

AMWA NMOS: The whole story

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Technical challenges in an all-IP infrastructure

Transport
ST 2110



Discovery



Security



Timing
ST 2059



Connection



Monitoring



Resilience
ST 2022-7



Control



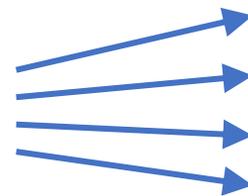
Automation



Networked Media Open Specifications

- Specifications for discovering, connecting and managing resources
- Developed by AMWA, published openly via GitHub
- Tested at Networked Media Incubator workshops
- Web-friendly: JSON, REST HTTP, WebSockets, message queues...

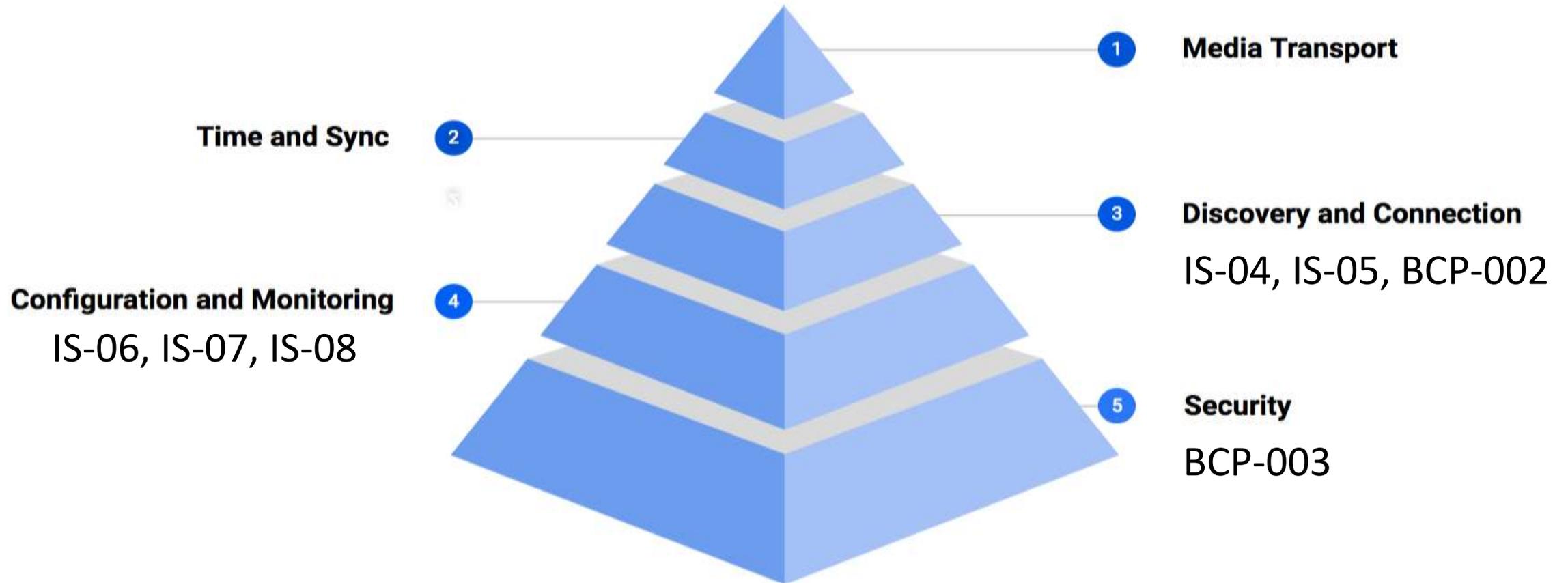
amwa-tv.github.io/nmos



Specifications
Documentation
Developer resources
Wiki

EBU's Technology Pyramid for Media Nodes

Minimum user requirements to build and manage an IP-based media facility tech.ebu.ch/docs/tech/tech3371.pdf



AMWA IS-04 v1.2

Discovery and Registration



What does it do?

