

BEST PRACTICES ON PTP AND MEDIA FLOW MONITORING FOR ALL-IP INFRASTRUCTURES

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IP SHOWCASE THEATRE AT METexpo 17-19 July 2019

INTRODUCTION

Our company: Skyline Communications

- established in 1985, independent
- headquartered in Izegem, Belgium
- global presence (19 international sites)
- 300+ employees
- acknowledged expert in e2e monitoring & orchestration

Our product: DataMiner

- Next generation multi-vendor off-the-shelf NMS, Orchestrator & OSS platform
- monitors, controls, orchestrates
- 6000+ systems deployed
- 5500+ drivers to interface with products from 600+ vendors



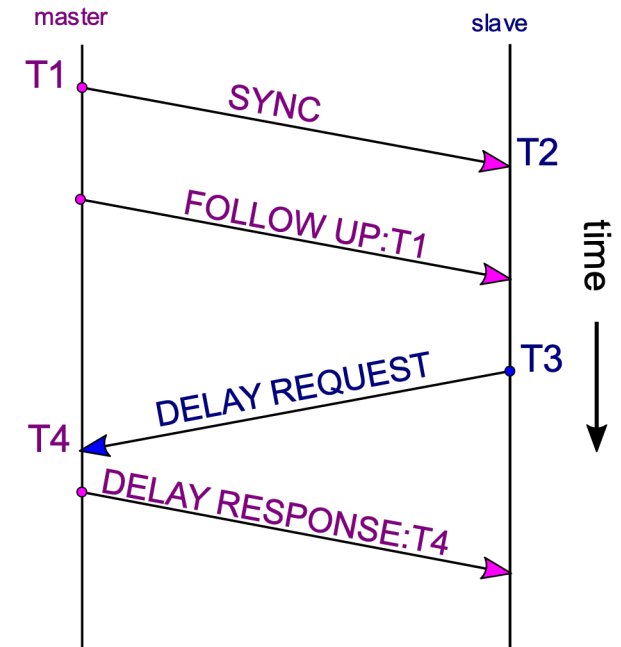
PTP – A PROTOCOL, NOT A SIGNAL

PTP standard has been designed for engineered environments and makes some assumptions

- no packet delay variation (PDV)
- no asymmetry (internal asymmetry, transmission asymmetry)
- timestamps are perfect

mechanisms to alleviate these sources of errors

- create timestamps in hardware
- use QoS to prioritize PTP traffic
- chose between BC, TC, E2E, P2P, correct timing intervals, etc.. to optimize the precision of time at the endpoint



but nothing is perfect

PTP – COMMON SOURCES OF ERROR



Configuration issues (ordinary clock, grandmaster clock, slave only clock, boundary clock, transparent clock)

- PTP parameters & BMCA settings (domain, priority1, priority2, profiles, delay mechanism ...)
- messaging rate intervals (announce message, announce timeout, sync message, delay request, delay response, ...)
- communication mode (unicast, multicast, mixed)

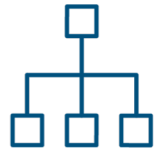


Device issues

- grandmaster, boundary clock failure
- loss of external reference
- badly implemented BMCA, PTP master election process



automate PTP configuration



Network issues

- missing event messages
- corrupted event messages
- increased packet delay variations (PDV)
- network asymmetry
- multicast issues

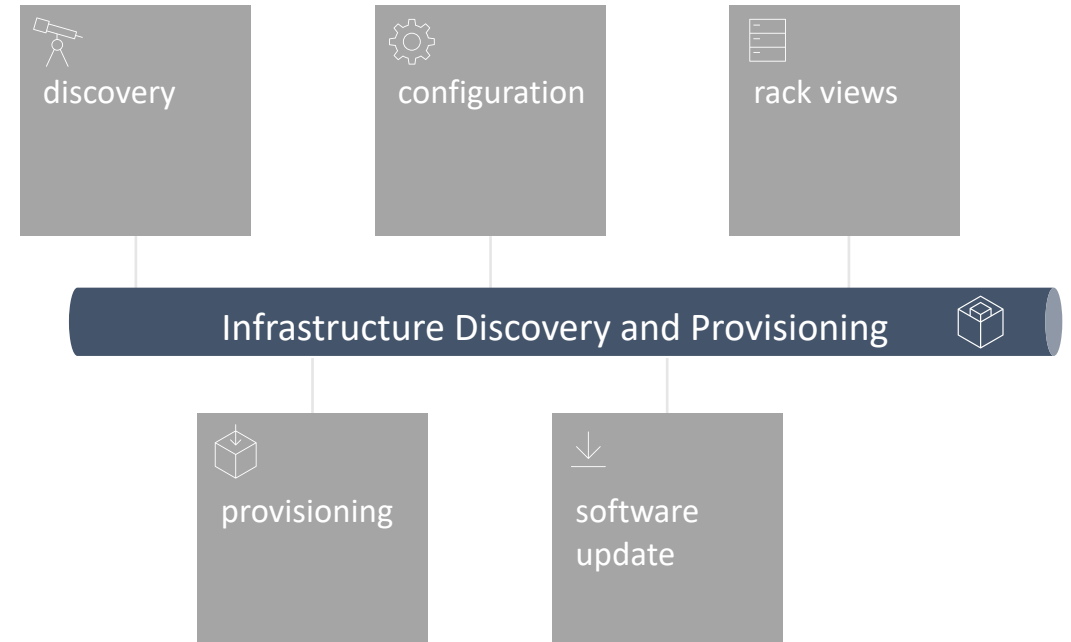


monitor & control PTP environment



AUTOMATED PTP PROVISIONING

- automatically detect ANY new PTP aware devices (IS-04 / proprietary protocols) – FUTURE PROOF
- automatically extract e2e PTP topology (LLDP)
- apply standard PTP settings/profiles to ANY grandmaster, switch, slave device
- compare PTP configurations
- define and apply “golden” configurations



