

# SDN orchestration across single converged networks for uncompressed and compressed media flows

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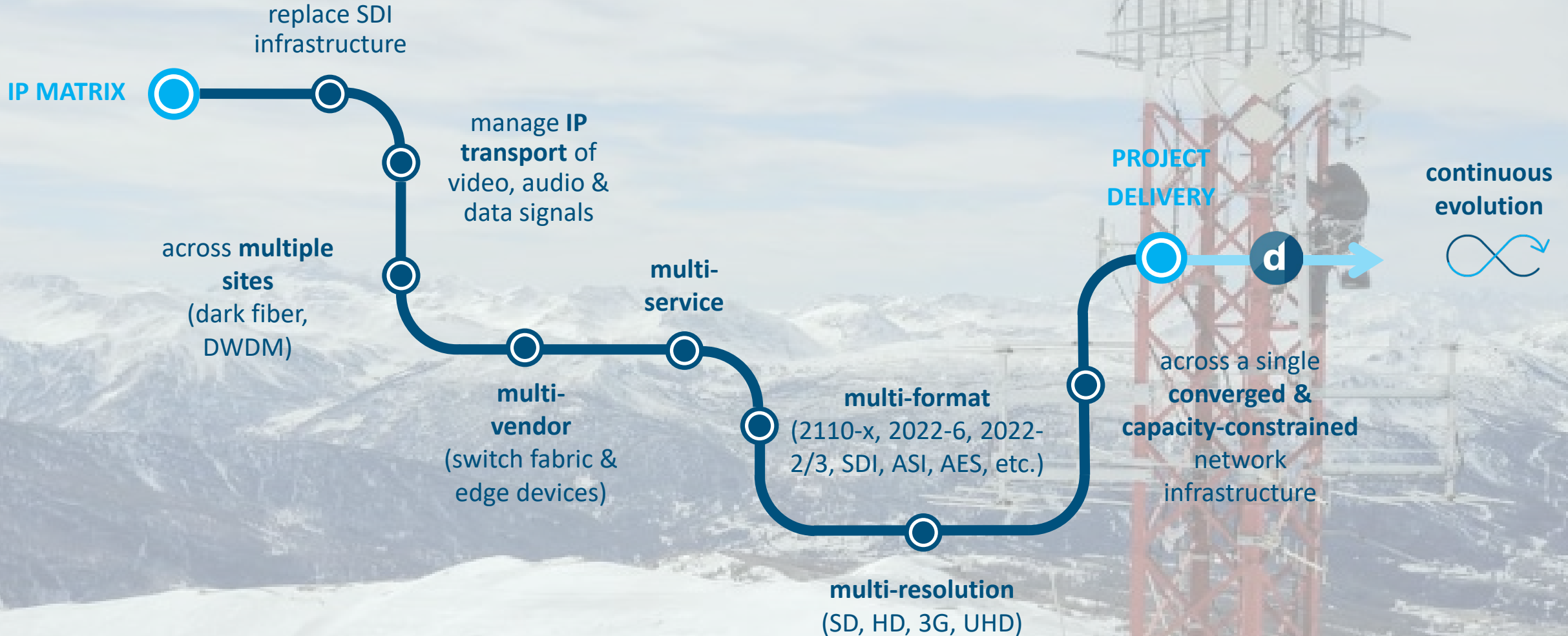
# CASE STUDY – RAI WAY



- Italian state-owned telecommunications and broadcast company
- TV (DVB-T2) and radio (FM, DAB+) transmission services for RAI and local broadcasters
- operates fiber network (6200 km) for contribution and distribution
- 2300+ DTT transmission sites
- DTH satellite infrastructure with footprint in Europe, Middle East and Africa
- multiple NOCs



# THE "IP MATRIX" PROJECT



# CUSTOMER ARCHITECTURE

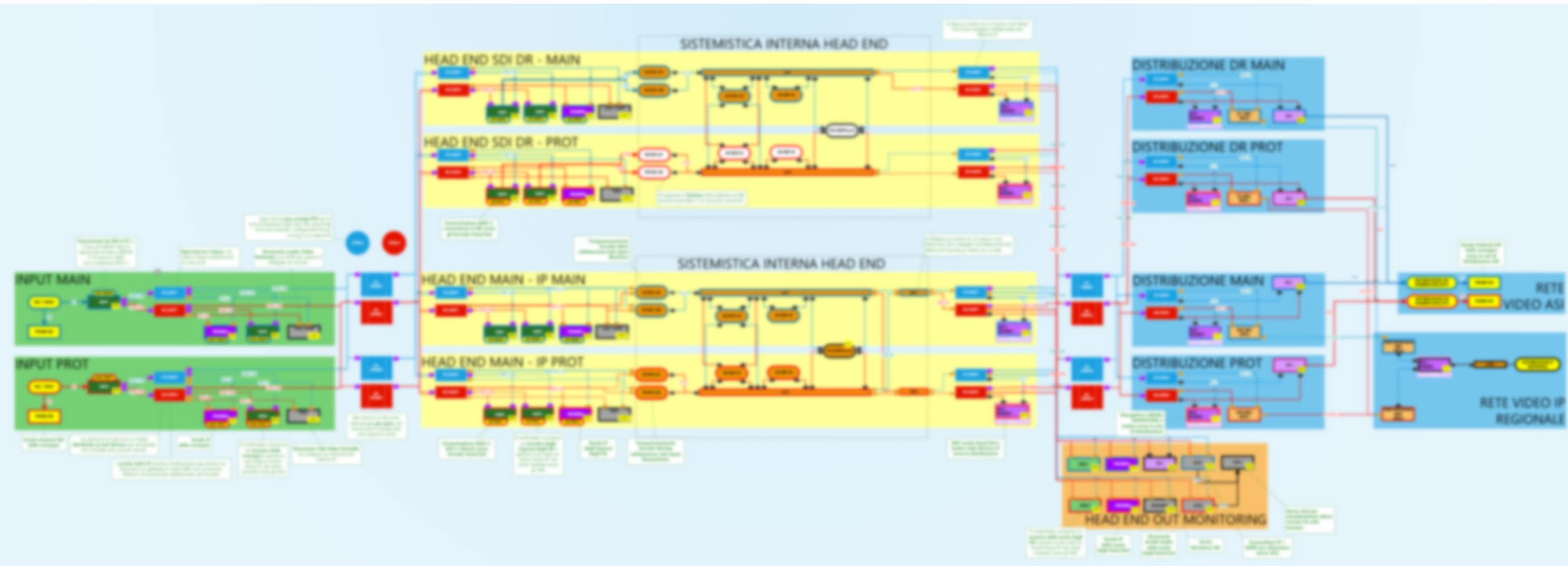


multi-location headends  
(4 x Rome, Milano, Torino)

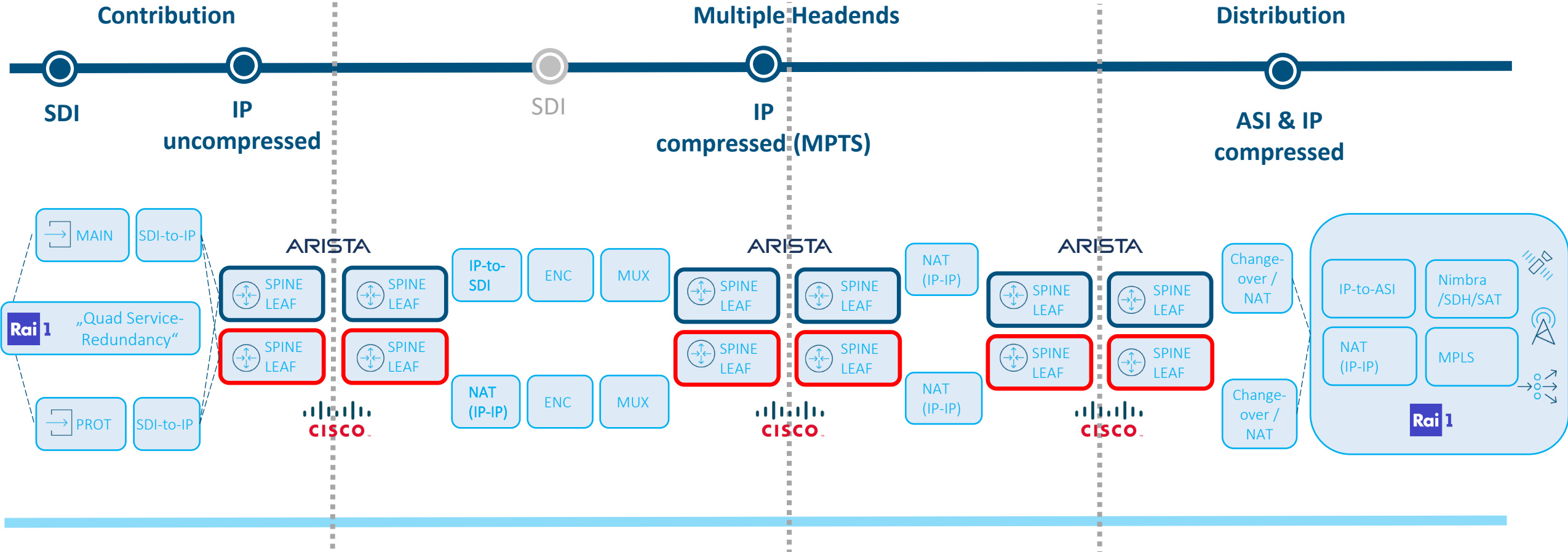
geo-redundant  
data center  
architecture

