

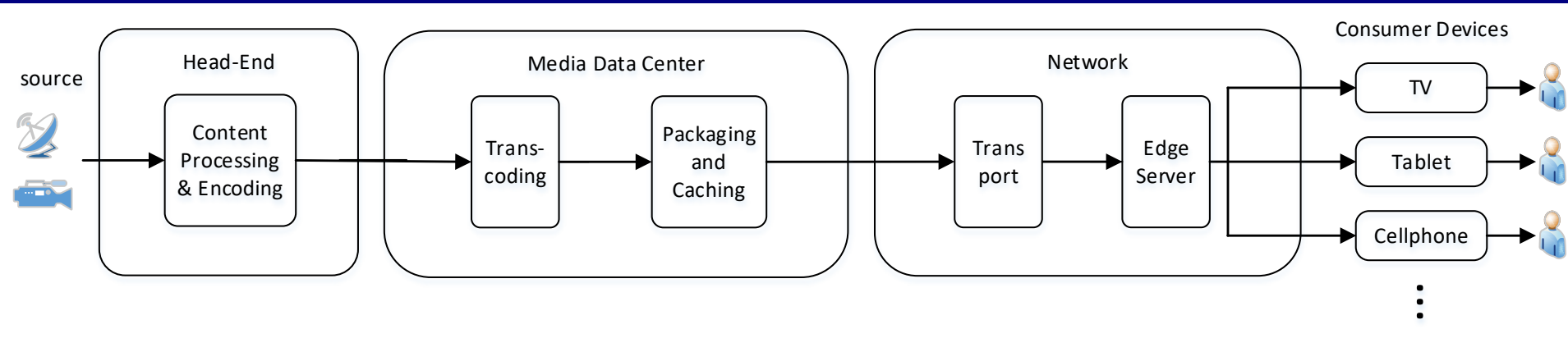
Image Processing and Visual Communications

Quality Assurance in Visual Communications

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Quality Assurance in Video Distribution



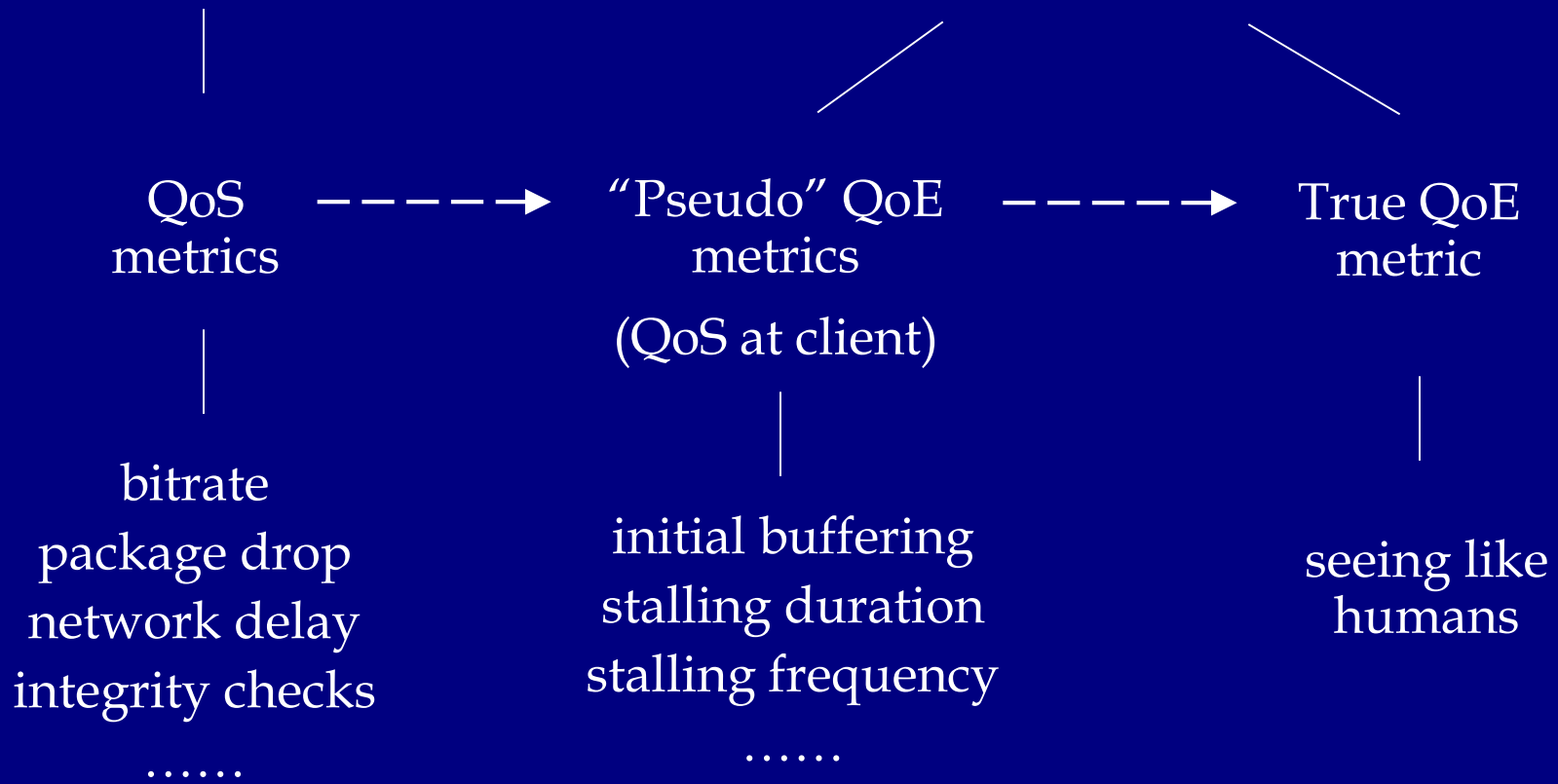
- **Major Questions**

- How do we ensure end users' quality-of-experience (QoE)?
- How do we ensure content producers' creative intent is faithfully delivered to users?
- How do we save resource/cost without sacrificing user QoE?