dataminer

infrastructure discovery and provisioning



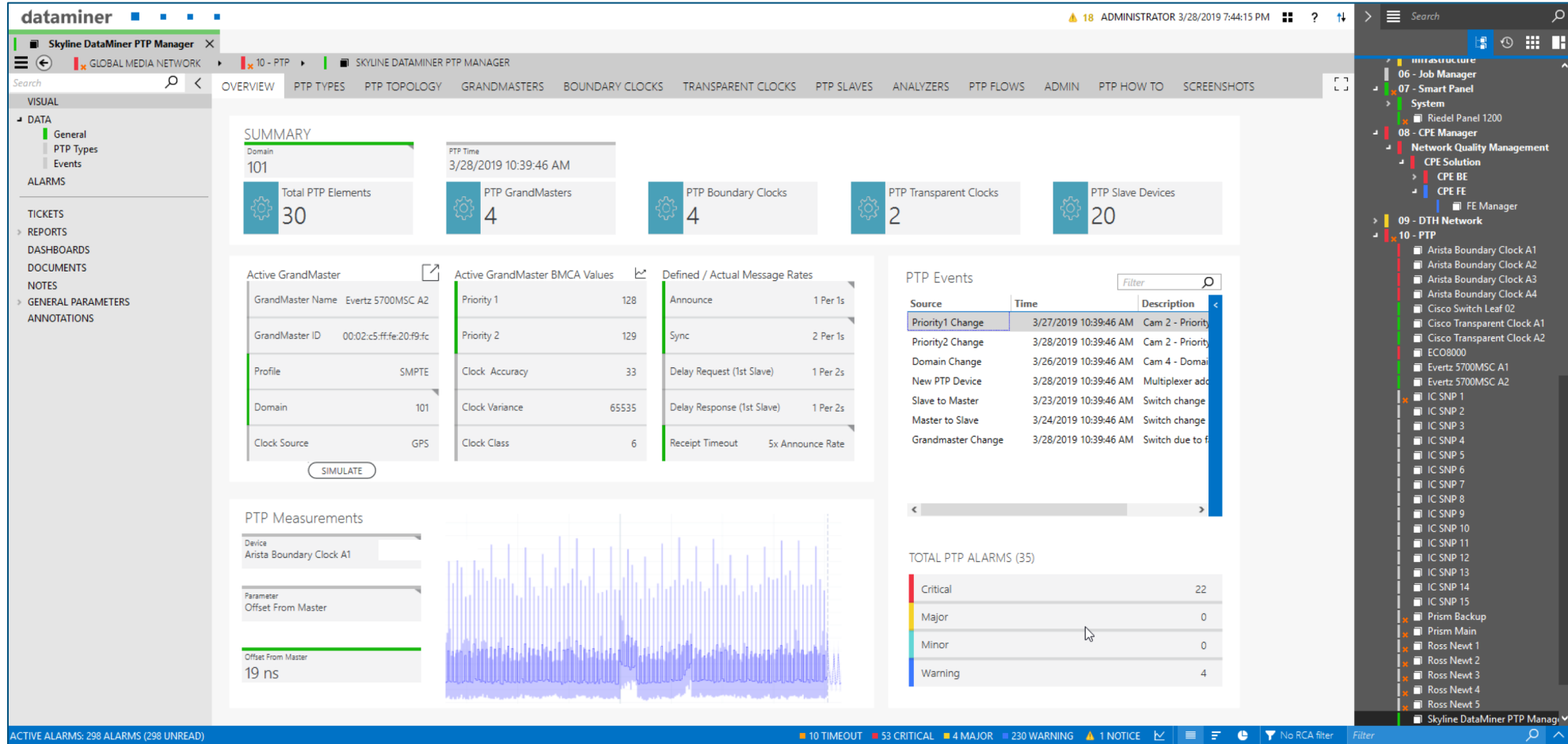
360° PTP MONITORING & CONTROL

- monitor every single PTP metric on all PTP grandmasters, PTP masters, PTP slaves
- monitor PTP performance (e.g. PTP offset, PTP mean path delay)
- monitor PTP multicast-traffic (network packets as well as switch tables)
- apply PTP security workflows (e.g. block PTP slave devices to never become a master)
- integrate network analyzers



dataminer
monitoring & control

PTP OVERVIEW



dataminer | Skyline DataMiner PTP Manager | ADMINISTRATOR 3/28/2019 7:44:15 PM

OVERVIEW | PTP TYPES | PTP TOPOLOGY | GRANDMASTERS | BOUNDARY CLOCKS | TRANSPARENT CLOCKS | PTP SLAVES | ANALYZERS | PTP FLOWS | ADMIN | PTP HOW TO | SCREENSHOTS

SUMMARY

- Domain: 101
- PTP Time: 3/28/2019 10:39:46 AM
- Total PTP Elements: 30
- PTP GrandMasters: 4
- PTP Boundary Clocks: 4
- PTP Transparent Clocks: 2
- PTP Slave Devices: 20

Active GrandMaster

GrandMaster Name	Evertz 5700MSC A2
GrandMaster ID	00:02:c5:ff:fe:20:f9:fc
Profile	SMPT
Domain	101
Clock Source	GPS

Active GrandMaster BMCA Values

Priority 1	128
Priority 2	129
Clock Accuracy	33
Clock Variance	65535
Clock Class	6

Defined / Actual Message Rates

Announce	1 Per 1s
Sync	2 Per 1s
Delay Request (1st Slave)	1 Per 2s
Delay Response (1st Slave)	1 Per 2s
Receipt Timeout	5x Announce Rate

PTP Events

Source	Time	Description
Priority1 Change	3/27/2019 10:39:46 AM	Cam 2 - Priority
Priority2 Change	3/28/2019 10:39:46 AM	Cam 2 - Priority
Domain Change	3/26/2019 10:39:46 AM	Cam 4 - Domain
New PTP Device	3/28/2019 10:39:46 AM	Multiplexer add
Slave to Master	3/23/2019 10:39:46 AM	Switch change
Master to Slave	3/24/2019 10:39:46 AM	Switch change
Grandmaster Change	3/28/2019 10:39:46 AM	Switch due to f

