

NMOS

Tutorial

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Outline

- **What is NMOS?**
- **Required Components**
 - IS-04 (Registration & Discovery)
 - IS-05 (Connection Management)
 - IS-07 (Event & Tally)
 - IS-08 (Audio Mapping)
 - IS-09 (System Discovery)
- **Optional Components**
 - IS-06 (Software Defined Networking)
 - BCP-002 (Grouping)
 - BCP-003/IS-10 (Security)
- **Under Development**
 - BCP-006 (NMOS for JPEG-XS/IPMX)
 - IS-11 (Receiver Capabilities)
 - BCP-005-01 (EDID)
 - IS-12 (Device Control Protocol)
 - MS-05-01/02/03 Modeling
- **Why is it important?**

What is NMOS?

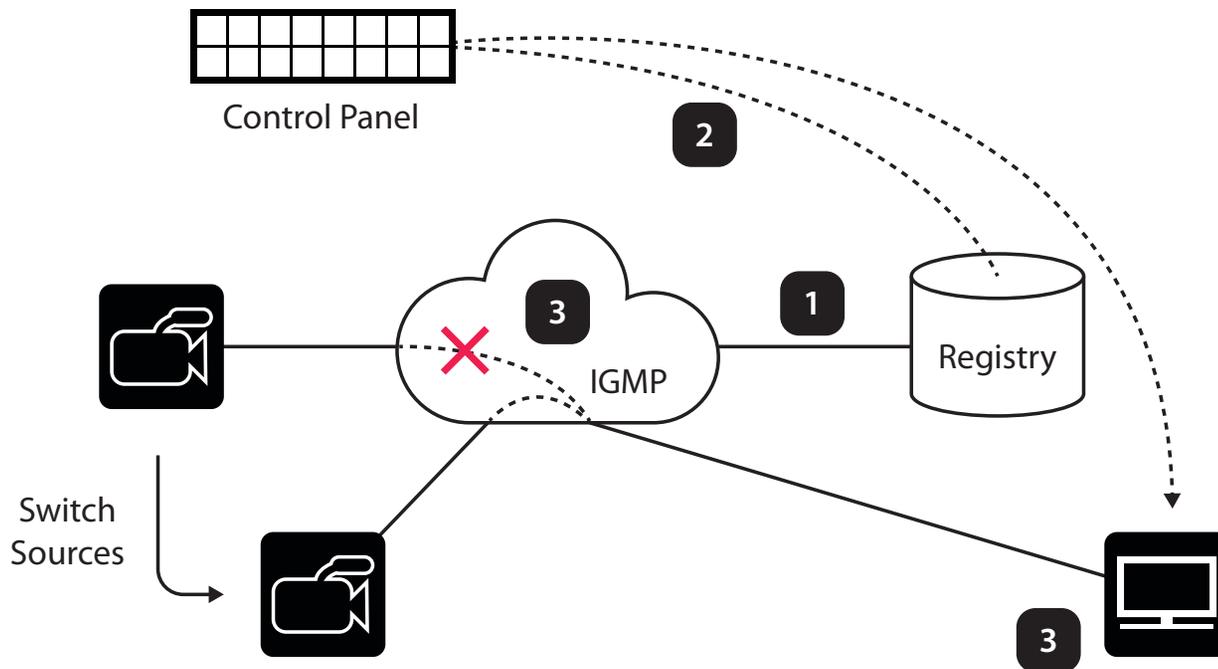
- NMOS is the Networked Media Open Specification, developed by the Advanced Media Workflow Association (AMWA)
- Delivered in the form of an open specification on the AMWA website
- Enables ST-2110 equipment to seamlessly interoperate across vendors and facilities
- Brings **Plug & Play** and **Push-Button** simplicity to Video over IP Routing



How does NMOS Work?