redundant operations  
(Rome & Milano)

no single point of failure

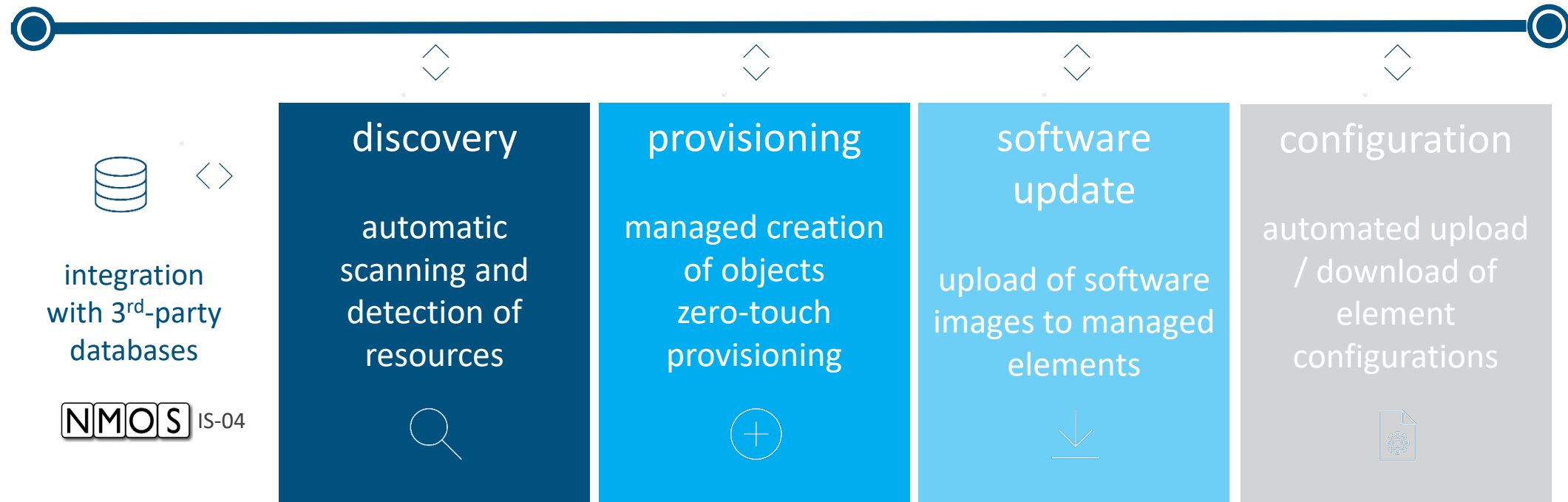


# HIGH-LEVEL ARCHITECTURE



converged **RED & BLUE** network  
non-blocking spine-leaf at each location  
blocking (capacity-constraint) WAN connections

## Infrastructure Discovery & Provisioning (IDP)



# CI-TYPES (CONFIGURATION ITEM)



- defines behavior & properties for each configuration item type
- not limited to switches



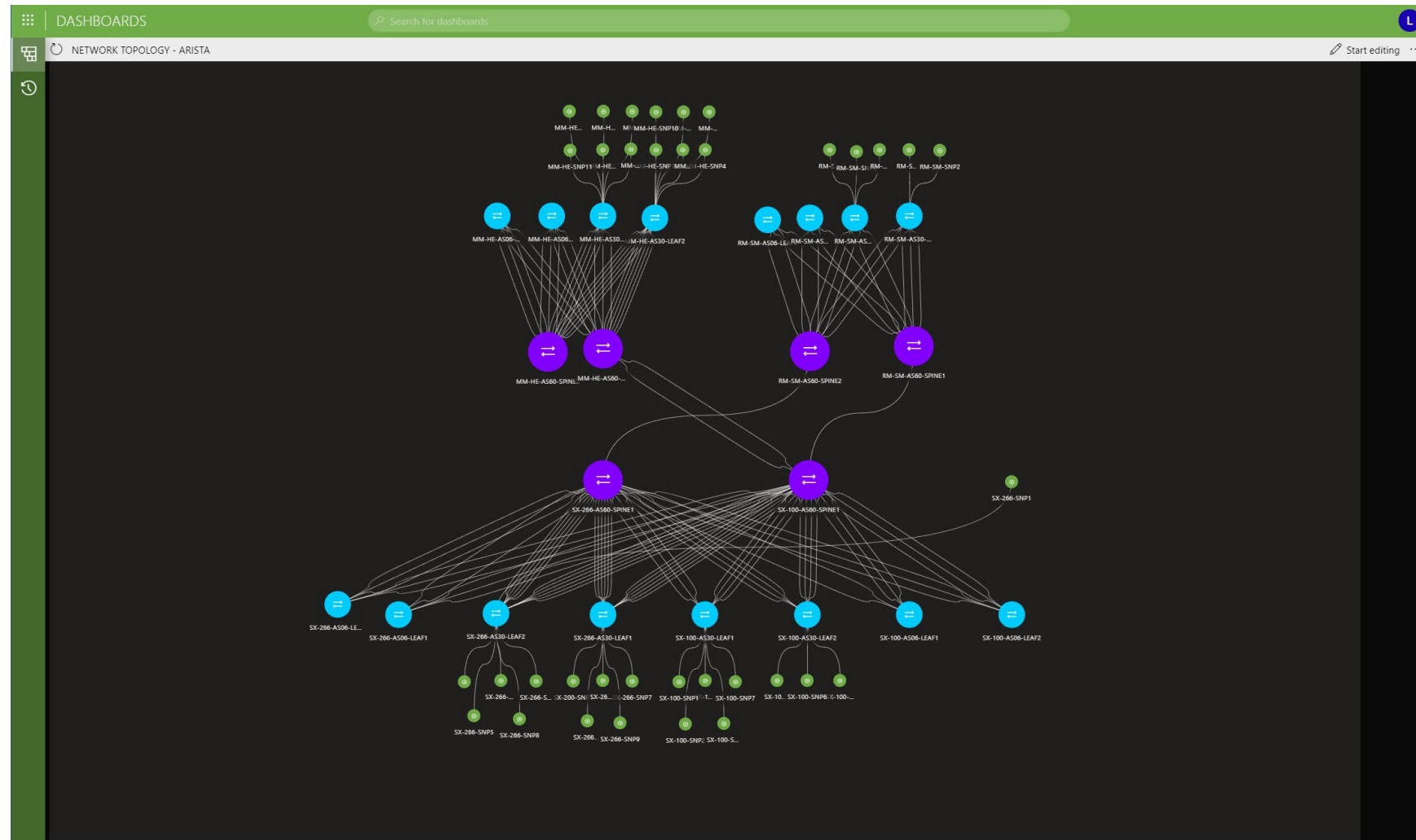
The screenshot shows the DataMiner IDP web interface. The top navigation bar includes 'OVERVIEW', 'INVENTORY', 'CONNECTIVITY', 'CONFIGURATION', 'SOFTWARE', 'FACILITIES', 'PROCESSES', 'ADMIN', and 'ABOUT'. The 'CONFIGURATION' section is expanded to show 'CI TYPES', 'DISCOVERY', 'PROVISIONING', 'CONFIGURATION', 'FACILITIES', and 'SETTINGS'. The main content area displays a table of CI Types with columns for 'CI Type [IDX]' and 'Edit...'. The table lists various device types such as 'AJA IPR-10G2-HDMI', 'Arista Switch', 'Cisco Nexus', 'Digicast DBM-8804', 'Enensys GigaCasterII', 'Enensys IPGuard v2', 'Imagine EPIC - MV', 'Imagine SNP', 'Imagine SNP - MV', 'Imagine SNP Decoder', 'Imagine EPIC MV', 'Magic DAB Encoder', 'Magic DAB MUX', 'Meinberg Lantime M3000', and 'TestTree StreamProbe'. Each row has an 'Edit...' button next to it. The interface also shows a search bar, a filter dropdown, and a status bar at the bottom indicating 'ACTIVE ALARMS: 382 ALARMS (382 UNREAD)'.

CI Type [IDX]	Edit...
AJA IPR-10G2-HDMI	Edit...
Arista Switch	Edit...
Cisco Nexus	Edit...
Digicast DBM-8804	Edit...
Enensys GigaCasterII	Edit...
Enensys IPGuard v2	Edit...
Imagine EPIC - MV	Edit...
Imagine SNP	Edit...
Imagine SNP - MV	Edit...
Imagine SNP Decoder	Edit...
Imagine EPIC MV	Edit...
Magic DAB Encoder	Edit...
Magic DAB MUX	Edit...
Meinberg Lantime M3000	Edit...
TestTree StreamProbe	Edit...

