

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

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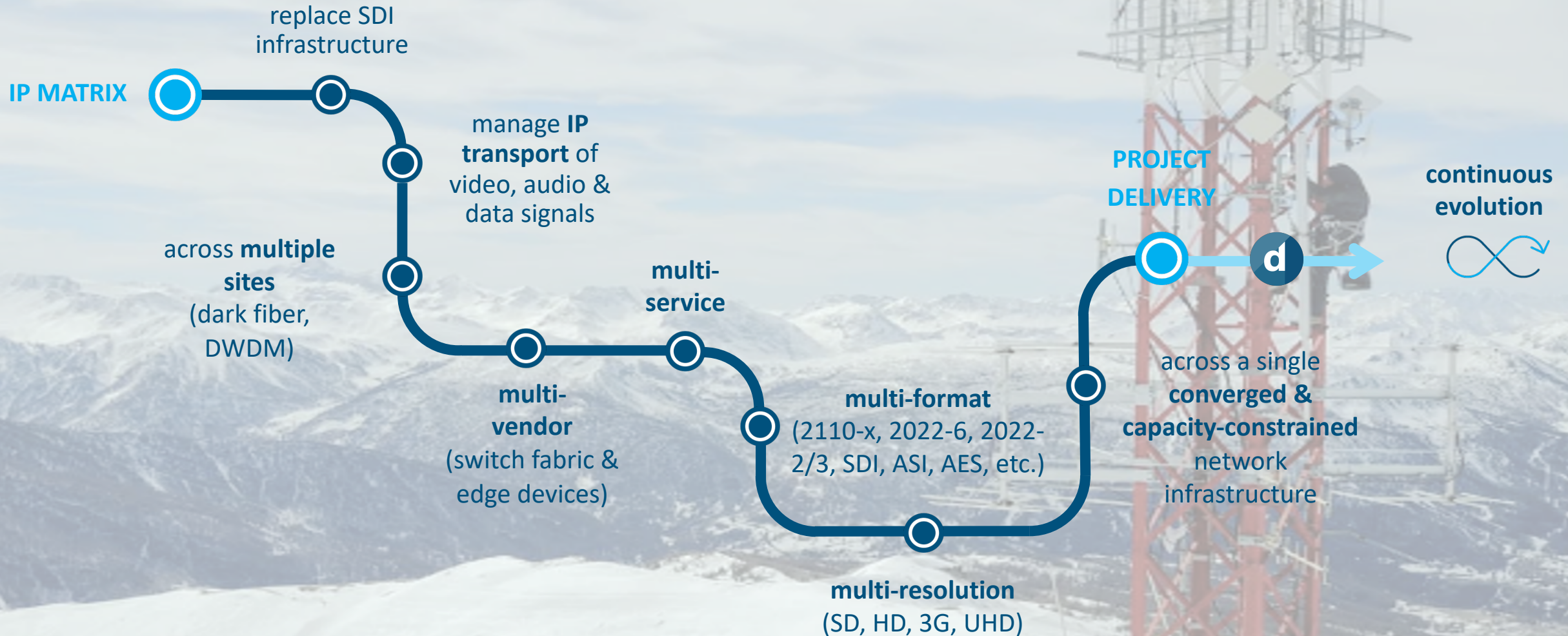
CASE STUDY – RAI WAY



- 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

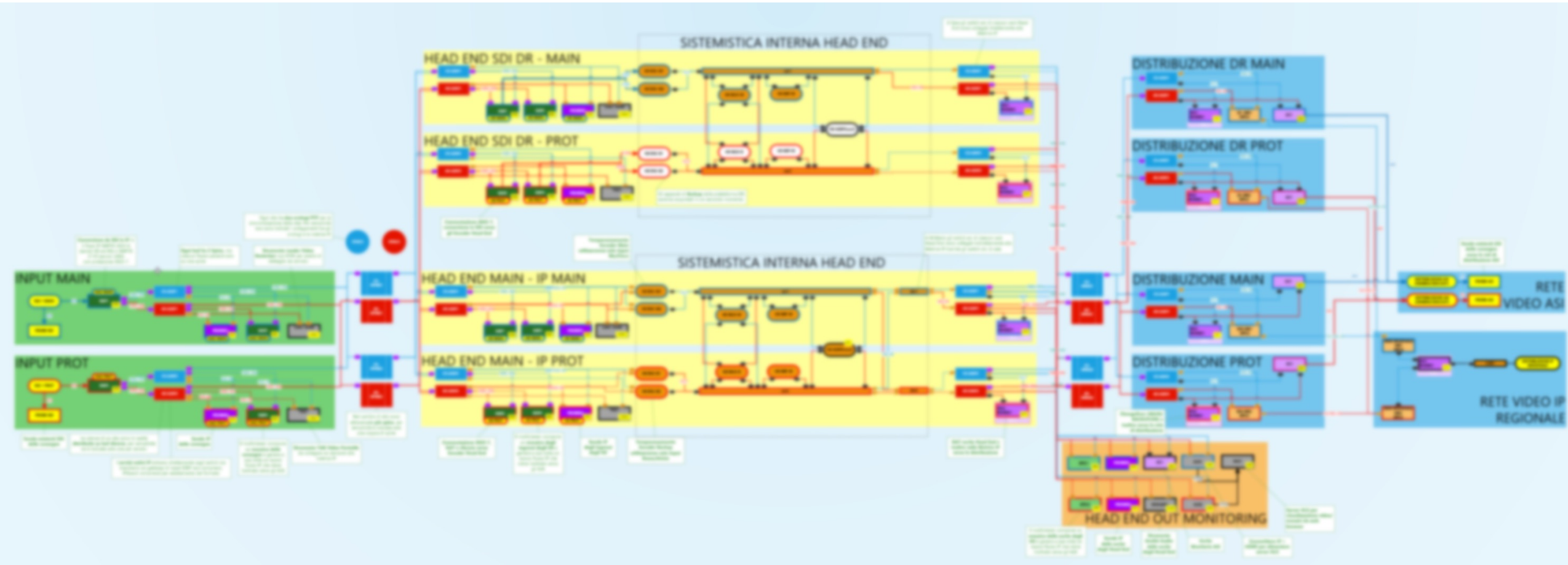


multi-location headends
(4 x Rome, Milano, Torino)