PTP Measurements

Device: Arista Boundary Clock A1

Parameter: Offset From Master

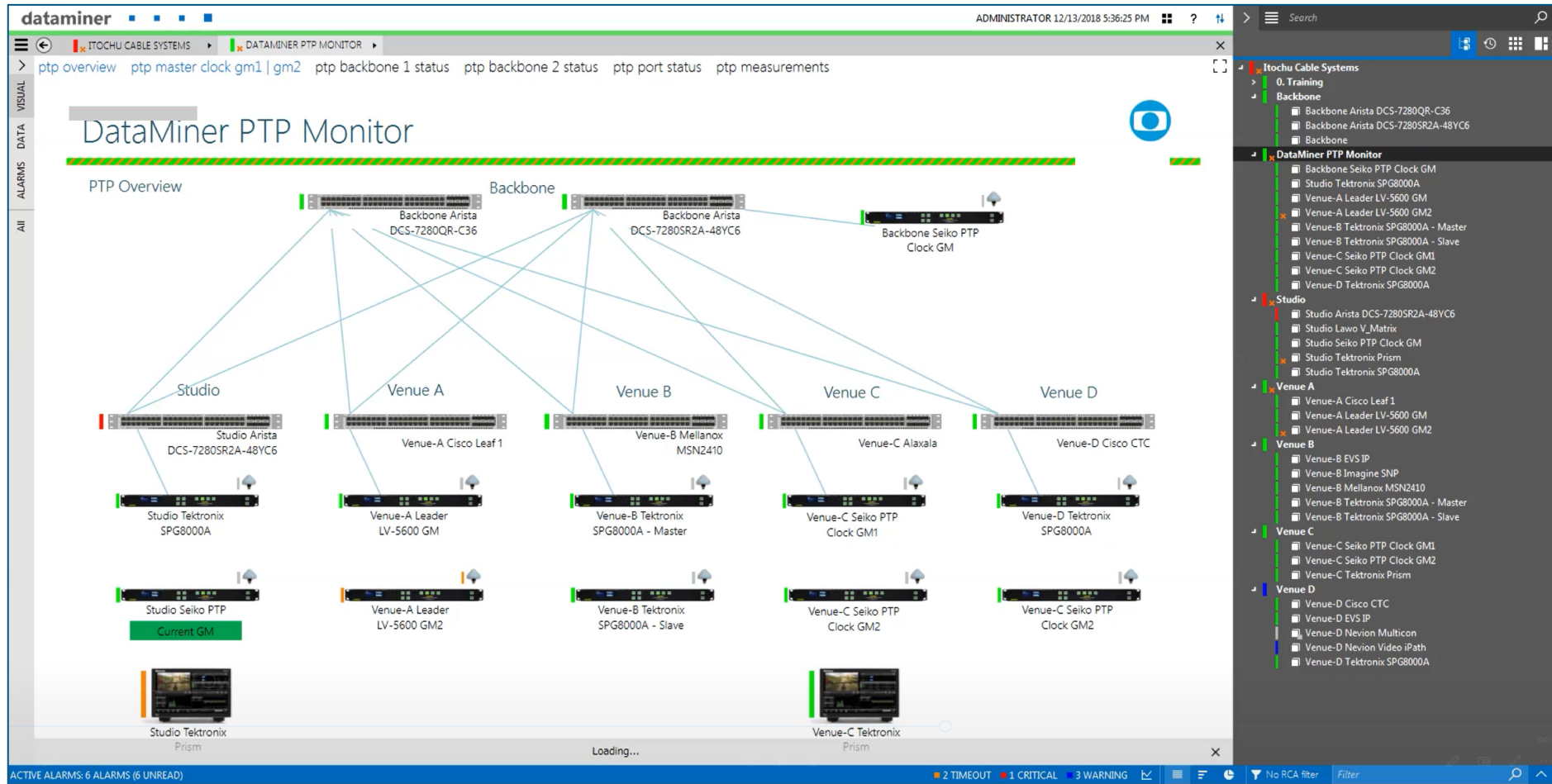
Offset From Master: 19 ns

TOTAL PTP ALARMS (35)

