

Best Practices for End-to-End Workflow Monitoring

SVA Measurement/QoE WG project update

Christopher Kulbakas
IETF 108, MOPS Tech Talk, July 28, 2020

Agenda

- Contributors
- Motivation
- Goals
- QoE definition
- Scope
- Framework
- Framework deployment example
- Outage detection example using the framework
- Q & A

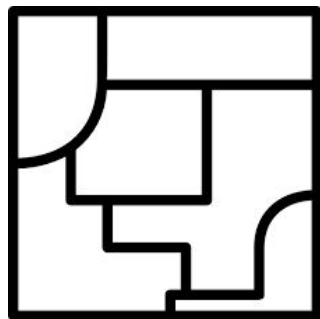
Contributors

- Datazoom
- Disney
- OPTICOM
- Sky
- SSIMWAVE
- Telestream
- Touchstream

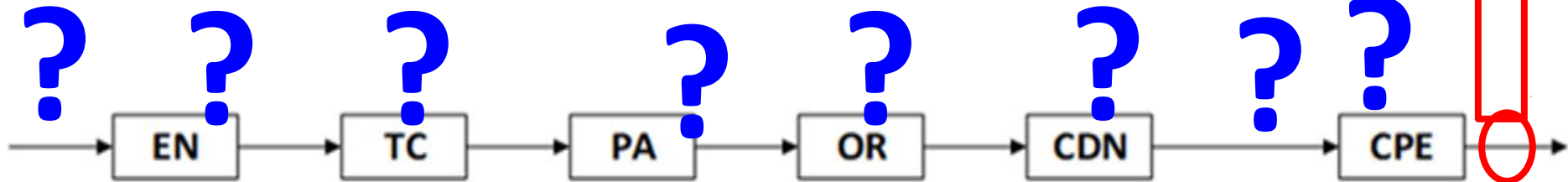
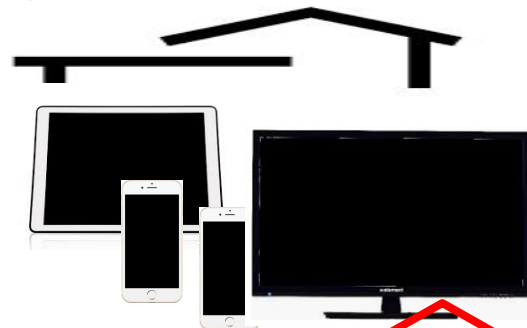
The logo for Telestream, featuring a blue arc above the word "telestream" in a lowercase, sans-serif font.The logo for Data Zoom, with "data" in a smaller font above "zoom" in a larger, bold, lowercase font.The logo for SSIMWAVE, consisting of a colorful square icon (red, yellow, green, blue) to the left of the word "SSIMWAVE" in a bold, uppercase font.The logo for Touchstream, featuring a blue bar chart icon to the left of the word "touchstream" in a lowercase font, with the tagline "24x7 proactive live stream monitoring" below it.The classic Disney logo in its signature script font.The logo for Opticom, featuring a blue square icon with a white circle and lines to the left of the word "OPTICOM" in a bold, uppercase font, with the tagline "THE PERCEPTUAL QUALITY EXPERTS" below it.The logo for Sky, with the word "sky" in a lowercase font where each letter has a different color gradient.

WG Chair: Thomas Edwards, Disney
Project Lead: Christopher Kulbakas, SVA
Project Lead: Brenton Ough, Touchstream

Motivation - What's the cause? What's the viewer impact scope?



e.g. Frozen Screen



Motivation - CDN/Player Data Insufficient

Frozen Screen to Viewing

Customers

Encoder loses input, ... but continues to generate well-formed video stream output with non-changing pixels!

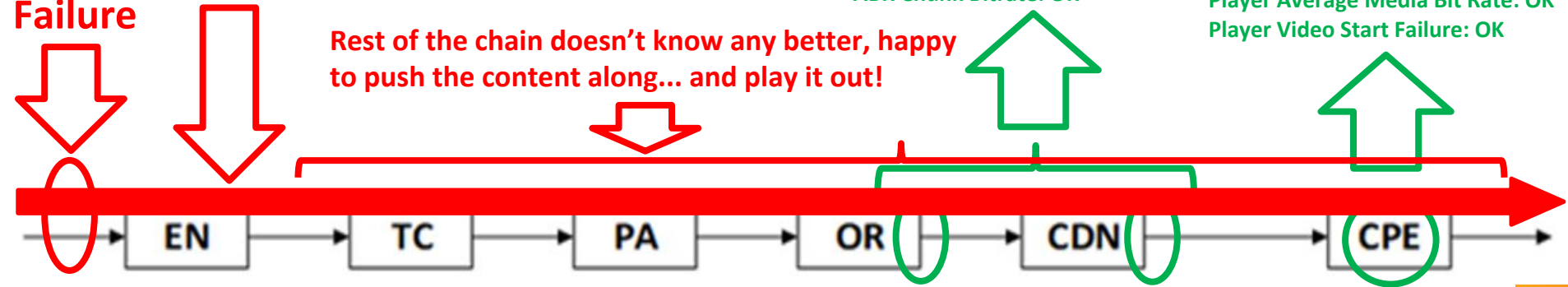
How is my "OTT Streaming QoE" ? ... OK ?

