction
 - ✦ Repeating sequence suppression

Compression Ratio

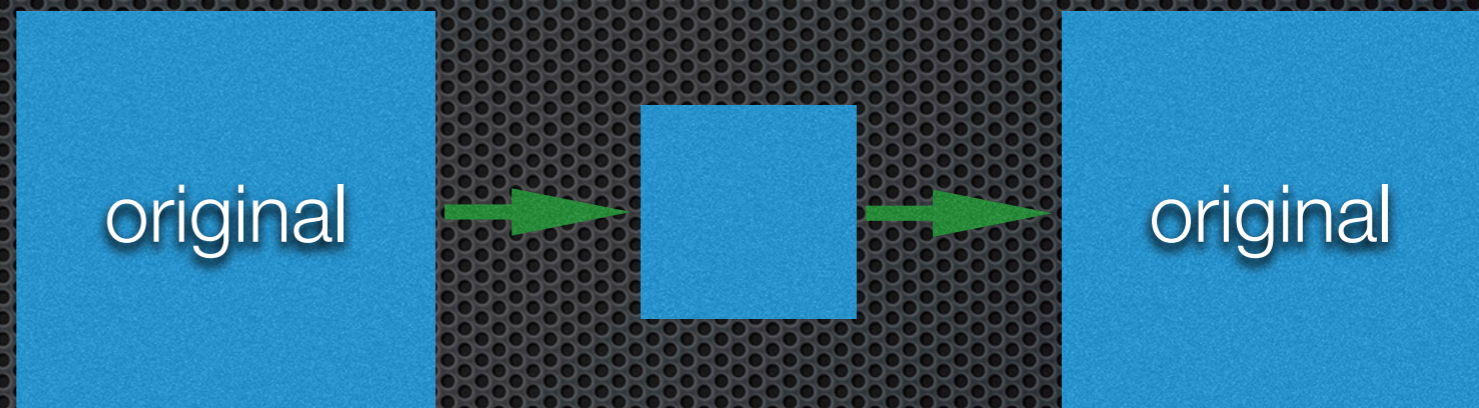
- Compression Ratio = Uncompressed Size / Compressed Size