Quality Assurance in Video Distribution

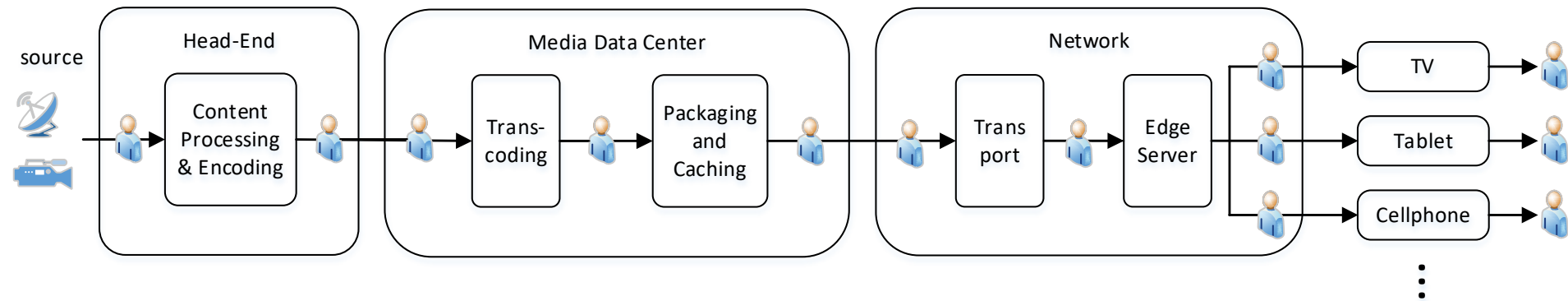
Quality-of-Serve (QoS)

Quality-of-Experience (QoE)



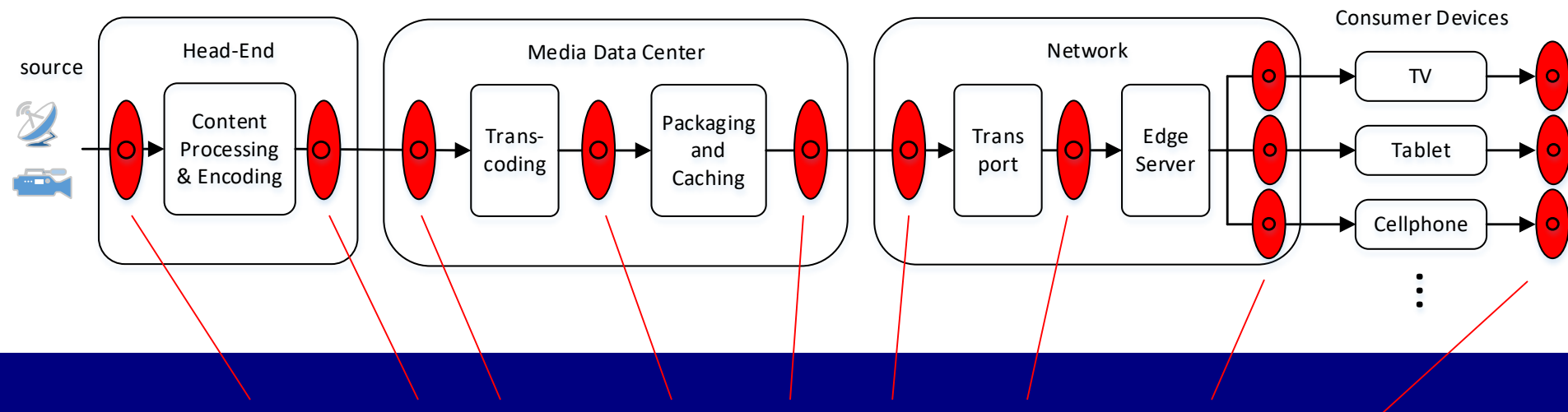
Quality Assurance in Video Distribution

“Ideal” Quality Monitoring Method



Quality Assurance in Video Distribution

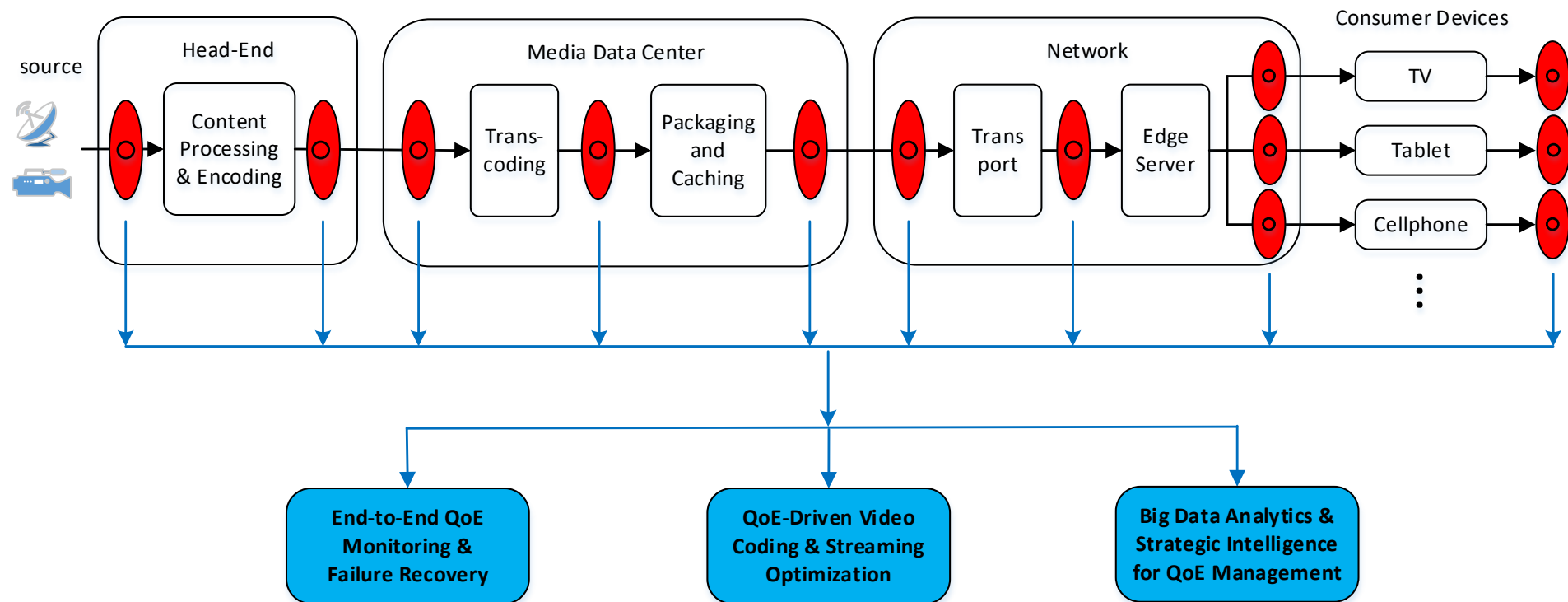
Automated Monitoring



Replacing human inspectors with quality “probes”

