IPTV Performance Measurement

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Outline

- IPTV Performance
- Performance Measurement Approaches
- Analyzing Encrypted Video Streams
- Telchemy's IPTV Test Lab

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IPTV Performance

- Transmission Impairments
  - Packet loss
- Codec configuration
  - Quantization level
  - GoP Length
  - Slice Structure
  - Bandwidth limitation
- Interaction of loss with video frame structure

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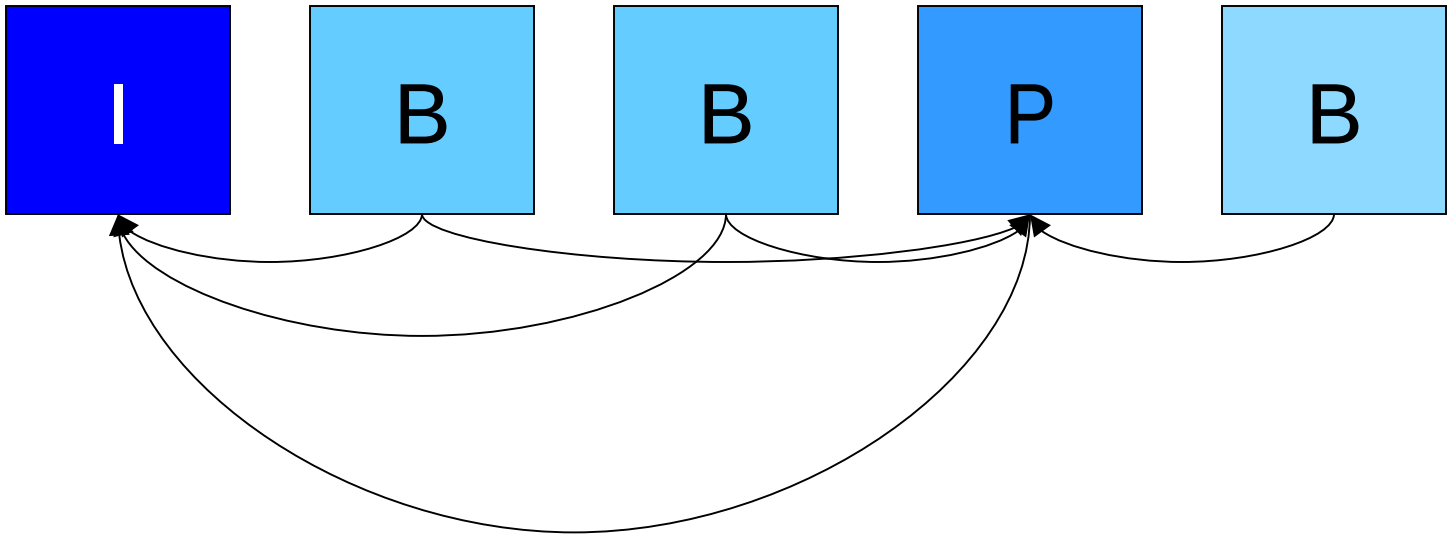
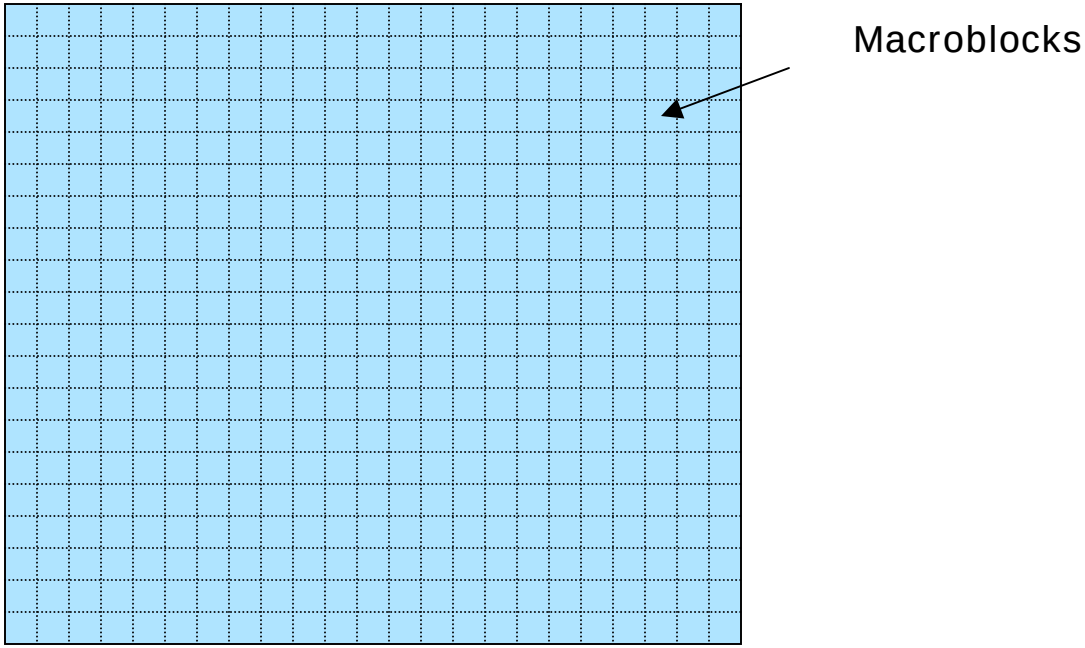
IP Video basics – 1 – I Frames



