

# ST 2110 Launch Pad

# NMOS

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**IP SHOWCASE™**



# Outline

- **What is NMOS?**
- **Why do I need it?**
- **How Does it Work?**
- **Components**
  - IS-04 (Registration & Discovery)
  - IS-05 (Connection Management)
  - IS-07 (Event & Tally)
  - IS-08 (Audio Mapping)
  - IS-09 (System Discovery)
  - BCP-003/IS-10 (Security)
  - BCP-006 (NMOS for JPEG-XS/IPMX)
- **Why Should I Care?**
- **How is it Going?**
- **Example System**
- **How Can I Try It?**



# Why do I need NMOS?



- Required to route AV Signals from A to B
- In SDI-land, every SDI router has a unique protocol
- In IP, we have all agreed on NMOS
- Alternative is lots of messy hand-editing of configuration files
- NMOS is
  - Auto-discovering
  - Auto-configuring
  - Multi-vendor Interoperable
  - Push-button simple

# Why Should I Care?



- During system provisioning, manually entering a sea of cryptic configuration options such as IP Addresses, Ports, PTP Parameters, etc. *is time consuming, costly, and error prone*
- **Plug and Play is a lot more Fun!** A red circular icon with a white border and a white shadow, containing the word 'easy' in white lowercase letters.
- Most all new facility build tenders are specifying NMOS
- Most Control System Providers have fully embraced NMOS
- The EBU wants you to use NMOS

# EBU Mandate

**EBU**

OPERATING EUROVISION AND EURORADIO

**Tech 3371**

## **THE TECHNOLOGY PYRAMID FOR MEDIA NODES**

MINIMUM USER REQUIREMENTS TO BUILD AND  
MANAGE AN IP-BASED MEDIA FACILITY USING  
OPEN STANDARDS & SPECIFICATIONS

Version 2.0

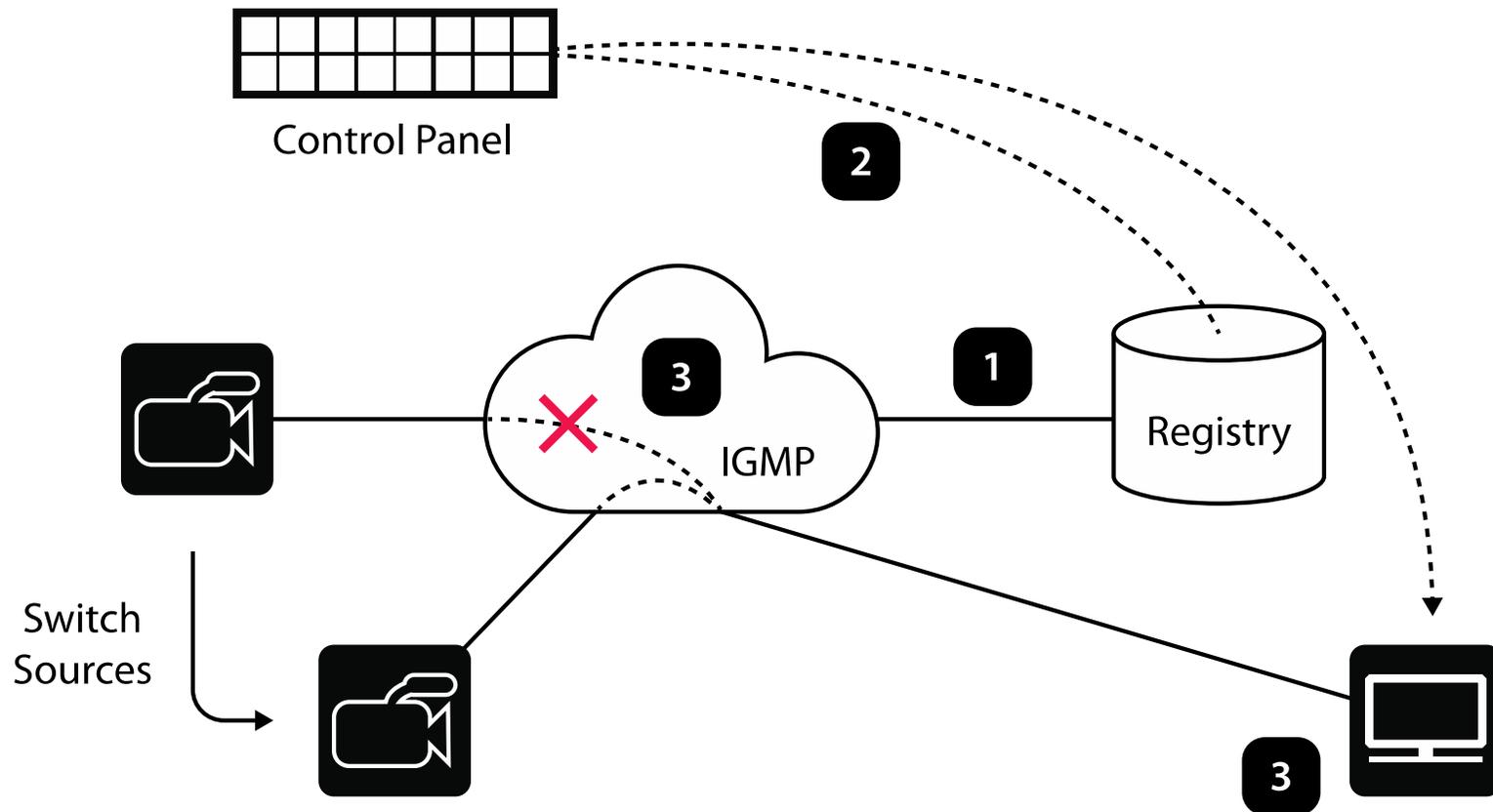
<b>III</b>	<b>Operational Control .....</b>
III.1	Discovery and Registration: AMWA IS-04 .....
III.2	Connection Management: AMWA IS-05.....
III.3	Device Control: Open Methods and AMWA IS-07 .....
III.4	Audio Channel Mapping: AMWA IS-08 .....
III.5	Topology discovery: LLDP.....
<b>IV</b>	<b>Configuration and Monitoring .....</b>
IV.1	IP assignment and low-level configuration: DHCP, AMWA IS-09