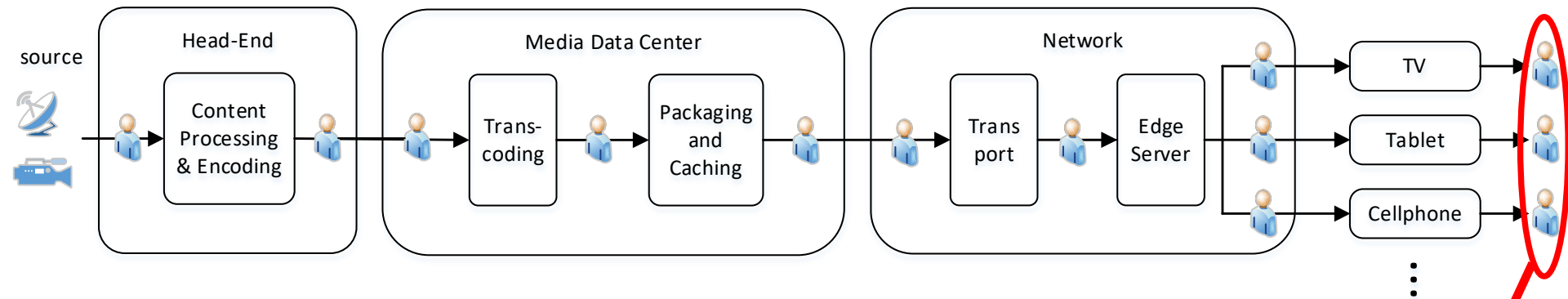
Quality Assurance in Video Distribution

Automated Monitoring, Optimization and Management



Quality Assurance in Video Distribution

End-to-End Monitoring, Optimization and Management

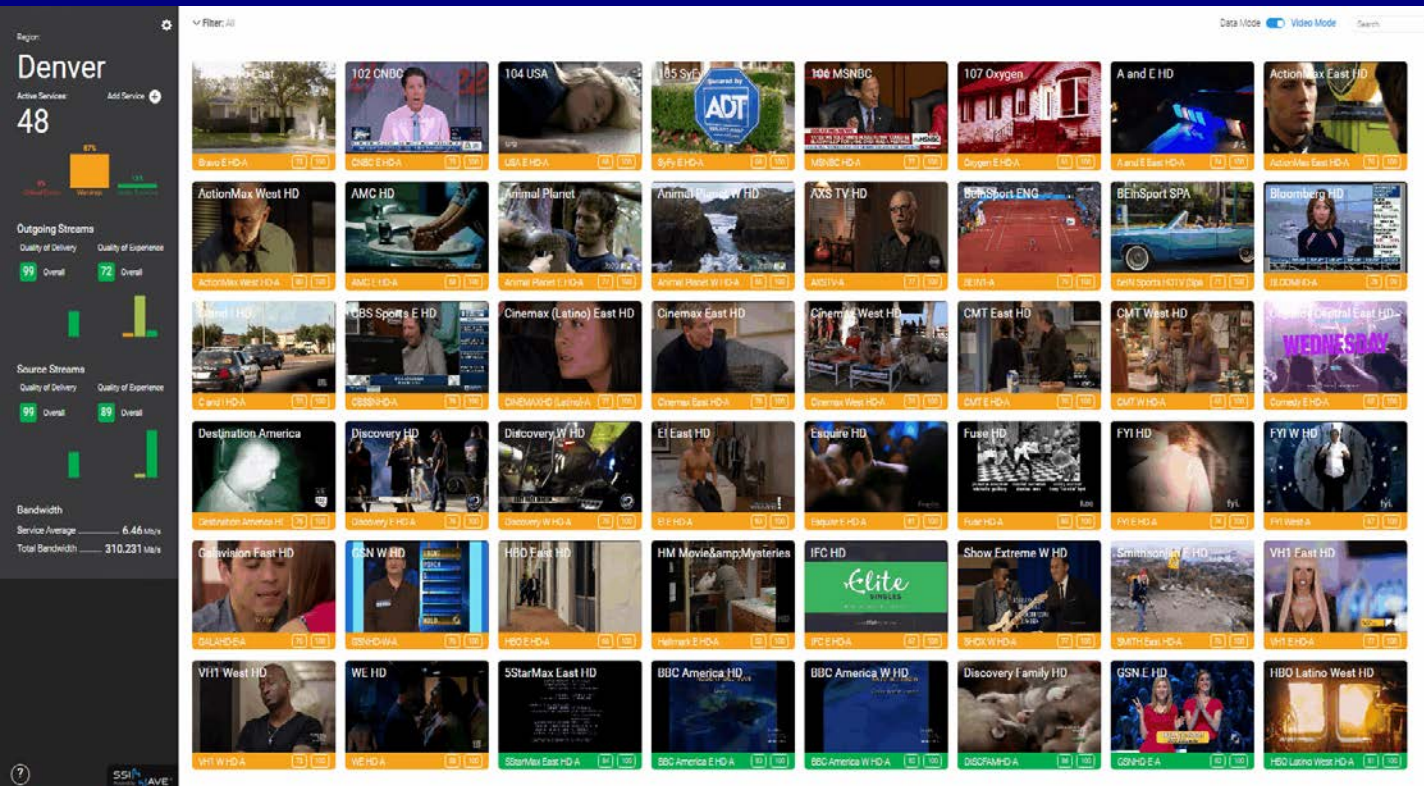


- Monitoring at every point in the delivery system should target at measuring the impact on end users' QoE
- Optimization and management at every point in the delivery system should aim to improve end users' QoE