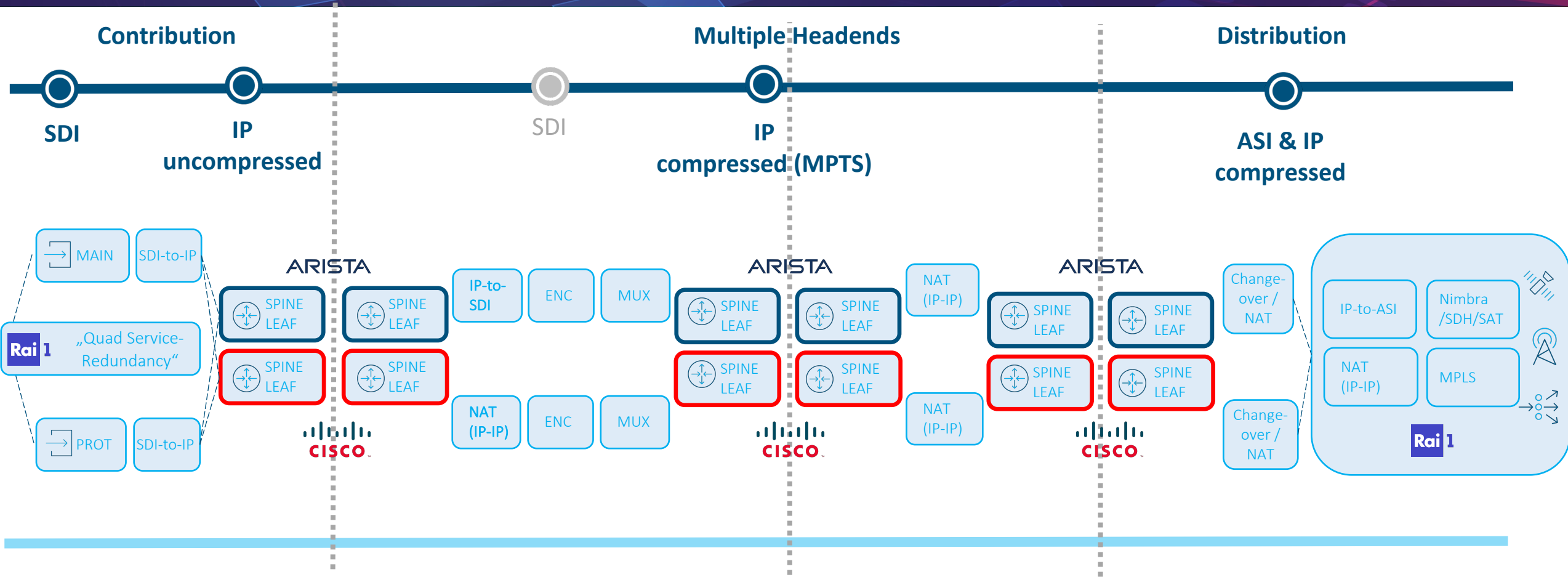
geo-redundant
data center
architecture

redundant operations
(Rome & Milano)

no single point of failure

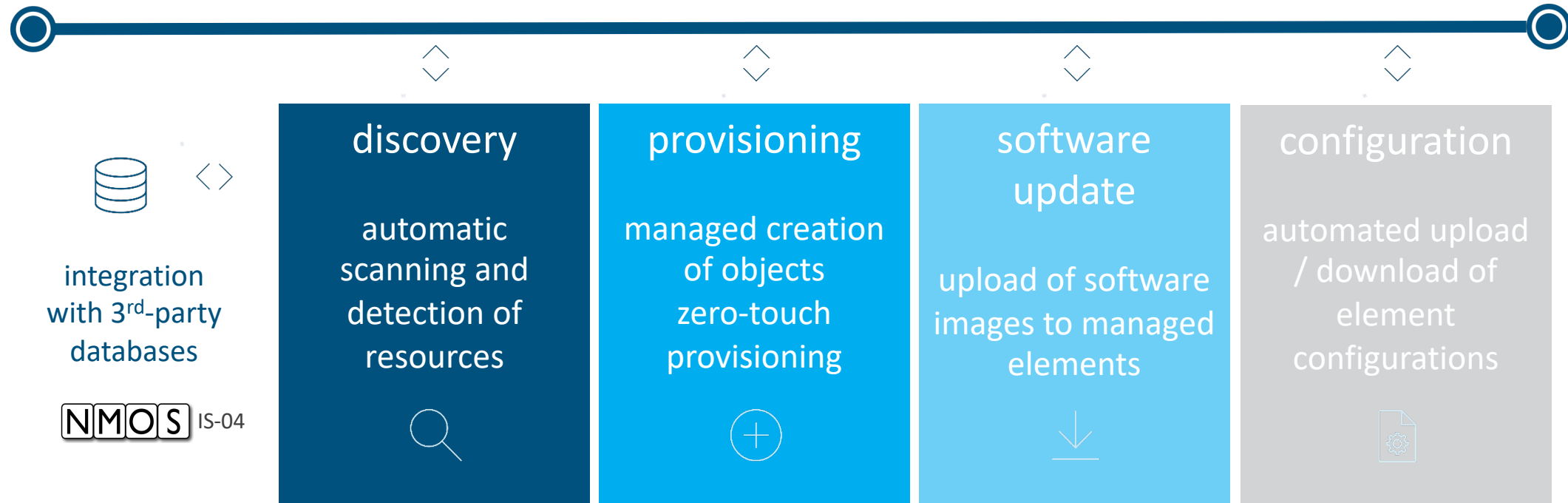


HIGH-LEVEL ARCHITECTURE



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



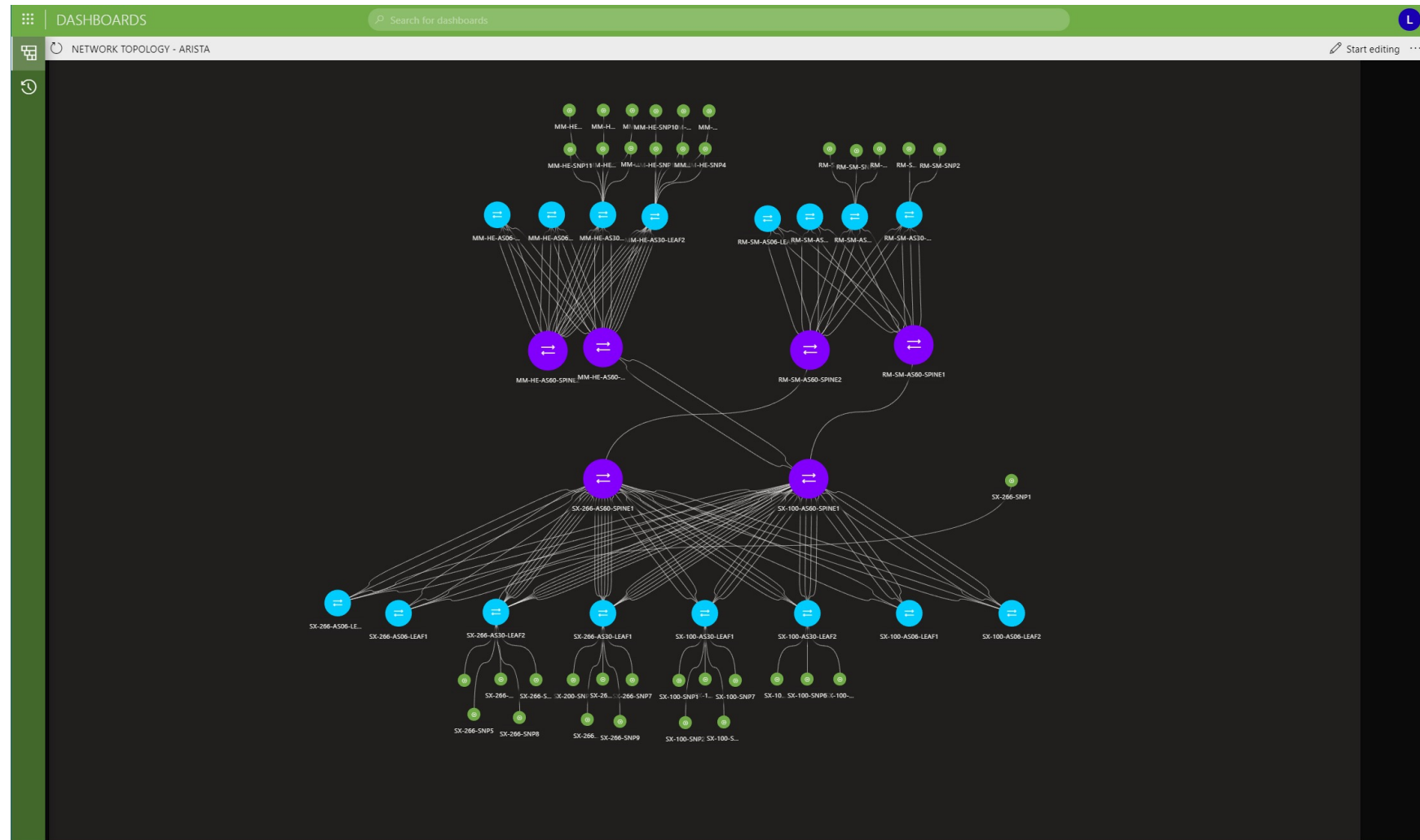
The screenshot shows the DataMiner IDP web interface. The browser title is 'dataminer' and the address bar shows 'RAIWAY (via CheckPoint VPN)'. The page is titled 'DataMiner IDP' and has a navigation menu with tabs for OVERVIEW, INVENTORY, CONNECTIVITY, CONFIGURATION, SOFTWARE, FACILITIES, PROCESSES, ADMIN, and ABOUT. The 'CONFIGURATION' tab is active, and the 'CI TYPES' sub-tab is selected. The main content area shows an 'OVERVIEW' section with a table of CI Types. The table has columns for 'CI Type [IDX]' and 'Edit...'. The table lists various device types with their corresponding 'Edit...' buttons.