IS-04/05 System Diagram



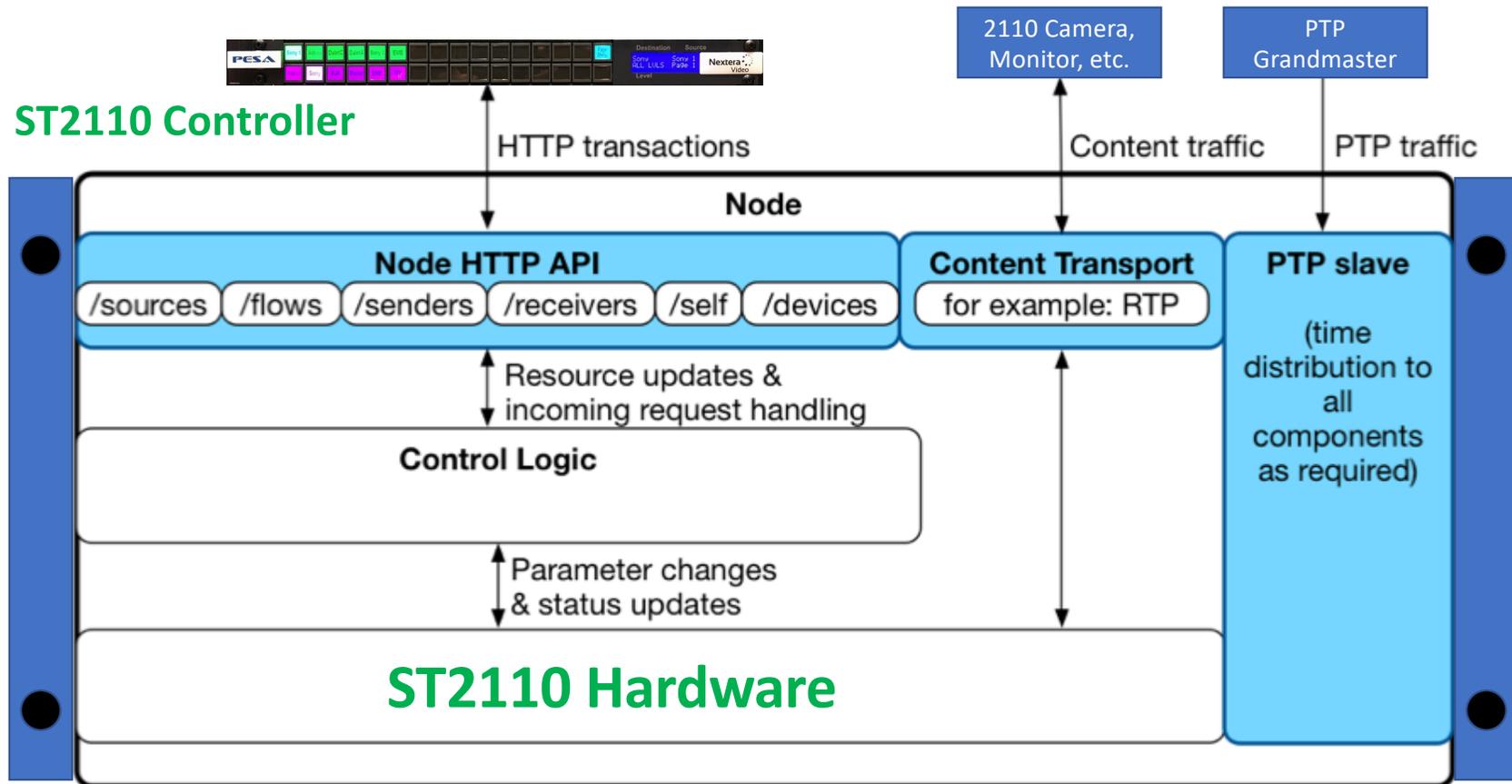
- 1 Sources automatically register with RDS
- 2 Control Panel gets list of devices from RDS
- 3 Upon button press, control system commands receiver to join the new multicast stream and leave the previous one

How is NMOS Accessed?



- Through a set of Application Program Interfaces (APIs) - RESTful
- **In Plain English:**
 - **http PUT/GET:** *http://<IP Address>/x-nmos /<API Name>/...*
- **Examples:**
 - *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 are the Interfaces?