**Begin with
the **END**
in mind**

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



Excellent (80-100)

Good (60-79)

Fair (40-59)

Poor (20-39)

Bad (0-19)

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



SSIMplus = 90

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



SSIMplus = 70

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



SSIMplus = 49

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



SSIMplus = 35

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



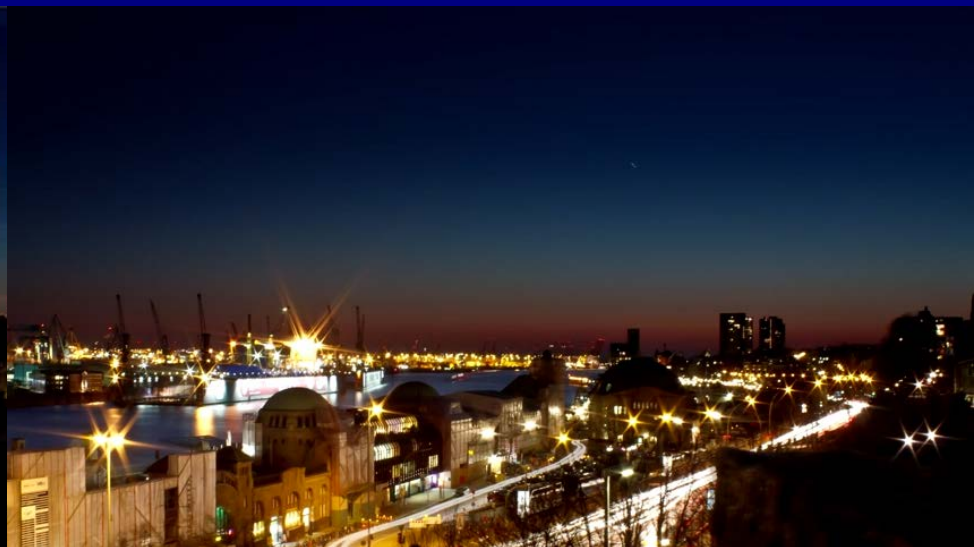
SSIMplus = 15

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



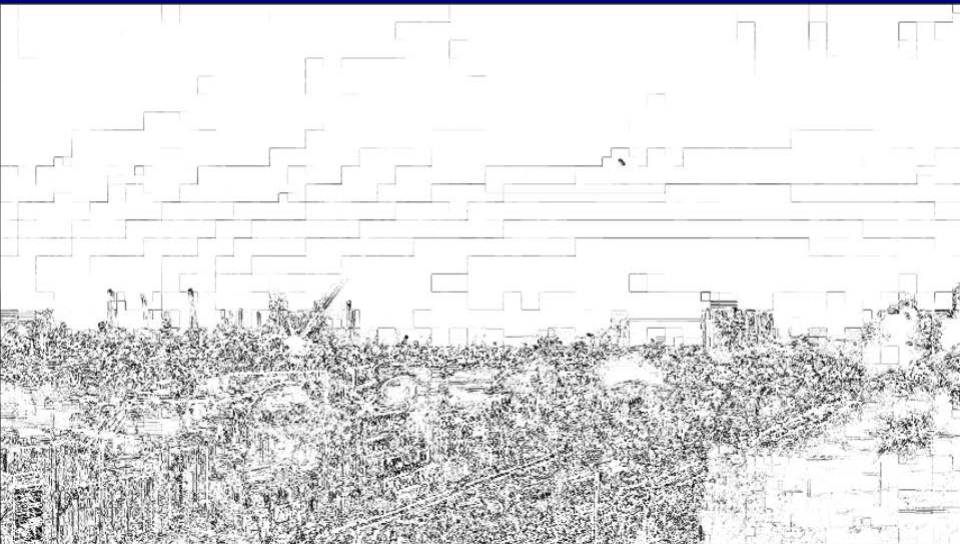
test video frame



original video frame

Key 1: Seeing Like Humans

QoE probes should “see” and “speak” like human inspectors



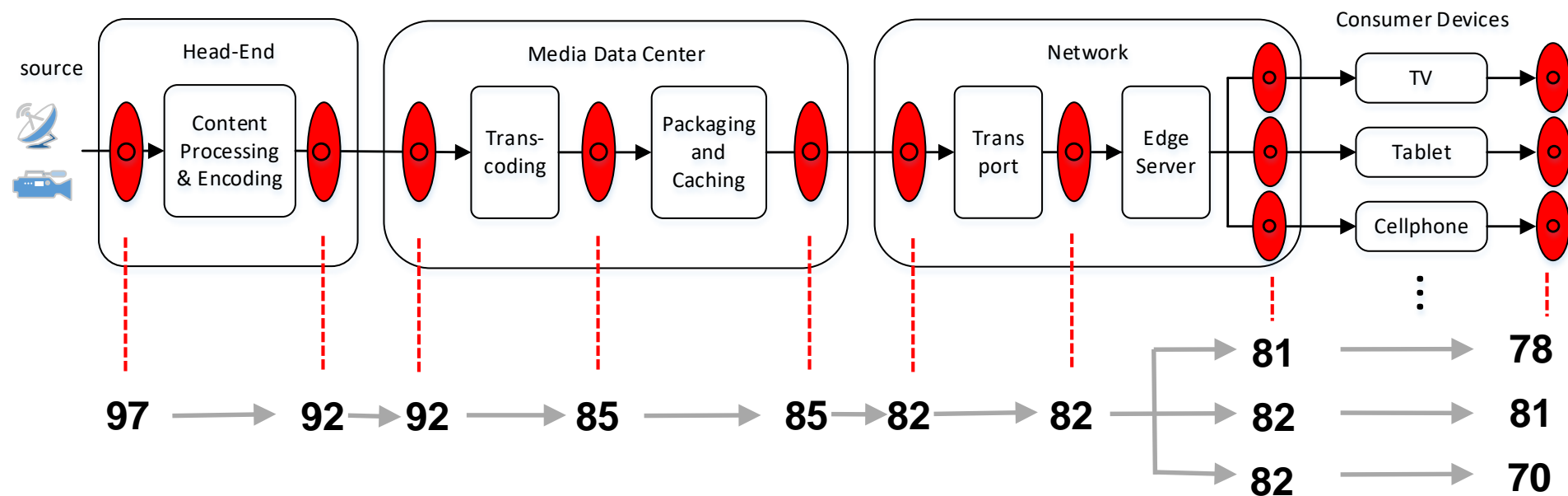
quality map (by SSIMplus)