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 (Cisco Nexus). The main dashboard shows the following information:

- OVERVIEW:** UPTIME: 220 days 17h 17m 38s; MEMORY USAGE: 35.8%; CPU USAGE: 22%.
- GENERAL INFORMATION:** 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; System Location: *ROMA CPTV - SALA MODEM - rack M8 - RU: 42*.
- FAN STATUS:** Fan Module-1 Status: Up; Fan Module-2 Status: Up; Fan Module-3 Status: Up; Fan Module-4 Status: Up.
- POWER STATUS:** PowerSupply-1 Operator Status: Enabled; PowerSupply-2 Operator Status: Enabled.

A line graph titled "HISTORY - TOTAL PROCESSOR LOAD - 24 HOURS" shows the processor load percentage over time, with a short-term prediction line. The y-axis ranges from 14% to 30%, and the x-axis shows dates from 11/04/2022 9:00 to 12/04/2022 9:00.

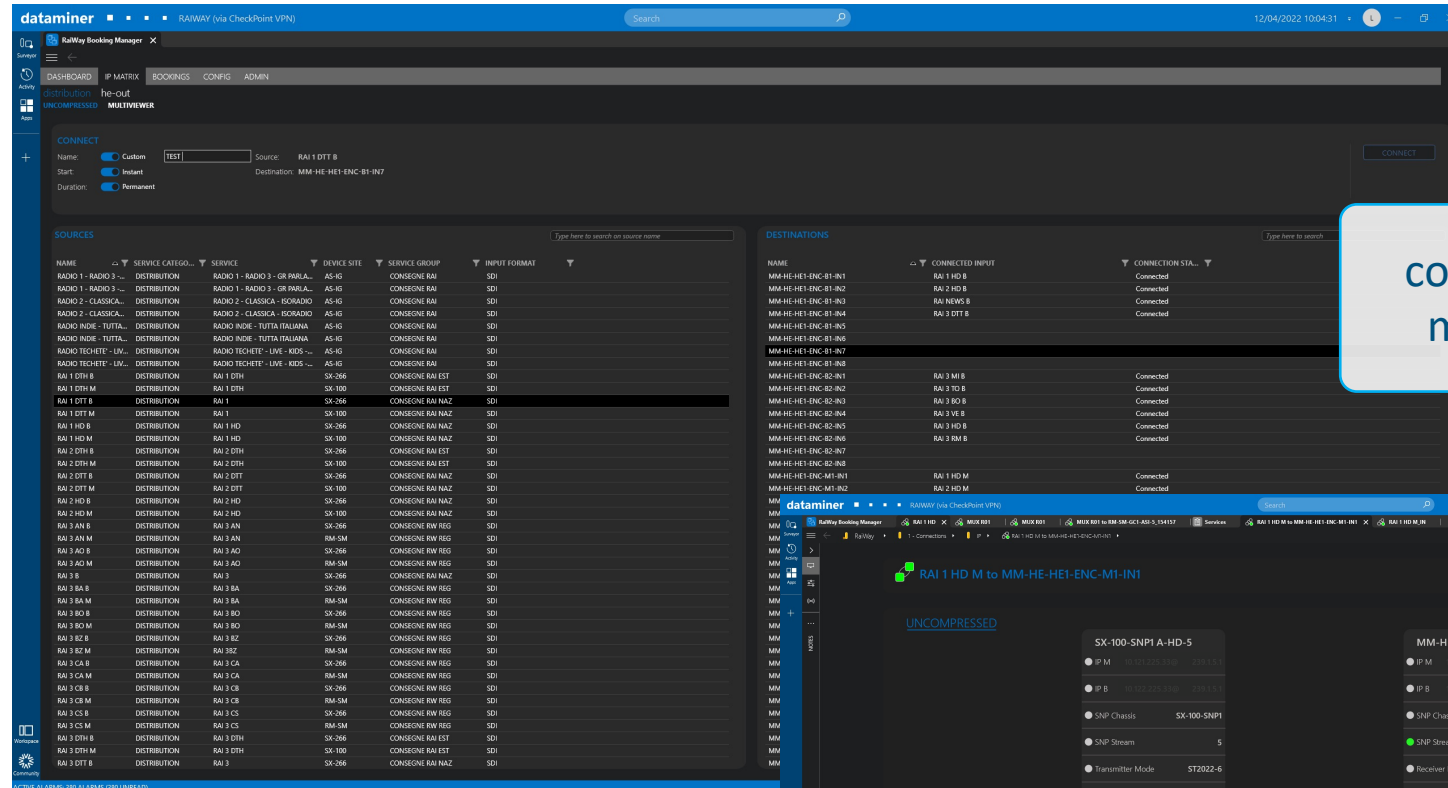
A callout box on the right side of the interface contains the text: "managed device (Cisco Nexus)".

CONNECTION MANAGEMENT



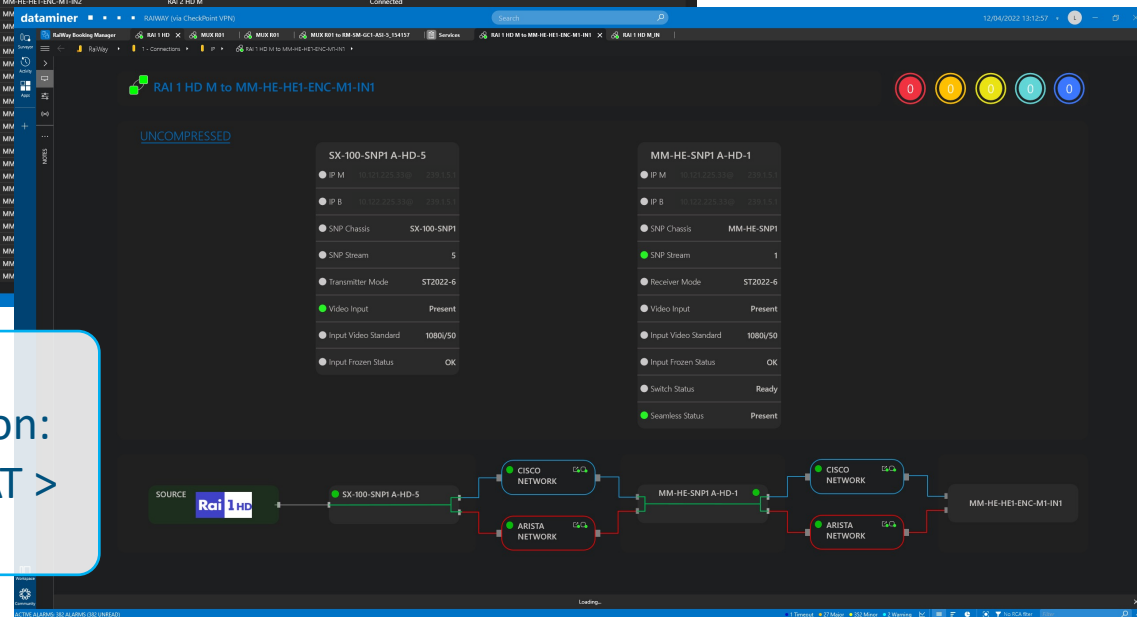
FOR THE USER

- 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.)