ABR Manifest Availability: OK
ABR Manifest Response Time: OK
ABR Manifest Bitrate: OK
ABR Chunk Availability: OK
ABR Chunk Response Time: OK
ABR Chunk Bitrate: OK

Player Video Startup Time: OK
Player Re-buffering Ratio: OK
Player Average Media Bit Rate: OK
Player Video Start Failure: OK

Rest of the chain doesn't know any better, happy to push the content along... and play it out!

Source Failure



streaming
video
alliance



I E T F

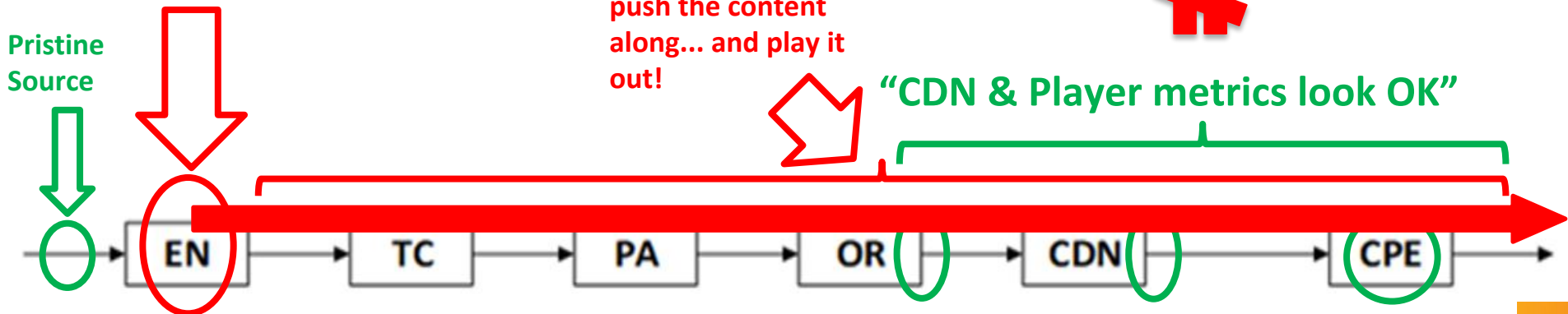
Motivation - Network-Only Metrics Not Sufficient

Poor Video Quality, ex. “not as sharp”, “fuzzy”, “blocky”, etc.

Encoder Too Aggressive, i.e. “over-compresses” the video, ... but still produces well-formed video stream!

Rest of the chain doesn't know any better, happy to push the content along... and play it out!

“CDN & Player metrics look OK”



Motivation - Transport Regeneration

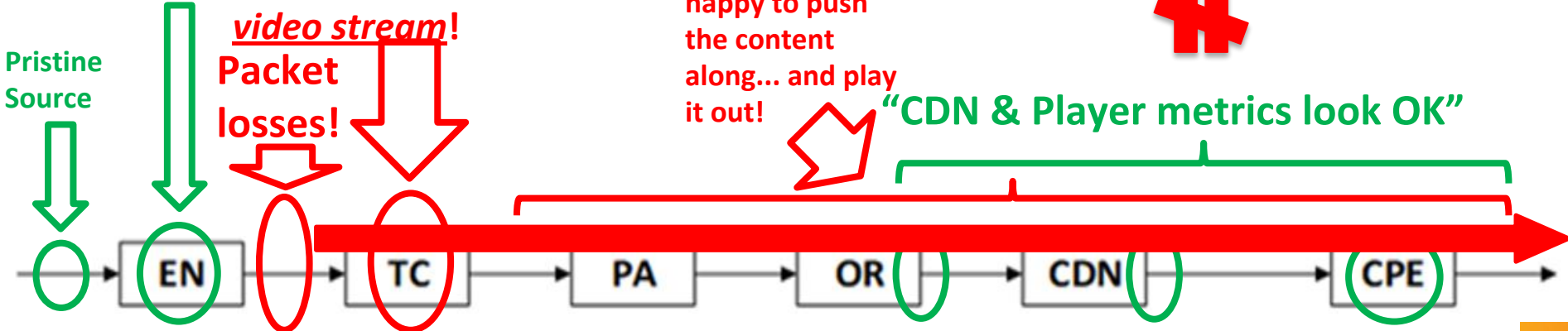
**“Unwatchable”
Audio / Video To
Viewing Customers,
ex. pixelating video,
choppy audio**