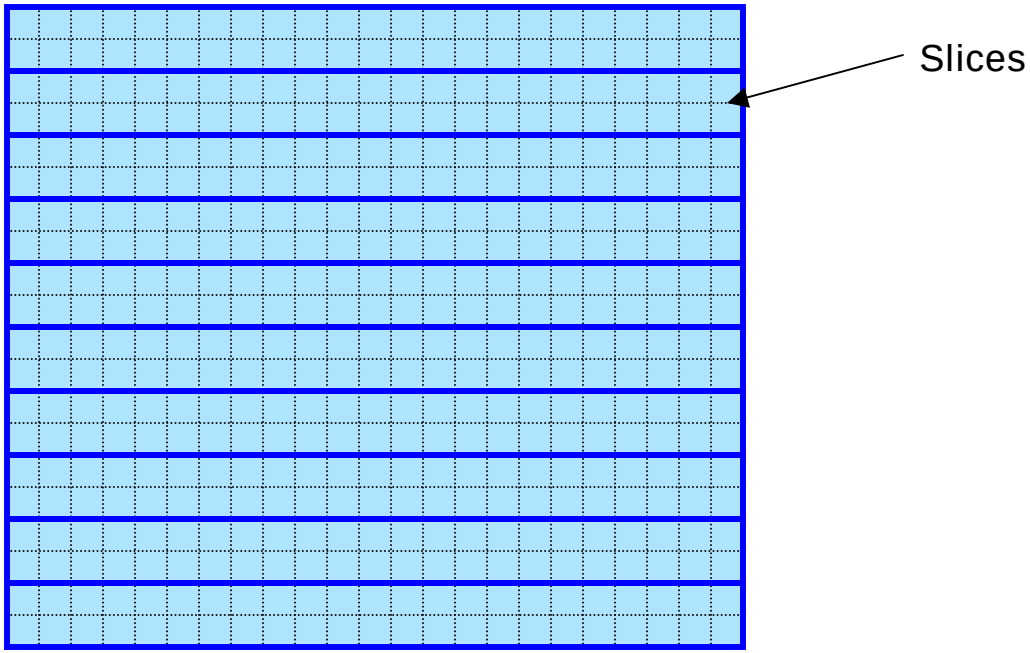
GoP Structure

- I frames are typically large (00's to 000's of IP packets per frame)
- P and B frames are typically much smaller (0's to 00's of packets per frame)
- GoP length – typically 15-250 frames in length