The screenshot shows the DataMiner interface with a table of virtual signal groups. The table has the following columns: Display Key [IDX], Linked Item, Multicast Address, IP Port, Source IP, Backup Multicast Address, and Backup IP. The data rows are as follows:

Display Key [IDX]	Linked Item	Multicast Address	IP Port	Source IP	Backup Multicast Address	Backup IP
RAI /239.1.1.30/5001	Video 1	39.1.1.30	5001	10.121.246.99	239.1.1.30	/
RAI /239.1.1.30/5000	Audio 1	39.1.1.30	50000	10.121.246.99	239.1.1.30	/
RAI /239.1.1.30/5000	Audio 1	39.1.1.30	50000	10.121.246.99	239.1.1.30	/
RAI /239.1.1.31/5000	Audio 2	39.1.1.31	50000	10.121.246.99	239.1.1.31	/
RAI /239.1.1.40/5000	Data 1	39.1.1.40	50000	10.121.246.99	239.1.1.40	/

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 STA...
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

RM-SM-IPG1B TS0

- IP1: 20 442 kbps
- IP2: 20 442 kbps
- IP3: 20 513 kbps
- IP4: 20 502 kbps

RM-SM-GC1 ASI5

- IP1: 20 442 kbps
- IP2: 20 442 kbps
- ASI Status: Locked

CONNECTION MANAGEMENT



FULL SERVICE CONNECT

- manage connections based on pre-configured service definitions (for operators)

SINGLE FLOW CONNECT

- make single x-points anywhere in the network e.g. to set up a new type of service on the fly (for engineers) or route to a MV

The screenshot shows the 'dataminer' interface with a 'CONNECT' configuration window. The 'Name' is 'Default', 'Start' is 'Instant', and 'Duration' is 'Permanent'. The 'Source' is 'RAI 1 HD B' and the 'Destination' is 'SK-266-HE3-ENC-M1-INT'. Below the configuration, there are tables for 'SOURCES' and 'DESTINATIONS'. The 'SOURCES' table lists various services like 'RAI 1 HD B', 'RAI 1 HD M', 'DISTRIBUTION', and 'RAI 1 HD'. The 'DESTINATIONS' table lists various network elements like 'SK-266-HE3-ENC-M1-INT', 'MIA-HE-HE3-ENC-B1-INT', 'RAI 1 HD B', etc. At the bottom, a network diagram shows three source nodes (Source HE MAIN, Source HE PROT, Source HE DR) connected to various transport and changeover nodes (Cisco Transport HE-DIST, Arista Transport HE-DIST, Cisco Transport DR HE-DIST, Arista Transport DR HE-DIST, and Changeover).

The screenshot shows the 'dataminer' interface with a 'CONNECT' configuration window. The 'Name' is 'Default', 'Start' is 'Instant', and 'Duration' is 'Permanent'. The 'Source' is 'TUELADA-LAB-HE-HE1-MUX-A-PROT' and the 'Destination' is 'TUELADA-LAB-DNPI-SD-1-RAI 2 HD M'. Below the configuration, there are tables for 'SOURCES' and 'DESTINATIONS'. The 'SOURCES' table lists various services like 'TUELADA-LAB-HE-HE1-MUX-A-DR', 'TUELADA-LAB-HE-HE1-MUX-A-MAN', 'TUELADA-LAB-HE-HE1-MUX-B-PROT', etc. The 'DESTINATIONS' table lists various network elements like 'TUELADA-LAB-IPCA-NAT24', 'TUELADA-LAB-IPCA-NAT25', 'TUELADA-LAB-IPCA-NAT26', etc. At the bottom, a network diagram shows a single source node (Source HE PROT) connected to various transport and changeover nodes (Cisco Transport HE-DIST, Arista Transport HE-DIST, Cisco Transport DR HE-DIST, Arista Transport DR HE-DIST, and Changeover).

same interface

service definition

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 search bar is present on the right. Below the navigation, there are tabs for 'New', 'Duplicate', 'Rename', and 'Finish'. The main area is a 'timeline view' showing a grid of bookings over time. A callout box labeled 'timeline view' points to this grid. Below the timeline is a detailed table of bookings.