Geneva  
July 2020



# How does NMOS Work?

## IS-04/05 System Diagram



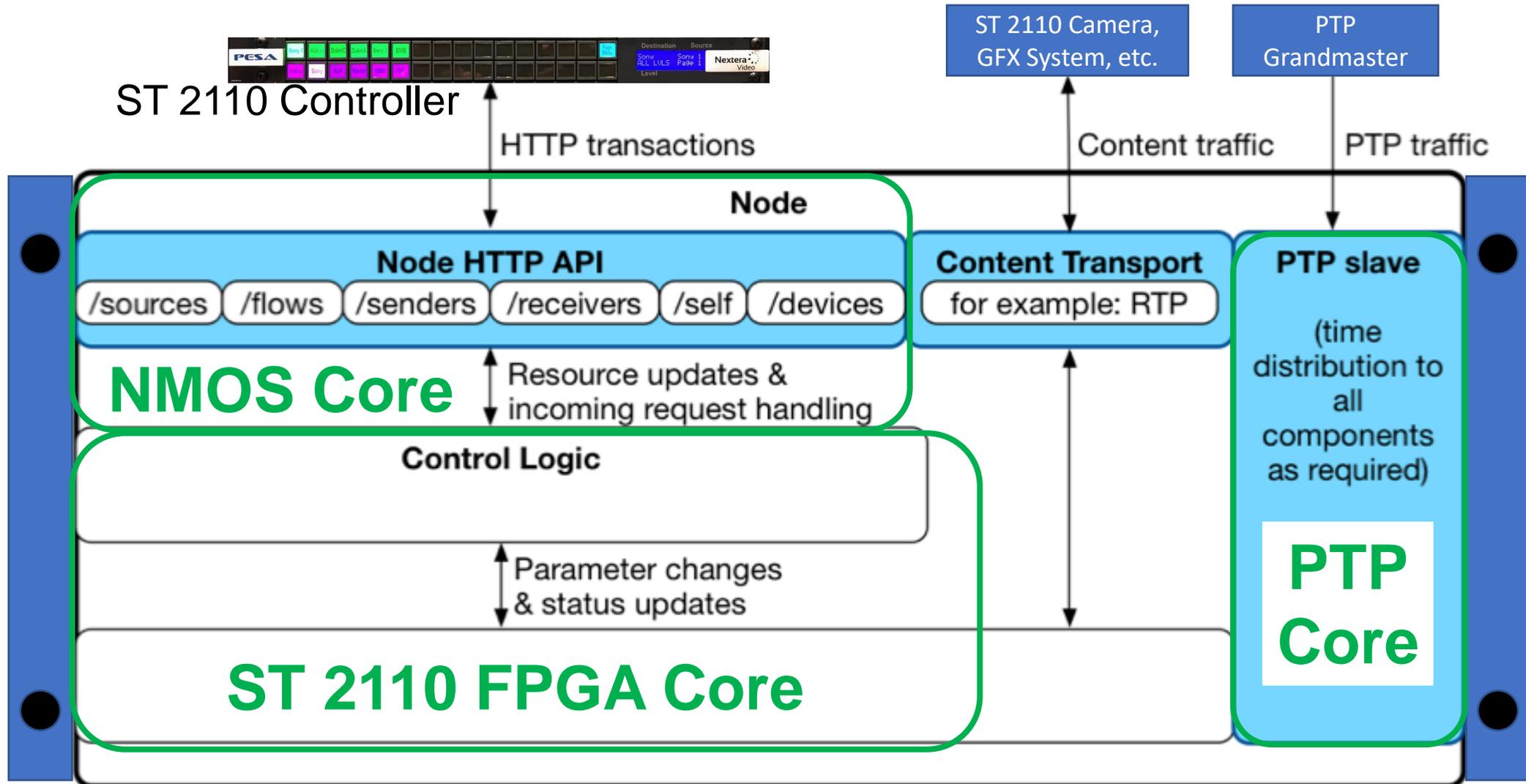
- 1 Sources automatically register with RDS
- 2 Control Panel gets list of devices from RDS
- 3 Upon button press, control system commands receiver to join the new multicast stream and leave the previous one