Required Components

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

Geneva
July 2020

- III Operational Control**
- 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
- IV Configuration and Monitoring**
- IV.1 IP assignment and low-level configuration: DHCP, AMWA IS-09



➤ Validated via the “JT-NM Tested” Program

IS-04 (Registration & Discovery)



Consists of 3 API's
(Application Programming Interfaces)

Node API

Registration
API

Query API

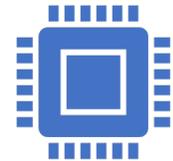
Node
[Camera, Monitor]

Registry
[PC running RDS SW or built into switch]

IS-05 (Connection Management)



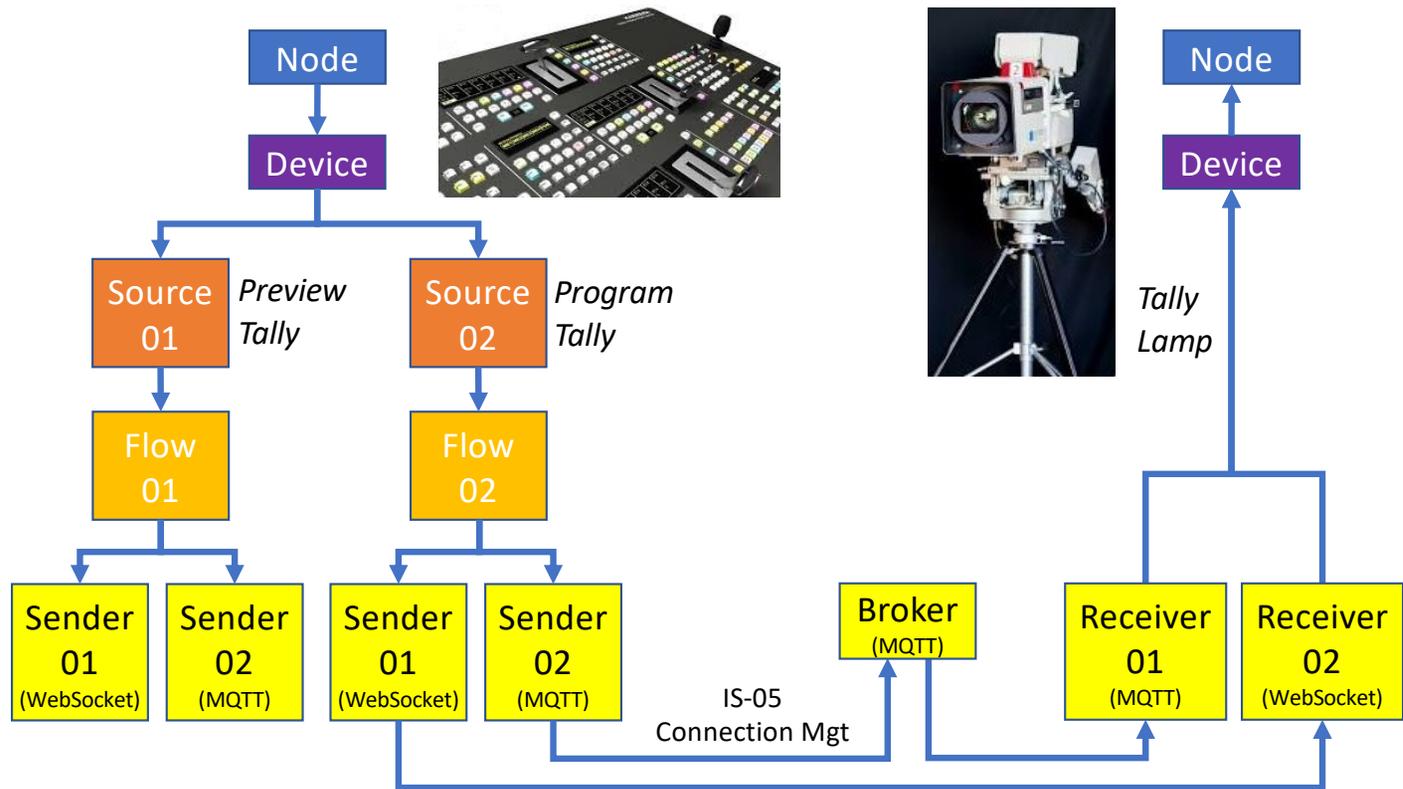
- IS-05 is an API which provides the means to create a connection between Senders and Receivers
- Enables switching through “activations”
- Activations can be immediate, relative, or absolute