# CONNECTIVITY DETECTION



- automatically detects physical network connectivity
  - Arista: LLDP
  - Cisco: CDP
- option to import connectivity via external topology DB





# AUTO-PROVISIONING / FW / CONFIG



- new elements are automatically added to DataMiner
- connector (w/ version)
- firmware upgrade
- base configuration
- alarm and trend templates

The screenshot displays the DataMiner interface for a managed device, identified as RM-SM-CS12-LEAF1. The interface is divided into several sections:

- Overview:** Shows key performance indicators: Uptime (220 days 17h 17m 38s), Memory Usage (35.8%), and CPU Usage (22%).
- General Information:** Provides system details such as System Description (Cisco NX-OS(tm) nxos.9.3.7.bin, Software (nxos), Version 9.3(7), RELEASE SOFTWARE Copyright (c) 2002-2021 by Cisco Systems, Inc. Compiled 3/10/2021 3:00:00), Serial Number (FDO25070A41), System Name (RM-SM-CS12-LEAF1), and System Location (\*ROMA CPTV - SALA MODEM - rack M8 - RU: 42\*).
- History:** A line graph titled "HISTORY - TOTAL PROCESSOR LOAD - 24 HOURS" showing CPU usage trends over the last 24 hours.
- Fan Status:** Displays the status of four fan modules, all of which are "Up".
- Power Status:** Displays the status of two power supply units, both of which are "Enabled".

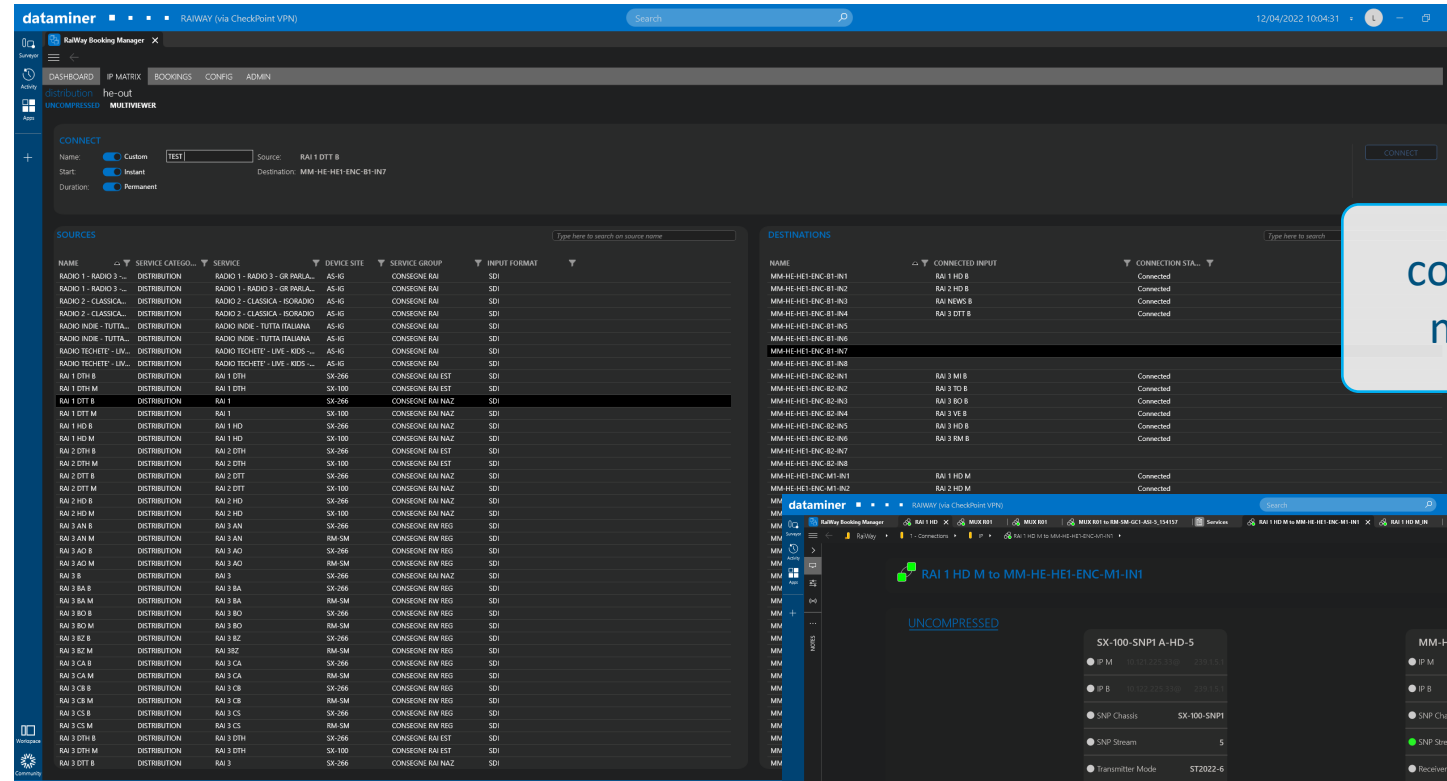
A callout box on the right side of the interface highlights the device as a "managed device (Cisco Nexus)".

# CONNECTION MANAGEMENT



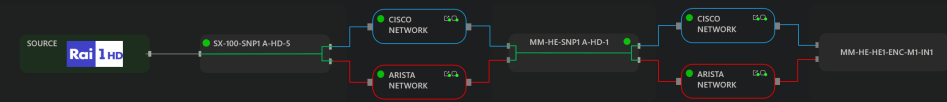
## FOR THE USER

- set up a complete service chain with a few clicks
- support compressed & uncompressed flows on same user interface
- one connection is more than a simple x-point



connection manager

monitored  
2022-7 connection:  
SDI > IP-GW > NAT > ENC



# CONNECTION MANAGEMENT



**CONNECT**

Name:  Default Source: RAI 1 HD B  
Start:  Instant Destination: SX-266-HE3-ENC-M1-IN1  
Duration:  Permanent

**SOURCES**

NAME	SERVICE CATEGO...	SERVICE	DEVICE SITE	SERVICE GROUP	INPUT FORMAT
RAI 1 HD B	DISTRIBUTION	RAI 1 HD	SX-266	CONSEGNE RAI NAZ	SDI
RAI 1 HD M	DISTRIBUTION	RAI 1 HD	SX-100	CONSEGNE RAI NAZ	SDI

**DESTINATIONS**

NAME	CONNECTED INPUT	CONNECTION STATUS	SIGNAL TYPE
SX-266-HE3-ENC-M1-IN1	RAI 1 HD B	Connected	Uncompressed
MM-HE-HE3-ENC-B1-IN1	RAI 1 HD B	Connected	Uncompressed
SX-266-HE3-ENC-M1-IN1	RAI 1 HD B	Connected	Uncompressed
MM-HE-HE2-ENC-B1-IN1	RAI 1 HD B	Connected	Uncompressed
SX-266-HE3-ENC-M1-IN1	RAI 1 HD B	Connected	Uncompressed
MM-HE-HE1-ENC-B1-IN1	RAI 1 HD B	Connected	Uncompressed
SX-266-HE4-ENC-M1-IN1	RAI 1 HD B	Connected	Uncompressed
MM-HE-HE4-ENC-B1-IN1	RAI 1 HD B	Connected	Uncompressed
MM-HE-HE1-ENC-M1-IN1	RAI 1 HD M	Connected	Uncompressed
MM-HE-HE2-ENC-M1-IN1	RAI 1 HD M	Connected	Uncompressed
MM-HE-HE3-ENC-M1-IN1	RAI 1 HD M	Connected	Uncompressed
MM-HE-HE4-ENC-M1-IN1	RAI 1 HD M	Connected	Uncompressed

two multicast flows per source

## RAI1 HD contribution

- ST2022-6
- ST2022-7
- point-to-multipoint connections

from two source sites to three headends (main, backup, DR)