Compression Techniques

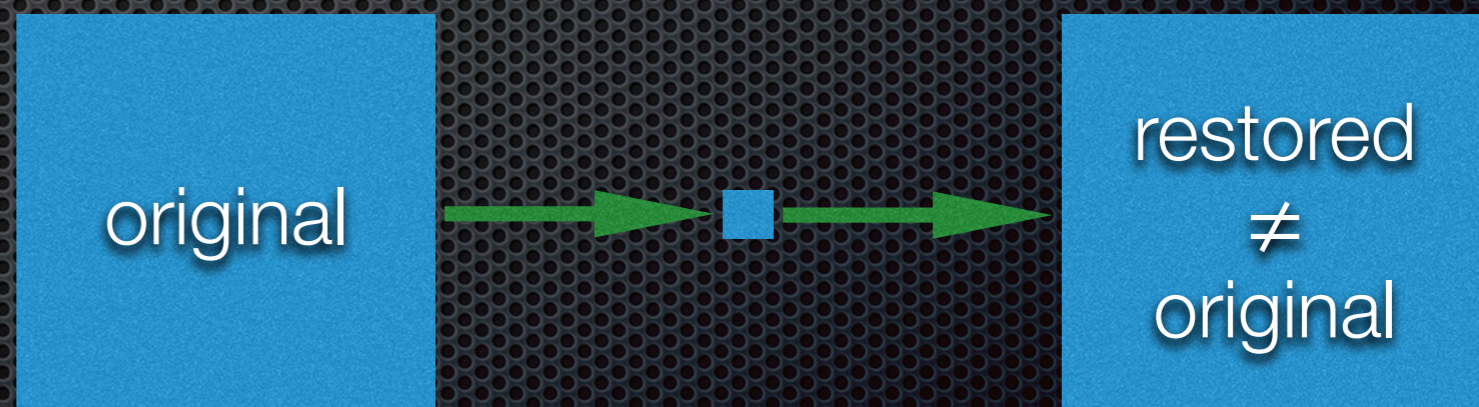
- Lossless

- Huffman
- Run-length
- Lempel Ziv



- Lossy

- JPEG
- MPEG
- MP3

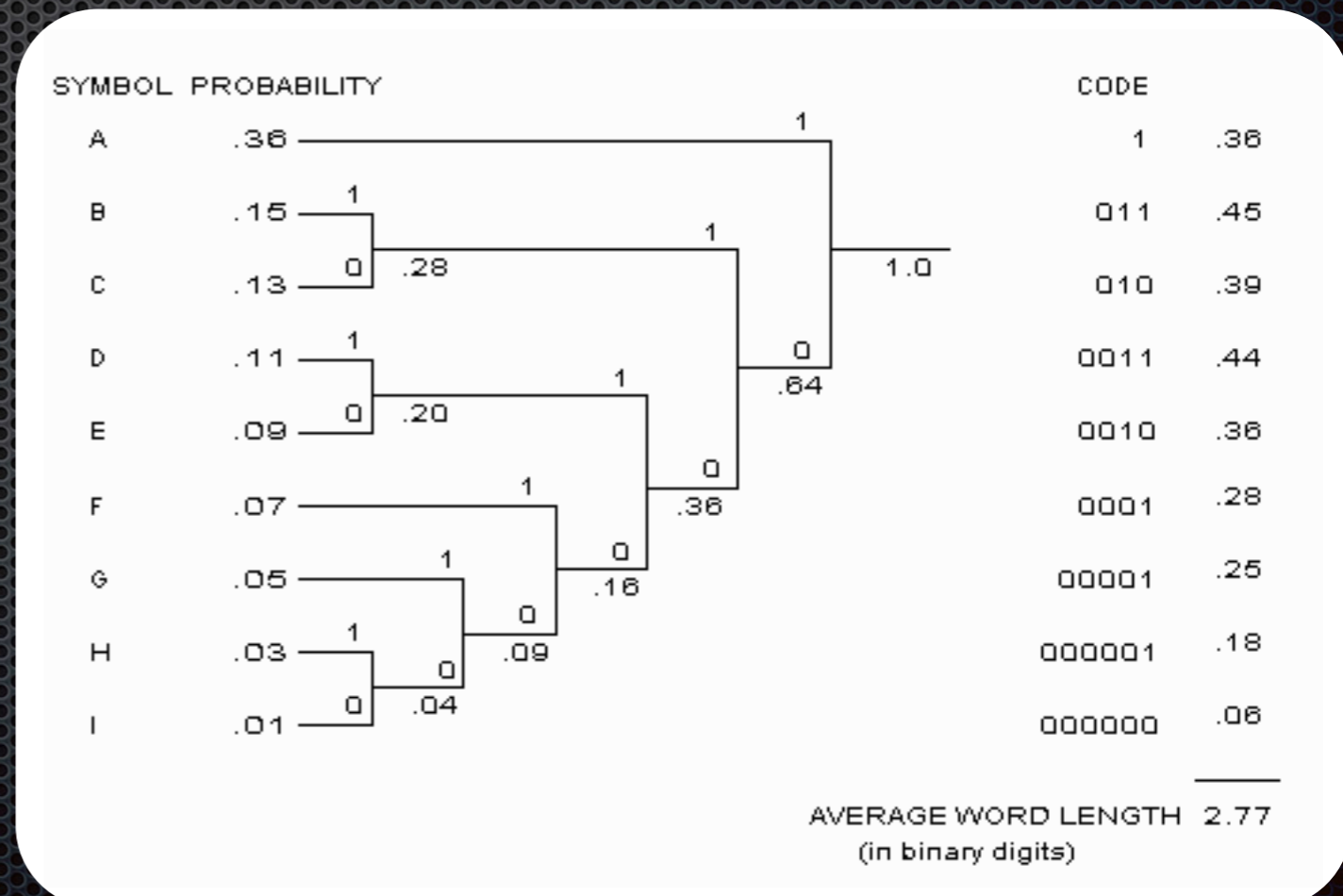


Huffman Algorithm

- Variable Length Encoding
 - Longest codeword to less probable block
 - Shortest codeword to most probable block