original video frame

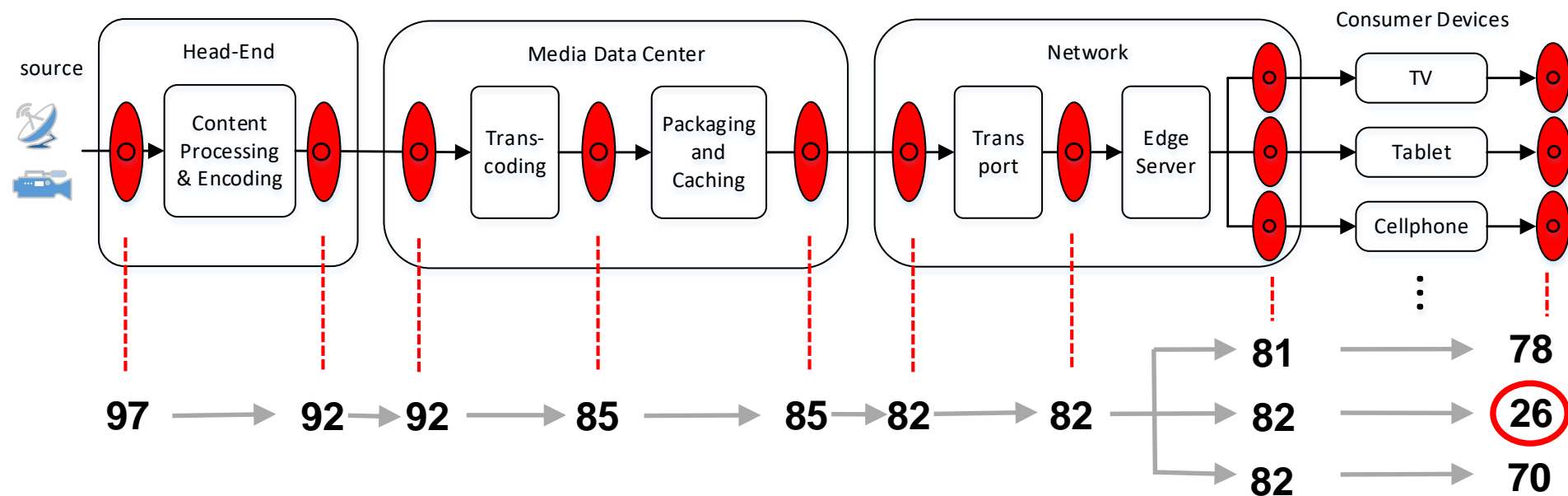
Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



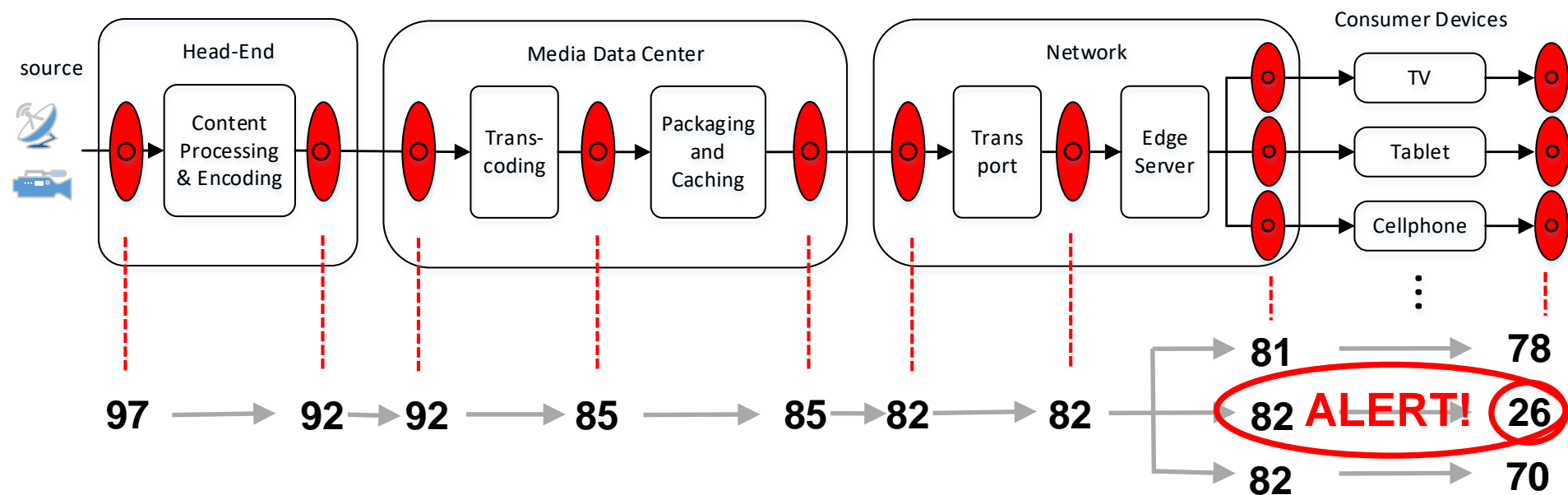
Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