Optimal
encode config,
great
perceptual
video quality

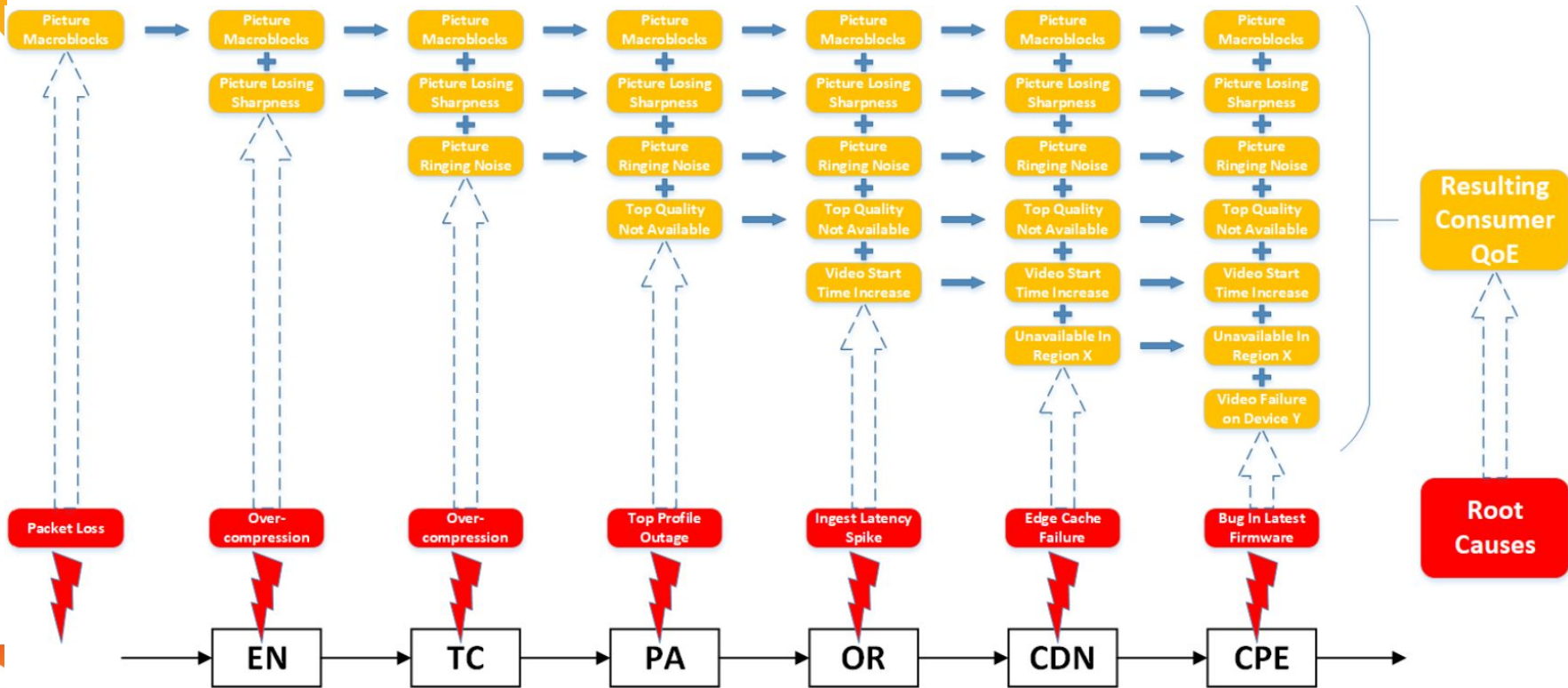
Transcoder “masks”
packet loss (not high
enough to stop
transcoding process), still
produces well-formed
video stream!

Rest of the chain
doesn't know
any better,
happy to push
the content
along... and play
it out!