# CONNECTION MANAGEMENT

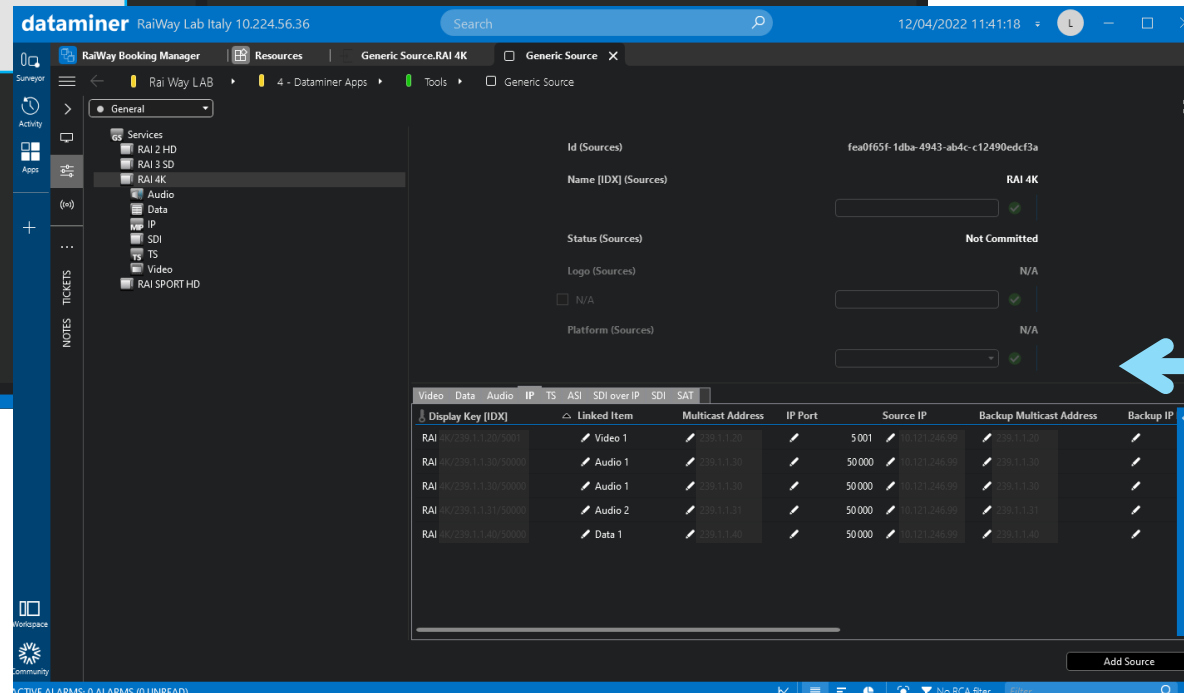
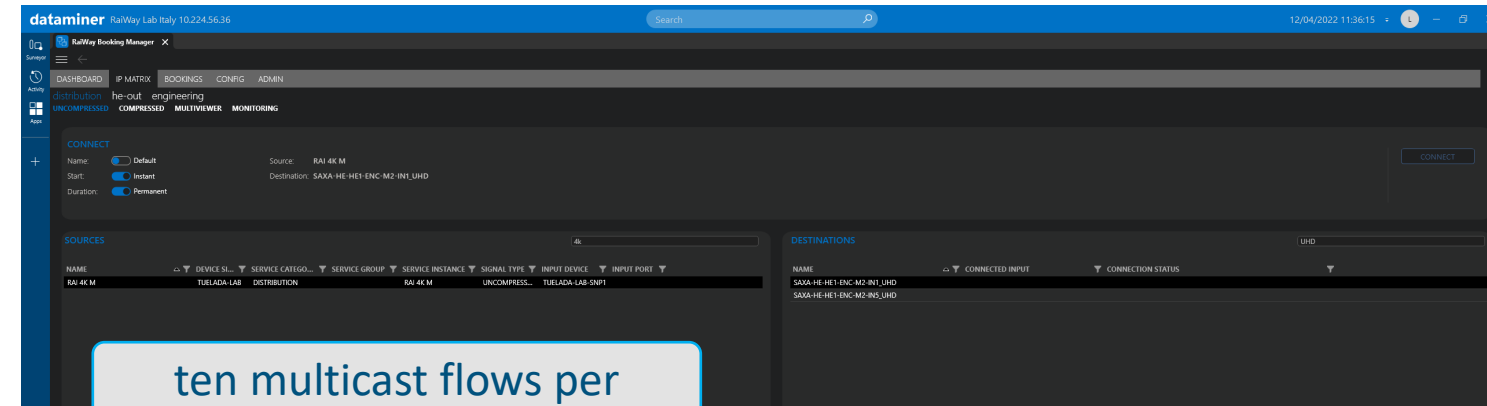


## RAI1 UHD contribution

- ST2110-20
- ST2110-30/-31
- ST2110-40
- ST2022-7

ten multicast flows per source

behind the scenes:  
DataMiner **Virtual Signal Groups** (any format, type, combination, etc.)



# CONNECTION MANAGEMENT



## MUX A distribution

- ST2022-2/3
- ST2022-7
- connect multiple sources (main, protect, DR) to single destination

SOURCES						DESTINATIONS		
NAME	SERVICE CATEGORY	SERVICE	DEVICE SITE	SERVICE GROUP	INPUT FORMAT	NAME	CONNECTED INPUT	CONNECTION STATUS
MM-HE-HES MUX A MAIN	HE-OUT	MUX A	MM-HE	MM-HE-HES	TSolP	MM-HE-HE1 MUX R01 MAIN	MM-HE-HE1 MUX R01 PROT	Connected
MM-HE-HES MUX A PROT	HE-OUT	MUX A	MM-HE	MM-HE-HES	TSolP	MM-HE-HE1 MUX R01 MAIN	MM-HE-HE1 MUX R01 PROT	Connected
SX-100-HE1 MUX A DR MAIN	HE-OUT	MUX A	SX-100	SX-100-HE1	TSolP	MM-HE-HE1 MUX R01 MAIN	MM-HE-HE1 MUX R01 PROT	Connected

two MPTS per source

monitored connection/service:  
3 x MPTS > Change-Over > NAT > ASI

MUX R01 to RM-SM-GC1-ASI-5\_154157

Device	Service	Bitrate
RM-SM-IPG1B TS0	IP1	20 513 kbps
RM-SM-IPG1B TS0	IP2	20 502 kbps



# TIME AWARENESS



- Connections can be:
  - made ad hoc or planned in the future
  - permanent or have an end date
- SDN controller knows current capacity AND future capacity

The screenshot displays the 'dataminer' interface for 'RAI 1 HD'. The top navigation bar includes 'DASHBOARD', 'IP MATRIX', 'BOOKINGS', 'CONFIG', and 'ADMIN'. A filter is set to 'Confirmed/Service Pre-Roll/Service Active/Service Post-Roll/Partial/On-Hold/Cancelled/Failed/Quarantined'. The main area features a 'timeline view' with a green background and a horizontal axis showing dates from 11 apr 2022 to 14 apr 2022. A list of bookings is visible below the timeline, including details like 'BOOKING LIFE C...', 'BLC DESCRIPTION', 'BOOKING NAME', 'SERVICE DEFINITION', 'SERVICE STATE', 'ALARM ST...', 'START TIME', 'END TIME', 'PRE-ROLL', 'POST-ROLL', 'OWNER', and 'CREATED AT'. The bottom status bar shows 'ACTIVE ALARMS: 381 ALARMS (381 UNREAD)' and 'NAME: MUX R10 to RM-SM-GG-ASI-4'.

# HOW DOES IT WORK? – BASICS



## DATAMINER NETWORK MANAGER

- detects input format and **configures sender**
- **calculates most efficient network path** based on:
  - device availability
  - shortest path & lowest cost (Dijkstra)
  - required & available bandwidth for the scheduled time
- sets **static multicast routes** and **flow policies** on each switch (running in passive mode)
- **configures receiver**

### full SDN control

over hybrid Arista & Cisco network

prevent network oversubscription

supports NMOS IS-05 & vendor-specific APIs



# HOW DOES IT WORK? – ADVANCED



## DATAMINER NETWORK MANAGER

- sets **diverse paths** for main, protect and DR flows
- routes flows that belong to one source on the same network paths (customer rule)
- knows about device limitations (e.g. licensed bandwidth per device, interface bandwidth)
- manages NATing functions & change-over units
- controls multiviewers
- adds multiple A/V probes to each service
- comes with comprehensive **service-aware monitoring**

### full SDN control

over hybrid Arista & Cisco network

prevent network oversubscription

supports NMOS IS-05 & vendor-specific APIs

# MONITORING



## CONTROL & MONITORING GO TOGETHER

- automatically starts monitoring services & connections
- dynamically creates comprehensive service visuals and dashboards across compressed (MUX) and uncompressed connections

The screenshot displays the 'dataminer' interface for 'RailWay Booking Manager'. The main area is a grid of service feeds. A callout box highlights the 'MUX R04' row, indicating that the dashboard provides details for this MUX and its contributing feeds.

