International Telecommunication Union

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Recent developments in objective voice and video quality assessment models

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Presentation Outline

- Industry perspective and need for QoS
- What is Quality?
- Objective perceptual quality assessment models
- Standards in voice and video
- On-going standardization effort in video (Video Quality Experts Group - VQEG)

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Recent Trends in the Industry

- New emerging multimedia services both in fixed and wireless networks
- Traditional voice carriers are moving to broadband and NGN:
  - Essential to control costs and drive up revenue
  - Triple play services: Voice - Video – Data
  - Video services a key value add
    - Price/quality balance must attract/retain users
    - TV quality must compete with satellite and cable

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Recent Trends in the Industry

- Mobile operators in 2.5/3G infrastructure:
  - Need to increase ARPU
  - Offering of new video services
  - Price/quality balance must attract/retain users

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Challenges and Quality Issues

- Users are conditioned to expect high-quality TV pictures:
  - Users unlikely to tolerate poor/fair quality pictures in IPTV
  - Early delivery of broadband services will be over limited bandwidth compared to cable and satellite
  - Compulsory data compression can potentially degrade quality
- Need for robust (IP) transmission to minimize data-loss and delay issues

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Challenges and Quality Issues

- Right balance between end-user quality of experience and bandwidth cost is vital
- Quality measurement for service assurance
  - End-to-end quality monitoring
  - Early fault detection and directed maintenance/solution
  - SLA based on QoS delivered to end-user

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Need for Objective Quality Metrics

- Measurement of end-user quality essential for industry
- Traditional metrics such as PSNR, PLR, BER are inadequate

Requirements for objective perceptual metrics

What is Quality?

- Perceptual quality
- Mean Opinion Score

Perception of Quality	MOS
Excellent	5
Good	4
Fair	3
Poor	2
Bad	1

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Full-Reference Quality Measurement

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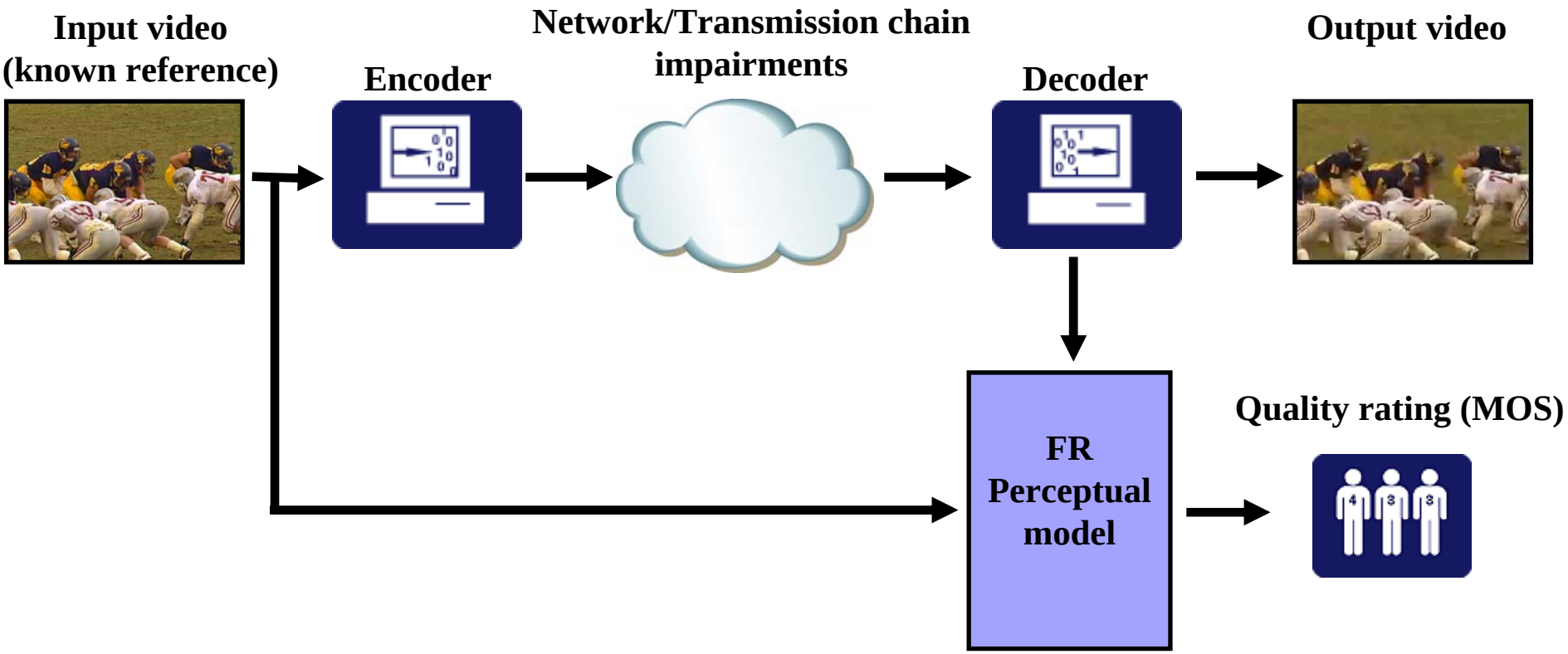