BOOKING LIFE C...	BLC DESCRIPTION	BOOKING NAME	SERVICE DEFINITION	SERVICE STATE	ALARM ST...	START TIME	END TIME	PRE-ROLL	POST-ROLL	OWNER	CREATED AT	CREATED BY	LAST MODIF...	LAST MI
Service Active		RAI 1 DTT_B_IN	Source SDI	START		13/12/2021 11:20:57	No date	00:00:00	00:00:00		13/12/2021 11:21:00	Leander	8/03/2022 5:11:08	
Service Active		RAI 1 DTT_M_IN	Source SDI	START		13/12/2021 11:53:02	No date	00:00:00	00:00:00		13/12/2021 11:53:03	Leander	8/03/2022 5:22:17	
Service Active		RAI 1 HD_B_IN	Source SDI	START		13/12/2021 11:55:08	No date	00:00:00	00:00:00		13/12/2021 11:55:09	Leander	8/03/2022 5:35:14	
Service Active		RAI 1 HD_M_IN	Source SDI	START		13/12/2021 11:56:17	No date	00:00:00	00:00:00		13/12/2021 11:56:18	Leander	8/03/2022 5:38:47	
Service Active		RAI 2 DTT_B_IN	Source SDI	START		13/12/2021 11:59:56	No date	00:00:00	00:00:00		13/12/2021 11:59:57	Leander	8/03/2022 5:13:19	
Service Active		RAI 2 DTT_M_IN	Source SDI	START		13/12/2021 11:59:02	No date	00:00:00	00:00:00		13/12/2021 11:59:03	Leander	8/03/2022 5:24:13	
Service Active		RAI 2 HD_B_IN	Source SDI	START		13/12/2021 12:00:49	No date	00:00:00	00:00:00		13/12/2021 12:00:50	Leander	8/03/2022 4:16:25	
Service Active		RAI 2 HD_M_IN	Source SDI	START		13/12/2021 12:01:49	No date	00:00:00	00:00:00		13/12/2021 12:01:51	Leander	8/03/2022 4:25:54	
Service Active		RAI 3 AO_B_IN	Source SDI	START		13/12/2021 12:03:36	No date	00:00:00	00:00:00		13/12/2021 12:03:37	Leander	13/12/2021 12:03:41	
Service Active		RAI 3 AO_B_MM-HE-HE4-ENC-B2-IN3_HE	SDI Decapsulator	START		13/12/2021 12:03:36	No date	00:00:00	00:00:00		13/12/2021 12:03:47	Leander	13/12/2021 12:03:48	
Service Active		RAI 3 AO_B_MM-HE-HE4-ENC-B2-IN3_HE_Cisco Network Transport	Cisco Network Transport_307261b7-f257-49de-9913-511d18ca845	START		13/12/2021 12:03:43	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:03:44	Leander	13/12/2021 12:03:49	
Service Active		RAI 3 AO_B_MM-HE-HE4-ENC-B2-IN3_HE_Arista Network Transport	Arista Network Transport_3386229c-878c-43fd-8892-709ef939c3ce	START		13/12/2021 12:03:45	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:03:46	Leander	13/12/2021 12:03:49	
Service Active		RAI 3 AO_B to MM-HE-HE4-ENC-B2-IN3_110336	SDI to IP	START		13/12/2021 12:03:36	No date	00:00:00	00:00:00		13/12/2021 12:03:55	Leander	13/12/2021 12:03:57	
Service Active		RAI 3 AO_B to MM-HE-HE4-ENC-B2-IN3_110336_Cisco Network Transport	Cisco Network Transport_82a3e430-dcfa-476a-af67-fae63772e4bc	START		13/12/2021 12:03:51	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:03:52	Leander	13/12/2021 12:03:54	
Service Active		RAI 3 AO_B to MM-HE-HE4-ENC-B2-IN3_110336_Arista Network Transport	Arista Network Transport_4dfab712-752c-47e7-ab23-663cde5a1053	START		13/12/2021 12:03:53	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:03:53	Leander	13/12/2021 12:03:55	
Service Active		RAI 3 AO_M_IN	Source SDI	START		13/12/2021 12:04:11	No date	00:00:00	00:00:00		13/12/2021 12:04:13	Leander	2/03/2022 6:38:47	
Service Active		RAI 3 BO_M_IN	Source SDI	START		13/12/2021 12:05:50	No date	00:00:00	00:00:00		13/12/2021 12:05:51	Leander	2/03/2022 5:49:14	
Service Active		RAI 3 BO_M_MM-HE-HE1-ENC-M2-IN3_HE	SDI Decapsulator	START		13/12/2021 12:05:50	No date	00:00:00	00:00:00		13/12/2021 12:06:00	Leander	13/12/2021 12:06:02	
Service Active		RAI 3 BO_M_MM-HE-HE1-ENC-M2-IN3_HE_Cisco Network Transport	Cisco Network Transport_307261b7-f257-49de-9913-511d18ca845	START		13/12/2021 12:05:56	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:05:57	Leander	13/12/2021 12:06:02	
Service Active		RAI 3 BO_M_MM-HE-HE1-ENC-M2-IN3_HE_Arista Network Transport	Arista Network Transport_3386229c-878c-43fd-8892-709ef939c3ce	START		13/12/2021 12:05:58	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:05:59	Leander	13/12/2021 12:06:03	
Service Active		RAI 3 BO_M to MM-HE-HE1-ENC-M2-IN3_110550	SDI to IP	START		13/12/2021 12:06:50	No date	00:00:00	00:00:00		13/12/2021 12:06:59	Leander	13/12/2021 12:06:10	
Service Active		RAI 3 BO_M to MM-HE-HE1-ENC-M2-IN3_110550_Cisco Network Transport	Cisco Network Transport_82a3e430-dcfa-476a-af67-fae63772e4bc	START		13/12/2021 12:06:05	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:06:06	Leander	13/12/2021 12:06:08	
Service Active		RAI 3 BO_M to MM-HE-HE1-ENC-M2-IN3_110550_Arista Network Transport	Arista Network Transport_4dfab712-752c-47e7-ab23-663cde5a1053	START		13/12/2021 12:06:07	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:06:07	Leander	13/12/2021 12:06:08	
Service Active		RAI 3 BZ_B_IN	Source SDI	START		13/12/2021 12:06:50	No date	00:00:00	00:00:00		13/12/2021 12:06:52	Leander	13/12/2021 12:06:55	
Service Active		RAI 3 BZ_B_MM-HE-HE4-ENC-B1-IN4_HE	SDI Decapsulator	START		13/12/2021 12:06:50	No date	00:00:00	00:00:00		13/12/2021 12:07:01	Leander	13/12/2021 12:07:02	
Service Active		RAI 3 BZ_B_MM-HE-HE4-ENC-B1-IN4_HE_Cisco Network Transport	Cisco Network Transport_307261b7-f257-49de-9913-511d18ca845	START		13/12/2021 12:06:57	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:06:58	Leander	13/12/2021 12:07:03	
Service Active		RAI 3 BZ_B_MM-HE-HE4-ENC-B1-IN4_HE_Arista Network Transport	Arista Network Transport_3386229c-878c-43fd-8892-709ef939c3ce	START		13/12/2021 12:06:59	No date	00:00:00	00:00:00	Leander Druwel	13/12/2021 12:07:00	Leander	13/12/2021 12:07:03	
Service Active		RAI 3 BZ_B to MM-HE-HE4-ENC-B1-IN4_110650	SDI to IP	START		13/12/2021 12:06:50	No date	00:00:00	00:00:00		13/12/2021 12:07:09	Leander	13/12/2021 12:07:10	

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

dataminer RAILWAY (via CheckPoint VPN)

RaiWay Booking Manager

DASHBOARD IP MATRIX BOOKINGS CONFIG ADMIN

MUX DR SWITCH MM - DR SWITCH IPG CHO DAB ALL SERVICES SMALL ICON

NAT & REG LOCAL

MUX A	RAI 3 DTH	RAI GULP	RAI MOVIE	RAI PREMIUM	RAI SPORT + HD	RAI STORIA	RAI YOYO	
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

- Surveyor
- Activity
- Apps
- RAiWay Booking Manager
- RAI 1 HD
- RAiWay
- 1 - Connections
- Service Overview
- RAI 1 HD
- VISUAL
- DATA
- RAI 1 HD B to N
- Arista Transf
- Cisco Transf
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transf
- Cisco Transf
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transf
- Cisco Transf
- Generic Dest
- Source HE
- RAI 1 HD B to N
- Arista Transf
- Cisco Transf
- 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_IN
- 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 M to I
- RAI 1 HD M to I
- RAI 1 HD M to I
- RAI 1 HD M,IN
- 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

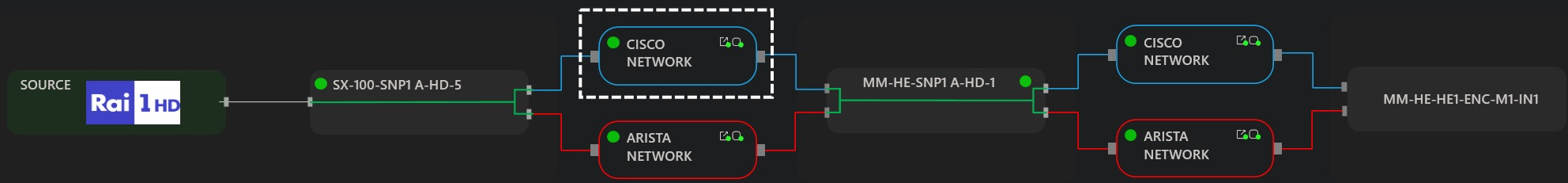
multiple ST2022-6/7 connections

RAI1 HD single ST2022-6/7 connection SDI > SDI-to-IP GW > NAT > ENC

Table with 2 columns: Property and Value for SX-100-SNP1 A-HD-5. Includes IP M, IP B, SNP Chassis, SNP Stream, Transmitter Mode, Video Input, Input Video Standard, and Input Frozen Status.

Table with 2 columns: Property and Value for MM-HE-SNP1 A-HD-1. Includes IP M, IP B, SNP Chassis, SNP Stream, Receiver Mode, Video Input, Input Video Standard, Input Frozen Status, Switch Status, and Seamless Status.

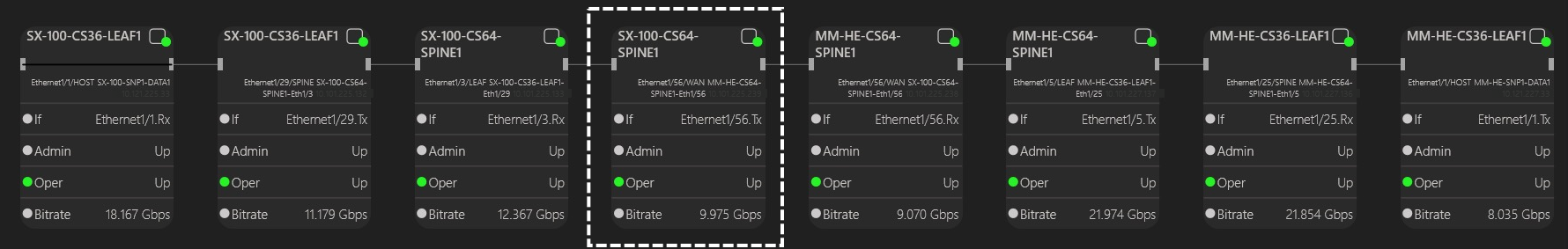
RAI1 HD HEADEND CONTRIBUTION ST2022-6 / ST2110