MUX	RAI 3 DTH	RAI GULP	RAI MOVIE	RAI PREMIUM	RAI SPORT + HD	RAI STORIA	RAI YOYO	
MUX A								
MUX B	RAI 1 DTT	RAI 2 DTT	RAI 3 HD	RAI 4	RAI 5	RAI SCUOLA	RAI SPORT	RTV SAN MARINO
MUX R01	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 BO	RAI 3 MI	RAI 3 TO	
MUX R02	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 BZ	RAI 3 SDT	RAI 3 TN	
MUX R03	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 CB	RAI 3 PE	RAI 3 RM	
MUX R04	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 FI	RAI 3 PG	RAI 3 RM	
MUX R05	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 BA	RAI 3 CB	RAI 3 PZ	
MUX R06	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 VE	RAI 3 BO	RAI 3 MI	
MUX R07	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 TS	RAI 3 AO	RAI 3 SLV	
MUX R08	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 CA	RAI 3 FI	RAI 3 GE	
MUX R09	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 AN	RAI 3 PE	RAI 3 PG	
MUX R10	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 CS	RAI 3 PA	RAI 3 PZ	
MUX R11	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RAI 3 CS	RAI 3 NA	RAI 3 PZ	
MUX R12	RAI 1 HD	RAI 2 HD	RAI NEWS	RAI 3 HD	RETE ORO			
MUX LAZIO-RETE ORO	RAI 3 RM	RETE ORO						
TS RAI 3 DTT	RAI 3 DTT							

**Service Dashboard (MUX & all contributing feeds per MUX)**  
drill down to more details

ACTIVE ALARMS: 381 ALARMS (381 UNREAD) | 1 Timeout | 27 Major | 351 Minor | 2 Warning

- RaiWay Booking Manager
- RAI 1 HD
- Surveyor
- Activity
- Visual
- Data
- RAI 1 HD B to N
- Arista Transp
- Cisco Transp
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transp
- Cisco Transp
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transp
- Cisco Transp
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transp
- Cisco Transp
- Generic Dest
- Source HE
- RAI 1 HD B to S
- Generic Dest
- Source HE
- RAI 1 HD B to S
- Generic Dest
- Source HE
- RAI 1 HD B to S
- RAI 1 HD B to S
- RAI 1 HD B\_MM
- RAI 1 HD\_B\_MM
- RAI 1 HD\_B\_MM
- RAI 1 HD\_B\_MM
- RAI 1 HD\_B\_MM
- RAI 1 HD\_B\_SX
- RAI 1 HD\_B\_SX
- RAI 1 HD\_B\_SX
- RAI 1 HD\_B\_SX
- RAI 1 HD\_B\_SX
- RAI 1 HD M to
- RAI 1 HD M to
- RAI 1 HD M to
- RAI 1 HD M to
- RAI 1 HD M\_MM
- RAI 1 HD M\_MM
- RAI 1 HD M\_MM
- RAI 1 HD M\_MM

### RAI 1 HD



#### MAIN SOURCES

SERVICE RAI 1 HD M

#### MAIN DESTINATIONS

MM-HE-HE1-ENC-M1-IN1

MM-HE-HE2-ENC-M1-IN1

MM-HE-HE3-ENC-M1-IN1

MM-HE-HE4-ENC-M1-IN1

#### BACKUP SOURCES

SERVICE RAI 1 HD B

#### BACKUP DESTINATIONS

MM-HE-HE1-ENC-B1-IN1

MM-HE-HE2-ENC-B1-IN1

MM-HE-HE3-ENC-B1-IN1

MM-HE-HE4-ENC-B1-IN1

**RAI1 HD Summary**

contribution uncompressed

multiple ST2022-6/7 connections

# RAI 1 HD M to MM-HE-HE1-ENC-M1-IN1

UNCOMPRESSED



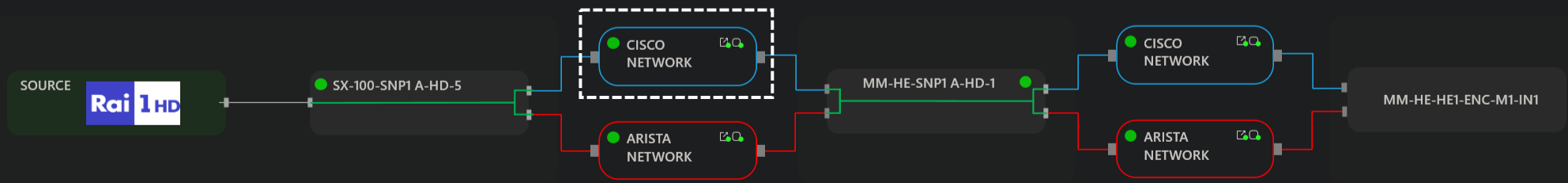
**RAI1 HD**  
**single ST2022-6/7**  
**connection**

SDI > SDI-to-IP GW >  
 NAT > ENC

SX-100-SNP1 A-HD-5	
● IP M	10.121.225.33@ 239.1.5.1
● IP B	10.122.225.33@ 239.1.5.1
● SNP Chassis	SX-100-SNP1
● SNP Stream	5
● Transmitter Mode	ST2022-6
● Video Input	Present
● Input Video Standard	1080i/50
● Input Frozen Status	OK

MM-HE-SNP1 A-HD-1	
● IP M	10.121.225.33@ 239.1.5.1
● IP B	10.122.225.33@ 239.1.5.1
● SNP Chassis	MM-HE-SNP1
● SNP Stream	1
● Receiver Mode	ST2022-6
● Video Input	Present
● Input Video Standard	1080i/50
● Input Frozen Status	OK
● Switch Status	Ready
● Seamless Status	Present

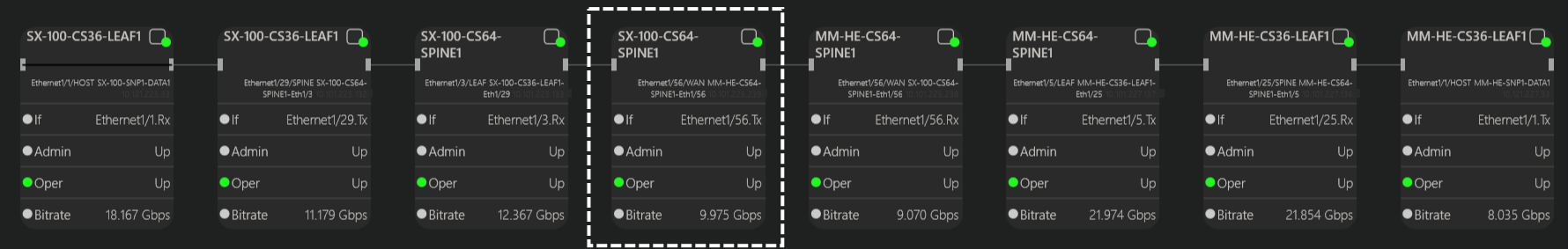
**RAI1 HD**  
**HEADEND**  
**CONTRIBUTION**  
**ST2022-6 / ST2110**



# RAI 1 HD M\_MM-HE-HE1-ENC-M1-IN1\_HE\_Cisco Network Transport



## NETWORK



**Cisco Nexus**

calculated path across two spine-leaf networks between two sites



The screenshot shows the dataminer interface for a specific Cisco Nexus switch. The top part of the interface displays various system metrics and status indicators. Below this, there is a detailed configuration table for the switch's interfaces.

Description	Admin Description	Name	Physical Address	Type	Operational Status	Administrative Status	Bandwidth	Utilization	Utilization Percent	MTU	Last Change	duplex Status	0 Packets To Errors	0 Packets To Discards	0 Packets To Drops	0 Packets To Errors	0 Packets To Discards	0 Packets To Drops
Ethernet1/1	HOST SX-100-SNIP1-DATA1	Ethernet1/1	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/29	SPINE SX-100-CS64-SPINE1-Eth1/29	Ethernet1/29	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/3	LEAF SX-100-CS36-LEAF1-Eth1/3	Ethernet1/3	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/56	WAN MM-HE-CS64-SPINE1-Eth1/56	Ethernet1/56	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/56	WAN SX-100-CS64-SPINE1-Eth1/56	Ethernet1/56	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/5	LEAF MM-HE-CS36-LEAF1-Eth1/5	Ethernet1/5	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/25	SPINE MM-HE-CS64-SPINE1-Eth1/25	Ethernet1/25	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...
Ethernet1/1	HOST MM-HE-SNIP1-DATA1	Ethernet1/1	...	...	Up	...	...	...	...	...	...	...	...	...	...	...	...	...

# RAI 4K M to SAXA-HE-HE1-ENC-M2-IN1\_UHD



UNCOMPRESSED

RAI UHD  
ST-2110

**TUELADA-LAB-SNP1 C-UHD-1**

- IP M 10.121.246.99@ 239.1.1.20
- IP B 10.122.246.99@ 239.1.1.20
- SNP Chassis TUELADA-LAB-SNP1
- SNP Stream 17
- Transmitter Mode ST2110-20
- Video Input Present
- Input Video Standard 2160p/50
- Input Frozen Status OK



**Audio 2**

- IP M WAN 1@ 239.1.1.31
- IP B WAN 1@ 239.1.1.31
- Transmitter Mode ST2110-31
- Bit 32 bits
- Number of Channels 2

**Data 1**

- IP M WAN 1@ 239.1.1.40
- IP B WAN 1@ 239.1.1.40

**SAXA-LAB-SNP1 D-UHD-1**

- IP M 10.121.246.99@ 239.1.1.20
- IP B 10.122.246.99@ 239.1.1.20
- SNP Chassis SAXA-LAB-SNP1
- SNP Stream 25
- Receiver Mode ST2110-20
- Video Input Present
- Input Video Standard 2160p/50
- Input Frozen Status OK
- Switch Status Ready
- Seamless Status Present



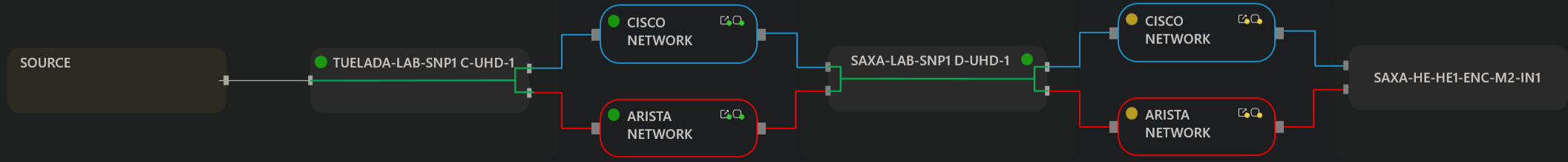
**Audio 2**

- IP M 10.121.246.99@ 239.1.1.31
- IP B 10.122.246.99@ 239.1.1.31
- Receiver Mode ST2110-31
- Bit 32 bits
- Seamless Status Present