- Allows control and monitoring applications to find the resources on a network

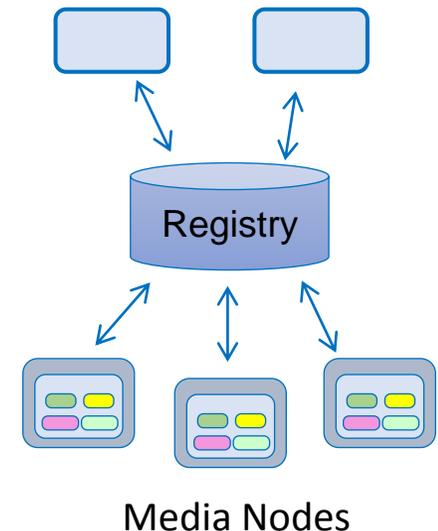
Why does it matter?

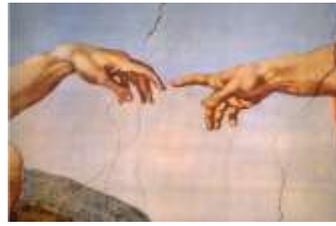
- Enables for automation and reducing manual overhead
- Essential for dynamic deployment

How does it work?

- Media Nodes locate IS-04 registry using DNS-SD (unicast preferred)
- Media Nodes register their resource information with HTTP + JSON
- Applications query with HTTP and/or subscribe with WebSockets

Control and Monitoring Applications





What does it do?

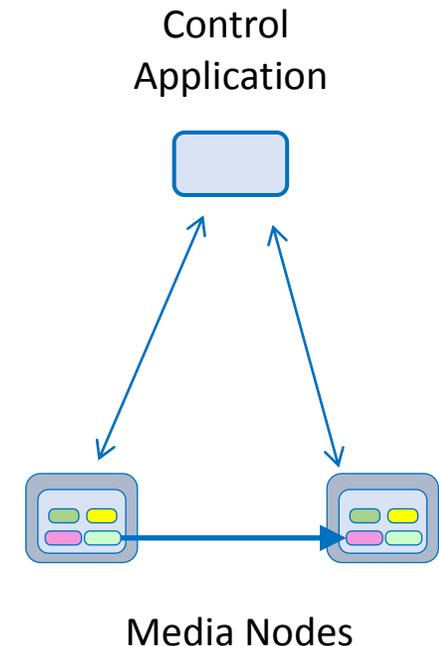
- Provides a transport-independent way of connecting Media Nodes
- Supports single + bulk connections, immediate + delayed connections

Why does it matter?