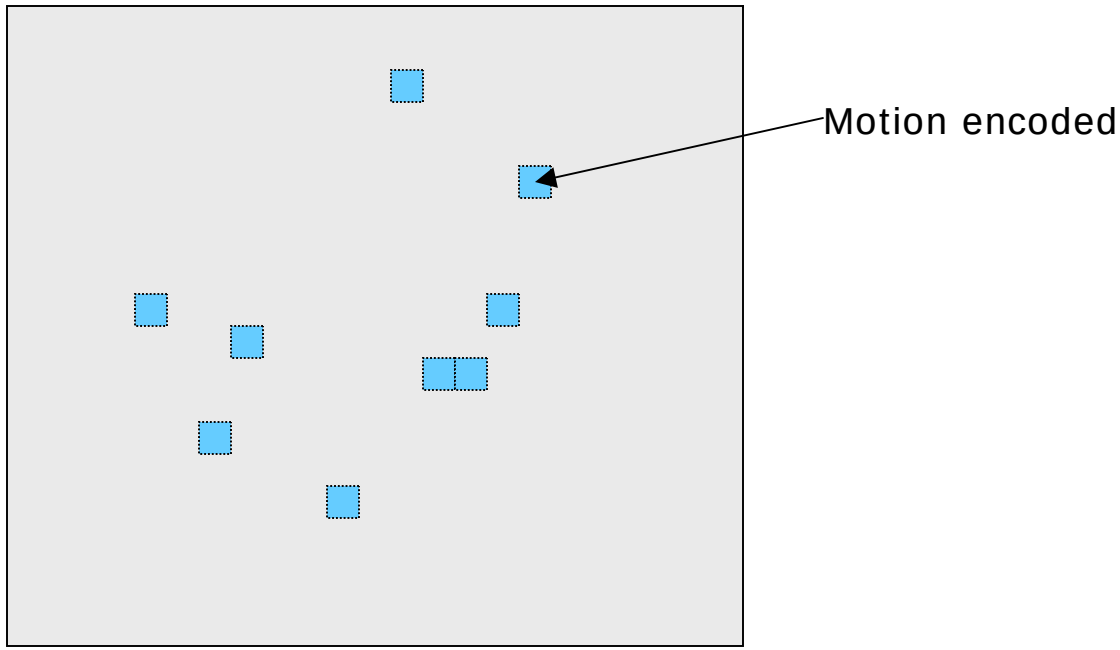
IP Video basics – 2 – I Frames



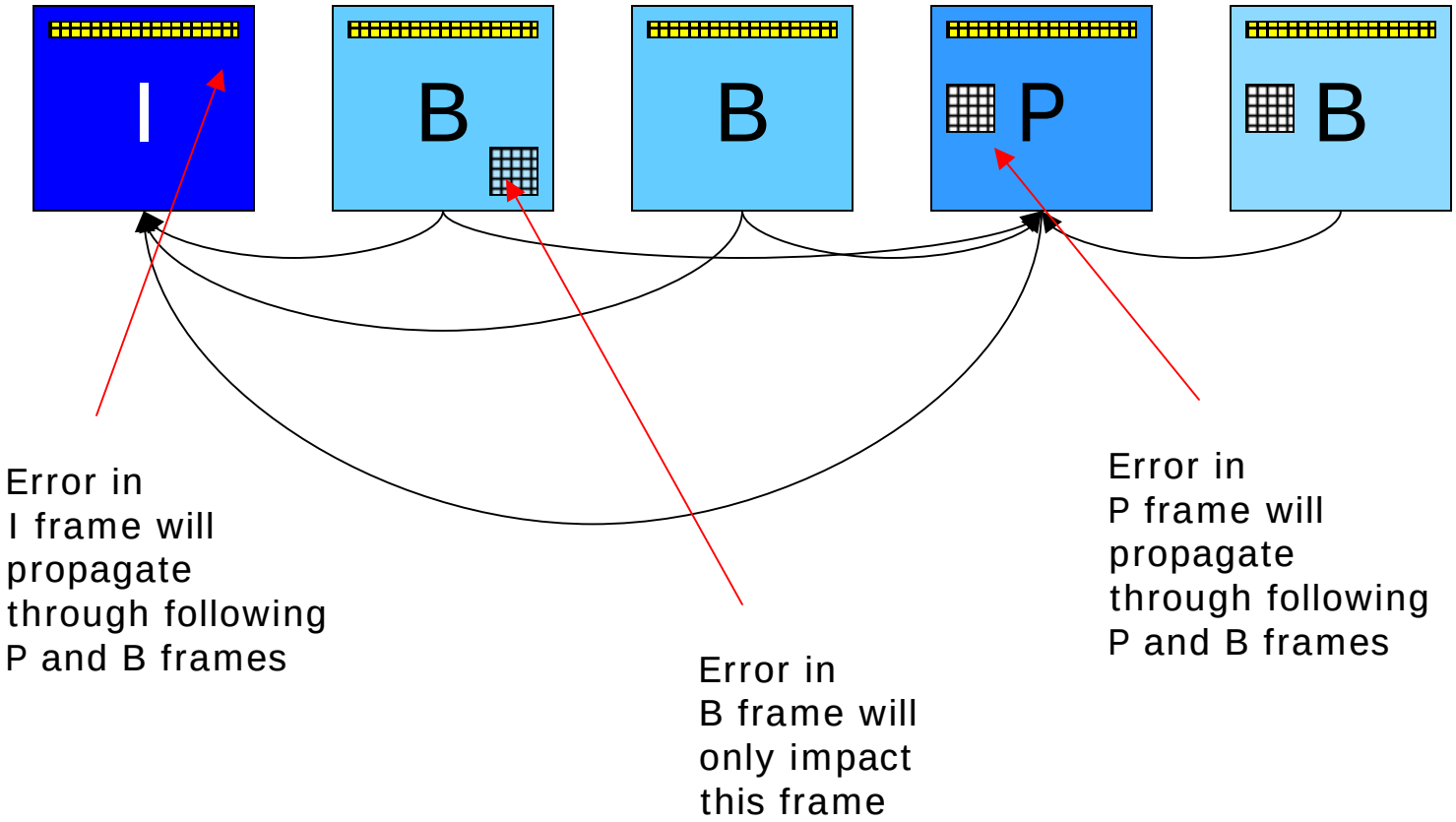
IP Video basics – 3 – I Frames



IP Video basics – 4 – P/B Frames



Impact of lost packet



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Example – I frame vs B frame loss

- I frame example – 161 packets lost
  - MOS-V = 3.3
  - Loss Rate = 0.27%
- B frame example – 161 packets lost
  - MOS-V = 3.7
  - Loss Rate = 0.27%

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IPTV Performance Measurement Approaches

- Full Reference
  - ITU J.144, PEVQ, PSNR…
- Zero Reference
  - “Bitstream” algorithms (e.g. IP based)
  - Decoded video analysis (pixel based)
- Partial Reference
  - Feature extraction/ comparison
  - Augmented zero reference algorithms

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Industry Standards Activities

- ATIS IPTV Interoperability Forum (IIF)
  - QoS Metrics Task Force/ ATIS 0800008 Metrics
  - Test & Interoperability Task Force
- ITU
  - SG9 – Standards for objective video test (J.nnn)
  - IPTV Focus Group
  - SG12 – Lead SG on QoS
- Video Quality Experts Group (VQEG)
  - Testing of objective video quality algorithms
- DSL Forum
  - WT135 – IPTV STB management

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IP Based “Bitstream” algorithms

- Efficiently measure the performance of high bandwidth IP Video streams
- In IPTV services - content of RTP/MPEG-TS is typically encrypted
- Ideally – report
  - Video MOS
  - Audio MOS
  - I/B/P frame statistics
  - RTP/MPEG TS statistics
  - IP Statistics