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



Description	Admin	Oper	Speed	MTU	Link	Flow Control	Flow Control	Flow Control	Flow Control
Ethernet1/56	Admin	Oper	1000000000	1500	Up	None	None	None	None

RAI 4K M to SAXA-HE-HE1-ENC-M2-IN1_UHD

0 1 0 0 0

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

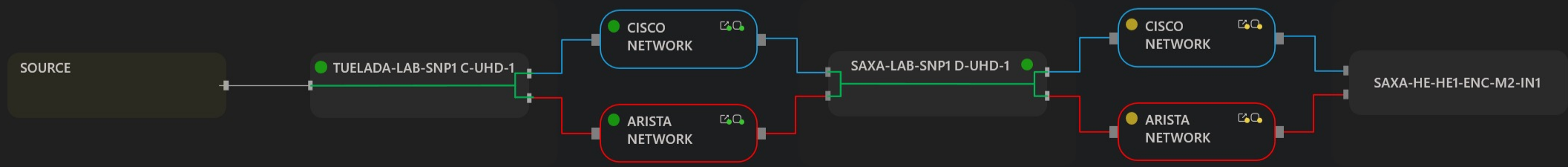
Audio 2

- 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

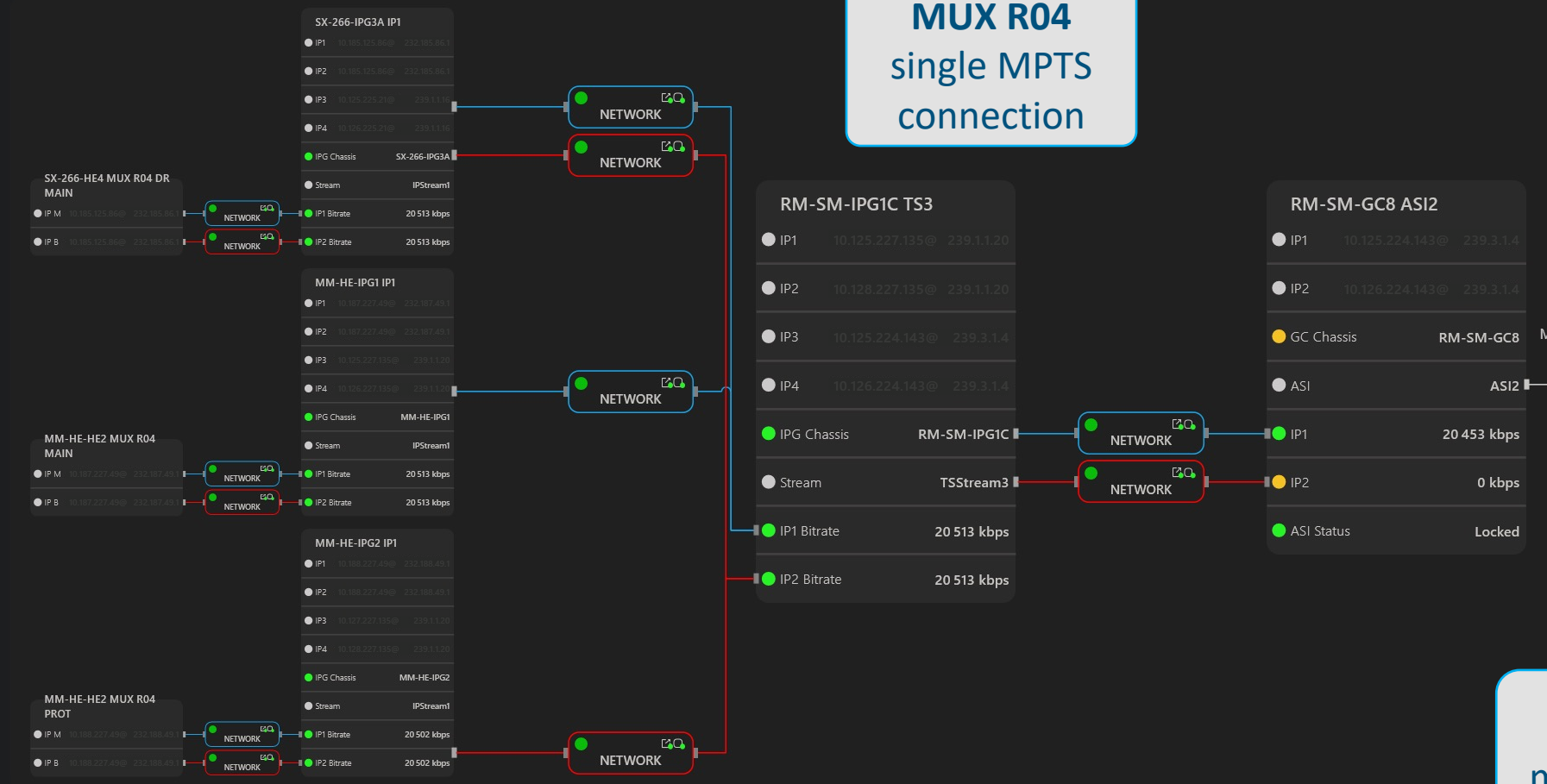
Main + Protect + DR

multiple MPTS connections

MUX R04 to RM-SM-GC8-ASI-2



MUX R04
single MPTS
connection

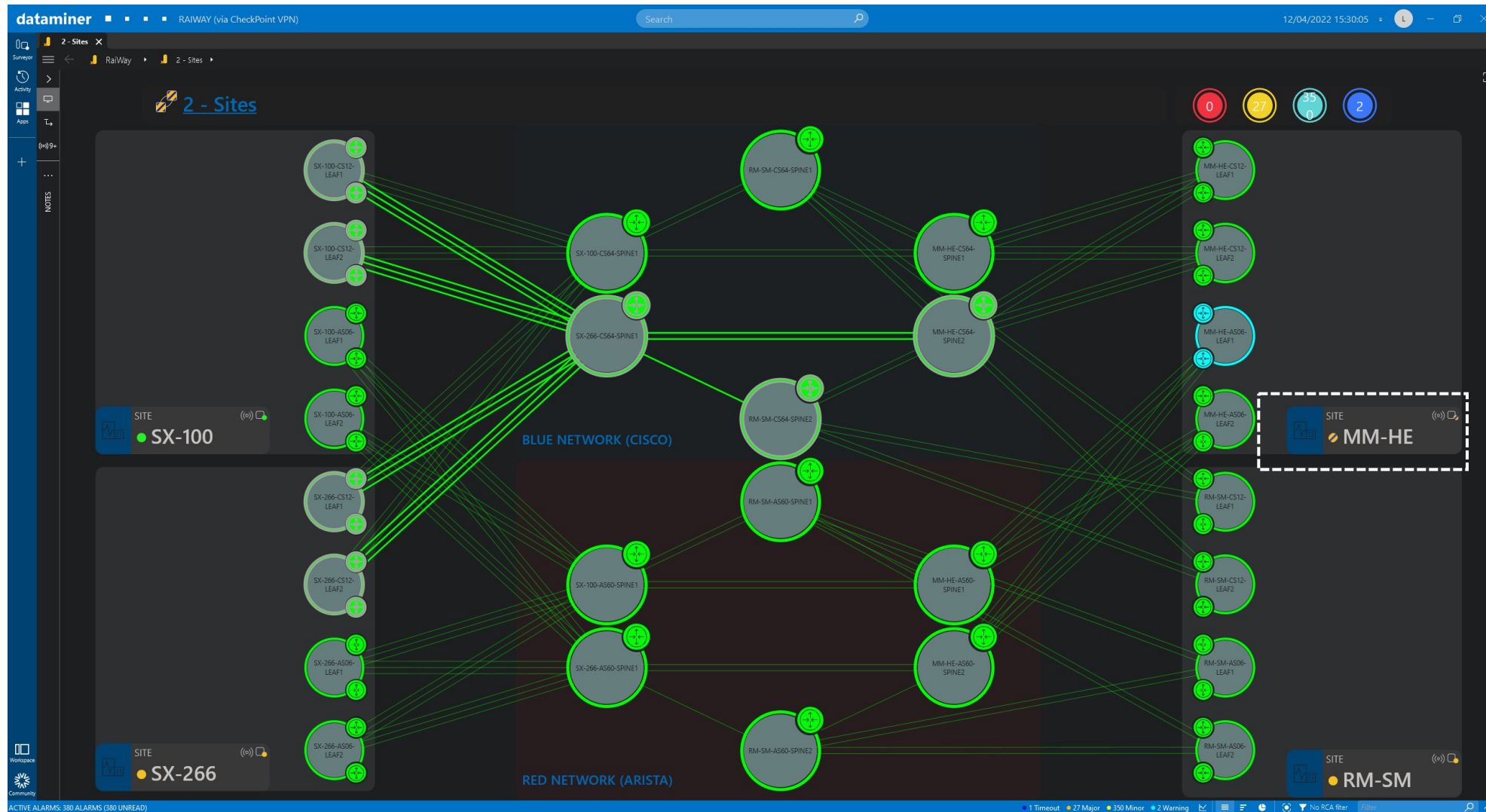


MUX R04 to RM-MG4-7-8 NIMBRA DR

