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International Telecommunication Union

ITU-T Recent Developments in Media Coding

Claude Lamblin

France Telecom

ITU-T SG16 Vice Chair

WP3/16 co-chair (Media Coding)

ITU-T Workshop on "End-to-End QoE/QoS"
Geneva, 14-16 June 2006

Media Coding Trends

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- **Universal Multimedia Access**
  - Various networks interconnected
  - Heterogeneous terminals / Different accesses
- **Network interoperability**
  - Multiple incompatible coding standards
  - Adaptation networks, accesses, terminals
- **Quality and Flexibility Enhancement**
  - Robustness to source types (e.g. speech/music, …) and channel errors
  - Audio: Bandwidth ↑ /Video: Resolution ↑
  - Scalable (⊃ Embedded)
    - A: Bit rate and now in audio bandwidth
    - V: Temporal, Spatial, SNR

Bit Rate Decrease → Quality Increase

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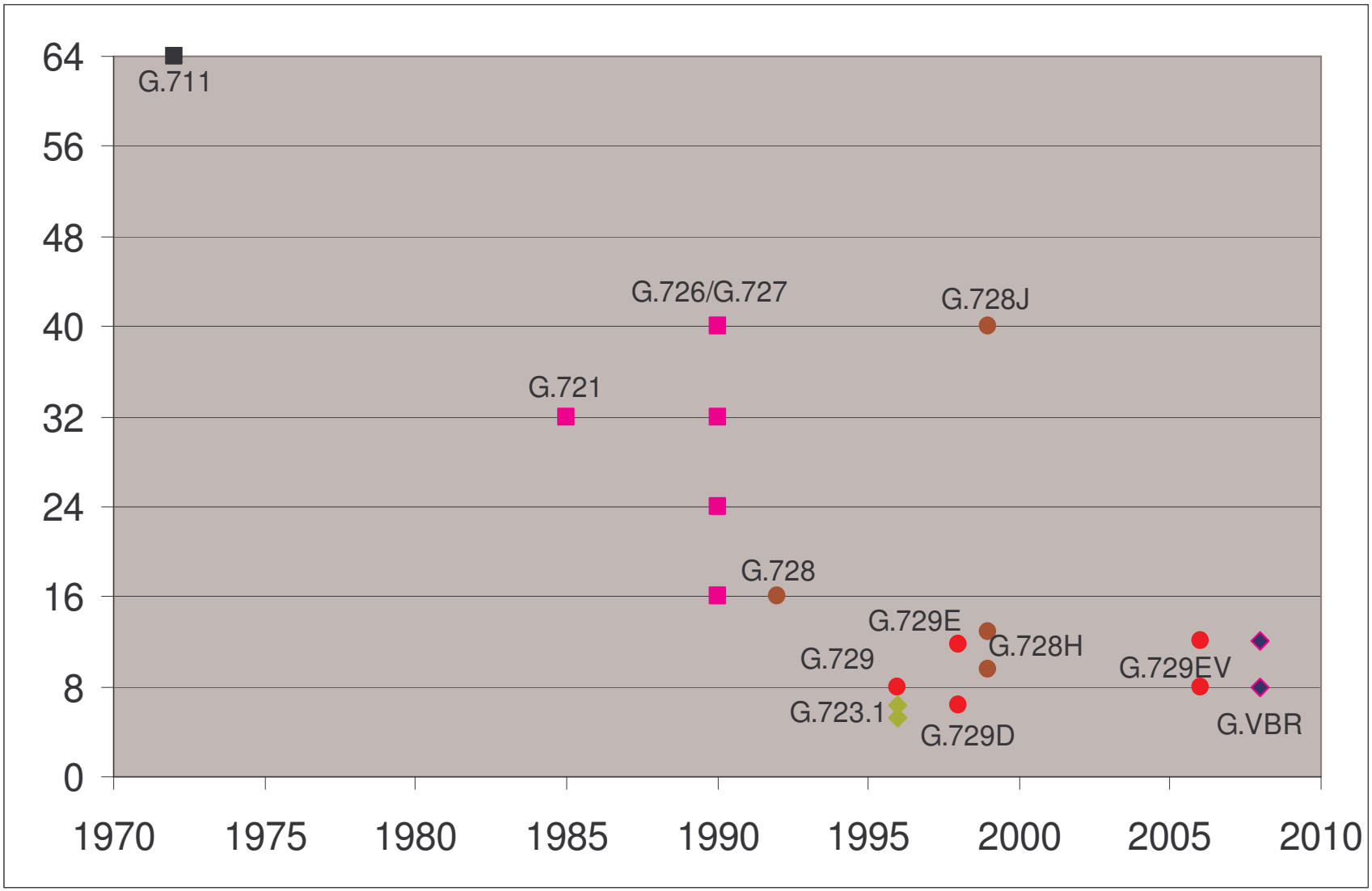
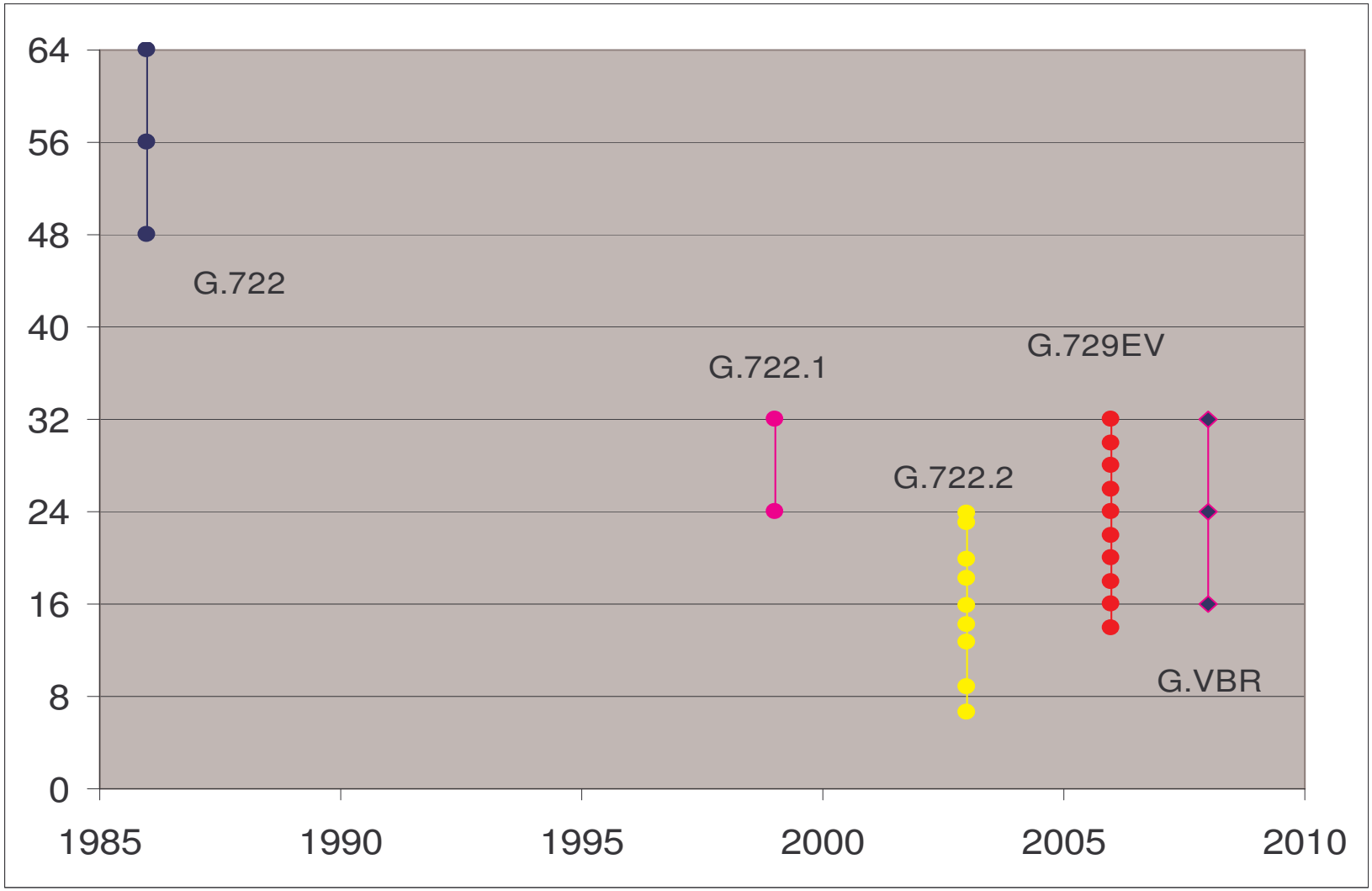
- **Media coding Objective: Quality /bit rate tradeoff**
  - Lower the bit rate / No quality degradation
  - Increase the quality / Keep the bit rate
  - Others: complexity, delay, error robustness
- Audio: enough compression; need for audio BW ↑
- Video: still need for compression and now also resolution ↑
- Audio Bandwidths / Bit Rate range