# How is NMOS Accessed?



- Through a set of Application Program Interfaces (APIs)
  - In Plain English:
    - **http PUT/GET** => *http://<IP Address>/x-nmos /<API Name>/...*
- Examples (Viewable in Web Browser):
  - <http://192.168.10.2/x-nmos/node/v1.3/self>
  - <http://192.168.10.2/x-nmos/query/v1.3/senders>
  - <http://192.168.10.2/x-nmos/channelmapping/v1.0/map>
  - <http://192.168.10.2/x-nmos/channelmapping/v1.0/outputs>
  - <http://192.168.10.2/x-nmos/auth/v1.0/certs>

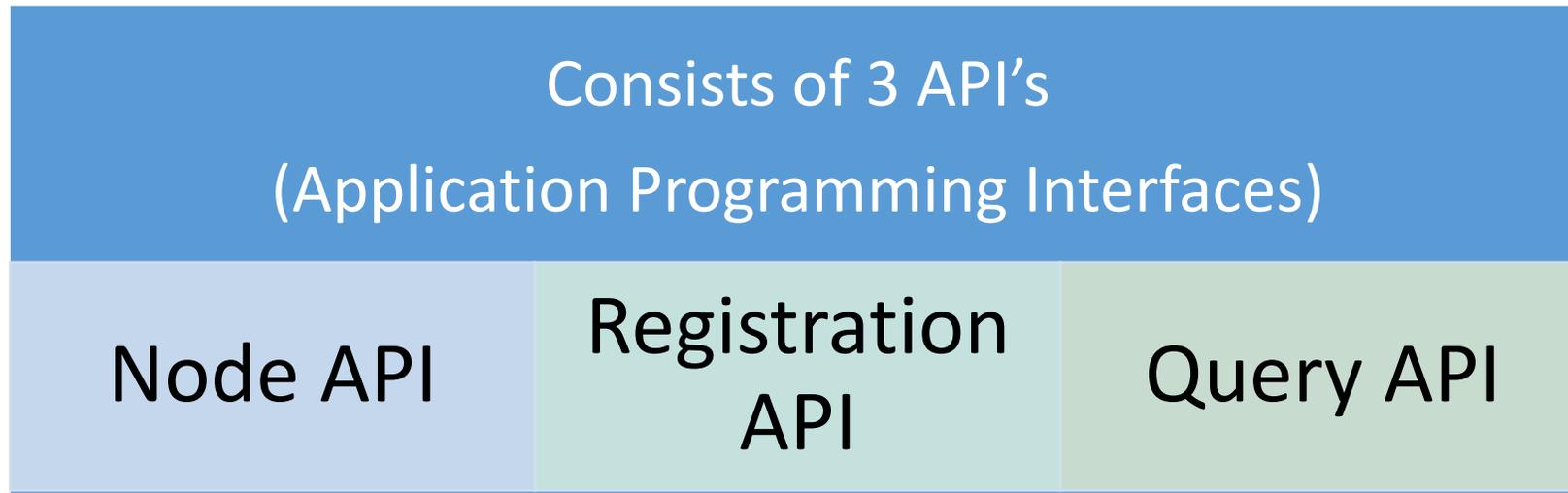
# What is a Typical Implementation?