- Algo

- Sort probabilities
- Begin with the lowest ones
- Build tree
- Assign bits to branches
- Get code



Lempel Ziv

- Dictionary-based Encoding
 - Create dictionary of strings used
 - Substitute strings by indices in the dictionary

- Algo
 - Find the smallest unique substring
 - Store substring in dictionary
 - Substitute substring by index
 - Repeat for next largest unique string

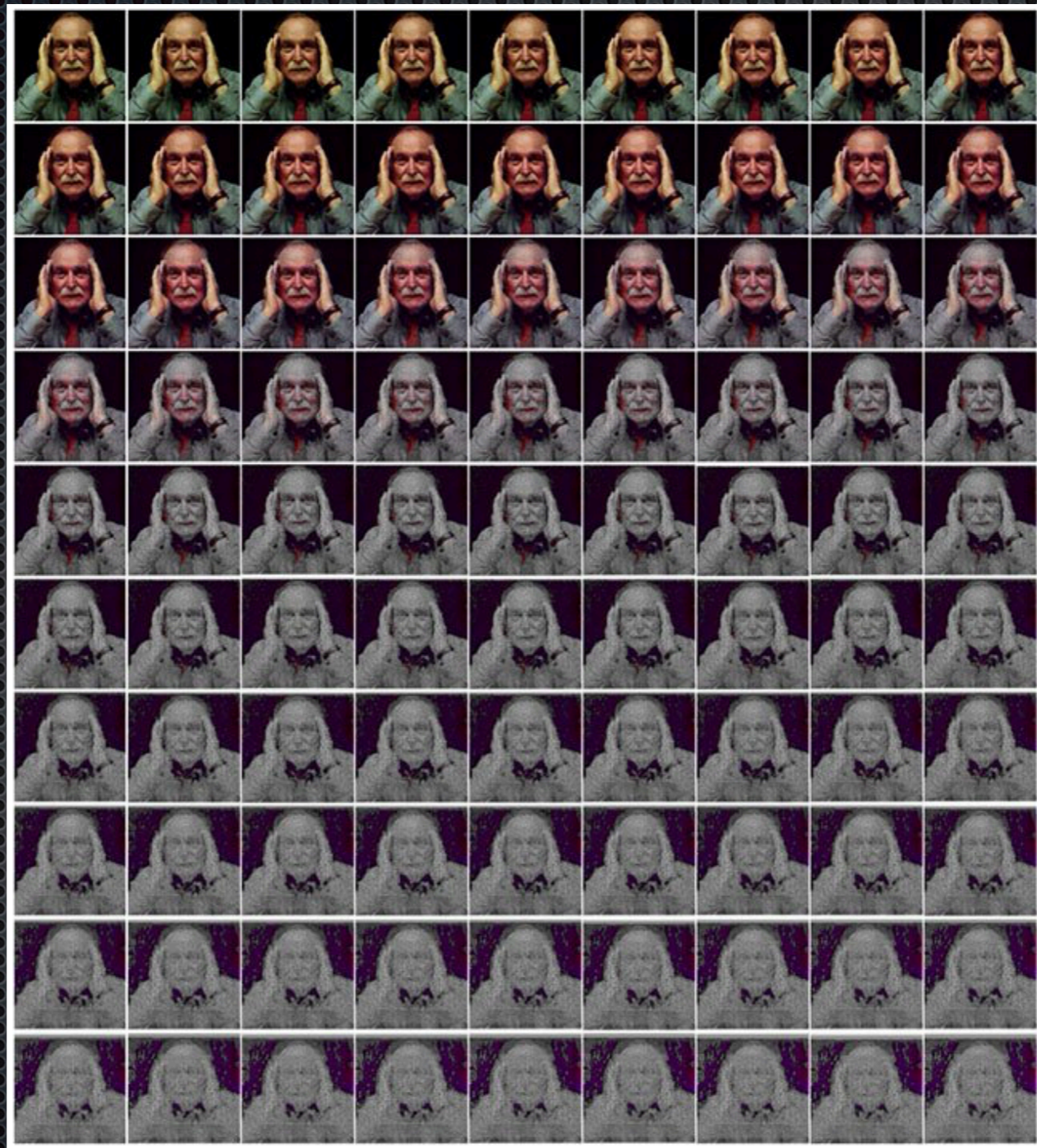
```
AABABBBABAABABBBBABBABB
A | ABABBBABAABABBBBABBABB
A | AB | ABBBABAABABBBBABBABB
A | AB | ABB | B | ABAABABBBBABBABB
A | AB | ABB | B | ABA | ABAB | BB | ABBA | BB
```