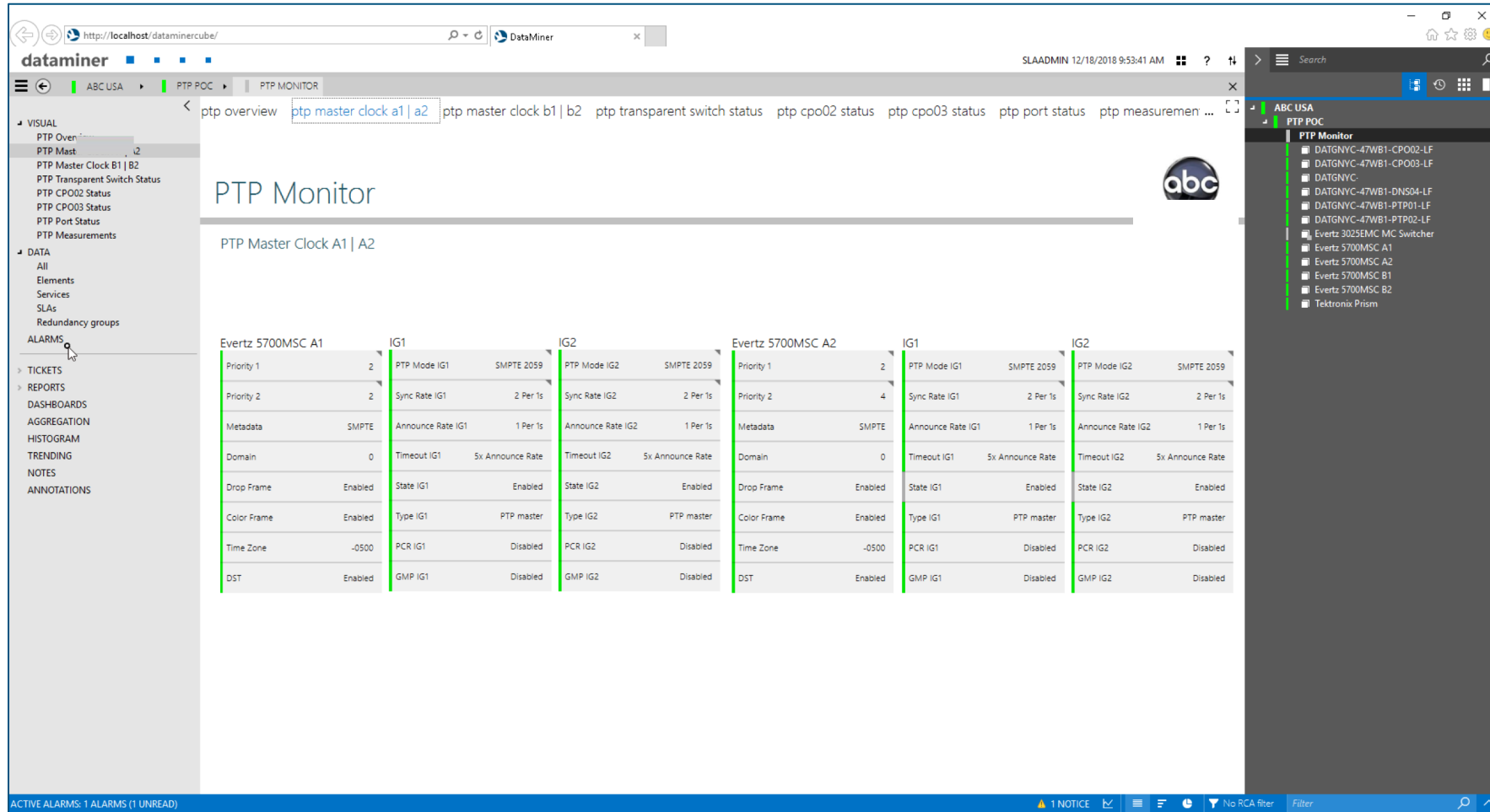
Critical	22
Major	0
Minor	0
Warning	4

ACTIVE ALARMS: 298 ALARMS (298 UNREAD) | 10 TIMEOUT | 53 CRITICAL | 4 MAJOR | 230 WARNING | 1 NOTICE | No RCA filter

PTP TOPOLOGY



PTP COMPARISON



The screenshot displays the 'PTP Monitor' interface for 'PTP Master Clock A1 | A2'. It compares two devices, Evertz 5700MSC A1 and Evertz 5700MSC A2, across several parameters. The interface includes a navigation menu on the left, a search bar on the right, and a table of comparison data.

Evertz 5700MSC A1		IG1		IG2		Evertz 5700MSC A2		IG1		IG2	
Priority 1	2	PTP Mode IG1	SMPTE 2059	PTP Mode IG2	SMPTE 2059	Priority 1	2	PTP Mode IG1	SMPTE 2059	PTP Mode IG2	SMPTE 2059
Priority 2	2	Sync Rate IG1	2 Per 1s	Sync Rate IG2	2 Per 1s	Priority 2	4	Sync Rate IG1	2 Per 1s	Sync Rate IG2	2 Per 1s
Metadata	SMPTE	Announce Rate IG1	1 Per 1s	Announce Rate IG2	1 Per 1s	Metadata	SMPTE	Announce Rate IG1	1 Per 1s	Announce Rate IG2	1 Per 1s
Domain	0	Timeout IG1	5x Announce Rate	Timeout IG2	5x Announce Rate	Domain	0	Timeout IG1	5x Announce Rate	Timeout IG2	5x Announce Rate
Drop Frame	Enabled	State IG1	Enabled	State IG2	Enabled	Drop Frame	Enabled	State IG1	Enabled	State IG2	Enabled
Color Frame	Enabled	Type IG1	PTP master	Type IG2	PTP master	Color Frame	Enabled	Type IG1	PTP master	Type IG2	PTP master
Time Zone	-0500	PCR IG1	Disabled	PCR IG2	Disabled	Time Zone	-0500	PCR IG1	Disabled	PCR IG2	Disabled
DST	Enabled	GMP IG1	Disabled	GMP IG2	Disabled	DST	Enabled	GMP IG1	Disabled	GMP IG2	Disabled

ACTIVE ALARMS: 1 ALARMS (1 UNREAD) | 1 NOTICE | No RCA filter

PTP DETAILS

dataminer | SLAADMIN 12/18/2018 9:55:21 AM

ABC USA > PTP POC > DATGNYC-47WB1-CPO02-LF

Up to "General"