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	

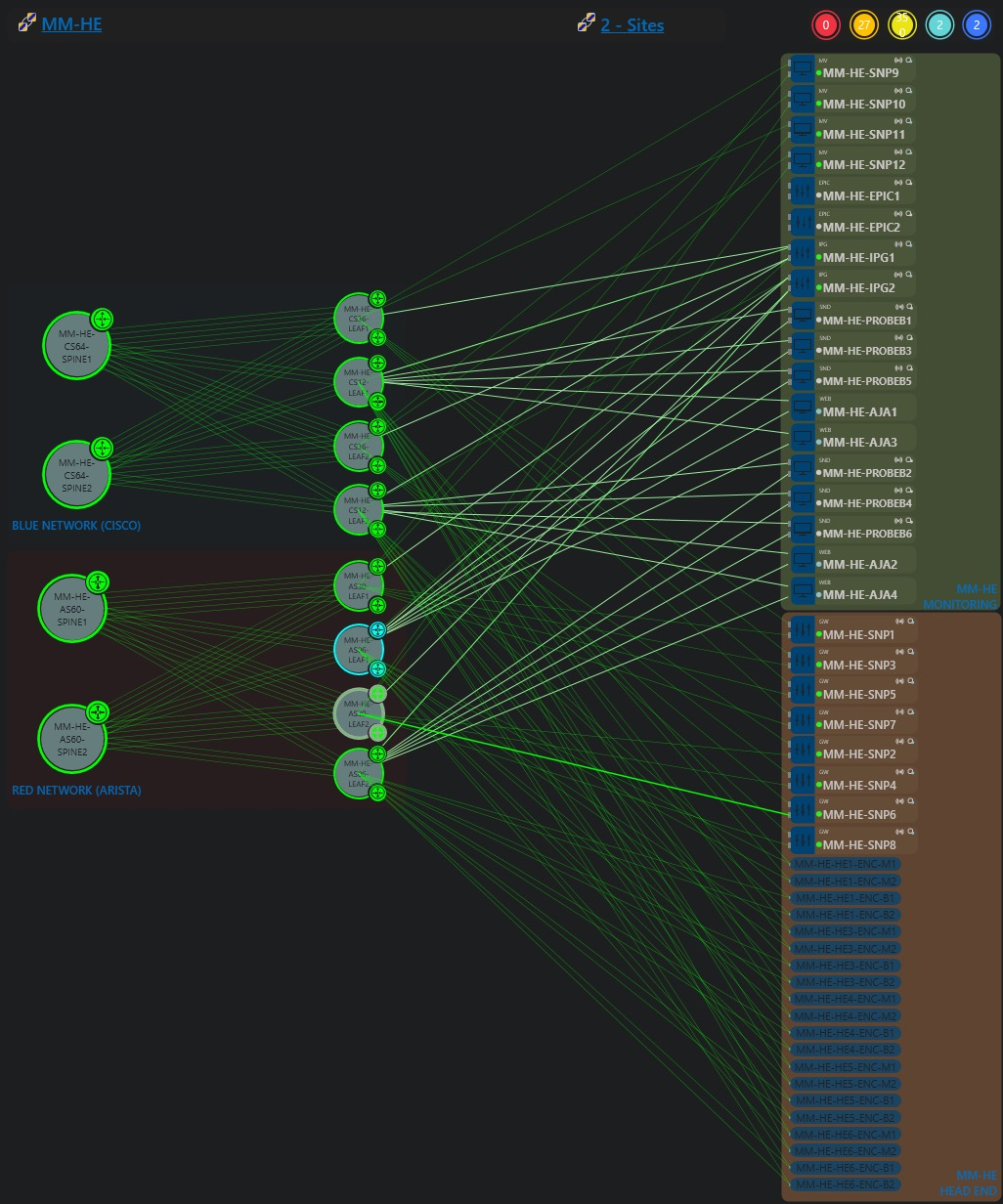
NETWORK MONITORING - DETAILS



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, Prim Rx: 8.05 Gbps
- Sec Tx: 8.05 Gbps, Sec Rx: 8.05 Gbps

MM-HE-AS30-LEAF2

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

VIRTUAL SOURCES

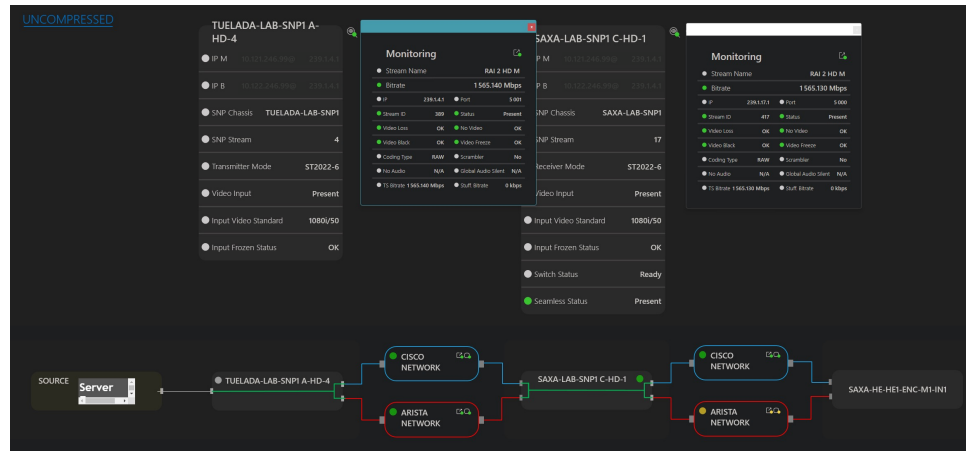


- virtual sources get created after every device

SOURCES				DESTINATIONS				
NAME	DEVICE SITE	SERVICE Catego...	SERVICE GROUP	SERVICE INSTANCE	SIGNAL TV	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-...	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		