1	2	3	4	5	6	7	8	9
A	AB	ABB	B	ABA	ABAB	BB	ABBA	BB
∅A	1B	2B	∅B	2A	5B	4B	3A	7

JPEG

- ✦ Joint Photographic Experts Group
- ✦ 10:1 little perceptible loss in image quality
- ✦ Based on the discrete cosine transform (DCT)
 - ✦ From the spatial (2D) domain into the frequency domain
 - ✦ Discards high-frequency information [Perceptual model based on the human psychovisual system]

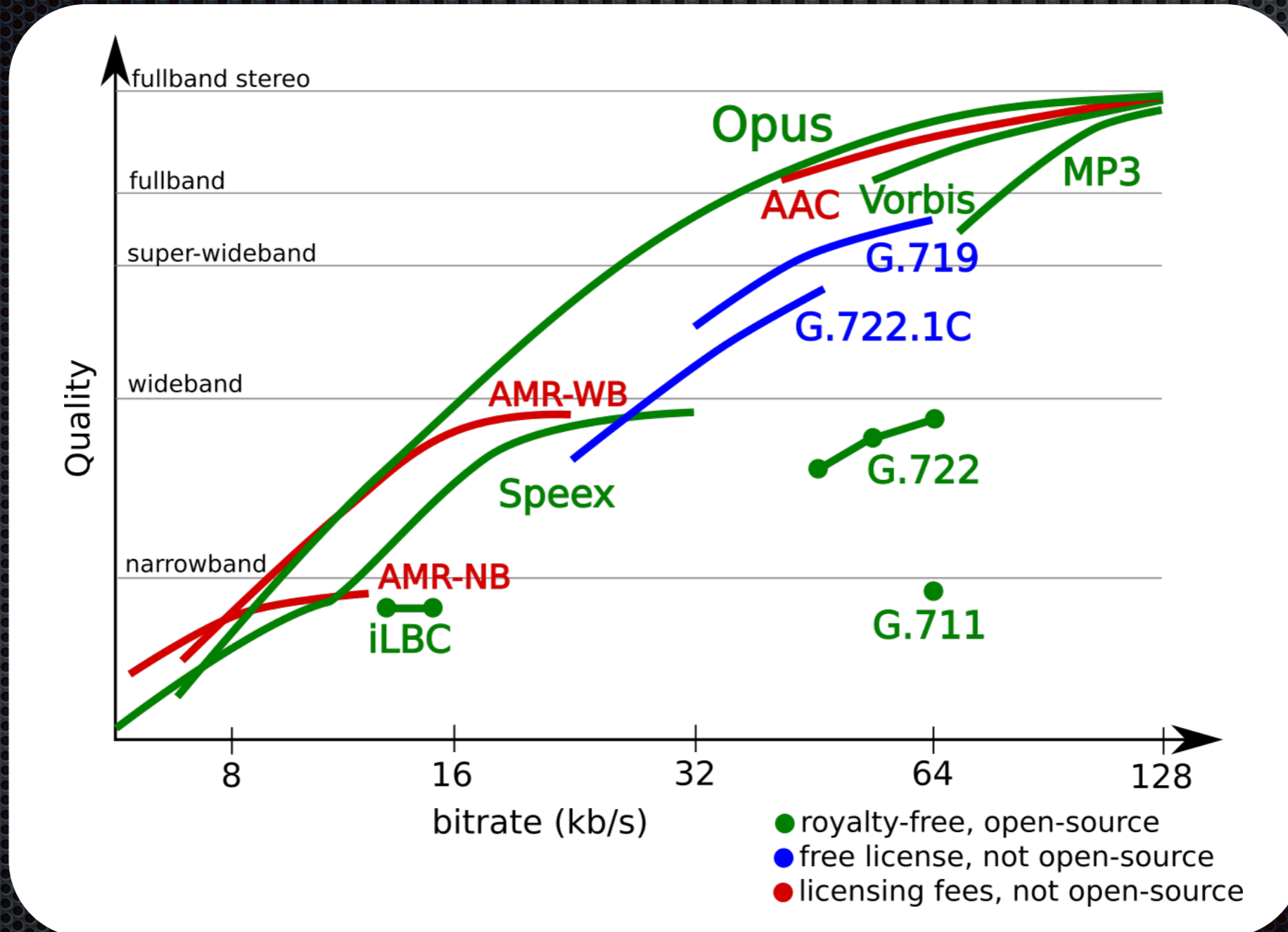
JPEG



MP3

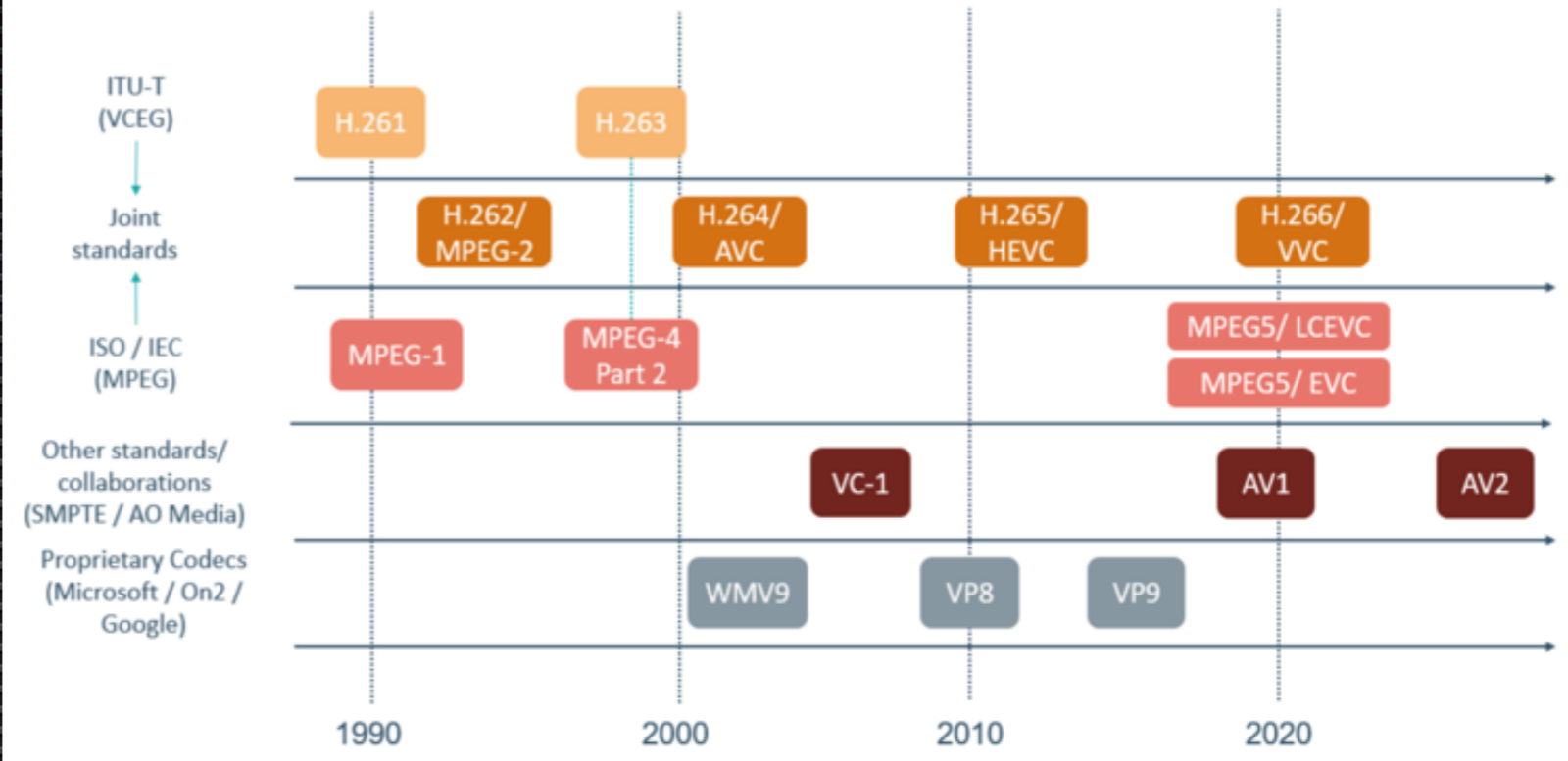
- ✦ JMPEG-1 and/or MPEG-2 Audio Layer III
- ✦ 10:1 little perceptible loss in audio quality
- ✦ Uses perceptual coding [psychoacoustic models to discard or reduce precision of components less audible to human hearing, and then records the remaining information in an efficient manner]