PTP Mode

Clock Identity

Grandmaster Clock ID 0x00:02:x5:fffe:20:f9:da

Number Of Slave Ports 1

Number Of Master Ports 1

Slave Port Ethernet23

Offset From Master -5 ns

Mean Path Delay 1859 ns

Steps Removed 1

Skew 1.00000000

Last Sync Time 12/18/2018 9:54:10 AM

Current PTP System Time 12/18/2018 9:54:10 AM

PTP Interfaces

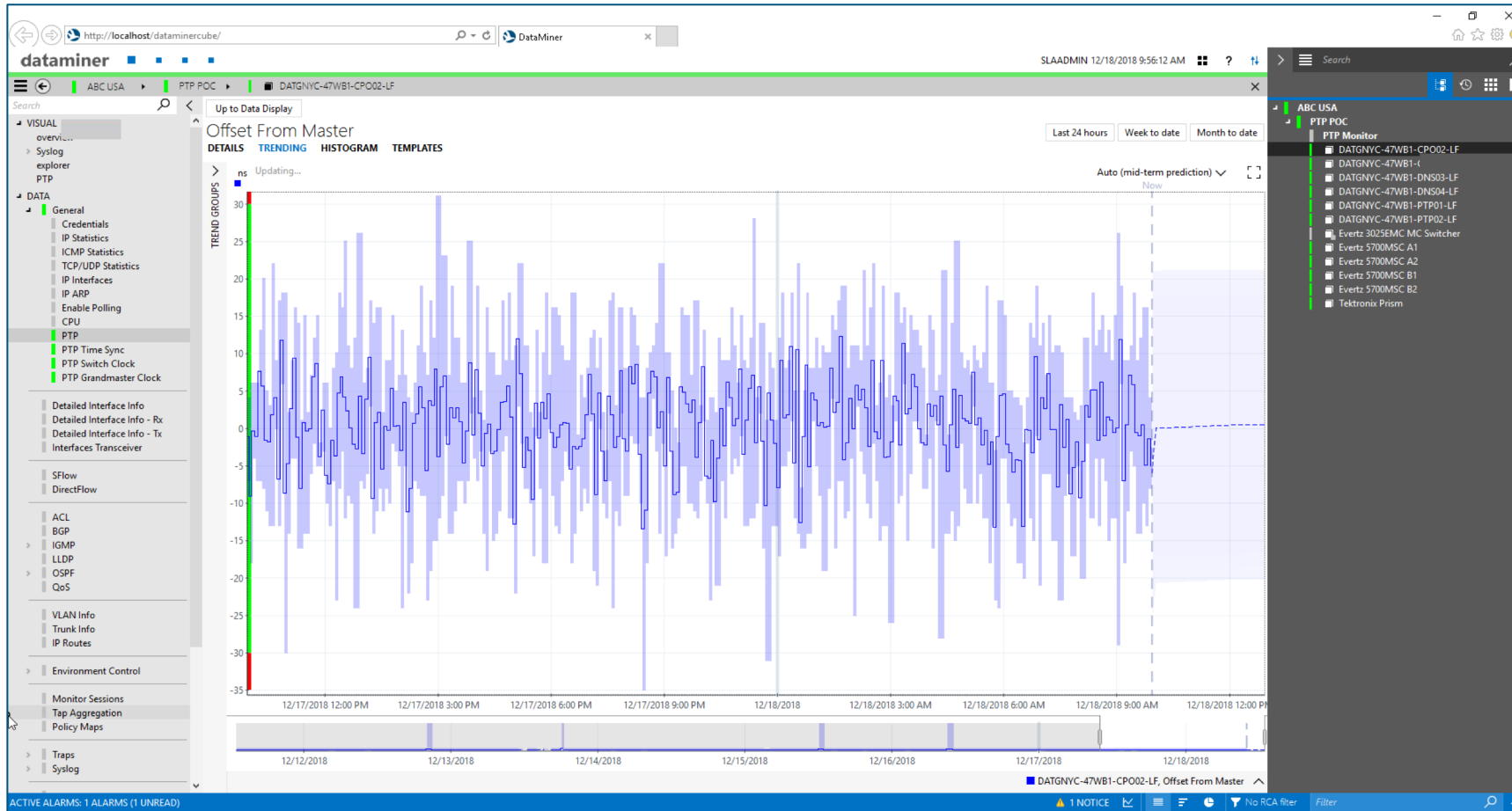
Name [IDX] (PTP Inter...	State (PTP Interface)	Transport (PTP Interfa...	Delay Mechanism (PTP...	Delay Request Interval (P...	Announce Receipt Timeout...
Ethernet23	Slave	IPv4	e2e	0.500 s	2
Ethernet24	Passive	IPv4	e2e	0.500 s	2
Ethernet1	Master	IPv4	e2e	0.500 s	2
Ethernet3	Disabled	IPv4	e2e	0.500 s	2
Ethernet2	Disabled	IPv4	e2e	0.500 s	2
Ethernet4	Disabled	IPv4	e2e	0.500 s	2
Ethernet18	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet19	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet16	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet17	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet22	Not initialized	Not initialized	Not initialized	32.000 s	3
Port-Channel999	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet20	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet21	Not initialized	Not initialized	Not initialized	32.000 s	3
Ethernet15	Not initialized	Not initialized	Not initialized	32.000 s	3

Details on: Ethernet23

- State (PTP Interface) Slave
- Transport (PTP Interface) IPv4
- Delay Mechanism (PTP Interf... e2e
- Delay Request Interval (PTP I... 0.500 s
- Announce Receipt Timeout (... 2
- Admin State (PTP Interface) Disabled
- Sync test (PTP Interface) Disabled
- Sync Interval (PTP Interface) 1 s
- Mode (PTP Interface) Boundary Clock
- Announce Interval (PTP Inter... 1 s
- Announce Messages Sent (P... 70
- Announce Messages Receive... 13769
- Sync Messages Sent (PTP Int... 142
- Sync Messages Received (PT... 27704
- Follow up Messages Sent (PT... 142
- Follow up Messages Receive... 12469
- Delay Request Messages Sent... 24282

ACTIVE ALARMS: 1 ALARMS (1 UNREAD) | NOTICE | No RCA filter

PTP PERFORMANCE DATA

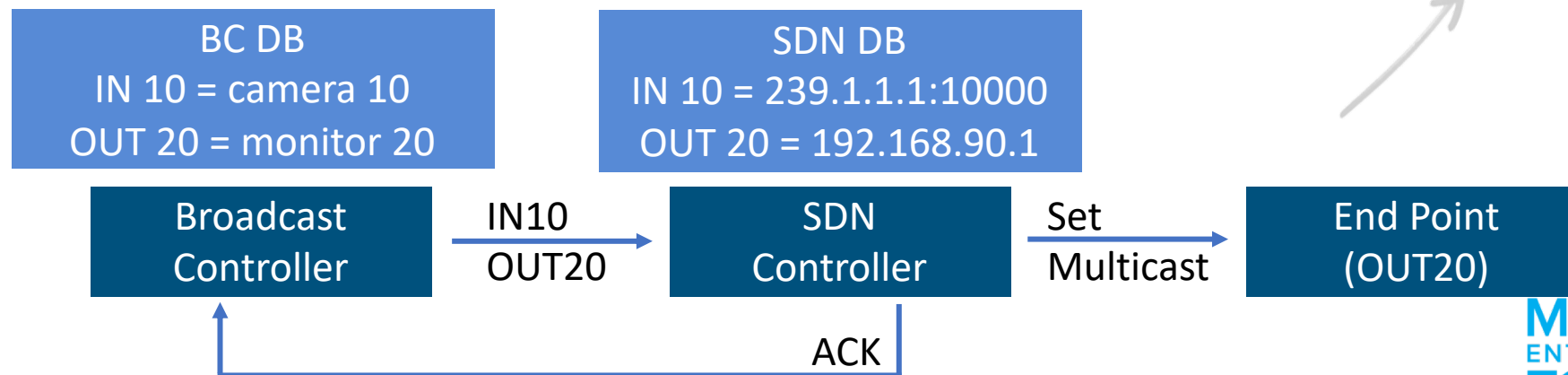




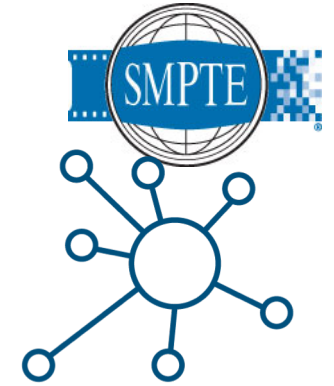
IP MEDIA FLOW TRACKING

- network is a shared & non-linear medium (vs single SDI cable)
- complex switch fabrics (vs single SDI router)
- multiple ST2110 essence streams (vs single SDI signal)
- SDN controllers talk to plenty of end points (vs single SDI router)
- broadcast and SDN controllers still use „classic“ SDI router protocols

what if the BC-controller panel shows a connection but the screen stays black?