Quality	Fs (Hz)	BW (kHz)	Rates (kbit/s)
NB	8000	0.3-3.4	64 (G.711) → 6.4 (G.729D)
WB	16000	0.05-7	64 (G.722) → 14 (G.729.1)
FM	32000	0.05-14	24,32,48 (G.722.1 C)
HIFI	48000	0.02-20	-

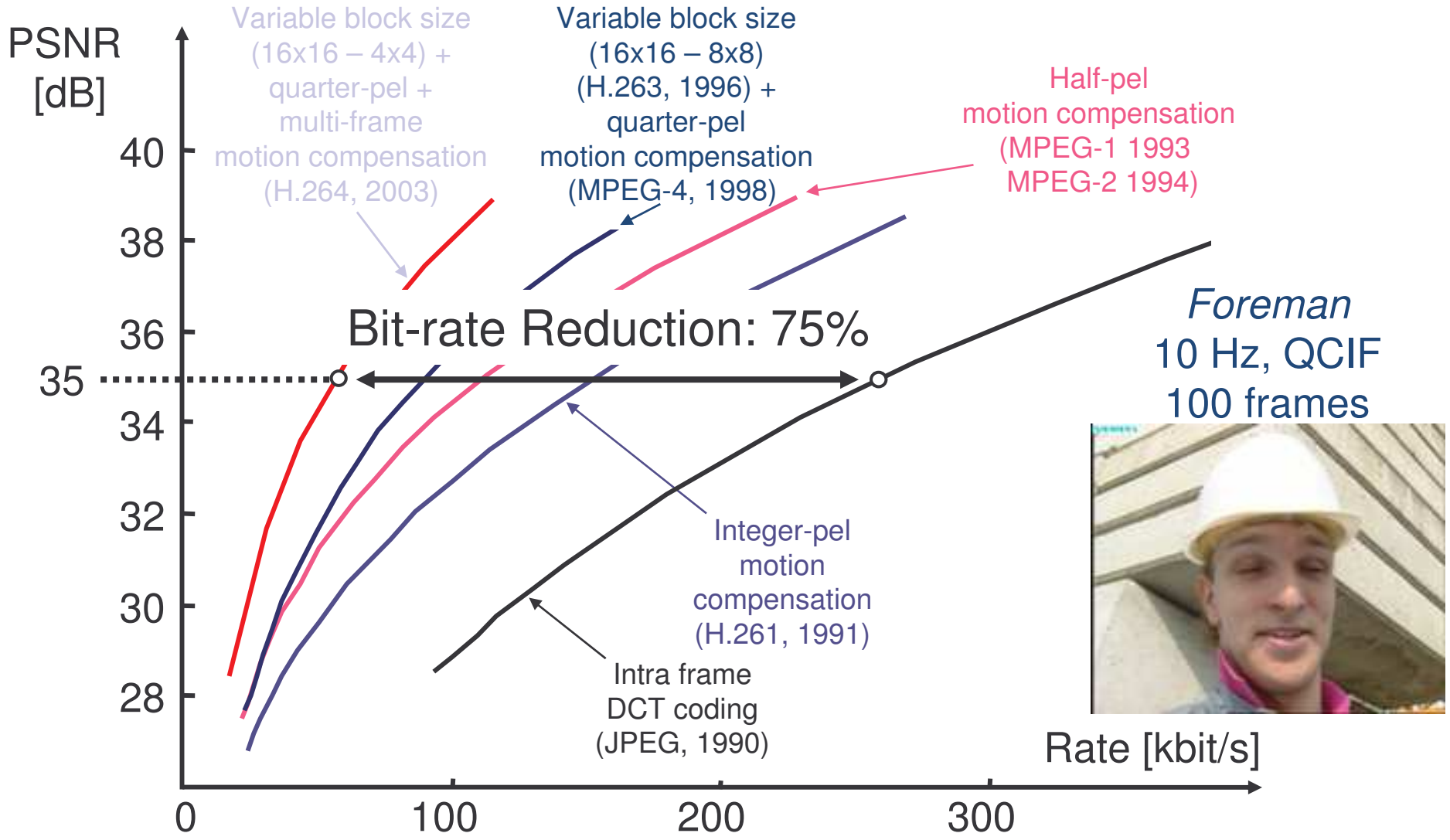
ITU-T Audio coders: Narrowband