NMOS

Components

# IS-04 (Registration & Discovery)



Node  
[Camera, Monitor]

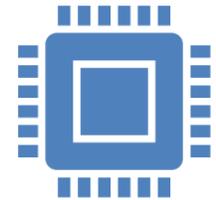
Registry  
[PC running RDS SW or built into switch]

- Contains a database of all NMOS devices on the network

# IS-05 (Connection Management)



- IS-05 is an API which provides the means to create a connection between Senders and Receivers
- Enables switching through “activations”
- Activations can be immediate, relative, or absolute



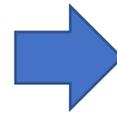
- Now
- In 5 seconds
- At 12:00 PM

# IS-07 Event & Tally

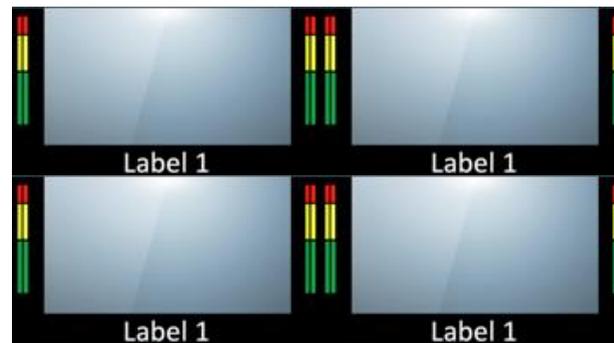
- “GPIO over IP”
  - Camera Tally
  - Dynamic Text (UMD)
  - Etc.



*Program  
Tally*



*Tally  
Lamp*



*Dynamic UMDs*



# IS-08 Demo – Audio Remapping



Harmonic 2

Harmonic 2

Harmonic 2

SDI A

Imagine SNP with IS-08

Nextera GW with IS-08

Imagine Communications EPIC-MV Multiviewer

VIZIO

# IS-09 (System Resource)



- Provides a global resource within the ST 2110 Environment
- Located using DNS Service Discovery (DNS-SD)
- Read by Media Nodes on Startup to determine:
  - System ID (assigned randomly at each facility)
  - Protocol (http or https)
  - NMOS API versions supported
  - PTP domain and announce interval
  - RDS Heartbeat Interval
  - Syslog hostname & port
- Implementation Guide
  - <https://specs.amwa.tv/info-004/>



*IS-09  
DNS-SD  
Server*

## Goals:

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**Confidentiality** - Data passing between client and the APIs is unreadable to third parties.

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**Identification** - The client can check whether the API it is interacting with is owned by a trusted party.

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**Integrity** - It must be clear if data travelling to or from the API been tampered with.

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**Authentication** - The client can check if packets actually came from the API it is interacting with, and vice versa.



BCP-003-01

Encrypting communications between NMOS controllers & devices (https)