IP MEDIA FLOWS – SOURCES OF ERRORS



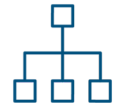
Controller

- wrong DB entries (initial setup, device replacement, IS-04 querier issue)
- BC-controller and SDN controller DBs are out of sync



Source

- source not active, not streaming
- wrong IP(s) or multicast transmit address(es)



Network

- IGMP join / leave issues
- static multicast issues
- source specific multicast issues
- oversubscription (ghost streams)



Destination

- IGMP join not sent
- wrong multicast receive address(es)



track your media flows in real-time

DATAMINER MEDIA FLOW MONITORING SOLUTION

read crosspoint status from SDN controller

“where are all my flows supposed to be?”

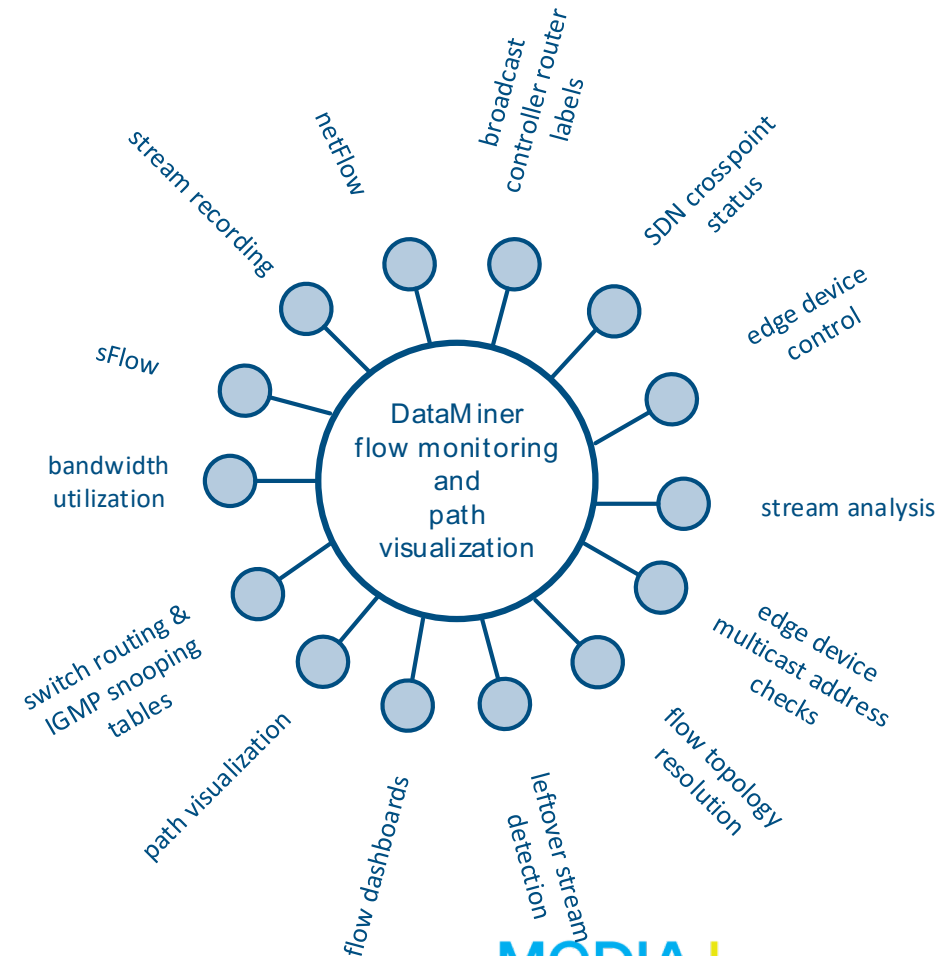
check this status versus the real-time situation

“where are my flows in reality?”

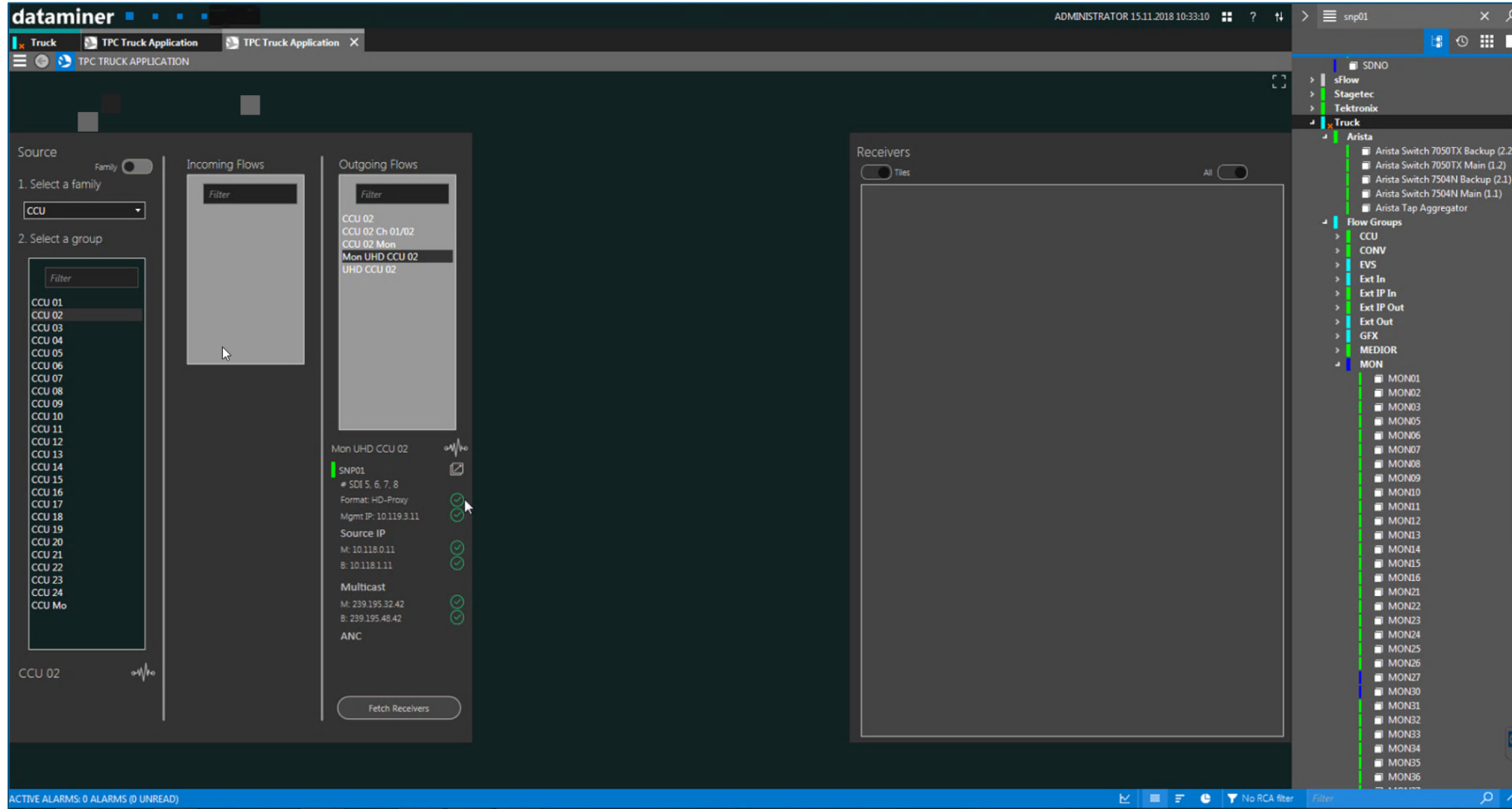
AND detect the flows which are there but should not be there