ITU-T Audio coders: Wideband



ITU-T Video Coders



H.264 versus MPEG-2/4 & H.263

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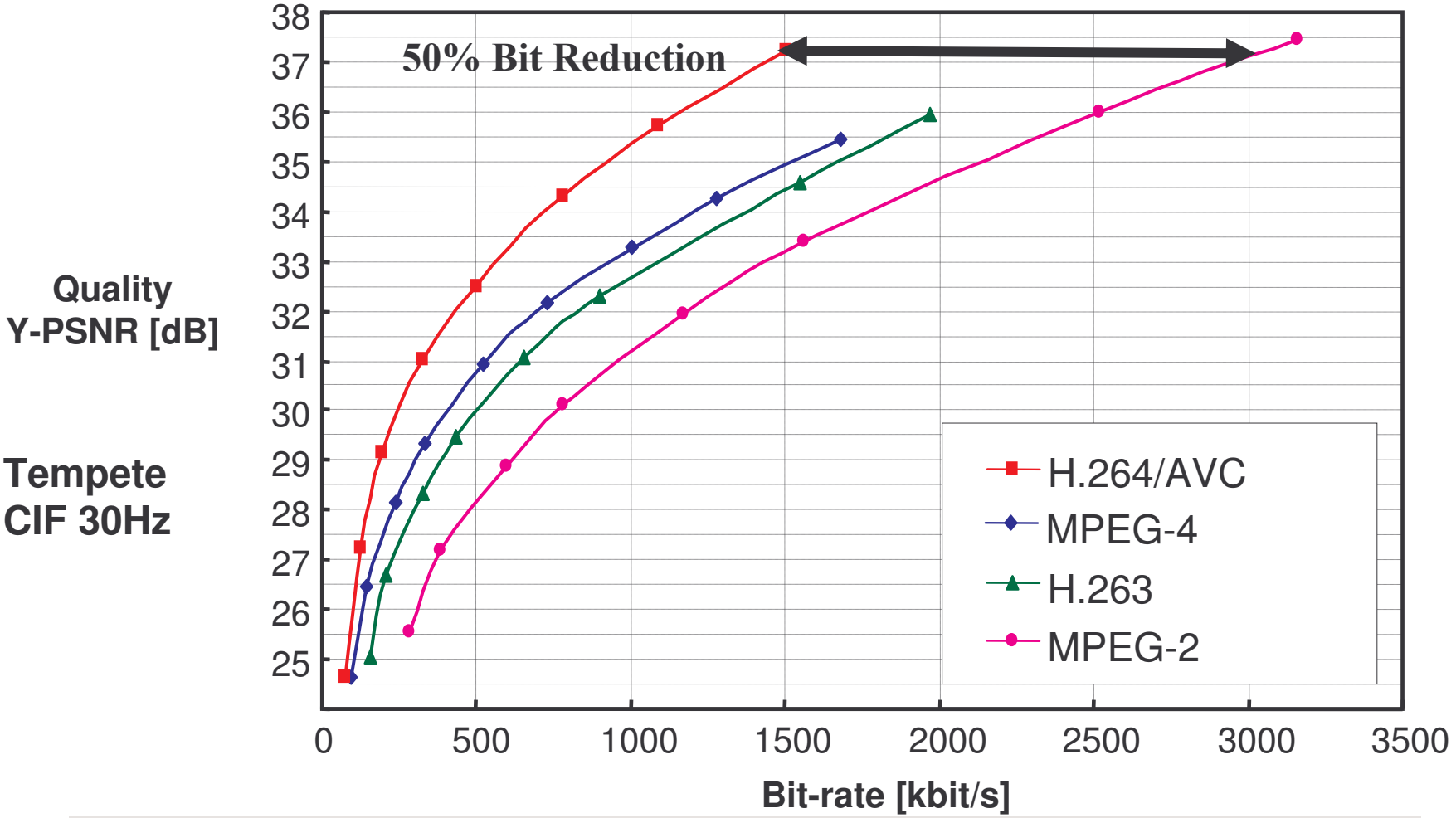
- H.264 doubles the compression of MPEG-2
- H.264 ubiquitous adoption in every video market segment