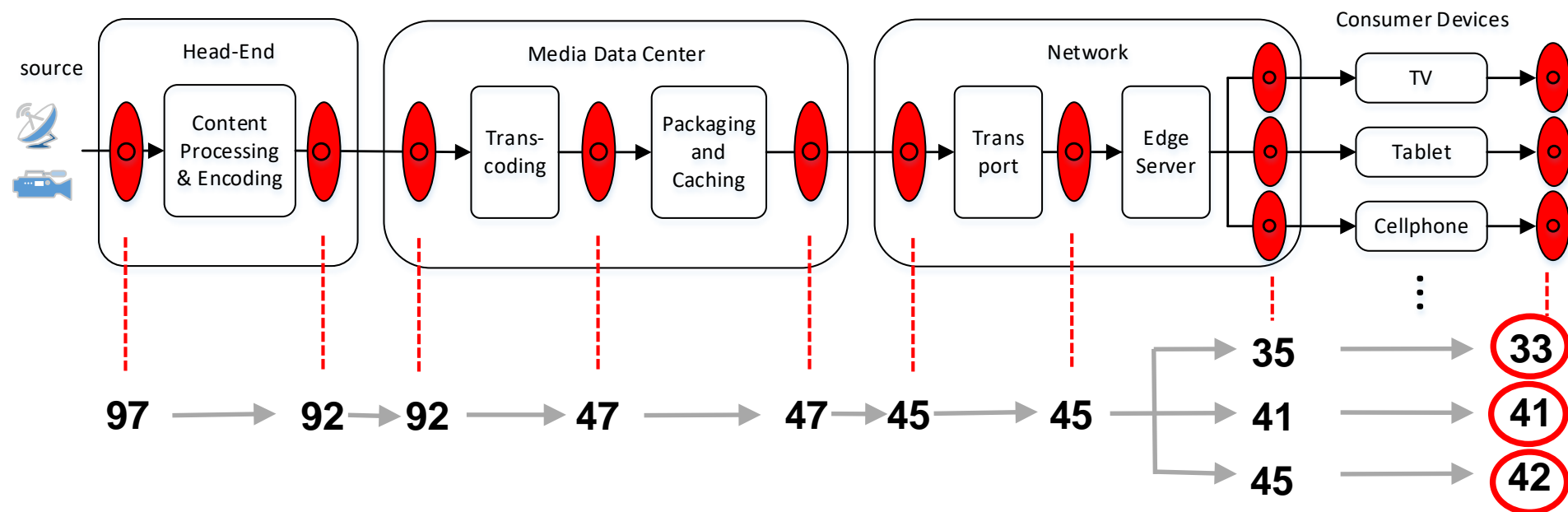
Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



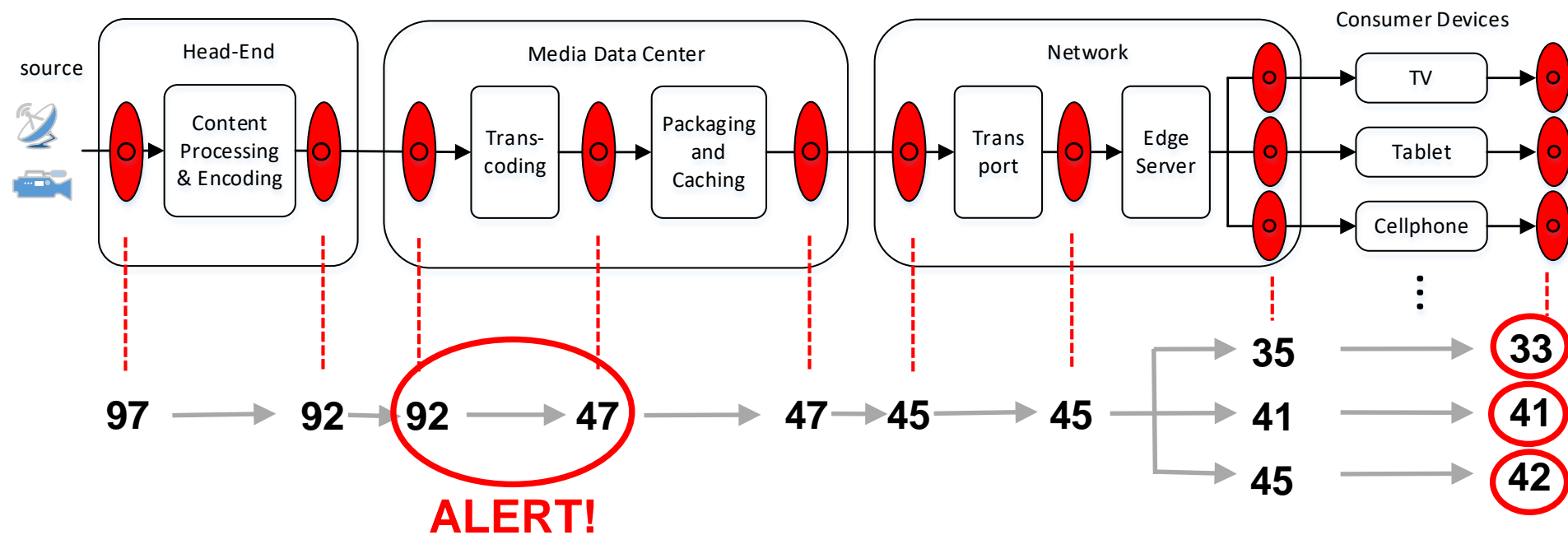
Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