“CDN & Player metrics look OK”



Motivation – Mixing of Root Causes



Goals

- create best practices on implementing a system to capture QoE and other measurement data **at each monitoring point across the workflow**;
- identify streaming video metrics to gather **at each monitoring point**;
- establish guidelines on how to calculate, **or leverage existing**, metrics **at each monitoring point, and investigate potential for an end-to-end metric(s) across all monitoring points**;

QoE definition

- *the degree of delight or annoyance of the user of an application or service [ITU-T P.10]*



Scope

- IPTV / OTT systems
- Live content workflows
- Sources to Device Output
- Both cloud-based and on-premises-based
- Operational use cases
- Monitoring instrumentation focus on Probes, Logs & Player-APIs
 - APM solutions not considered, e.g. node CPU load, e.g. memory utilization, e.g. temperature, etc.

Framework

1) Establish End-To-End Monitoring Scope

HOW IS MY END-TO-END QOE?

5) Aggregate MP monitoring results into: a) subsystem views; b) end-to-end view

3) Decompose each MP into Monitoring Layers (ML)

4) For each (MP, ML): describe monitoring methodology

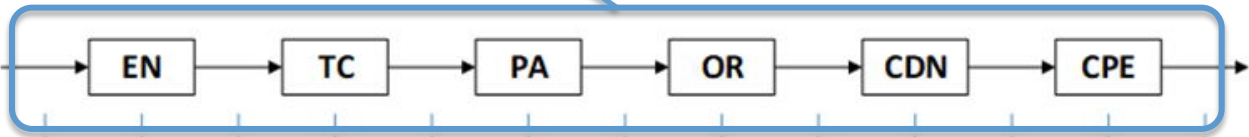
HOW IS MY SOURCE QOE?

HOW IS MY PROCESSING QOE?

HOW IS MY PUBLISHING QOE?

HOW IS MY DELIVERY QOE?

HOW IS MY PLAYOUT QOE?



MP	Content	Envelope	Auxiliary
Content
Envelope
Auxiliary

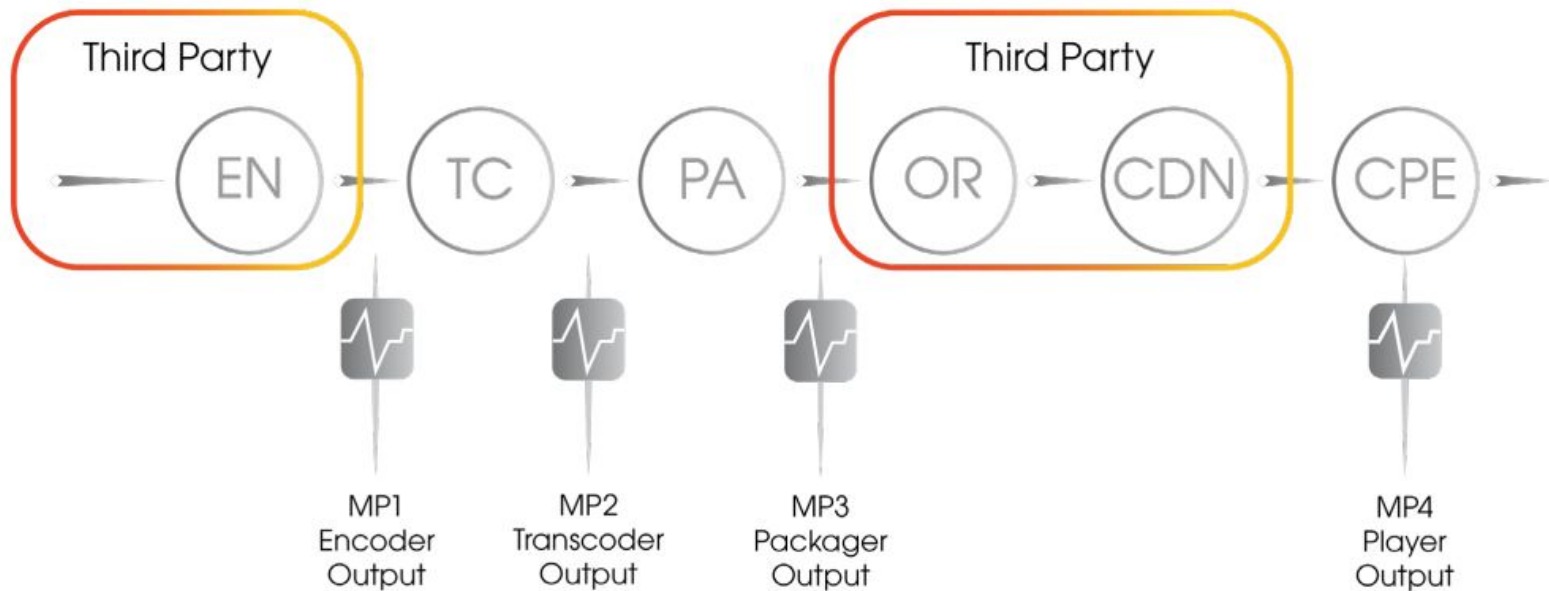
W h e r e	H o w	W h a t	W h y
...
...
...