Flexibility: Multirate codecs

- Quality ↗ with bit rate ↗
- Heterogeneous accesses
- Congestion control / Differentiated QoS
- Adaptation to channel errors
- Rate chosen at the encoder for each frame
  - NB: G.726 (40/32/24/16), G.723.1(6.3/5.3+DTX), G.729 (11.8/8/6.4+DTX)
  - WB: G.722.1 (24/32), G.722.2 (6.6/8.85/12.65/ 14.25/15.85/18.25/19.85/23.05/23.85+DTX)
  - SuperWB: G.722.1 C (24/32/48)
- Embedded schemes: layered media coding

Embedded Schemes

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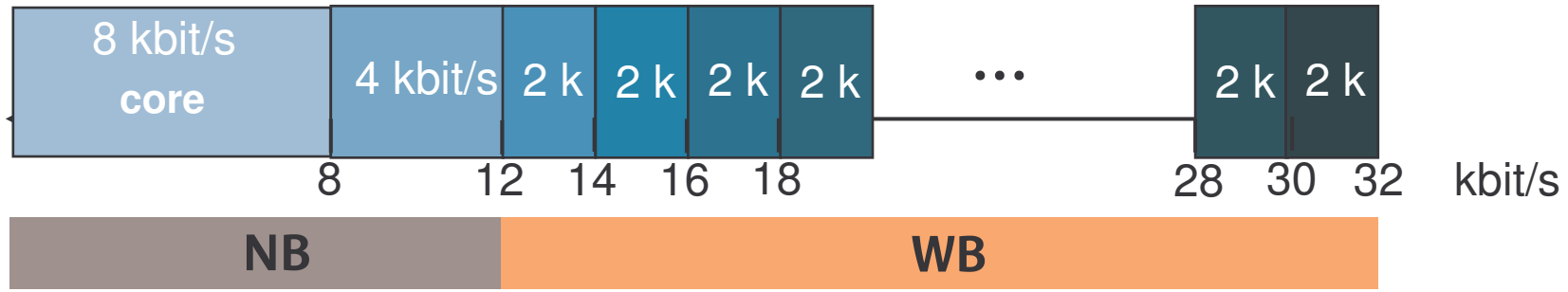
- "Layered" bitstream (ex. G.729.1)



- Higher flexibility
  - "on the fly" bit rate selection by simple truncation of the bit stream by any component of the communication chain
  - Easy adaptation to service requirements & interconnected networks/terminals
  - No out band signaling, no multiple codec negotiation, no transcoding

ITU-T Embedded Audio coders

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- "Old" embedded coders
  - No bandwidth scalability only bit rate scalability

G.72x	BW	Rates (kbit/s)	date
G.711	NB	64, 56, …	1972
G.727	NB	40,32, 24,16	1990
G.722	WB	64, 56, 48	1988

- New embedded coders
  - Bit rate and bandwidth scalability
  - G.729.1: NB-WB; (8/12/14/16/18/…/28/30/32)
  - G.VBR: NB-WB-(Super-WB)

ITU-T G.729.1

8-32 kbit/s scalable wideband coder bitstream interoperable with G.729 (G.729EV)

- **Bit rate and bandwidth scalability**
  - 8 and 12 kbit/s; [50-4000 Hz]
  - 14 → 32 kbit/s by steps of 2 kbit/s; [50-7000 Hz]
  - Delay:48.94 ms; Complx.(32 kbit/s): 35.8 WMOPS
- **Smooth transition from NB to WB telephony**
  - Bitstream interoperable with G.729 at 8kbit/s widely used in VoIP infrastructures
  - Packetized wideband voice applications (VoIP, VoATM, ToIP, IP phone)
- **Future: embedded WB→ SuperWB (G.72x.y)**

Conclusion

New media coding standards should be created sparingly to avoid interoperability problems

- Bandwidth cheaper ⇨ Requirements for standards changed
  - Compression is still important for video but less so than it used to be
  - Enough compression for audio
  - Increased Quality (audio bandwidth ↑, Channels ↑, resolution, robustness …
  - Increased Flexibility (scalability/embedded coding, Complexity, …)
- Audio coding
  - Many good codecs (≠ tradeoffs) ⇨ “Universal” codec
- Video coding
  - H.264 ext. ⇨ Higher resolution, Scalable Coding (SVC)