IS-07 Event & Tally



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



IS-08 (Audio Mapping)



Provides SDI-router-like capabilities

- Combine individual channels from multiple sources into any output

Audio routing/shuffling facility with 4 APIs:

Inputs

Outputs

Map

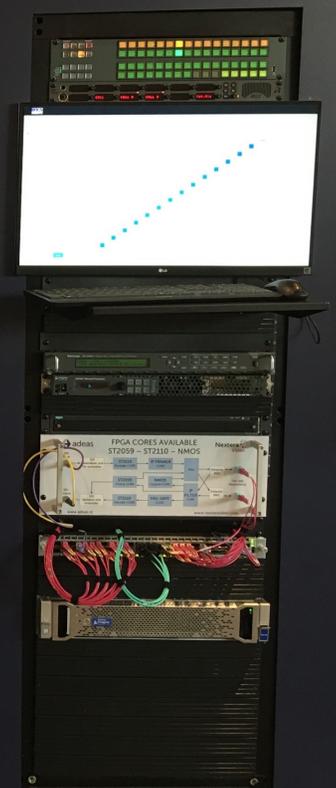
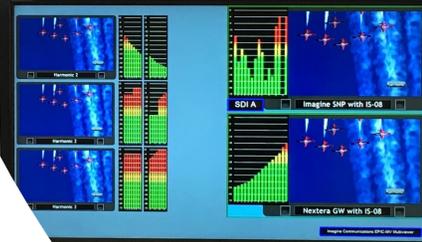
I/O

NAB '19 IP Showcase IS-08 Audio Demo

- Multi-vendor demonstration of Audio Mapping
- 3x 16-channel Senders
- 2x 16-channel Receivers

Support Audio Breakaway via an
Open Protocol using **AMWA** NMOS
IS-08 Audio Channel Mapping

IS-08 Demo Participants



IS-08 Demo – Audio Remapping



IS-09 (System Resource)



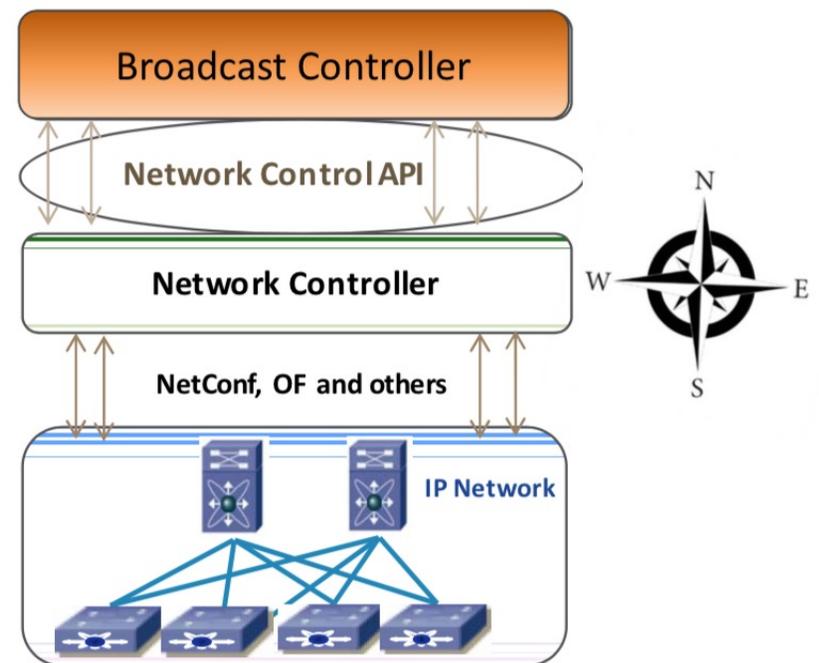
- Provides a global resource within the ST 2110 Environment
- Located using DNS Service Discovery (DNS-SD)
- Read by Media Nodes on Startup to determine:
 - System ID (assigned randomly at each facility)
 - Protocol (http or https)
 - NMOS API versions supported
 - PTP domain and announce interval
 -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