No-Reference Quality Measurement

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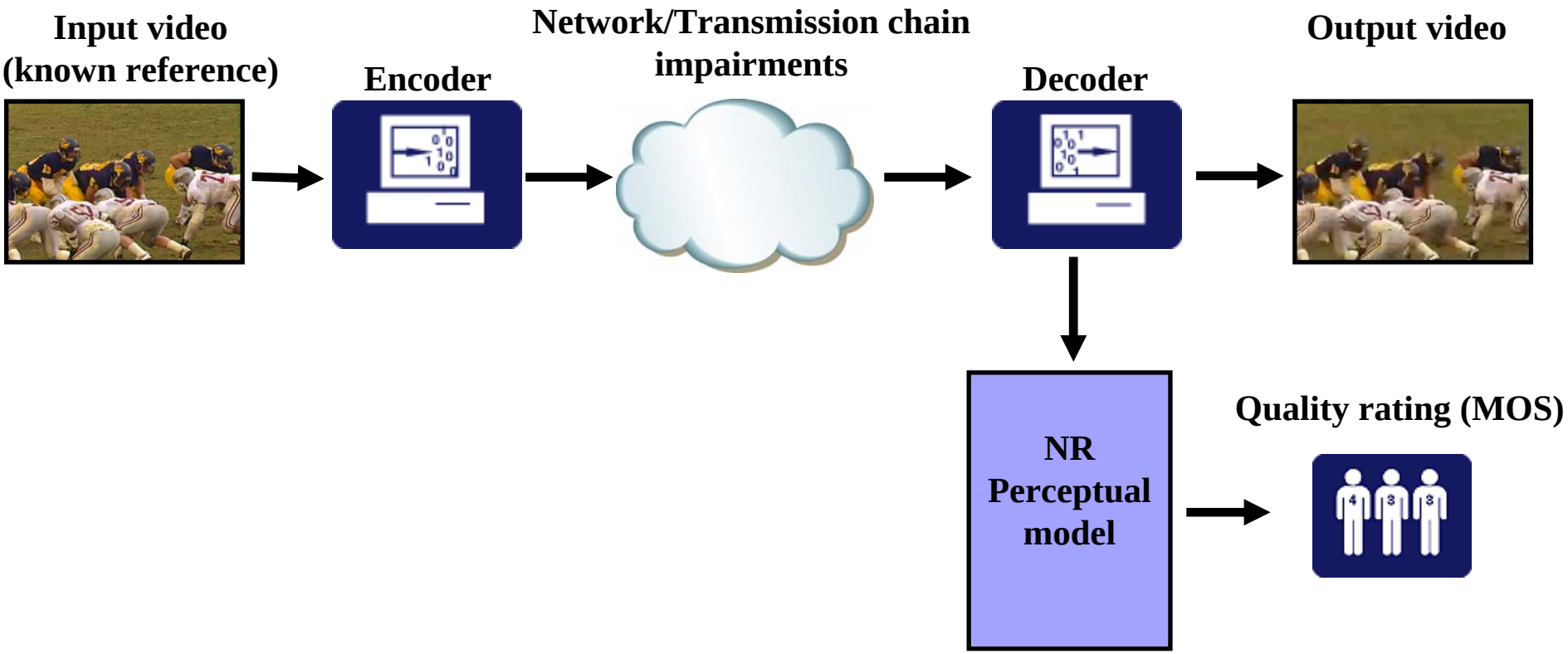