2) Decompose E2E scope into Monitoring Points (MP)

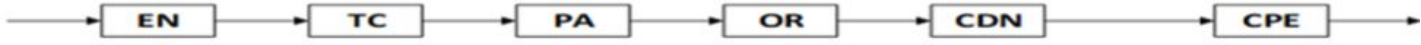
Framework Deployment - Modular

Ex. Service Operator



Framework Deployment - Modular

Ex. Service Operator



WHERE
HOW
WHAT
WHY

ENCODER output	TRANSCODER output	PACKAGER Output
Centralized On Prem HW Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe

IGMP-join output of Encoder & Transcoder with Probe & measure content & transport quality

- over-compression
- stream/comp fail
- performance

- over-compression
- stream/comp fail
- performance

HTTP-get output of Packager with Probe & measure transport quality

cannot monitor content (content is encrypted)

- mft/prf/chu avail
- stream/comp fail
- performance

other techniques are available

- ex. packager passive tap for HTTP-post



PLAYER output
Geo-Dist On Cons. Dev. SW Embedded

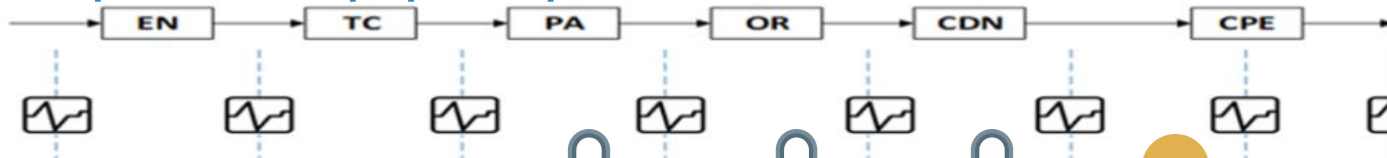
collect player events & errors - e.g. via player API

cannot monitor content (limited to what API provides)

- Device issues
- Delivery issues
- performance

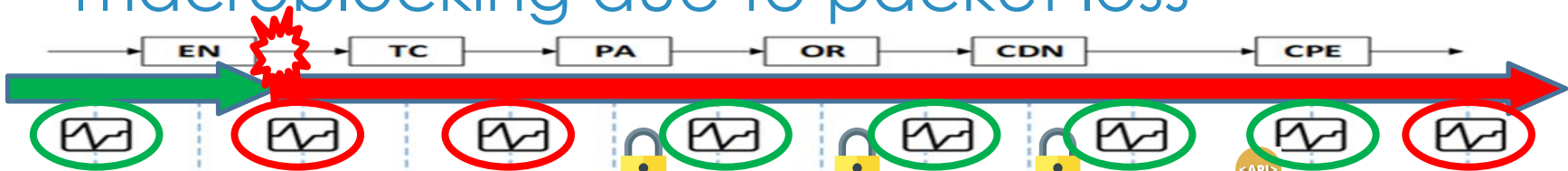
Framework Deployment - “Modules”

i.e. pick appropriate MP/ML subset



	SOURCES input	ENCODER output	TRANSCODER output	PACKAGER Output	ORIGIN output	CDN Output	PLAYER output	DEVICE output
WHERE	Centralized On Prem HW Probe	Centralized On Prem HW Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Geo-Distr In Cloud VM Probe	Geo-Dist On Cons. Dev. SW Embedded	Geo-Dist On Rep. Cons. Dev. HW Probe
HOW	Active Hard-wire Splitter All-In-Parallel	Active IGMP-Join Router All-In-Parallel	Active IGMP-Join Router All-In-Parallel	Active HTTP-GET Router All-In-Parallel	Active HTTP-GET Router All-Cycle-Slid-Win	Active HTTP-GET Router All-Cycle-Slid-Win	Passive API Call Player API All-AdHoc-Viewr.	Active Hard-wire + RC HDMI Output All-Cycle-Slid-Win
WHAT	SDI Content - Perc. Qual. - BS/VF/AS/MB/LS - Stream	IP[MCAST] Content + Envelope - Perc. Qual. - BS/VF/AS/MB/LS - Packet/Stream	IP[MCAST]/MBR Content + Envelope - Perc. Qual. - BS/VF/AS/MB/LS - Packet/Stream	HLS/ABR Envelope - Manif/Prof/Chunk - Packet/Stream	HLS/ABR Envelope - Manif/Prof/Chunk - Packet/Stream	HLS/ABR Envelope - Manif/Prof/Chunk - Packet/Stream	Player Messages Auxiliary - Startup Time - Buffering - Avg Vid Bitrate - Vid Start Fail.	HDMI Content - Perc. Qual. - BS/VF/AS/MB
WHY	- junk in / junk out - stream/comp fail - perf. baseline	- over-compression - stream/comp fail - performance	- over-compression - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- Device issues - Delivery issues - performance	- Cons. Perc. Qual - Device issues - performance