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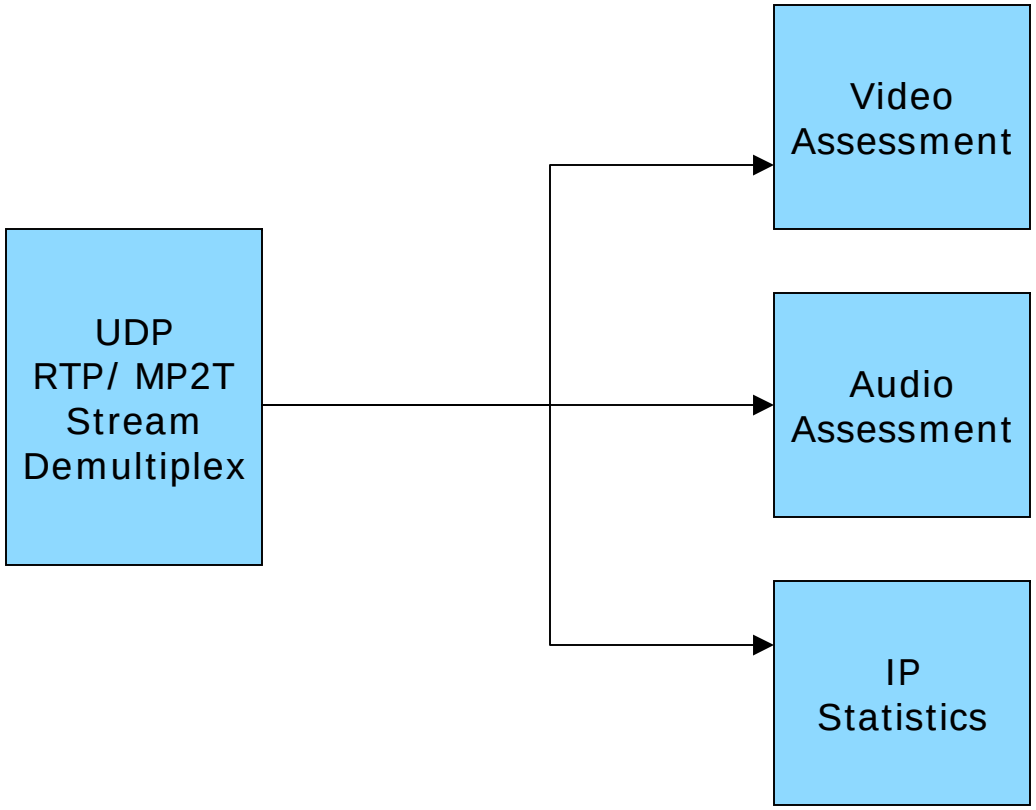