- route to probes & multiviewers

- multi-point probing



RaiWay Booking Manager - SAXA-LAB-PROBE5.Monitoring (TestTree StreamProbe).1

21/04/2022 7:51:04

SAXA-LAB-PROBE5.Monitoring (TestTree StreamProbe).1

General Info

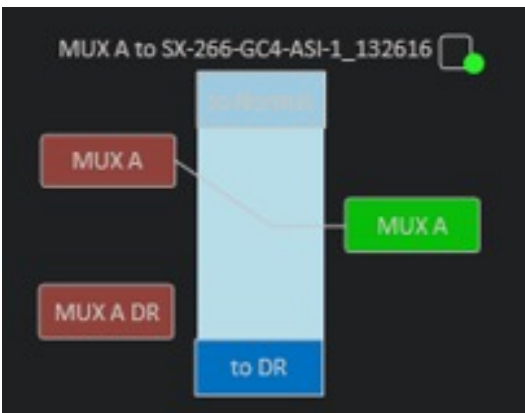
- Stream ID: 422
- Status: Present
- IP: 10.125.227.135@239.1.1.1
- Port: 5 000
- Bit Rate: 20.726 Mbps
- TS Bit Rate: 19.909 Mbps
- Video Loss: OK
- No Video: OK
- Stream Name: MUX A MAIN
- Stream Type: MPEG-2 Transport Stream
- No Audio: OK
- Global Audio Silent: OK
- IP Bit Rate: 20.726 Mbps
- Stuffing 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	
422.1004	Rai Gulp	No	1 004	Active	Rai	H264 SD DTV	104	7	1	2	OK	OK	
422.1002	Rai Movie	No	1 002	Active	Rai	H264 SD DTV	102	8	1	3	OK	OK	
422.1001	Rai Sport + HD	No	1 001	Active	Rai	HD DTV	101	7	1	2	OK	OK	
422.1006	Rai Premium	No	1 006	Active	Rai	H264 SD DTV	106	8	1	3	OK	OK	
422.1003	Rai 3 SD	No	1 003	Active	Rai	DTV	103	7	1	2	OK	OK	
422.1007	Rai Storia	No	1 007	Active	Rai	H264 SD DTV	107	6	1	1	OK	OK	

DISASTER RECOVERY / MAINTENANCE



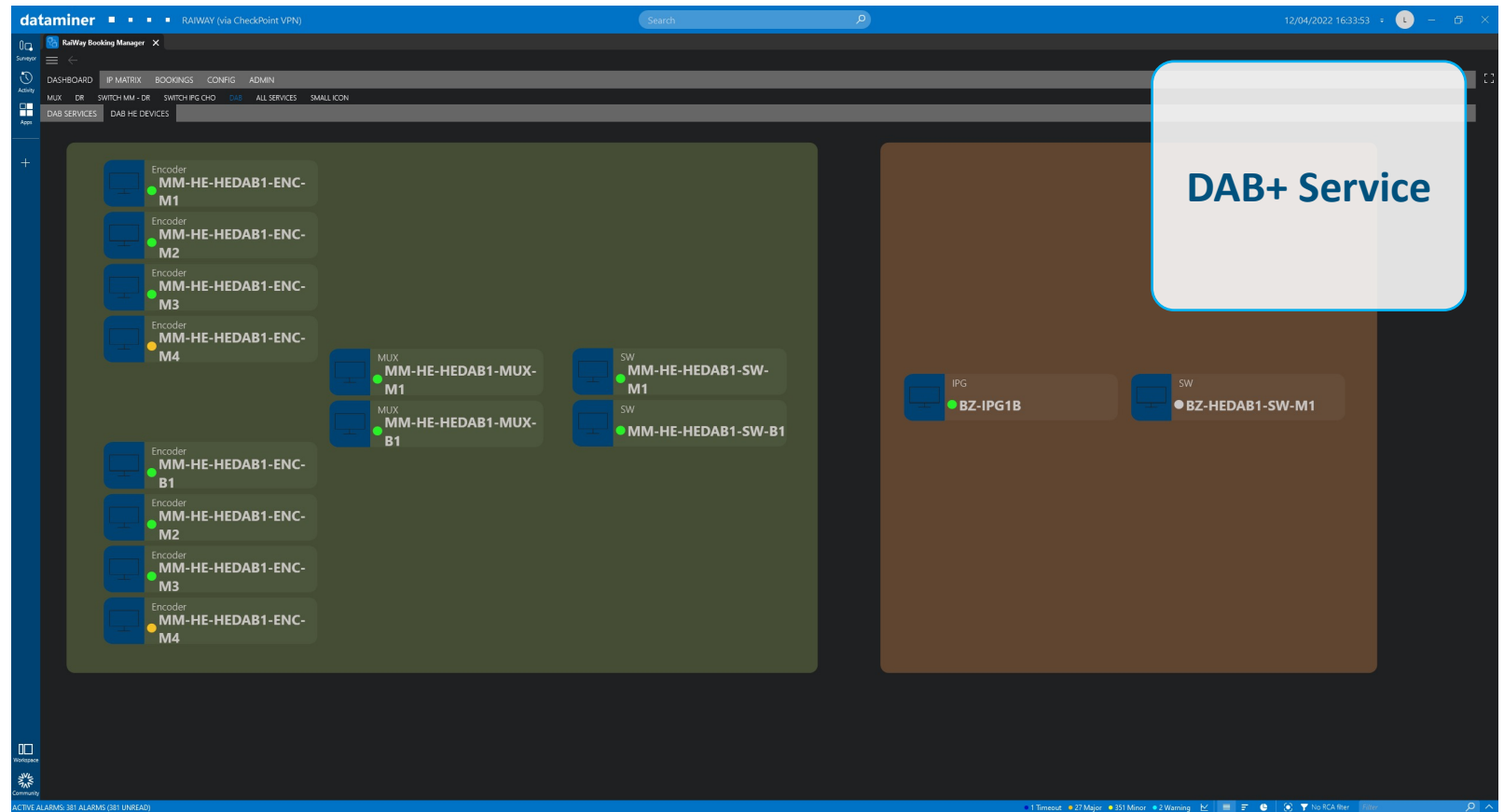
- e.g. switch ALL COMPRESSED FEEDS to DR site with a couple of clicks (free up one headend)



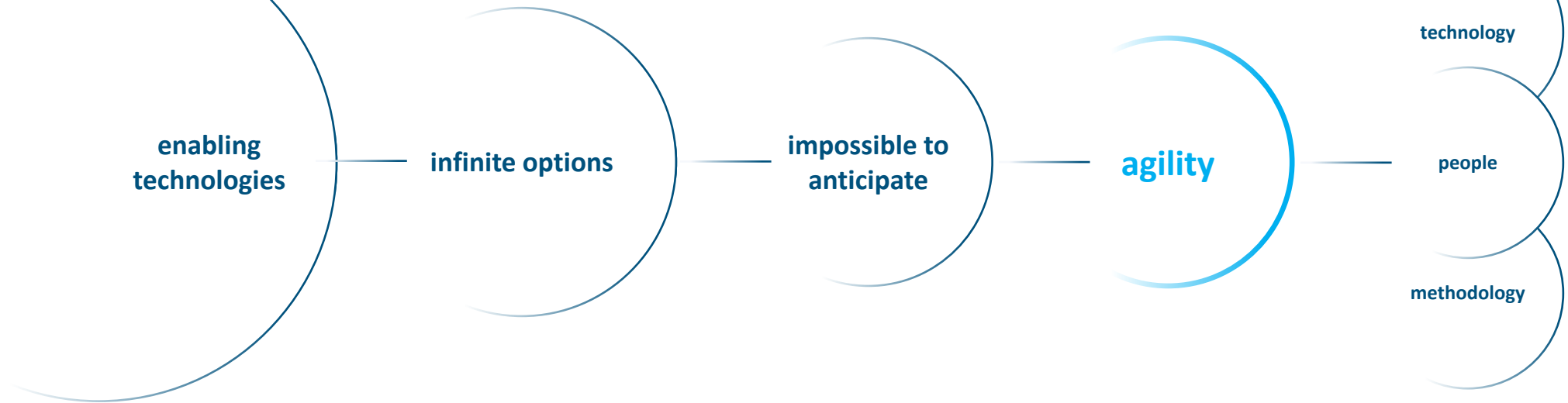
What's next?



- 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