BCP-003-02

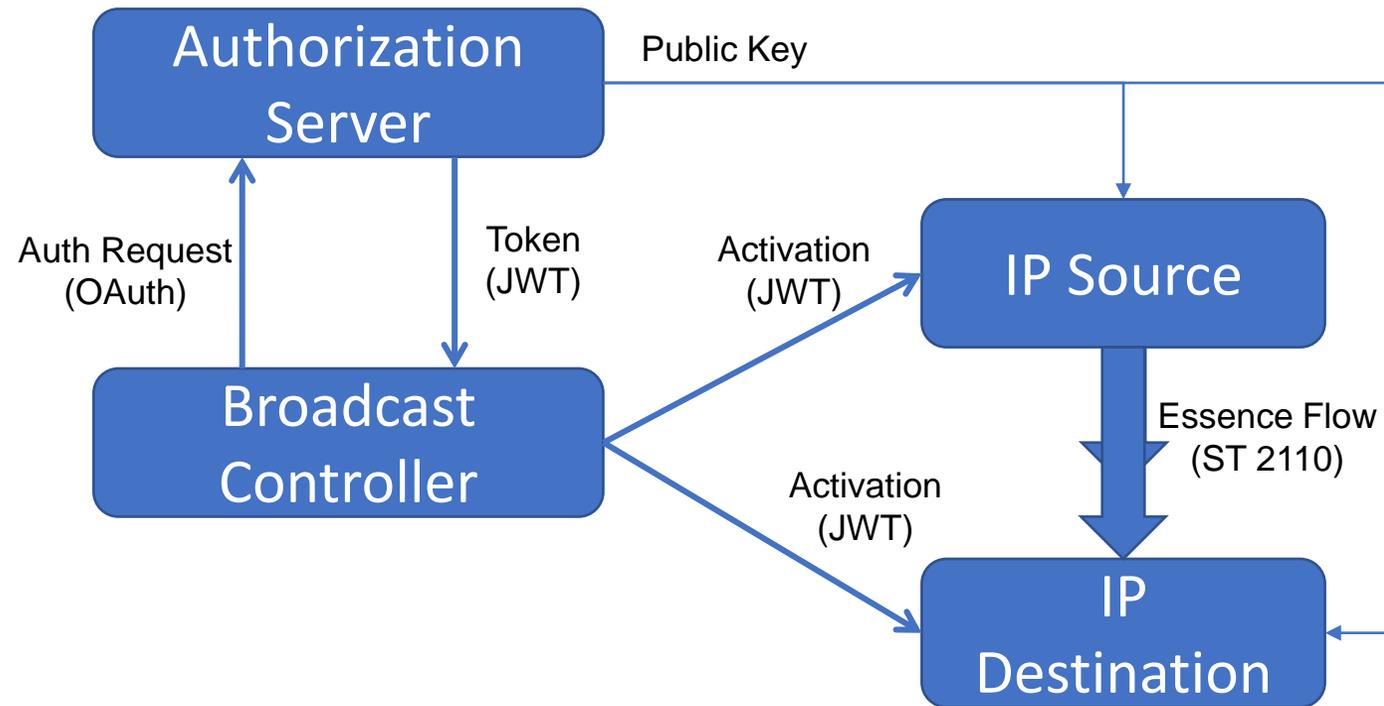
Client authorization and user management in NMOS systems



BCP-003-03

Certificate Provisioning using Enrollment over Secure Transport (EST)

# NMOS Security Example



# BCP-006 (NMOS for JPEG-XS)



- Enables ProAV applications to use NMOS
  - To be supplemented by VSF TR-10-8 (NMOS for IPMX)
- Refers to VSF TR-08 (Transport of JPEG-XS Video in ST 2110-22)
- Leverages IS-04 & IS-05
- Uses BCP-002-01 Natural Grouping
- Uses media\_type ***video/jxsv***
- Specifies updates to Session Description Protocol (SDP) file

# How is it going?



- Early facilities adopting NMOS control had some issues (teething pains)
  - Not all devices supported NMOS
  - Some new NMOS devices didn't get JT-NM testing (Covid)
  - **Controller specs not clear and Interop testing for controllers didn't exist**
- Mitigation
  - Most all new ST 2110 devices are support NMOS
  - JT-NM Testing is back!
    - Face2Face Interop August 19-23 @ Riedel (Germany), very productive
  - **AMWA INFO-005 Implementation Guide for NMOS Controllers**
  - Automated self-test suites NOW AVAILABLE for Devices & Controllers

# NMOS Testing

<https://github.com/AMWA-TV/nmos-testing>

## Easy-NMOS Docker Compose Solution

This starter kit allows the user to launch a simple NMOS setup with minimal installation steps. It is composed of three Docker containers:

- an NMOS Registry (from `nmos-cpp`)
- a virtual NMOS Node (from `nmos-cpp`) which should automatically register
- the [AMWA NMOS Testing Tool](#)