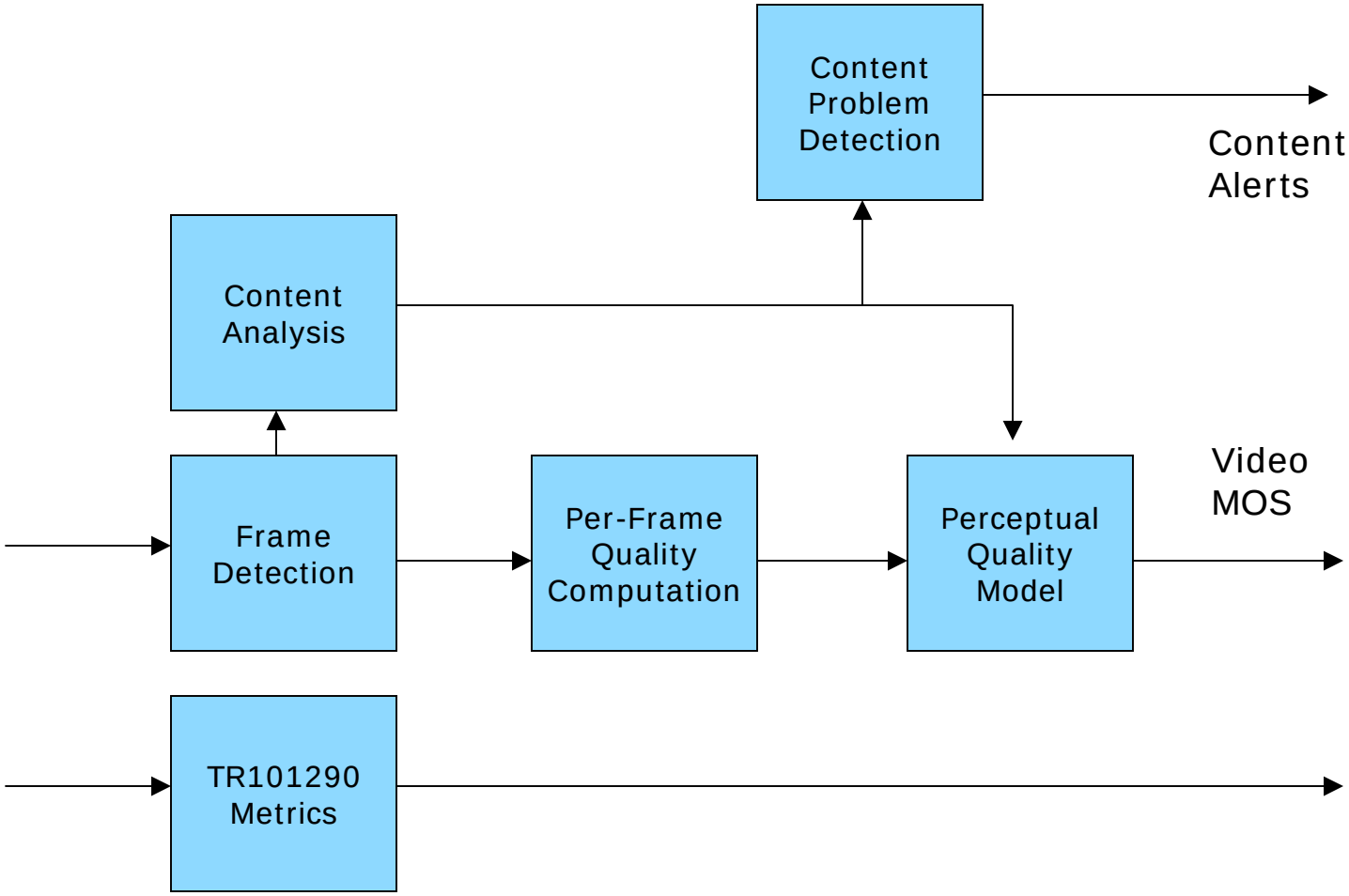
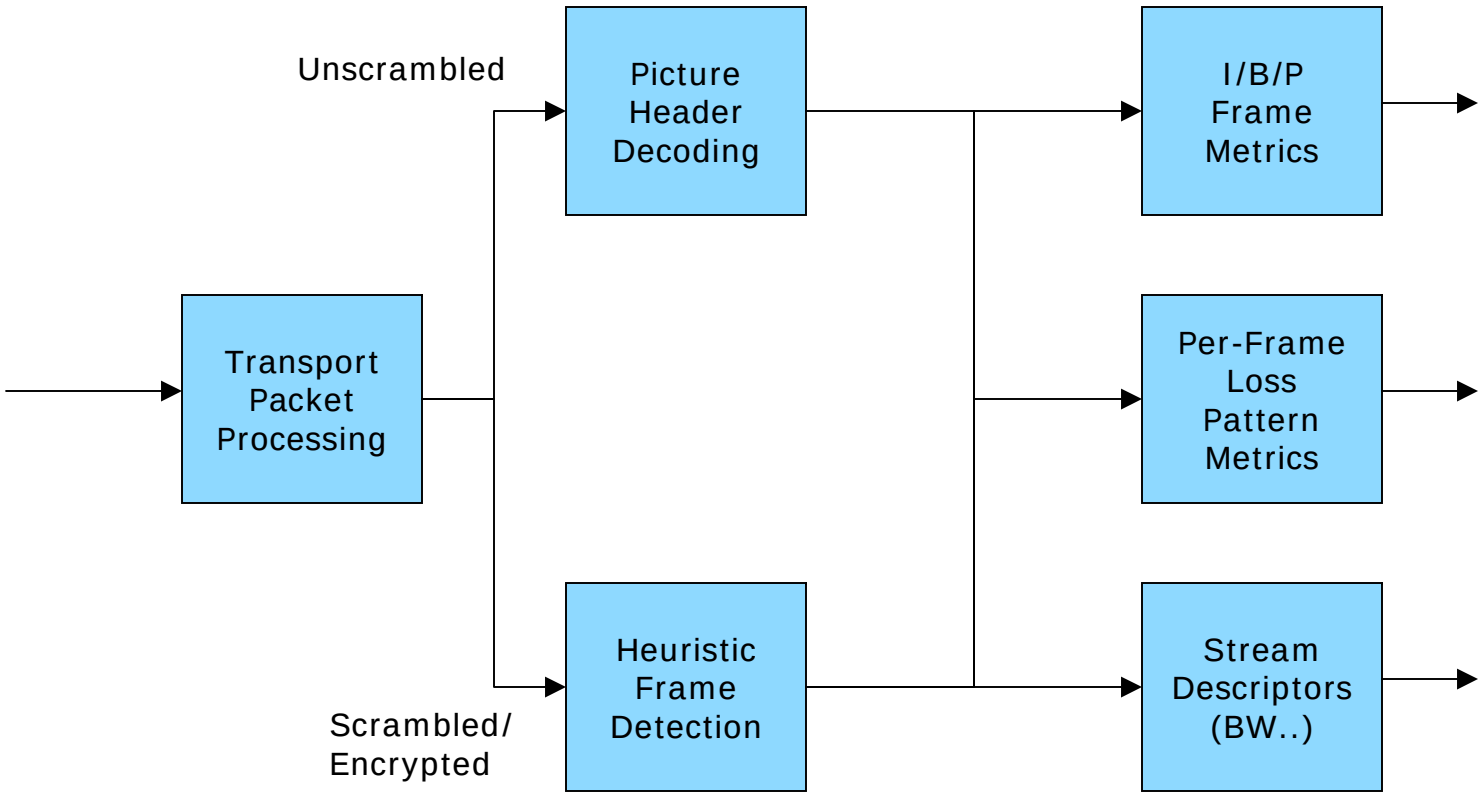
VQmon/HD