Optional Components

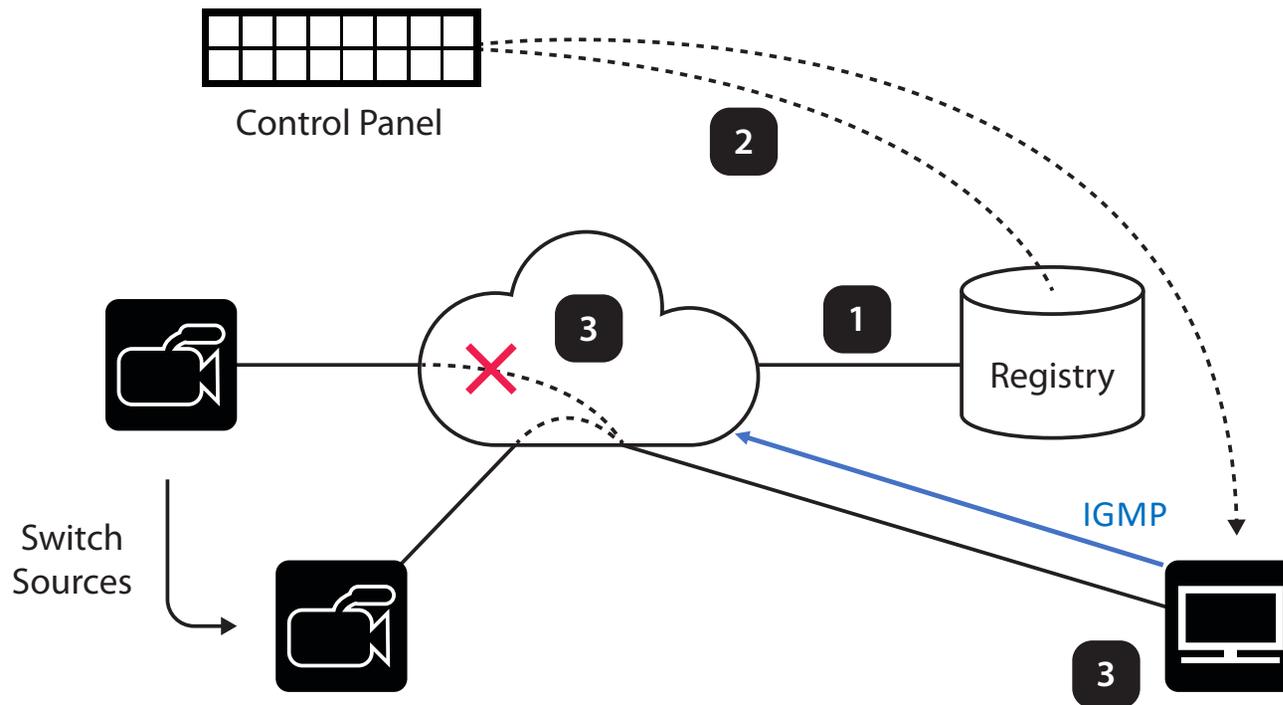
IS-06 (Software Defined Networking)