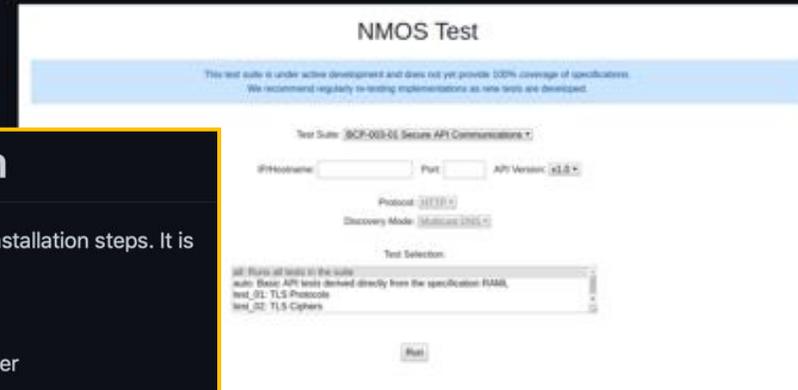
<https://github.com/rhastie/easy-nmos>

# NMOS API Testing Tool

/ license Apache-2.0 Lint passing Render passing Deploy passing

This tool creates a simple web service which tests implementations of the NMOS APIs.

## Selecting a test to run



## Examining the results

The screenshot shows the 'NMOS Test' results page. It displays a table of test results for the test suite 'IS-04 Registry APIs'. The table has columns for 'Test', 'Pass', 'Description', 'Reason', 'Completion Time', and 'Time Elapsed'. The results are as follows:

Test	Pass	Description	Reason	Completion Time	Time Elapsed
init_...	Not Applicable	Test Initialization		18/10/13, 20:2	1.208s
init_Nets	Not Applicable	Test setup		18/10/13, 20:3	0.001s
autoc_query_1	Pass	GET /v/nmos		18/10/13, 20:9	0.006s
autoc_query_2	Pass	GET /v/nmos/query		18/10/13, 20:5	0.006s
autoc_query_3	Pass	GET /v/nmos/query/v1.2		18/10/13, 20:2	0.006s
autoc_query_4	Pass	GET /v/nmos/query/v1.2/devices		18/10/13, 20:9	0.013s
autoc_query_5	Could Not Test	GET /v/nmos/query/v1.2/devices/deviceid	No resources found to perform this test	18/10/13, 20:9	0.006s
autoc_query_6	Pass	GET /v/nmos/query/v1.2/flows		18/10/13, 20:6	0.041s
autoc_query_7	Could Not Test	GET /v/nmos/query/v1.2/flows/flowid	No resources found to perform this test	18/10/13, 20:6	0.006s

The following test suites are currently supported:

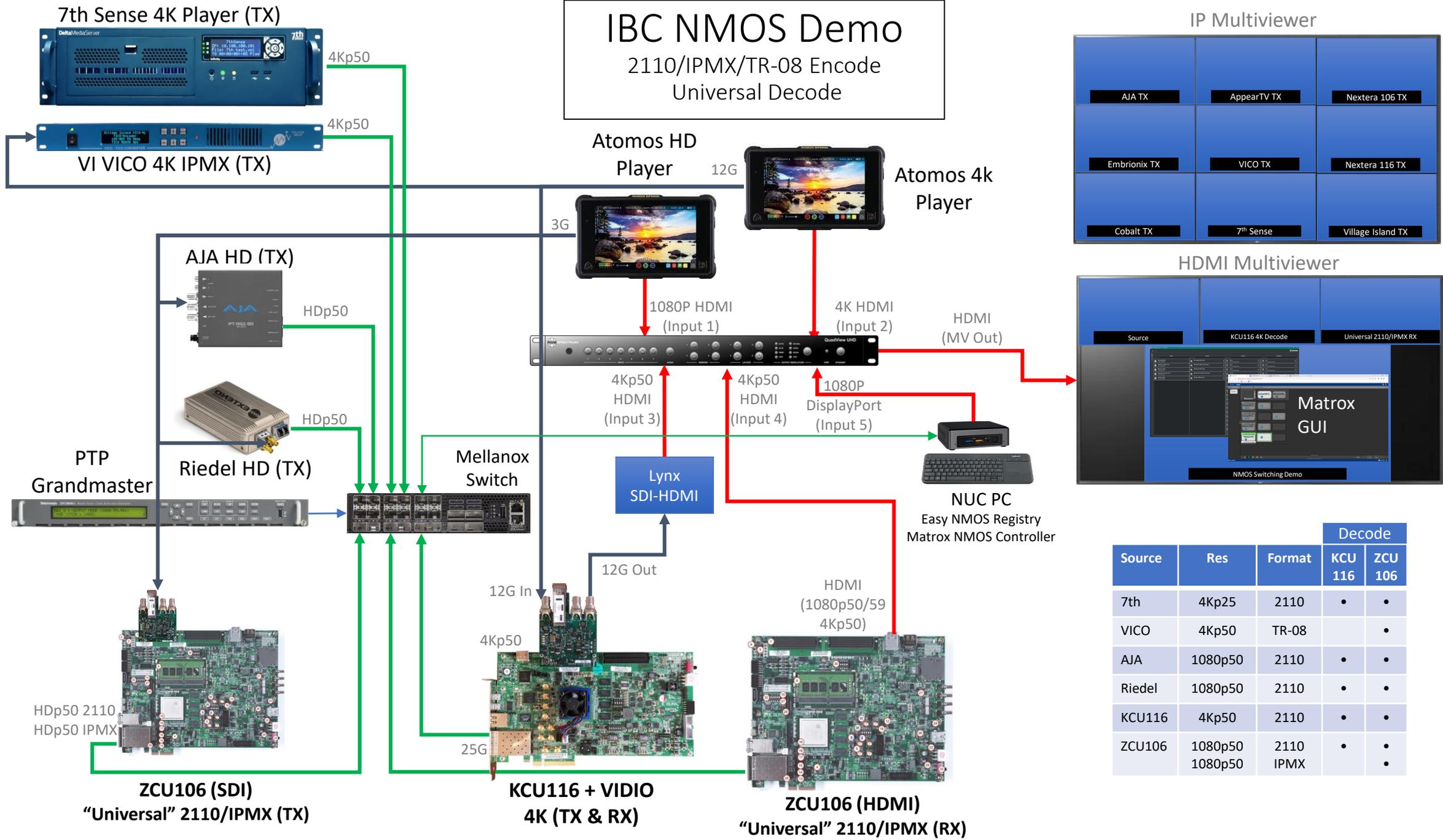
- IS-04 Node API
- IS-04 Registry APIs
- IS-04 Node API (Peer to Peer)
- IS-04 Controller (for usage see [Testing Controllers documentation](#))
- IS-05 Connection Management API