UDP
RTP/ MP2T
Stream
Demultiplex
Video
Assessment
Audio
Assessment
IP
Statistics

VQmon/HD – Video Assessment



VQmon/HD – Frame Detection



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Frame detection in encrypted streams

- Detect frame boundaries within the packet stream
- Measure frame size
- Analyze sequence of frame sizes
  - Low motion/ high detail – obvious GoP structure
  - High motion/ low detail – GoP size less obvious
  - I frames can be inserted when scene changes
- Assess content type

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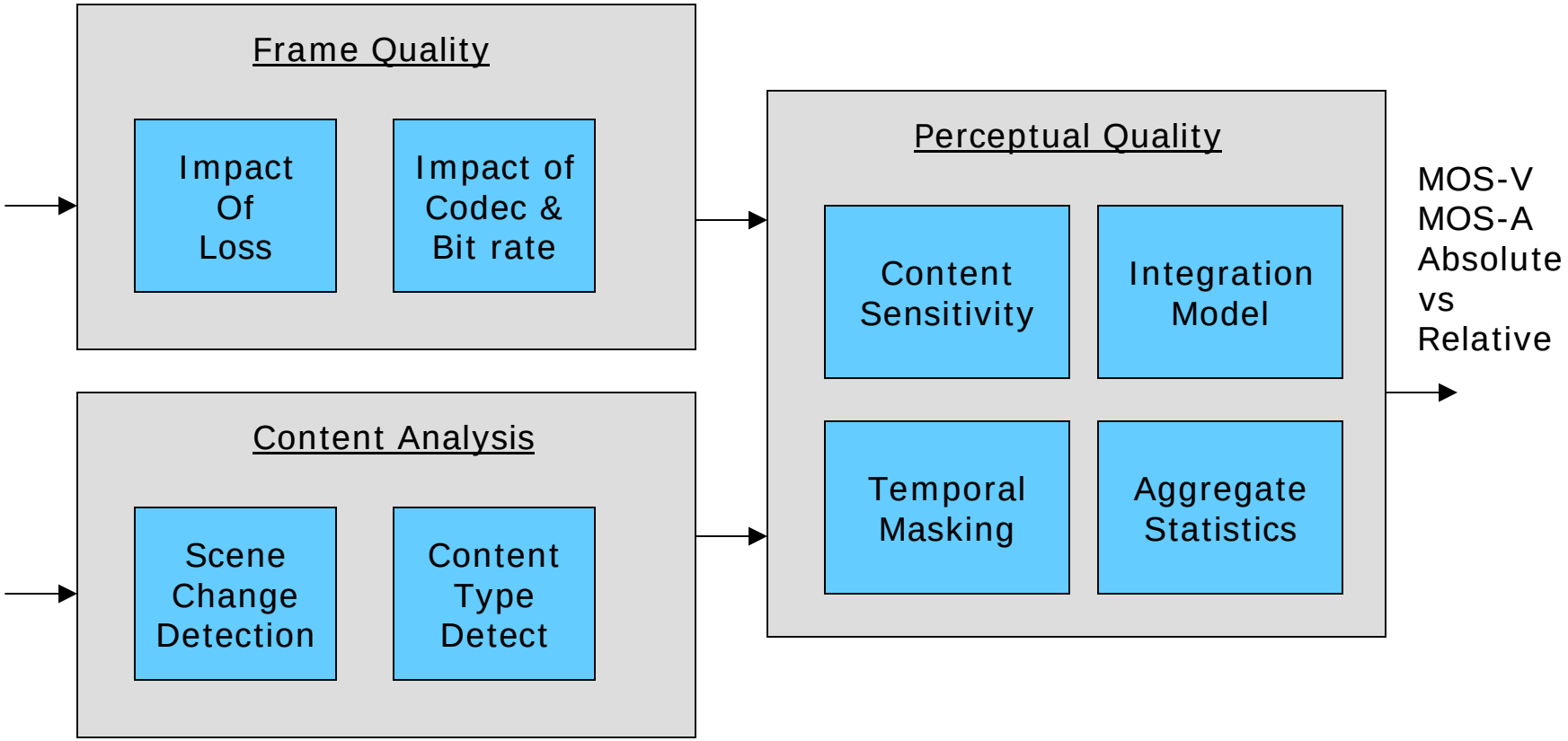
VQmon/HD – Perceptual Quality



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Example 2 – Hero_D02

- Detected GoP size 9, IBBPBB..
- Measured bit rate 5542 kbits/sec
- Image size 720x480, 29.97 frames/sec
- MOS-V = 3.7
- MOS-A = 3.7
- EPSNR = 31.0 dB
- Packet Loss Rate 0.11%
- I frame packets = 16108 rcvd, 28 lost
- P frame packets = 27551 rcvd, 42 lost
- B frame packets = 29984 rcvd, 14 lost
- MPEG Transport stats
  - Continuity Error count 12
  - PCR Repetition Error count 285

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Example 3 – Hero-05

- Detected GoP size 9, IBBPBB..
- Measured bit rate 5541 kbits/sec
- Image size 720x480, 29.97 frames/sec
- MOS-V = 1.8
- MOS-A = 1.8
- EPSNR = 21.0 dB
- Packet Loss Rate = 1.55%
- I frame packets = 15518 rcvd, 602 lost
- P frame packets = 26886 rcvd, 483 lost
- B frame packets = 30166 rcvd, 56 lost
- MPEG Transport stats
  - Continuity Error count 163
  - PCR Repetition Error count 282
  - PCR Discontinuity Error count 3

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Example 4 - Scrambled vs Unscrambled Video – Chan20_1

- Unscrambled
  - MOS-V = 3.1
  - EPSNR = 27.5
  - VSTQ = 41.5
  - I frame packets
    - Received 6225
    - Lost 42
  - P/B frame packets
    - Received 20779
    - Lost 40
  - IP Statistics
    - Loss rate = 0.23%
- Scrambled
  - MOS-V = 3.0
  - EPSNR = 27.0
  - VSTQ = 41.5
  - I frame packets
    - Received 6367
    - Lost 42
  - P/B frame packets
    - Received 20637
    - Lost 21
  - IP Statistics
    - Loss rate = 0.23%