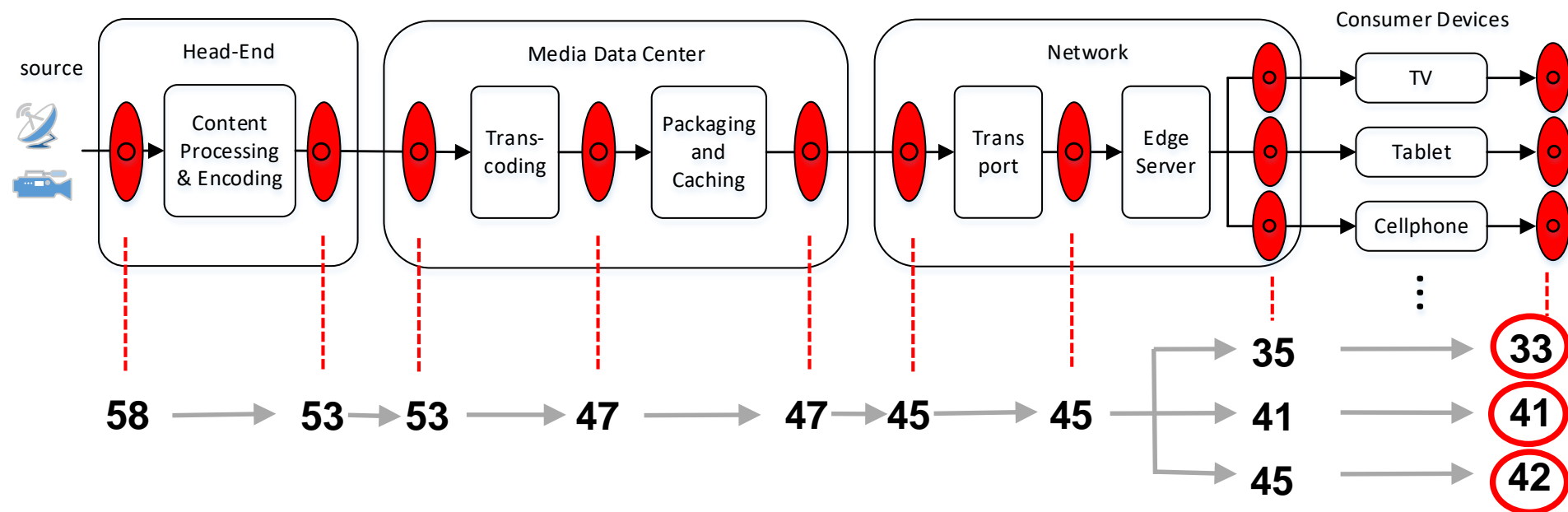
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QoE scores **consistent** and **comparable** throughout video delivery chain



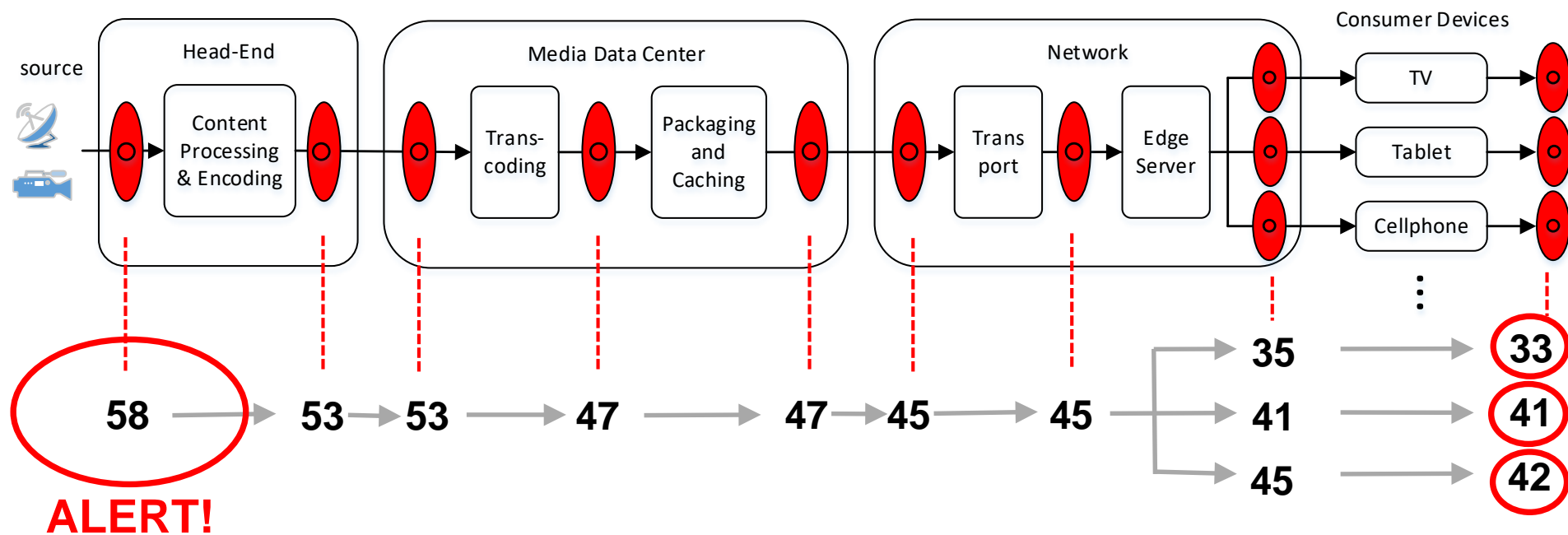
Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



Key 2: Unified End-to-End Monitoring

QoE scores **consistent** and **comparable** throughout video delivery chain



Benefit of Unified End-to-End QoE Monitoring

Operators	Design Engineers	Analyzer/Researchers
Gain instantaneous awareness of user QoE degradation along the chain ↓ Immediate problem identification, localization and repair	Measure the impact of system design and individual components on user QoE ↓ Optimal design and fine-tuning of systems and critical components for better user QoE	Visualize how video quality evolves throughout the network and over short/long time scales ↓ Long-time, large-scale, big data analytics and strategic intelligence for user QoE management