Outage detection example - macroblocking due to packet loss



	SOURCES input	ENCODER output	TRANSCODER output	PACKAGER output	ORIGIN output	CDN output	PLAYER output	DEVICE output
WHERE	Centralized On Prem HW Probe	Centralized On Prem HW Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Geo-Distr In Cloud VM Probe	Geo-Dist On Cons. Dev. SW Embedded	Geo-Dist On Rep. Cons. Dev. HW Probe
HOW	Active All-In-Parallel Hard-wire Splitter	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Passive All-AdHoc-Viewr. API Call Player API	Active All-Cycle-Slid-Win Hard-wire + RC HDMI Output
WHAT	Content OK Network OK	Content BAD Network BAD	Content Encrypted Network OK			Player Events OK	Content BAD	
WHY	- junk in / junk out - stream/comp fail - perf. baseline	- over-compression - stream/comp fail - performance	- over-compression - IBP/IDR alignment - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- Device issues - Delivery issues - performance	- Cons. Perc. Qual - Device issues - performance

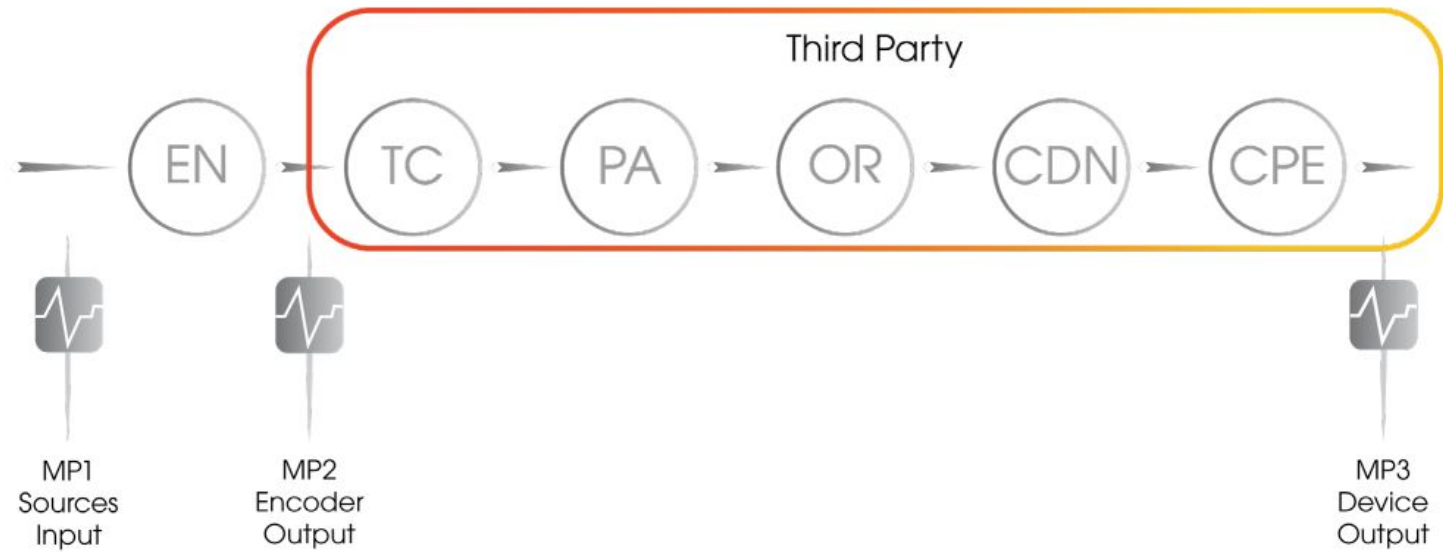
Q & A

- Thank you!