gather real-time information from source to destination:
„crawl“ through the network and find the root cause of any stream issue

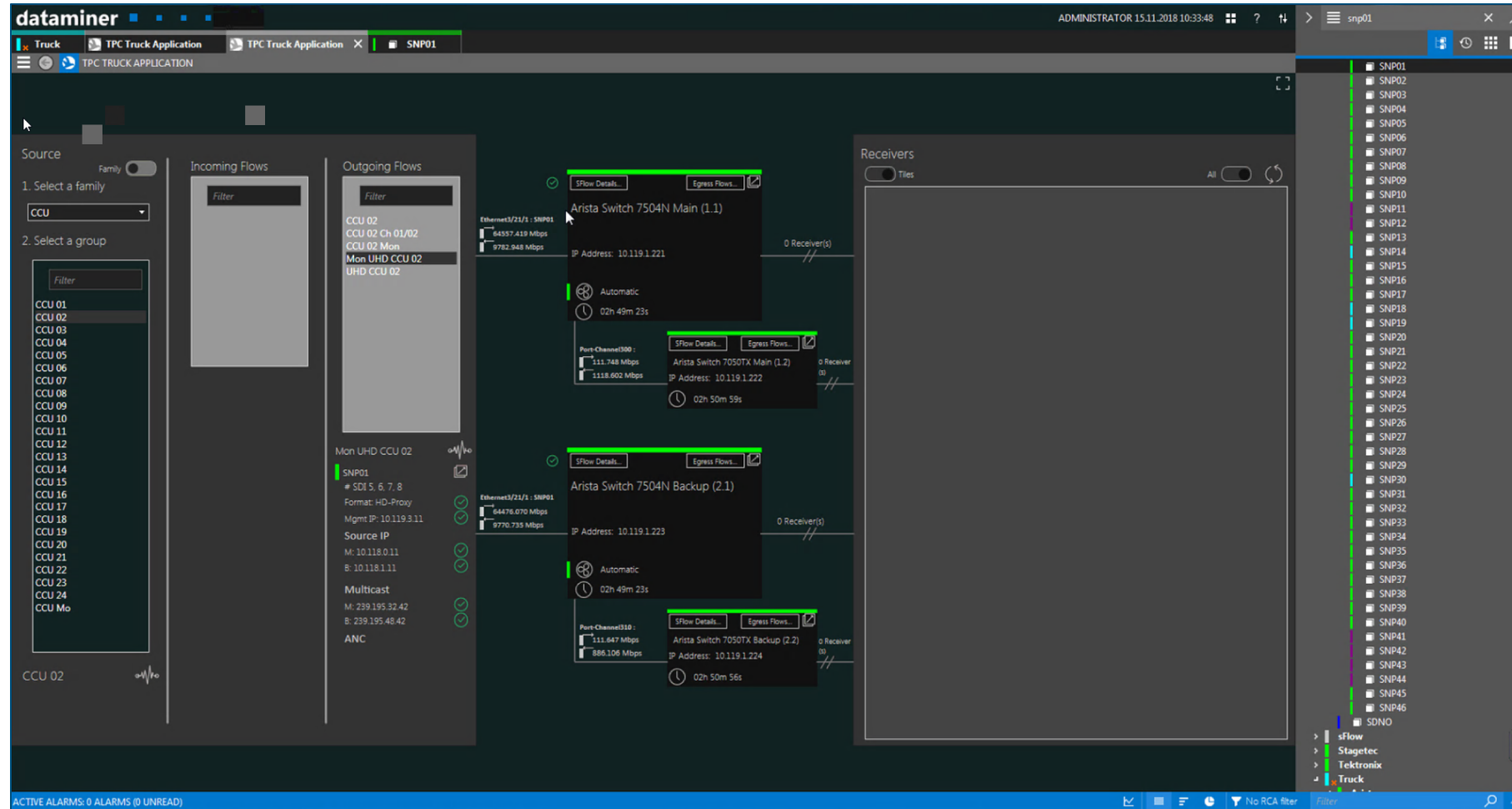


START WITH THE SOURCE



The screenshot displays the 'dataminer' software interface. The main window is titled 'TPC TRUCK APPLICATION' and shows a configuration screen for a source. On the left, there are sections for 'Source' (Family: CCU, Group: CCU 02), 'Incoming Flows', and 'Outgoing Flows'. The 'Outgoing Flows' section lists 'Mon UHD CCU 02' with a signal strength indicator. Below this, the 'SNP01' source details are shown, including SDI channels (5, 6, 7, 8), format (HD-Proxy), and source IP (10.118.0.11). A 'Fetch Receivers' button is at the bottom. On the right, a 'Receivers' panel is visible, showing a list of receivers under the 'MON' group, including MON01 through MON36. A tree view on the far right shows the network hierarchy, including 'Arista' switches and 'Flow Groups'.