NMOS

Example  
System

# IBC NMOS Demo

2110/IPMX/TR-08 Encode  
Universal Decode



Source	Res	Format	Decode	
			KCU 116	ZCU 106
7th	4Kp25	2110	•	•
VICO	4Kp50	TR-08		•
AJA	1080p50	2110	•	•
Riedel	1080p50	2110	•	•
KCU116	4Kp50	2110	•	•
ZCU106	1080p50	2110	•	•
	1080p50	IPMX		•

# Basic Controller - Riedel NMOS Explorer



The screenshot displays the Riedel NMOS Explorer interface, which is organized into four main columns: Nodes, Devices, Senders, and Receivers. Each column has a search filter at the top.

Nodes	Devices	Senders	Receivers
<b>MN Vasili (198)</b> 10.30.6.198:3000	<b>MN Vasili (198) Device</b>	<b>Out 8</b> urn:x-riemel:format:video	<b>In 2</b> urn:x-riemel:format:video
<b>Micro IP 1 (links 196)</b> 10.30.6.196:3000	<b>Micro IP 1 (links 196) Device</b>	<b>Out 7</b> urn:x-riemel:format:video	<b>In 1</b> urn:x-riemel:format:video
<b>MN Arne (199)</b> 10.30.6.199:3000	<b>MN Arne (199) Device</b>	<b>Out 9</b> urn:x-riemel:format:video	<b>In 4</b> urn:x-riemel:format:video
<b>Micro IP 2 (rechts 197)</b> 10.30.6.197:3000	<b>Micro IP 2 (rechts 197) Device</b>	<b>Out 10</b> urn:x-riemel:format:video	<b>In 3</b> urn:x-riemel:format:video
<b>MN Max (200)</b> 10.30.6.200:3000	<b>MN Max (200) Device</b>	<b>Out 10</b> urn:x-riemel:format:video	<b>In 2</b> urn:x-riemel:format:video
		<b>Stream 1</b> urn:x-riemel:format:audio	<b>In 4</b> urn:x-riemel:format:video
		<b>Out 7</b> urn:x-riemel:format:video	<b>In 3</b> urn:x-riemel:format:video
		<b>Out 8</b> urn:x-riemel:format:video	<b>In 1</b> urn:x-riemel:format:video
		<b>Out 9</b> urn:x-riemel:format:video	<b>In 4</b> urn:x-riemel:format:video
		<b>Out 9</b> urn:x-riemel:format:video	<b>In 3</b> urn:x-riemel:format:video
		<b>Out 7</b> urn:x-riemel:format:video	<b>In 2</b> urn:x-riemel:format:video
		<b>Out 10</b> urn:x-riemel:format:video	<b>In 1</b> urn:x-riemel:format:video
		<b>Out 9</b> urn:x-riemel:format:video	<b>In 2</b> urn:x-riemel:format:video
		<b>Out 7</b> urn:x-riemel:format:video	<b>In 3</b> urn:x-riemel:format:video
		<b>Out 10</b> urn:x-riemel:format:video	<b>In 1</b> urn:x-riemel:format:video
		<b>Out 9</b> urn:x-riemel:format:video	<b>In 4</b> urn:x-riemel:format:video
		<b>Out 7</b> urn:x-riemel:format:video	<b>In 3</b> urn:x-riemel:format:video
		<b>Out 8</b> urn:x-riemel:format:video	<b>In 1</b> urn:x-riemel:format:video
		<b>Out 7</b> no active flow	<b>Stream 1</b> urn:x-riemel:format:audio