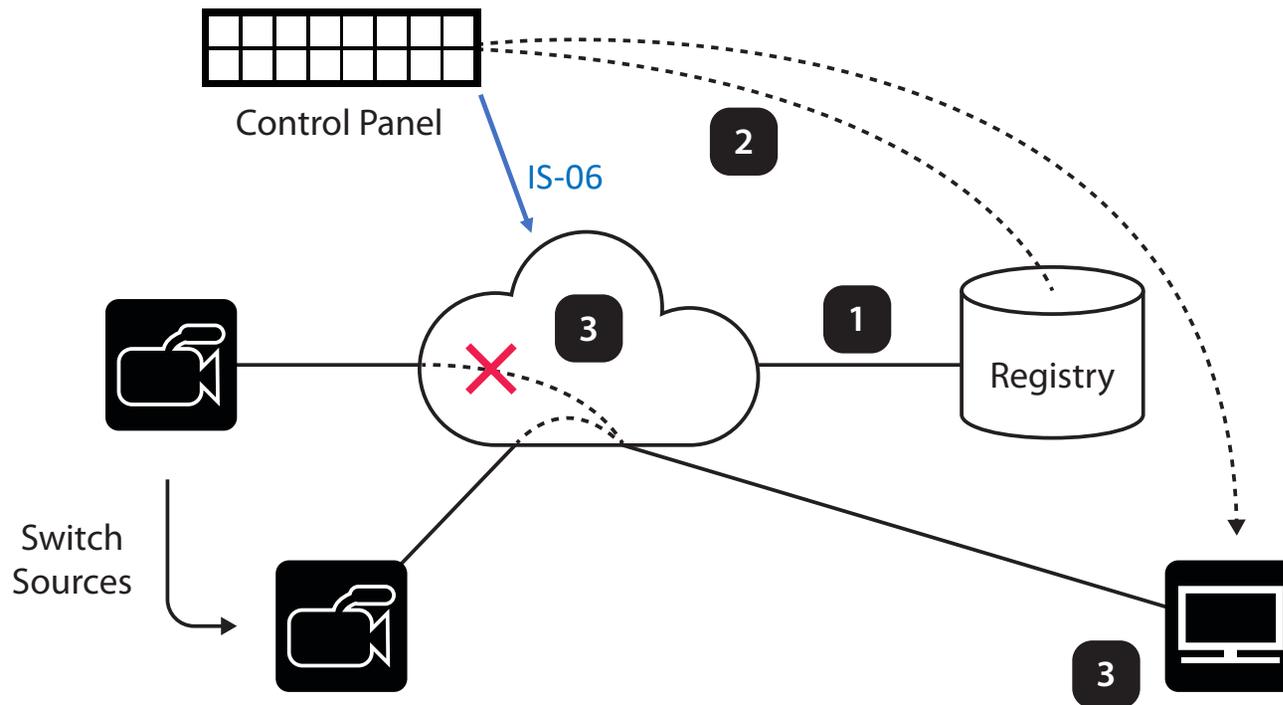
- Defines a “northbound API” between the network controller and the broadcast controller
- Benefits:
 - Network Topology Discovery
 - Direct authorized control over the packet routing (vs IGMP)
 - Bandwidth Management
 - Can be used to prevent dropped packets in under-provisioned networks



IGMP Switching



SDN Switching



BCP-002 (Grouping)

- Best practices for grouping NMOS resources
- Uses the 'tags' resource in IS-04 in order to achieve 'natural grouping' of Senders and Receivers
- Ex) Video, Audio, and ANC from a specific device
- Uses “grouphint” tag & roles

Grouping Example



Playout server sender with 1 video & 2 audio flows

Video 1 group:
“Playout
Master”

Audio 1 group:
“Playout
Master”

Audio 2 group:
“Playout
Master”

Video 1 role:
“Primary”

Audio 1 role:
“Audio 1 –
2ch”

Audio 2 role:
“Audio 2 –
5.1ch”

Goals:

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

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

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

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

Control Security (Work In Progress)



BCP-003-01

Uses Transport Layer Security (TLS) to encrypt 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)

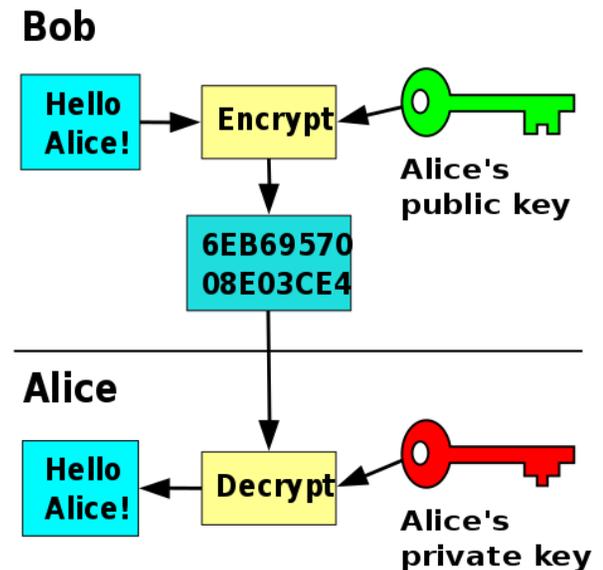
IS-10 Authorization API

- Accompanies the [BCP-003-02](#) specification to restrict what users are authorized to change in an NMOS system.
- Based on JSON Web Tokens and OAuth 2.0