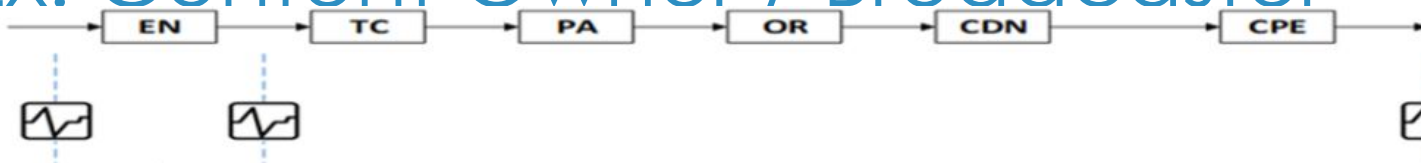
email: christopher.kulbakas@gmail.com

Backup Slides

Framework Applications - Ex. Content Owner / Broadcaster



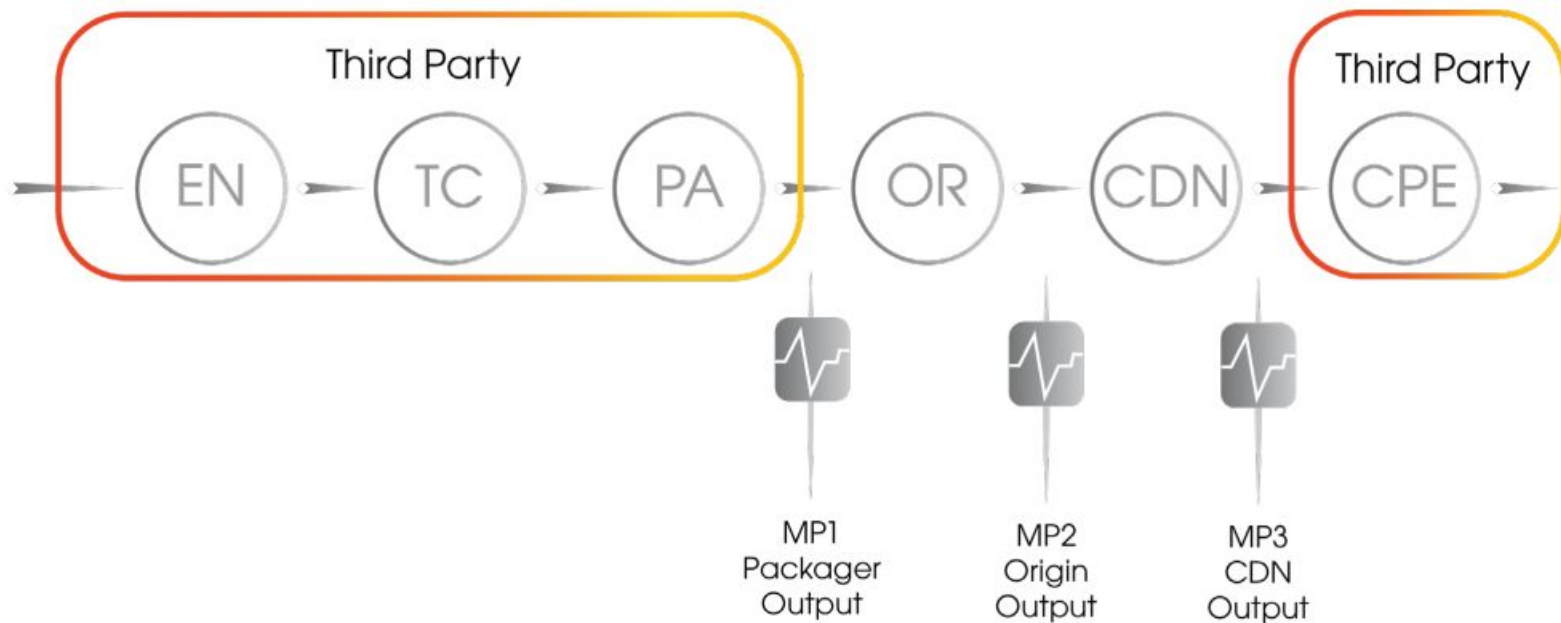
Framework Applications - Ex. Content Owner / Broadcaster



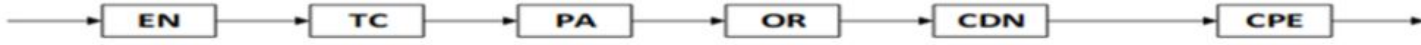
	SOURCES input	ENCODER output
WHERE	Centralized On Prem HW Probe	Centralized On Prem HW Probe
HOW	hook up SDI splitter to Probe & measure content & stream quality	IGMP-join output of Encoder with Probe & measure content & transport quality
WHAT		
WHY	<ul style="list-style-type: none"> - junk in / junk out - stream/comp fail - perf. baseline 	<ul style="list-style-type: none"> - over-compression - stream/comp fail - performance