**Data 1**

- IP M 10.121.246.99@ 239.1.1.40
- IP B 10.122.246.99@ 239.1.1.40
- Receiver Mode Present

comes with more detailed view per flow



- Surveyor
- Activity
- Apps
- DATA
  - MUX R04 DR\_RM
  - MUX R04 DR\_SX
  - MUX R04 MAIN
  - MUX R04 PROT
  - MUX R04 to RM
  - MUX R04 to RM
  - MUX R04 to RM
  - MUX R04 to RM
  - MUX R04 to SX
  - MUX R04 to SX
  - MUX R04 to SX
- ALARMS 1
- REPORTS
- DASHBOARDS
- DOCUMENTS
- NOTES
- ANNOTATIONS

### MUX R04



#### MAIN SOURCES

SERVICE MUX R04 MAIN

#### RM-SM DESTINATIONS

RM-SM RM-SM RM-SM-GC5-ASI-2

RM-SM RM-SM RM-SM-GC6-ASI-2

RM-SM RM-SM RM-SM-GC7-ASI-2

RM-SM RM-SM RM-SM-GC8-ASI-2

#### BACKUP SOURCES

SERVICE MUX R04 BU

#### SX-266 DESTINATIONS

SX-266 SX-266 SX-266-GC6-ASI-2

SX-266 SX-266 SX-266-GC7-ASI-2

SX-266 SX-266 SX-266-GC8-ASI-2

#### DR SOURCES

SERVICE MUX R04 DR

SERVICE MUX R04 DR

#### REGIONAL SITES DESTINATIONS

**MUX R04 Summary**

Main + Protect + DR

multiple MPTS connections

ALARMS 1

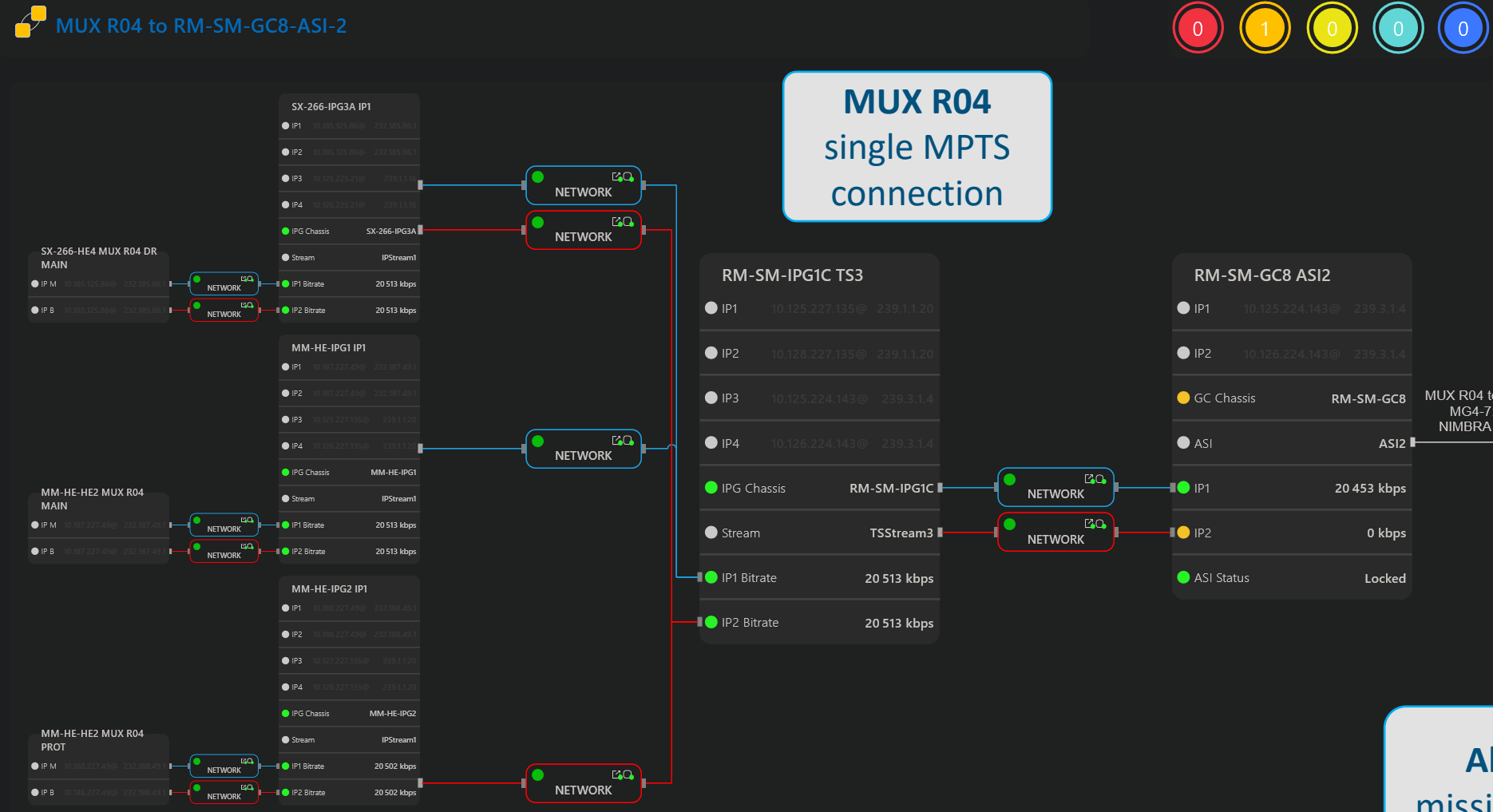
REPORTS

DASHBOARDS

DOCUMENTS

NOTES

ANNOTATIONS



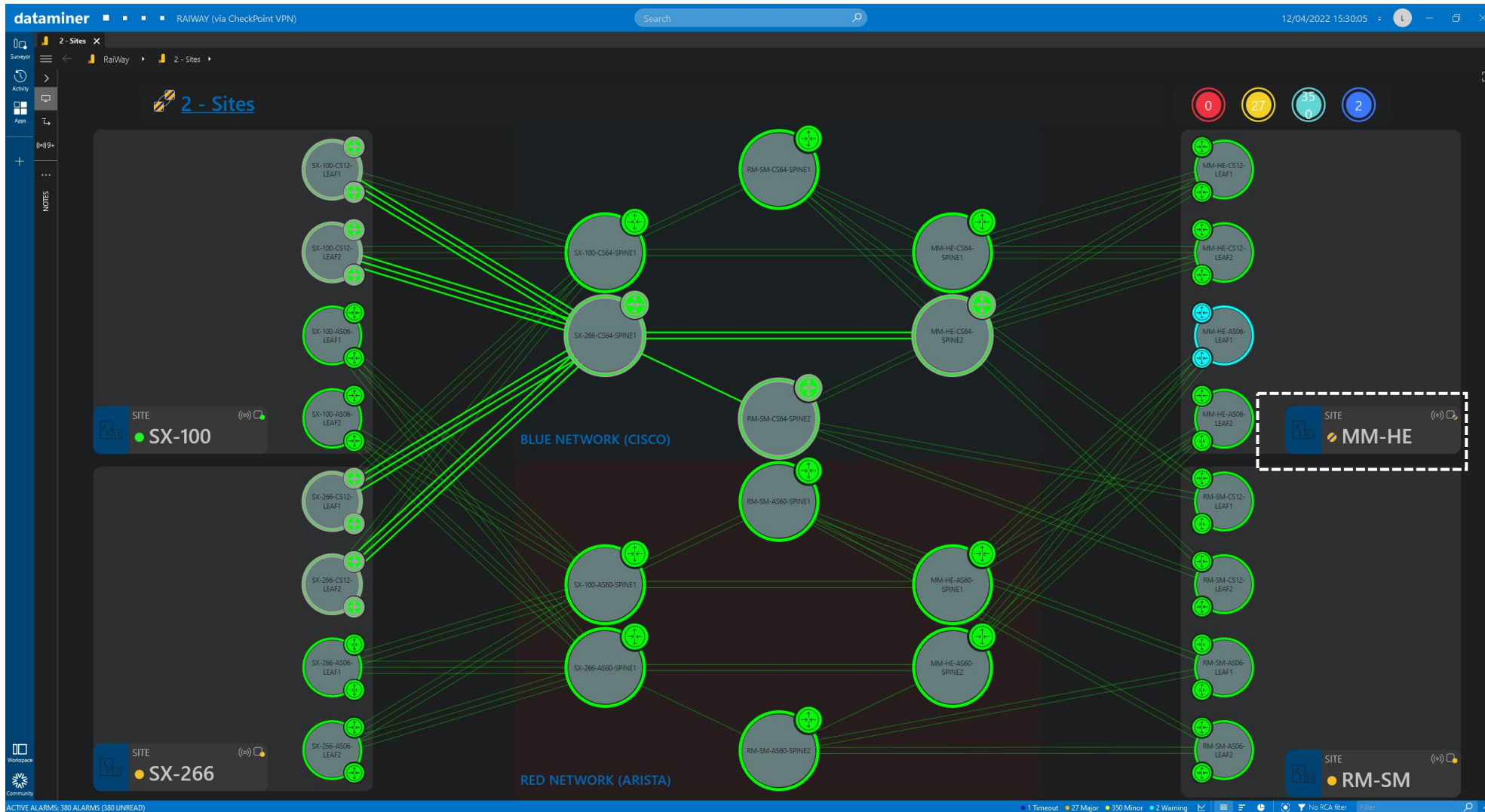
**MUX R04**  
single MPTS  
connection

**Alarm:**  
missing input  
stream on  
GigaCaster

ELEMENT NAME	PARAMETER DESCRIPTION	VALUE	TIME	ROOT TIME	SEVERITY	SERVICE IMP...	SERVICES	RCA LEVEL	ALARM TYPE	OWNER
RM-SM-GC8	Redundant Bitrate IP (IP to ASI Stats) 2	0 kbps	14/03/2022 16:47:12	14/03/2022 12:07:53	Major Low	2	MUX R04, MUX R04 to RM-SM-GC8...	None.None.None	Properties	...



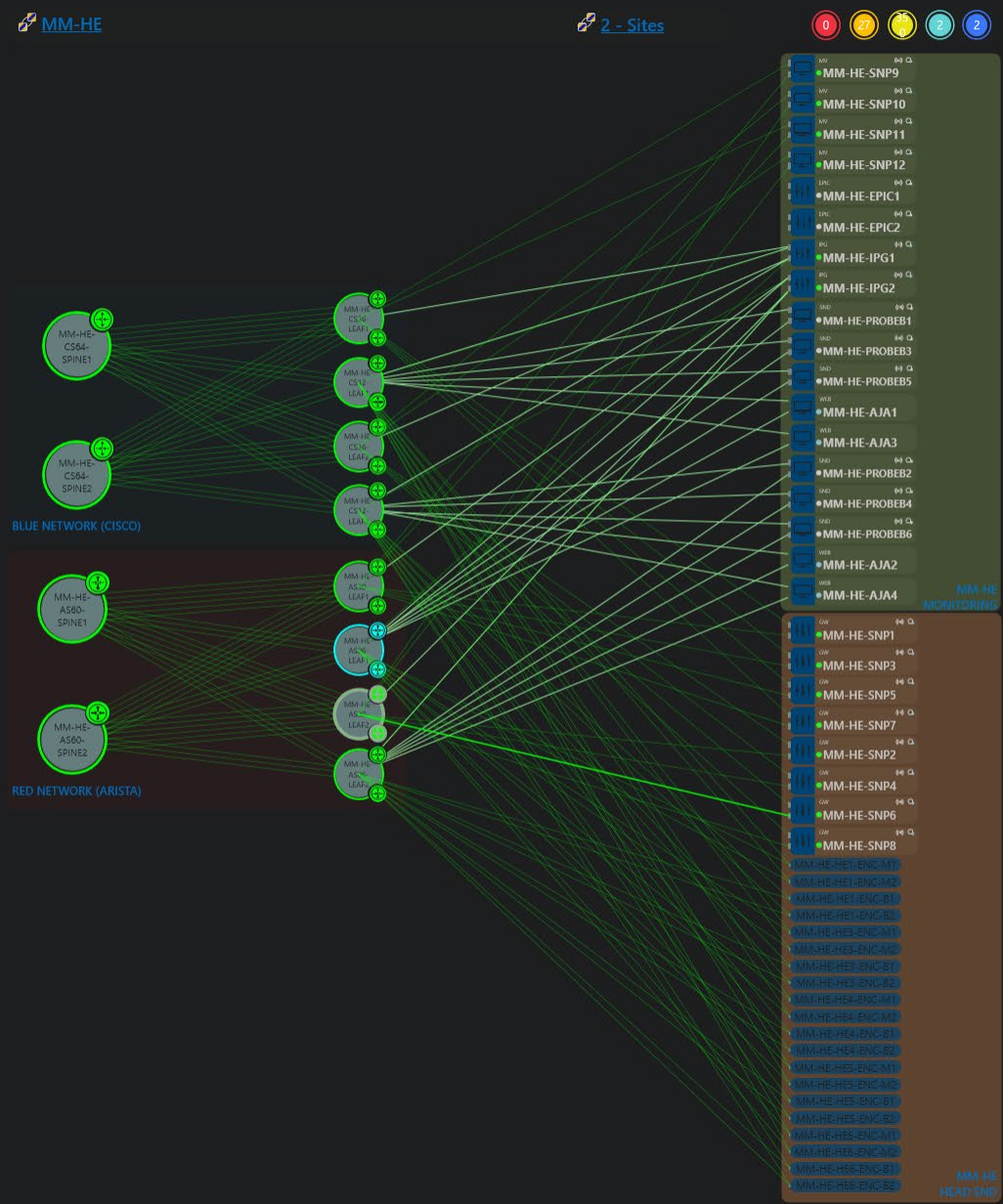