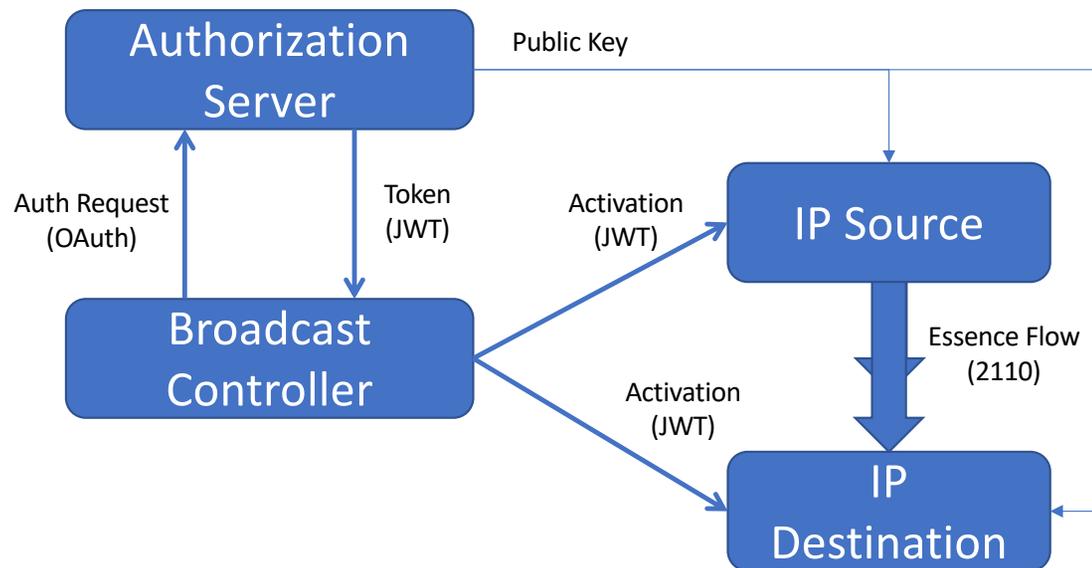
Public Key Infrastructure (PKI)



- A set of roles, policies, and procedures needed to create, manage, distribute, use, store & revoke digital certificates and manage public-key encryption



NMOS Security Example



The Future of NMOS (Under Development)

BCP-006 (NMOS for JPEG-XS)



- 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

IS-11 (Stream Compatibility Management)



- Formerly EDID (Extended Display Identification Data)
- State of a Sender can be tuned to be compatible with a corresponding Receiver or many compatible Receivers
- Example:
 - Receiver supports 2160p59 or 1080p59
 - Sender set to 2160p59
 - Second receiver subscribes but only supports 1080p59
 - Sender TX Format is adjusted to 1080p59
- See BCP-004-01 Receiver Capabilities
 - Establishes a Capabilities register
- See BCP-005-01 NMOS EDID to Receiver Capabilities Mapping

IS-12 (Device Control Protocol)



- Goal is to create a Universal Control Protocol
- Exposes a common, but vendor-extensible API
- Replacement for:
 - SNMP – Too difficult to add standard MIBs
 - OpenConfig – Scope too narrow
 - Ember+ – Great approach, but not 100% open
- Device Model provides a structured view of the controls and statuses of the parameters inside the device
- Uses Websockets & JSON
- References MS-005-01/02/03 Frameworks/Block Specs

Take-aways



NMOS IS-04 and 05 are solid, stable, and mature



They are employed in most all new SMPTE 2110 products



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 enables plug and play switching of IP devices and is being extended to go far beyond that with stream mapping, and ultimately full device configuration.

Thank You – Any Questions...?



NMOS

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Please see our Live Demo at C2620
(Between Grass & Imagine)