DEVICE output
Geo-Dist On Rep. Cons. Dev. HW Probe
monitor device HDMI out using Probe & measure content quality, cycle channels using remote control
<ul style="list-style-type: none"> - Cons. Perc. Qual - Device issues - performance

Framework Applications - Ex. Cloud CDN Provider



Framework Applications - Ex. Cloud CDN Provider



- WHERE
- HOW
- WHAT
- WHY

PACKAGER Output	ORIGIN output	CDN Output
Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Geo-Distr In Cloud VM Probe

other techniques are available
- ex. packager passive tap for HTTP-post

HTTP-get output of Packager with Probe & measure transport quality

cannot monitor content (content is encrypted)

HTTP-get output of Origin, CDN with Probe & measure transport quality

cannot monitor content (content is encrypted)

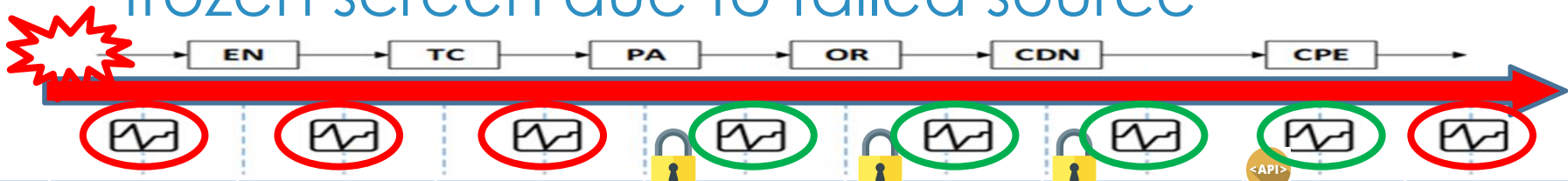
other techniques are available
- ex. origin & cdn log scraping

- mft/prf/chu avail
- stream/comp fail
- performance

- mft/prf/chu avail
- stream/comp fail
- performance

- mft/prf/chu avail
- stream/comp fail
- performance

Outage detection example - frozen screen due to failed source



	SOURCES input	ENCODER output	TRANSCODER output	PACKAGER output	ORIGIN output	CDN output	PLAYER output	DEVICE output
WHERE	Centralized On Prem HW Probe	Centralized On Prem HW Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Geo-Distr In Cloud VM Probe	Geo-Dist On Cons. Dev. SW Embedded	Geo-Dist On Rep. Cons. Dev. HW Probe
HOW	Active All-In-Parallel Hard-wire Splitter	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Passive All-AdHoc-Viewr. API Call Player API	Active All-Cycle-Slid-Win Hard-wire + RC HDMI Output
WHAT	Content BAD Network BAD	Content BAD	Content Encrypted				Player Events OK	Content BAD
WHY	- junk in / junk out - stream/comp fail - perf. baseline	- over-compression - stream/comp fail - performance	- over-compression - IBP/IDR alignment - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- Device issues - Delivery issues - performance	- Cons. Perc. Qual - Device issues - performance

Outage detection example - bad video quality due to over-compression



	SOURCES input	ENCODER output	TRANSCODER output	PACKAGER output	ORIGIN output	CDN output	PLAYER output	DEVICE output
WHERE	Centralized On Prem HW Probe	Centralized On Prem HW Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Centralized In Cloud VM Probe	Geo-Distr In Cloud VM Probe	Geo-Dist On Cons. Dev. SW Embedded	Geo-Dist On Rep. Cons. Dev. HW Probe
HOW	Active All-In-Parallel Hard-wire Splitter	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel IGMP-Join Router	Active All-In-Parallel HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Active All-Cycle-Slid-Win HTTP-GET Router	Passive All-AdHoc-Viewr. API Call Player API	Active All-Cycle-Slid-Win Hard-wire + RC HDMI Output
WHAT	Content OK	Content BAD	Content Encrypted				Player Events OK	Content BAD
WHY	- junk in / junk out - stream/comp fail - perf. baseline	- over-compression - stream/comp fail - performance	- over-compression - IBP/IDR alignment - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- mft/prf/chu avail - stream/comp fail - performance	- Device issues - Delivery issues - performance	- Cons. Perc. Qual - Device issues - performance