RESOLVE TOPOLOGY



The screenshot displays the 'dataminer' interface for a network named 'SNP01'. The interface is divided into several sections:

- Source:**
 - 1. Select a family: CCU
 - 2. Select a group: CCU 01 through CCU 24, CCU Mo
- Incoming Flows:** A filter box is present.
- Outgoing Flows:**
 - CCU 02
 - CCU 02 Ch 01/02
 - CCU 02 Mon
 - Mon UHD CCU 02
 - UHD CCU 02
- Receivers:** A filter box is present.
- Network Topology:**
 - Arista Switch 7504N Main (1.1):** IP Address: 10.119.1.221. Connected to Ethernet3/21/1: SNP01 (64557.419 Mbps In, 9782.948 Mbps Out). Port-Channel300 is connected to Arista Switch 7050TX Main (1.2) (111.748 Mbps In, 1118.602 Mbps Out).
 - Arista Switch 7504N Backup (2.1):** IP Address: 10.119.1.223. Connected to Ethernet3/21/1: SNP01 (64478.070 Mbps In, 9770.735 Mbps Out). Port-Channel310 is connected to Arista Switch 7050TX Backup (2.2) (886.106 Mbps In, 886.106 Mbps Out).
 - Mon UHD CCU 02:** SDI 5, 6, 7, 8. Format: HD-Proxy. Mgmt IP: 10.119.3.111. Source IP: M: 10.118.0.11, B: 10.118.1.11. Multicast: M: 239.195.32.42, B: 239.195.48.42. ANC.
- Right Panel:** A tree view showing the hierarchy of network elements: SNP01, SNP02 through SNP46, sFlow, Stagetec, Tektronix, and Truck.

At the bottom, it shows 'ACTIVE ALARMS: 0 ALARMS (0 UNREAD)' and a 'No RCA filter' indicator.

CHECK DESTINATIONS

The screenshot displays the 'dataminer' network monitoring application. The interface is divided into several sections:

- Source:** A list of devices on the left, including MON53 through SNP16. Below it, a 'Select a group' dropdown is set to 'EVS 1'.
- Incoming Flows:** A list of flows for 'EVS 1-07', showing source IP, destination IP, and multicast addresses. A 'Connected Source' section shows details for 'CCU 07 Mon' and 'SDNO'.
- Outgoing Flows:** A list of flows for 'EVS 1-01', showing source IP, destination IP, and multicast addresses.
- Receivers:** A grid of receiver cards for various devices like 'Arista Switch 7504N Main (1.1)', 'MV Regie 8.1-1', and 'VMix 1-7'. Each card shows IP addresses, SDNOs, and egress states.
- Right Panel:** A vertical list of destination nodes from SNP18 to SNP46, with a tree view below it showing a hierarchy of flow groups like 'Arista', 'Flow Groups', and 'CCU'.
- Bottom Bar:** A status bar showing 'ACTIVE ALARMS: 29 ALARMS (29 UNREAD)' and a legend for alarm types: 5 TIMEOUT, 2 MAJOR, 19 MINOR, 2 WARNING, 1 NOTICE.

DRILL DOWN TO DETAILS

The screenshot displays the dataminer application interface. The main window shows a detailed view of traffic from an Arista Switch 7504N Main (1.1) with IP Address 10.119.1.221. The traffic is being analyzed on Ethernet3/21/1 : SNP01. A table of traffic data is visible, showing source and destination IP addresses, ports, and various performance metrics.

Source IP (SFlo...)	Source Port (SF...)	Destination IP...	Destination Port...	Bitrate (SFlow Data)	Packet Rate (SF...)	IPDSCP (SFlow...)	Input (SFlow D...	Output (SFlow...	Sub Agent ID (...)	Source ID (SFlo...
10.118.0.11	50000	239.195.32.42	50201	1759.600000 Mbps	150000 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.69	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.38	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.28	50201	1075.866667 Mbps	91667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.19	50201	880.400000 Mbps	75000 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.41	50201	1174.800000 Mbps	100000 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.137	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.31	50201	1663.866667 Mbps	141667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.212	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.43	50201	1369.466667 Mbps	116667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.22	50201	1466.800000 Mbps	125000 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.171	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.246	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.0.2	50200	6942.266667 Mbps	591667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.34	50300	46.133333 Mbps	16667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.24	50201	1271.733333 Mbps	108333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.46	50201	1075.466667 Mbps	91667 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.218	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.128.37	50300	23.066667 Mbps	8333 Pps	AF41	3253	2147483648	0	0
10.118.0.11	50000	239.195.32.27	50201	977.733333 Mbps	83333 Pps	AF41	3253	2147483648	0	0

Additional details shown in the interface include a summary for Arista Switch 7504N Backup (2.2) with IP Address 10.119.1.224, showing 111.122 Mbps and 884.687 Mbps. The interface also features a sidebar with a tree view of network elements (SNP01 to SNP46) and a bottom status bar indicating 'ACTIVE ALARMS: 0 ALARMS (0 UNREAD)'.

CUSTOMER EXAMPLE – STREAM ISSUE

The screenshot shows the dataminer interface with the following details:

- Source:** EVS 1 is selected. Incoming flows include EVS 1-01 (Ch 01-02 to 03-04) and EVS 1-02 (Ch 07-08 to 13-14). Connected sources include CCU 08 (SDI 13) and SNP02 (SDI 13).
- Receivers:** A grid of MV Regie units (8.4-2, 8.3-8, 8.1-8, 7.4-8, 7.3-8, 7.2-8, 4.3-8) is shown, each with IP Main and Backup addresses and SDNO/V_Nos.
- Network:** Arista Switch 7504N Main (1.1) and Backup (2.1) are visible, along with Arista Switch 7050TX Main (1.2) and Backup (2.2).
- Alerts:** A status bar at the bottom indicates 22 active alarms, including 4 timeouts, 1 critical, 14 minor, and 2 warnings.

Customer example

EVS1 Input1 has no input signal

check input: CCU08 is the connected source

check CCU08 output: CCU08 is routed to 7 destinations but none of them receive any signal

root cause: wrong source IP – IGMPV3 SSM blocks multicast traffic

SUMMARY

MONITOR AND MANAGE
YOUR PTP INFRASTRUCTURE
WITH CARE

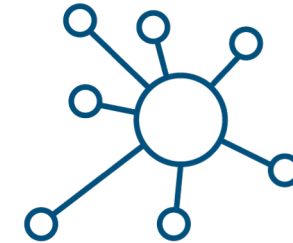


GO FOR TRUE E2E
SDN ORCHESTRATION
RATHER THAN
SDN CONTROL



Monitor
Control
Orchestrate

TRACK YOUR UNCOMPRESSED
MEDIA FLOWS IN REAL-TIME



Thank You!

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IP SHOWCASE THEATRE AT METexpo 17-19 July 2019