Implementing Unified End-to-End QoE Monitoring

- Most critical and challenging task

A Good QoE Measure

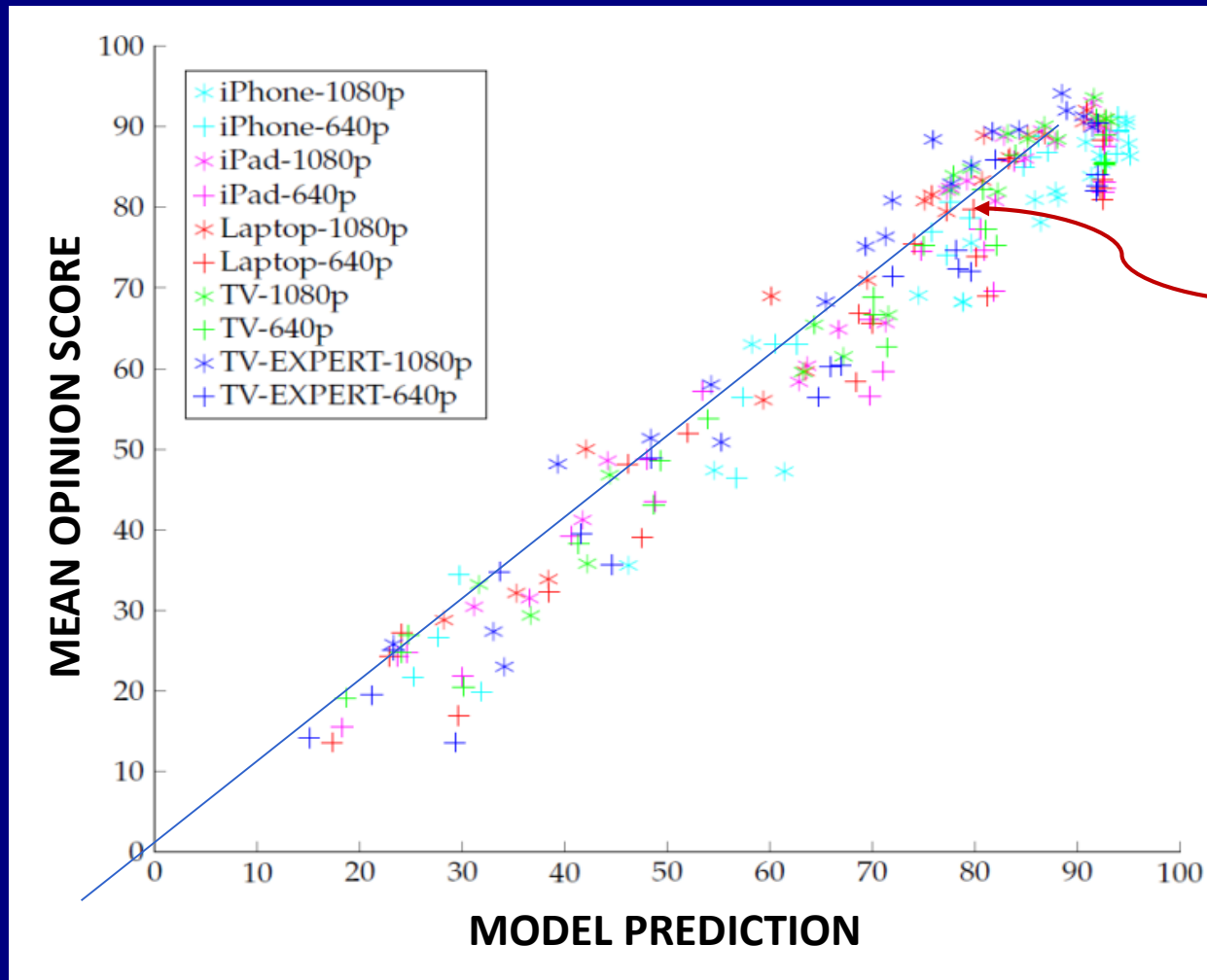
- Traditional methods won't work

PSNR/SSIM/MS-SSIM/MOVIE/BRISQUE/VQM/PEVQ/VMAF ...

far short for real-world video delivery environment

Essential Requirements for QoE Measure

1: Accurate and Fast



Diagonal line represents 100% accuracy of model to human visual system.

DESIRED

Correlation: > 90%

Speed: > real-time

Essential Requirements for QoE Measure

2: Easy-to-Understand and Easy-to-Use

- Intuitive scoring – “See” and “speak” like humans
- Create “common language” across hierarchy

Overall Network
Performance

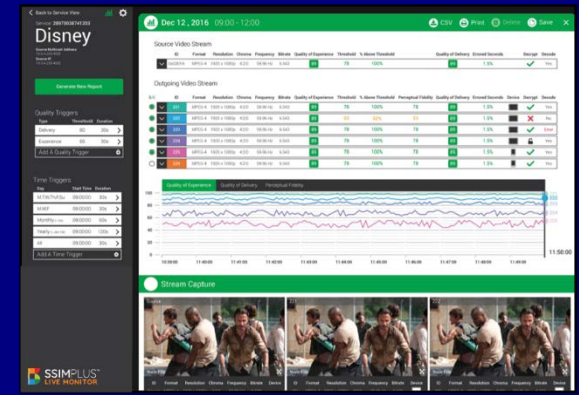
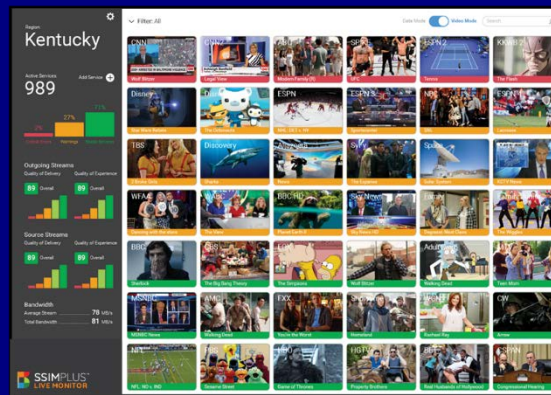
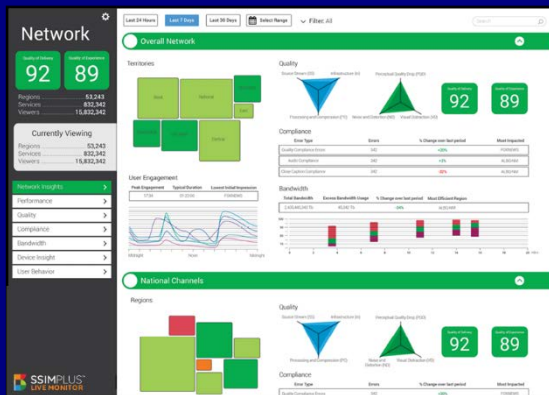
Per-Channel
Performance

Technical Details
for Each Channel

BUSINESS/STRATEGIC

DEEP DASHBOARDS AND CONTROLS

OPERATIONAL/TACTICAL



Essential Requirements for QoE Measure

3: Consistent Measurement

cross resolution/
frame rate



cross video
content



cross user
device



cross dynamic
range



Essential Requirements for QoE Measure

4: Versatile

- Full-reference (double-ended)
- No-reference (single-ended)
- Reduced-reference and degraded-reference
- QoE assessment on client device