<https://www.riedel.net/downloads/firmware-software/>

# NMOS Control GUI (Matrox ConductIP)



The screenshot displays the Matrox ConductIP NMOS Control GUI. The interface is divided into several sections:

- Rooms / Panels:** Located at the top left, with a search bar and a zoom level of 120%.
- IBC Demo:** A central workspace showing a network diagram with transmitter (Tx) and receiver (Rx) nodes. The nodes are arranged in two columns. The left column contains: KCU116\_TX, IPMX\_TX\_20, IPMX\_TX\_22, 7thSense\_TX, VICO\_TX, AJA\_TX, and RIEDEL\_TX. The right column contains: KCU116\_RX, IPMX\_RX\_20, IPMX\_RX\_22. A blue dashed line connects IPMX\_TX\_22 to IPMX\_RX\_22. A blue curved line connects KCU116\_TX to KCU116\_RX.
- Component List:** A vertical list on the right side of the workspace, showing a detailed view of each component. Each entry includes a checkmark, a status icon (green, yellow, or red), and the component name (e.g., 7thSense\_TX, AJA\_TX, IPMX\_TX\_20, IPMX\_TX\_22, KCU116\_TX, RIEDEL\_TX, VICO\_TX, IPMX\_RX\_20, IPMX\_RX\_22).
- Footer:** The bottom of the window features the Matrox ConductIP logo and the text "10 of 10".

# NMOS Control GUI (Matrox ConductIP)



The screenshot displays the Matrox ConductIP NMOS Control GUI interface. At the top, there are tabs for "Rooms" and "Panels", with "Panels" selected. A search bar and zoom controls (145%) are visible. On the left, a sidebar shows a panel named "IBC Demo" with a green checkmark. The main area is divided into "Senders" and "Receivers".

**Senders:** A row of seven buttons: 7thSense\_TX, AJA\_TX, IPMX\_TX\_20, IPMX\_TX\_22, KCU116\_TX, RIEDEL\_TX, and VICO\_TX. Each button has a blue dot indicating status.

**Receivers:** A grid of receiver buttons. The first column contains three buttons: IPMX\_RX\_20, IPMX\_RX\_22, and \*IPMX\_TX\_20 KCU116\_RX. The other columns are empty boxes. Blue dots are present in the intersection of the first row and third column, and the first row and fifth column.

At the bottom, there is a control bar with a "Direct" toggle, "Queue", "Reset", "Disconnect", and "Take" buttons. Below this is an "Information" section with "Attached room: IBC Demo" and a "Description" field.

The footer shows "Matrox ConductIP" on the left and "10 of 10" on the right.

# Take-aways



NMOS IS-04 and 05 are solid, stable, and mature & offered in most all new ST 2110 products



NMOS Control Systems are greatly improved thanks to spec clarifications and interop testing



Features like IS-08 (Audio Mapping), IS-09 (System Discovery), and BCP-002 (Grouping) take NMOS to a new level, surpassing the level of control provided in SDI



BCP-003 (Security) adds a layer of security that has been sorely needed in control systems for quite some time



NMOS makes IP control easy, try it yourself!

# Any Questions?

# NMOS

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Please see our Live Demo in Hall 10, A26 (Next to EVS)