# NETWORK MONITORING - DETAILS



WAN connectivity

- path highlighting
- alarm aggregation

# Monte Mario Headend



### Connection Details

**MM-HE-SNP6**

- Name: WAN 1 Secondary
- Type: Secondary
- IP Address: 10.124.227.37
- Prim Tx: 8.05 Gbps
- Sec Tx: 8.05 Gbps

**MM-HE-AS30-LEAF2**

- Name: Ethernet3/1
- Oper Status: Up
- Tx: 8.068 Gbps
- Rx: 8.068 Gbps

# VIRTUAL SOURCES



- virtual sources get created after every device
- route to probes & multiviewers

SOURCES					DESTINATIONS		
Type here to search on source name					Type here to search		
NAME	DEVICE SITE	SERVICE Catego...	SERVICE GROUP	SERVICE INSTANCE	NAME	CONNECTED INPUT	CONNECTION STATUS
RAI 2 HD M_IN	TUELADA-LAB				SAXA-LAB-SNP2-PIP01	RAI 2 HD M_IN	Connected
RAI 2 HD M_SAXA-HE-HE1-ENC-M1-IN1_HE	SAXA-HE-HE1-ENC-M1-IN1				SAXA-LAB-SNP2-PIP02	RAI 2 HD M_SAXA-HE-HE1-ENC-M1-IN1_...	Connected
					SAXA-LAB-SNP2-PIP03		
					SAXA-LAB-SNP2-PIP04		
					SAXA-LAB-SNP2-PIP05		
					SAXA-LAB-SNP2-PIP06		
					SAXA-LAB-SNP2-PIP07		
					SAXA-LAB-SNP2-PIP08		

- multi-point probing

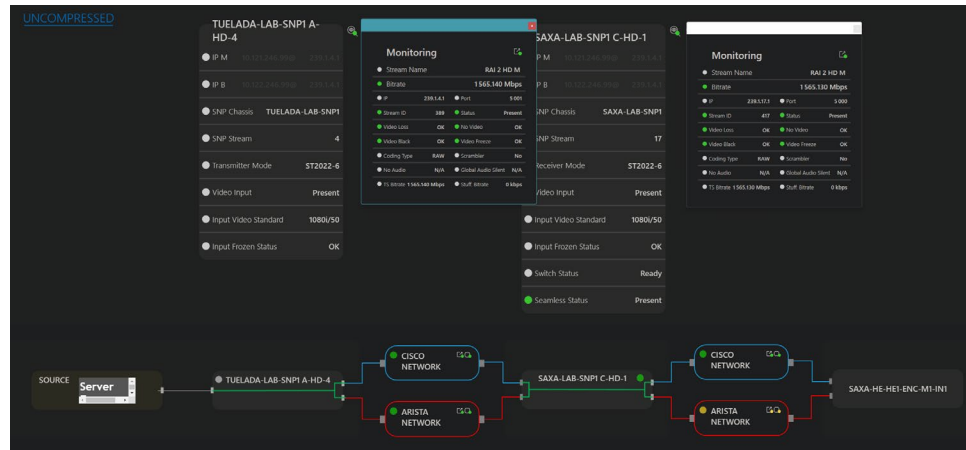


**SAXA-LAB-PROBES.Monitoring (TestTree StreamProbe).1**

**General Info**

- Stream ID: 422
- Status: Present
- IP: 10.125.227.135@239.1.1.1
- Port: 5 000
- Bit Rate: 20.726 Mbps
- TS Bit Rate: 19.909 Mbps
- Video Loss: OK
- No Video: OK
- Stream Name: MUX A MAIN
- Stream Type: MPEG-2 Transport Stream
- No Audio: OK
- Global Audio Silent: OK
- IP Bit Rate: 20.726 Mbps
- Stuffing Bit Rate: 755 kbps
- Video Black: OK
- Video Freeze: OK