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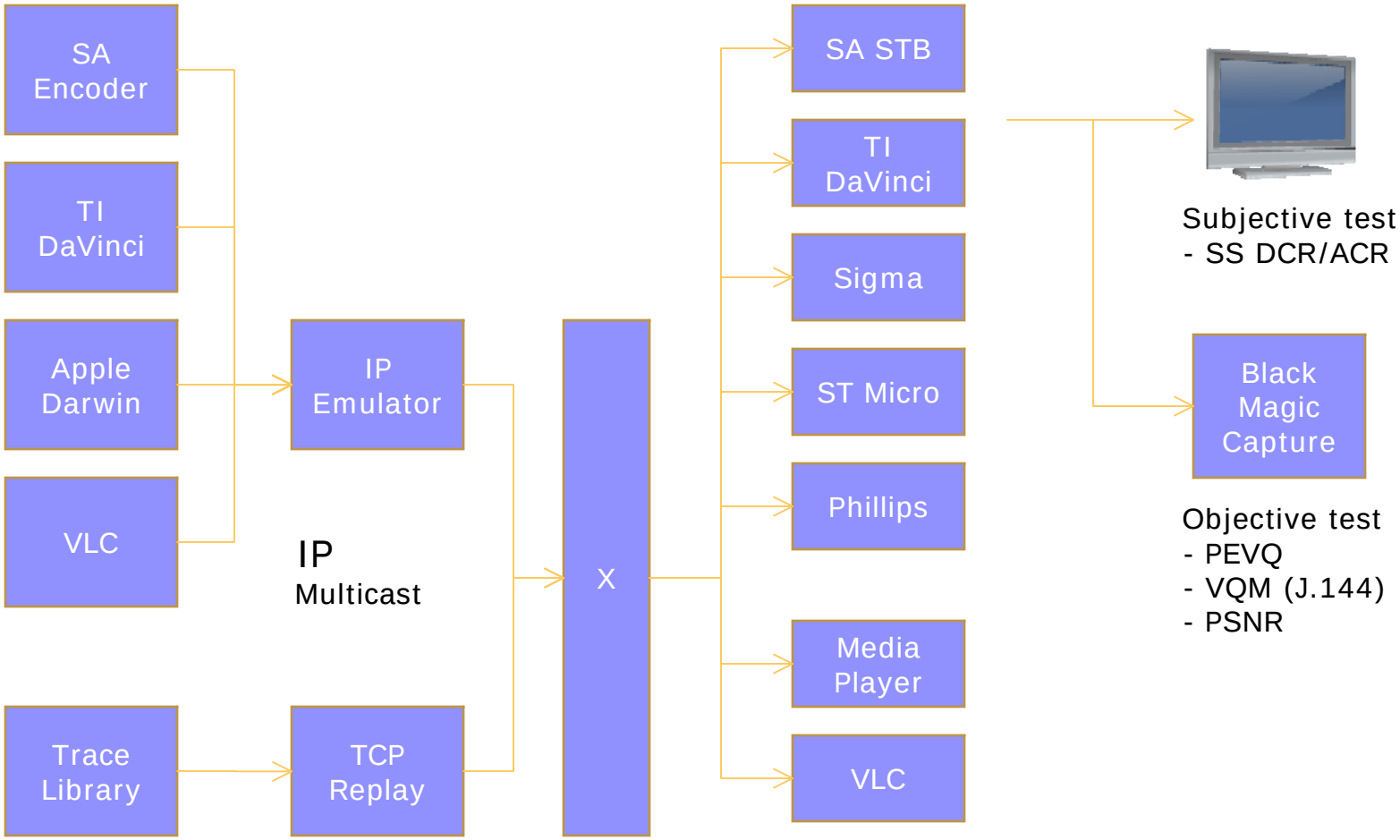
Telchemy's IPTV Test Lab



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Example test - Noticeability

- Introduced impairment
  - Small number of macroblock errors (1, 4, 8)
  - Frame freezes
- Varied duration of impairment
- Subject test
  - Was impairment
    - Not noticeable
    - Just noticeable
    - Definitely noticeable