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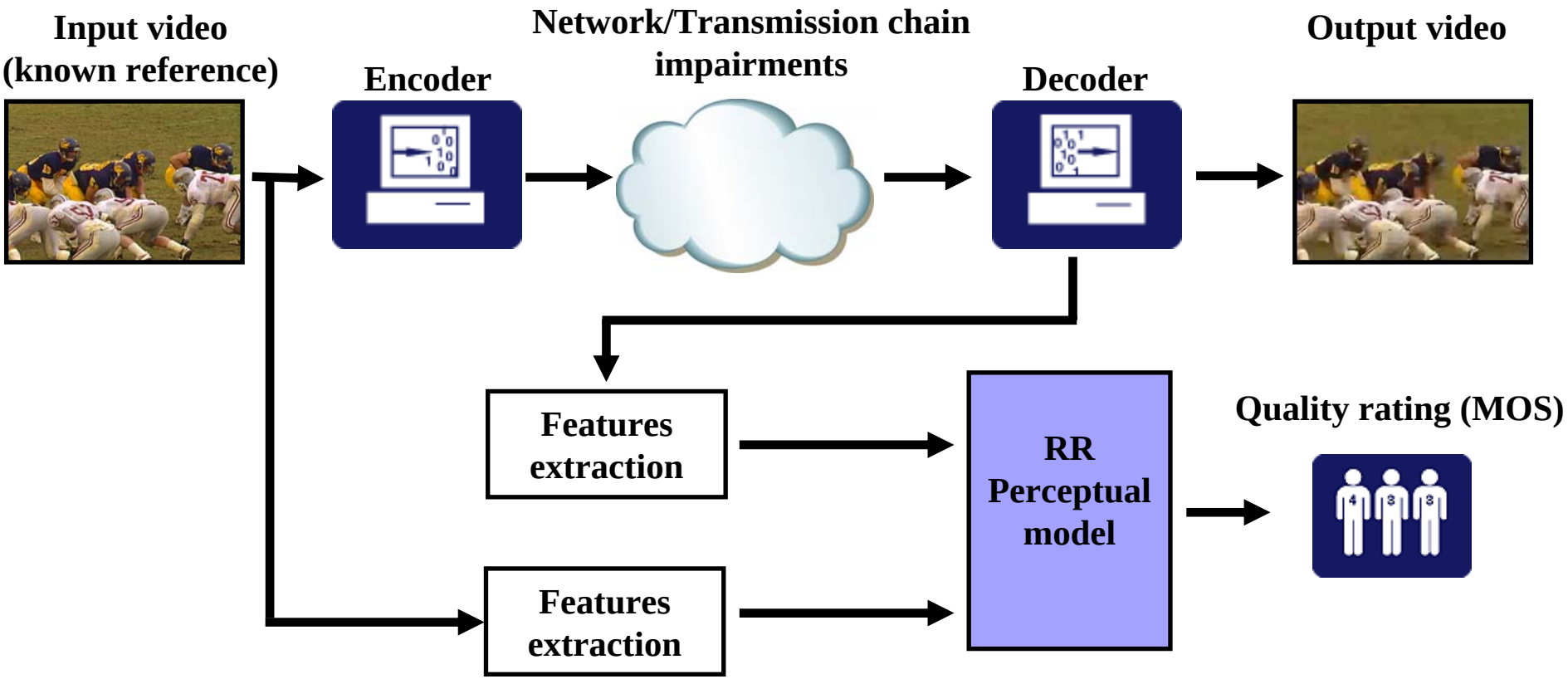
Reduced-Reference Quality Measurement