MP3 vs ...



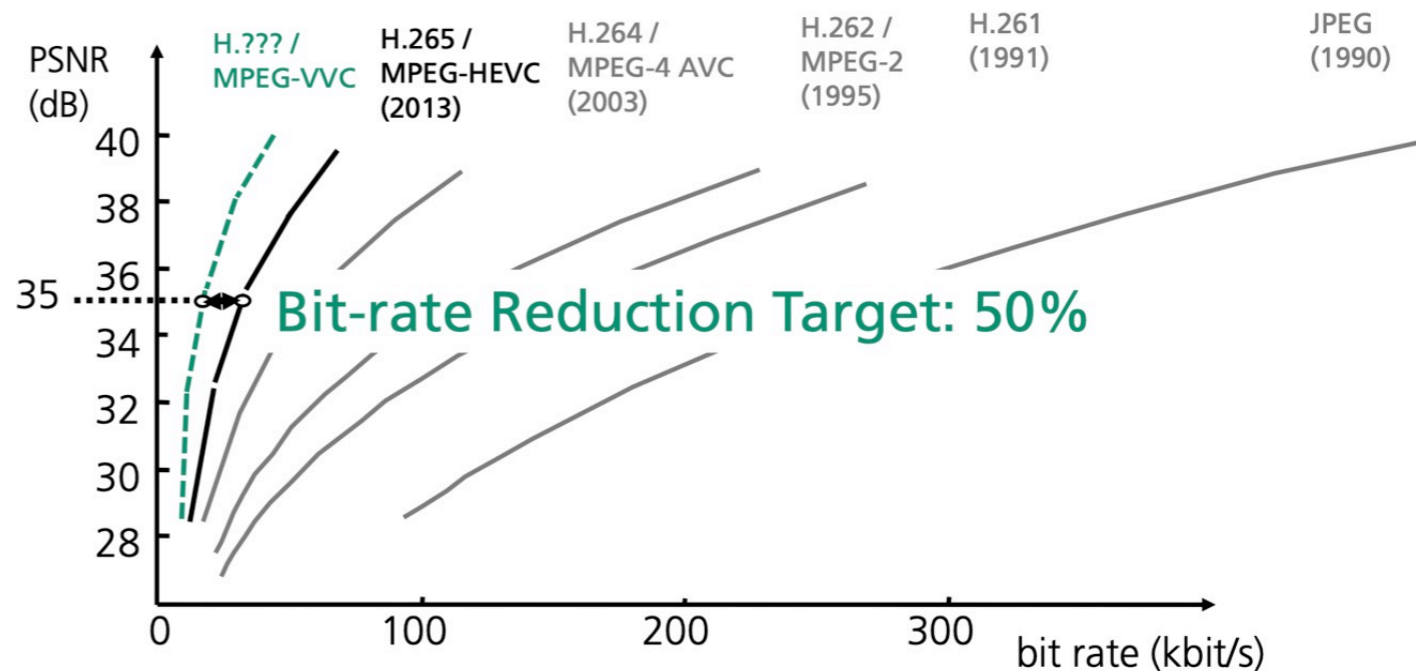
MPEG etc.

Timeline of MPEG/VCEG standards and examples of alternative codecs



VVC – Coding Efficiency

Target for the final VVC standard



Color

- ✦ Chroma subsampling
- ✦ RGB vs YCbCr
- ✦ Luma - Chroma
- ✦ Bayer filter (in camera sensor)