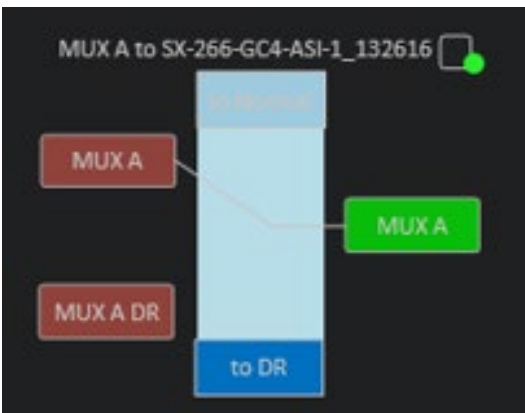
Instance (...)	Channel Name (Pr...	Qualified Progra...	Service...	Status (Progra...	Provider (Prog...	Type (Program...	PMT PID (Prog...	PID Count (Pr...	Video PID Count (Pr...	Audio PID Count (Pr...	No Video (Pro...	No Audio (Pr...	PMT Repetition
422.1005	Rai YoYo	No	1 005	Active	Rai	H264 SD DTV	105	7	1	2	OK	OK	15
422.1004	Rai Gulp	No	1 004	Active	Rai	H264 SD DTV	104	7	1	2	OK	OK	15
422.1002	Rai Movie	No	1 002	Active	Rai	H264 SD DTV	102	8	1	3	OK	OK	15
422.1001	Rai Sport + HD	No	1 001	Active	Rai	HD DTV	101	7	1	2	OK	OK	15
422.1006	Rai Premium	No	1 006	Active	Rai	H264 SD DTV	106	8	1	3	OK	OK	15
422.1003	Rai 3 SD	No	1 003	Active	Rai	DTV	103	7	1	2	OK	OK	15
422.1007	Rai Storia	No	1 007	Active	Rai	H264 SD DTV	107	6	1	1	OK	OK	15



# DISASTER RECOVERY / MAINTENANCE



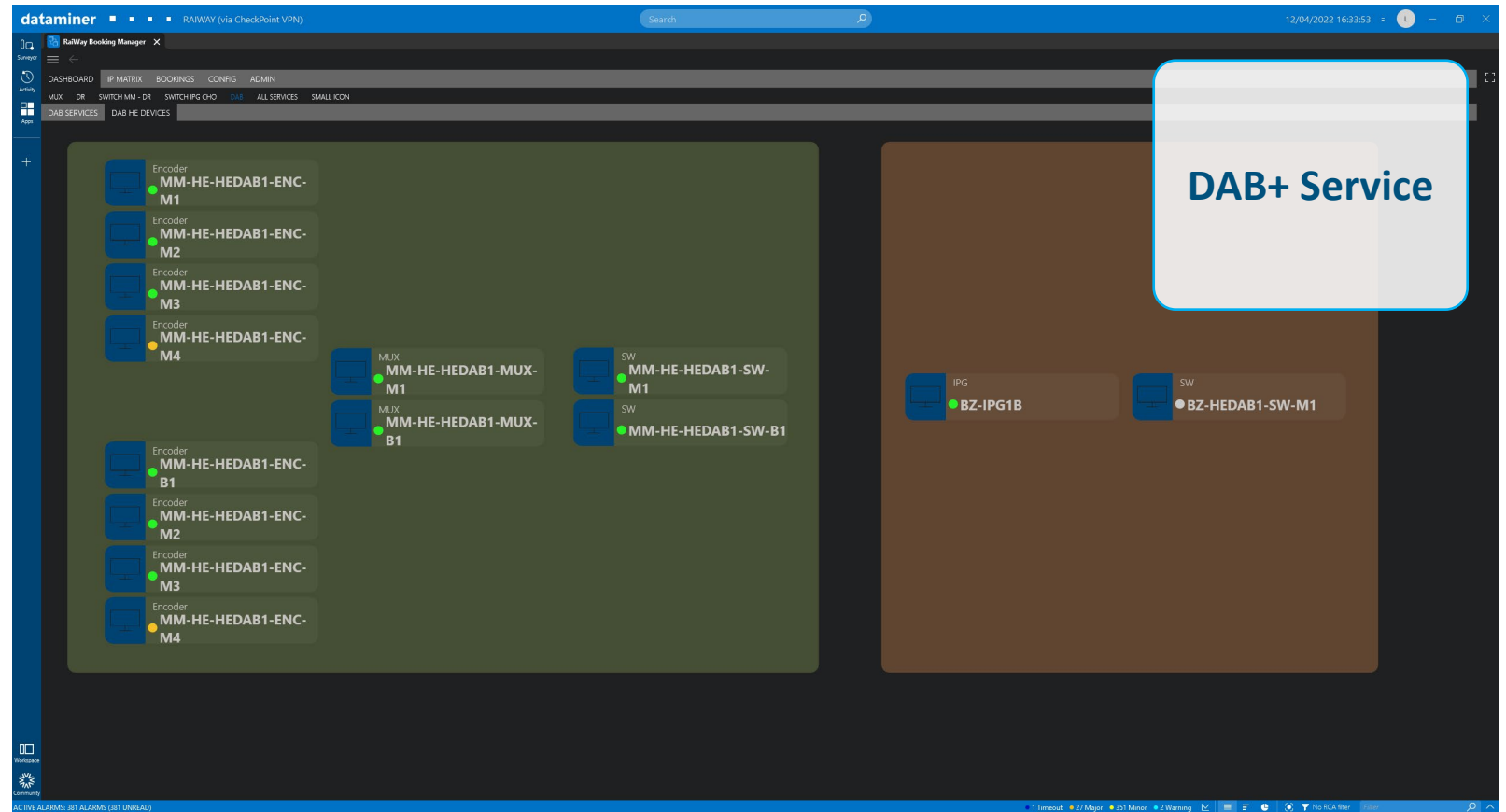
- e.g. switch ALL COMPRESSED FEEDS to DR site with a couple of clicks (free up one headend)



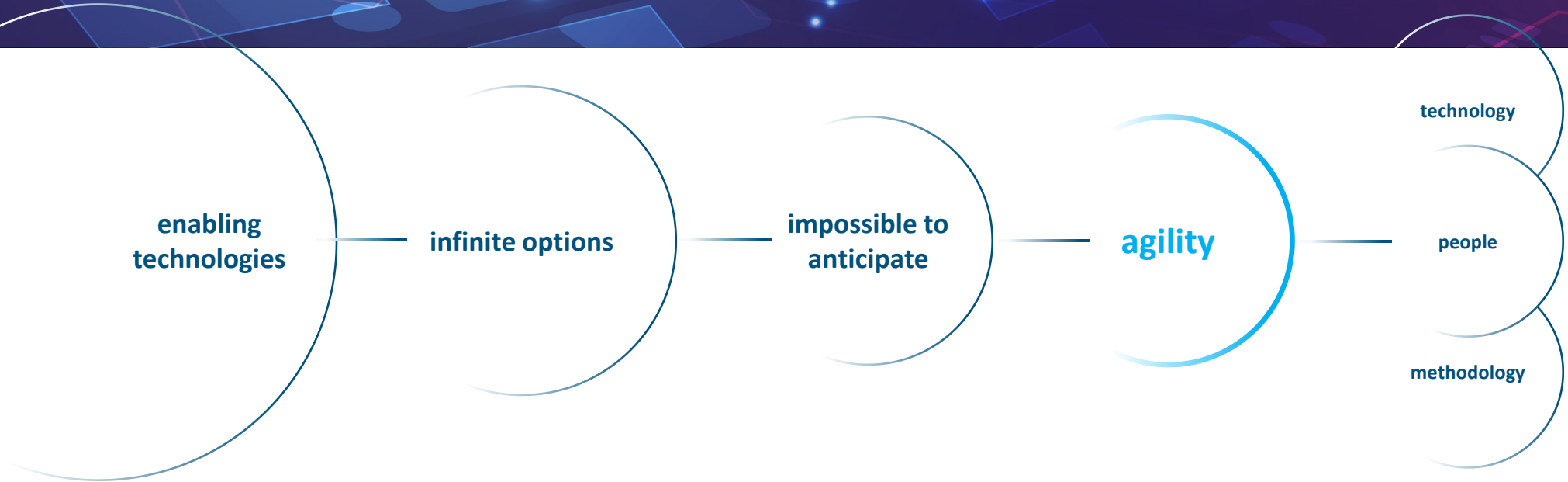
# What's next?



- expand system to manage DAB services
- add more UHD channels
- full headend management / IP migration
- transmitter site monitoring with IoT sensors / 5G



# LESSONS LEARNED



- Cisco / Arista fabrics & media edge devices behave differently
- all teams need to deal with new (and still buggy) devices & changing APIs, you cannot wait for all fixes
- a properly managed lab system is a must to test all details and constantly evolve the system
- close relationship to all parties involved is essential (Skyline, tech partners, system integrator, end customer)
- complex projects can only be managed in an agile & DevOps style

# Thank You ..... Or ..... Any Questions?

Thomas Gunkel



**IP SHOWCASE**