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Standards for Voice Quality Assessment

- ITU-T P.862 (Feb 2001):
  - Full-reference perceptual model (PESQ)
  - Signal-based measurement
  - Narrow-band telephony and speech codecs
  - P.862.1 provides output mapping for prediction on MOS scale
- ITU-T P.563 (May 2004):
  - No-reference perceptual model
  - Signal-based measurement
  - Narrow-band telephony applications

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Recent Standards for Voice Quality Assessment

- ITU-T P.862.2 (Nov 2005):
  - Extension of ITU-T P.862
  - Wide-band telephony and speech codecs (5 ~ 7Khz)
- ITU-T P.VTQ (on-going):
  - Targeted at VoIP applications
  - Minimum performance framework for no-reference packet-based measurement
  - Models analyse packet statistics; speech payload is assumed
  - Uses P.862 as a measurement reference

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Standards for Video Quality Assessment

- ITU-T J.144 and ITU-R BT.1683 (2004):
  - Full-reference perceptual models
  - Digital TV
  - Rec. 601 image resolution (PAL/NTSC)
  - Bit rates: 768 kbps ~ 5 Mbps
  - Compression errors

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Current On-going Standardization Efforts in Video

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Image resolution	FR	NR	RR
SDTV	ITU-T J.144 ITU-R BT.1683	RRNR-TV project	
HDTV	HDTV project		
VGA	MM project		
CIF			
QCIF			

- Completed
- On-going VQEG projects

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Current On-going Standardization Efforts in Video

- RRNR-TV project:
  - RR and NR perceptual models
  - Digital TV
  - Rec. 601 image resolution (PAL/NTSC)
  - Bit rates: 1 Mbps ~ 6 Mbps
  - Compression errors
  - Transmission errors

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Current On-going Standardization Efforts in Video

- HDTV project:
  - FR, RR and NR perceptual models
  - 1080p, 1080i and 720p image resolutions
  - Bit rates: 8 Mbps ~ 25 Mbps
  - Compression errors
  - Transmission errors
  - Pre/Post-processing

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Current On-going Standardization Efforts in Video

- MM project:
  - FR, RR and NR perceptual models
  - Multimedia-type video
  - VGA/CIF/QCIF image resolutions
  - Bit rates: 16 kbps ~ 4 Mbps
  - Frame rates: 2.5 ~ 30 fps
  - Compression errors
  - Transmission errors
  - Pre/Post-processing

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Challenges in MM project

- Need to cover most of multimedia-type scenarios:
  - Codecs, bit rates, frame rates, transmission errors
  - Representative content types
  - Several image resolutions (VGA, CIF, QCIF)
- Evaluation of all types of objective models (FR/NR/RR)

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Challenges in MM project

- Subjective experiments: > 40 (largest ever testing campaign)
  - Massive pool of reference video material
  - Processing of test video sequences
  - Coordination between test labs across continents
    - 11 proponents
    - 7 independent labs
- Subjective testing methodology: pre-testing / investigation for
  - Software playback
  - Display
  - Experiment set-up

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Summary

- Standardized perceptual models for
  - Narrow-band and wide-band voice
  - SDTV
- On-going standardization efforts for
  - SDTV
  - HDTV
  - Multimedia-type video
- VQEG ambitious targets for testing new objective perceptual models