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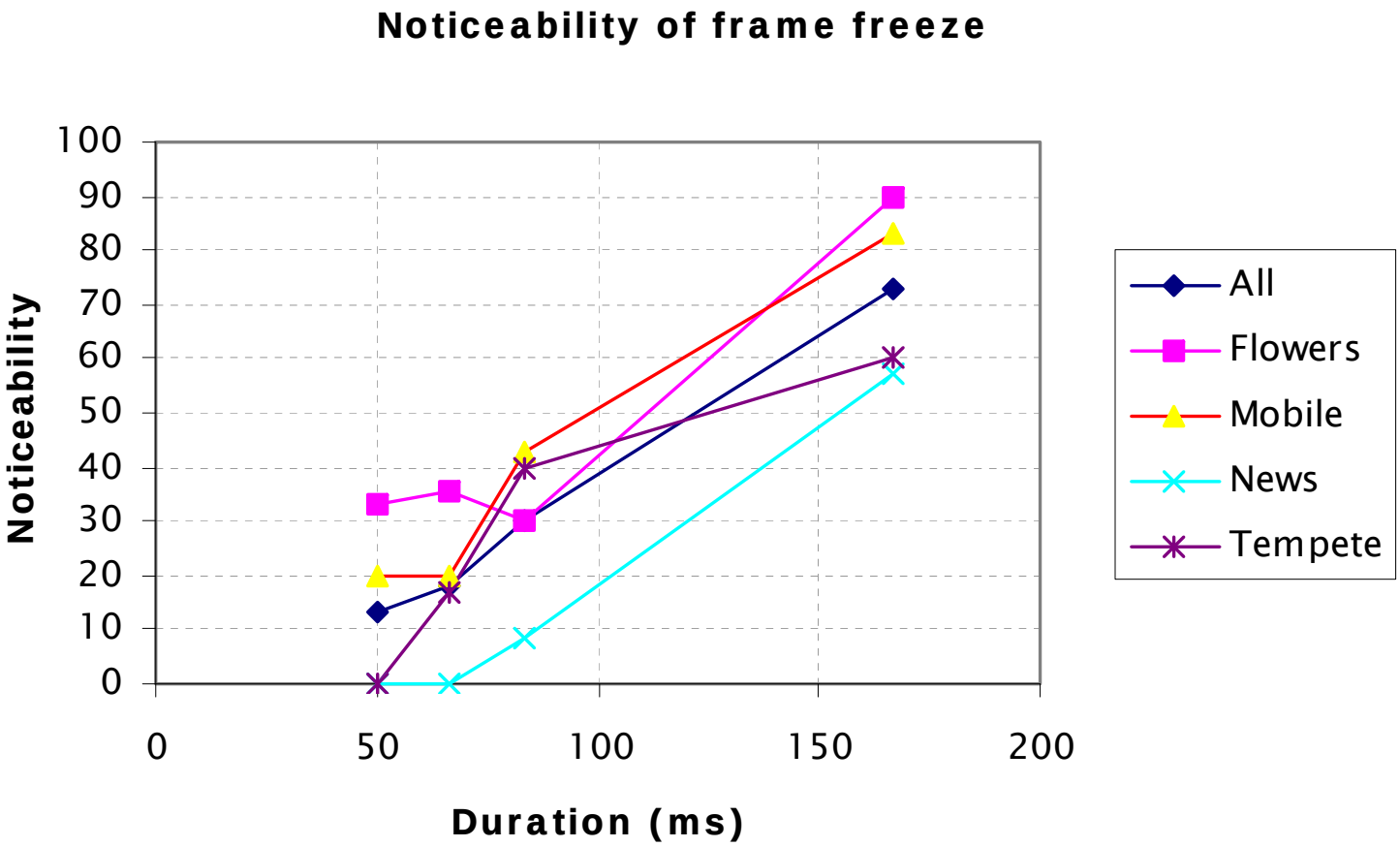
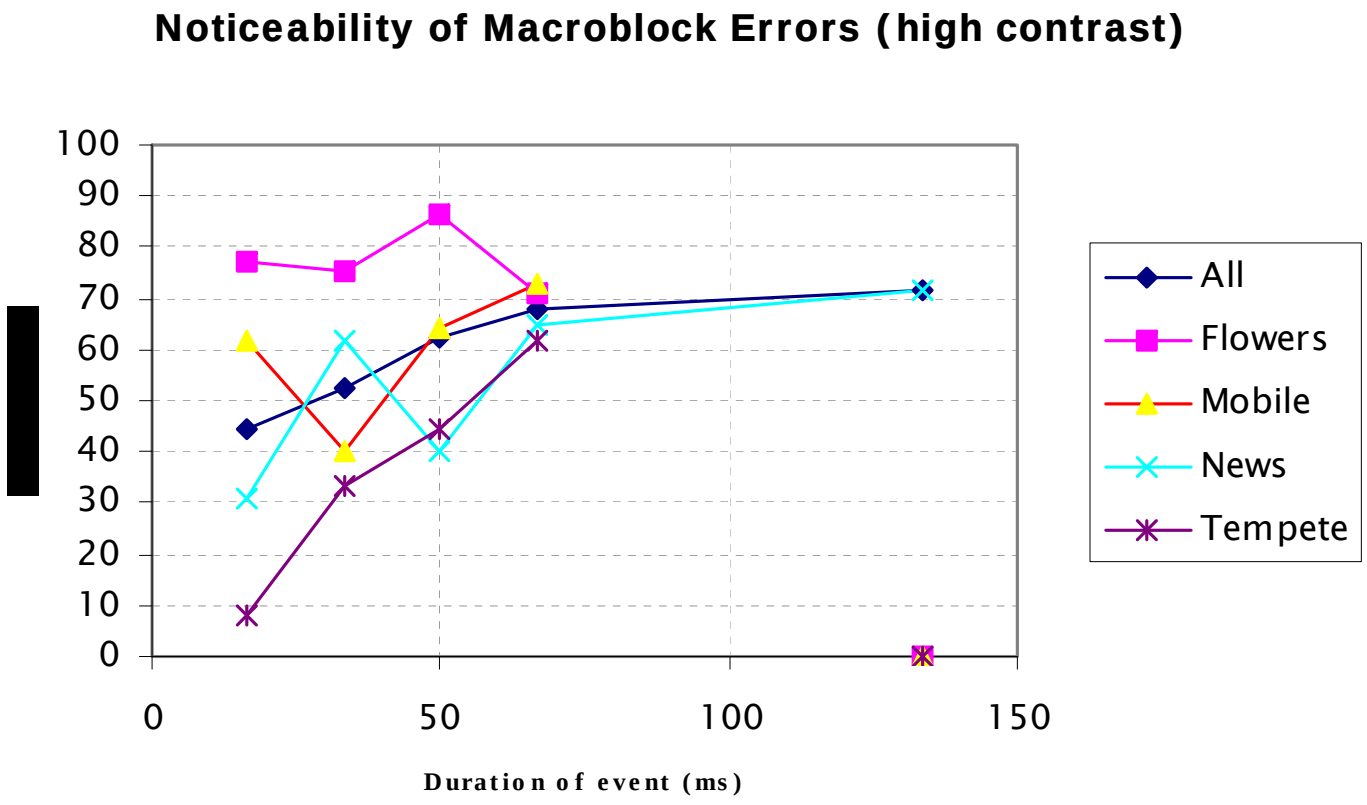
Frame Freeze



Macroblock Errors



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Current test project

- Impaired capture files, replayed through ADB Set Top Box to HD monitor
- MPEG-2 and H.264 encoder
- H.264 – wide range of encoder configurations

- Single Stimulus, Degradation Category Rating test
- Series of tests – each with 60 x 10 second video clips, wide range of content
- Presentation order randomized for each viewing panel
- At least 4 different viewing panels

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Summary

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