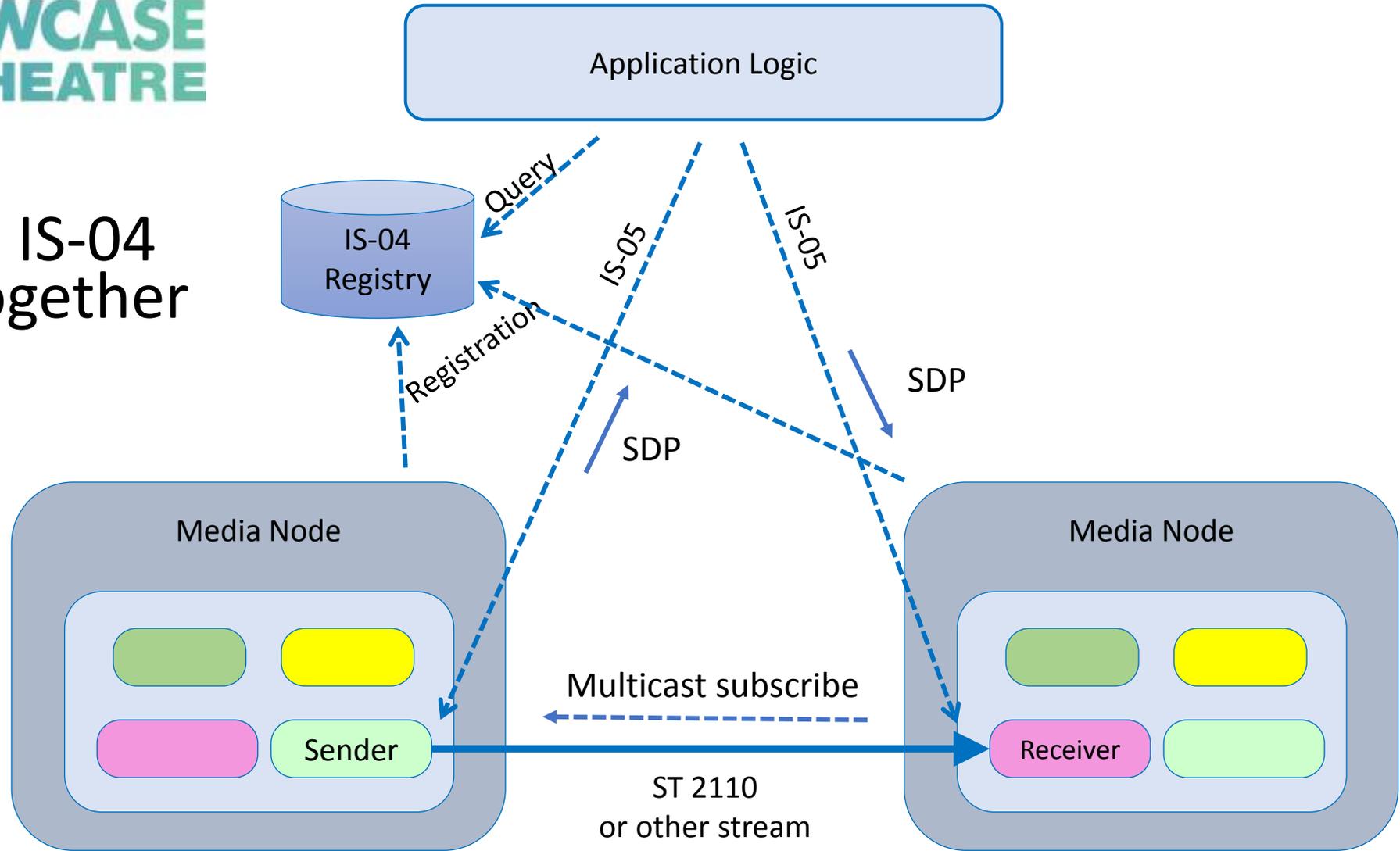
- ST 2110 does not specify how to do this
- Danger of multiple proprietary approaches
- Provides extensibility to other types of IP transport

How does it work?

- IS-04 provides information about Senders and Receivers
- Control application sends instructions to Media Nodes
- `transportfile` parameter conveys the connection information for ST 2110 streams



IS-05 and IS-04 working together





What does it do?

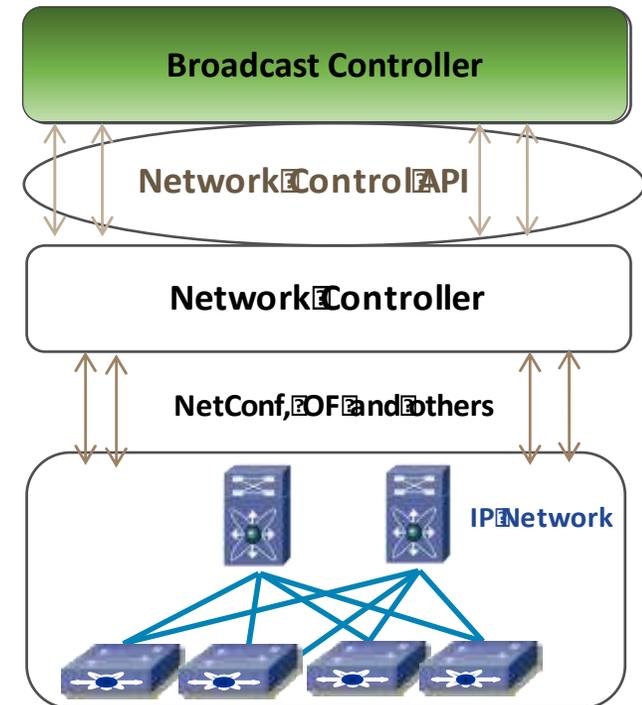
- Lets broadcast control applications

Why does it matter?

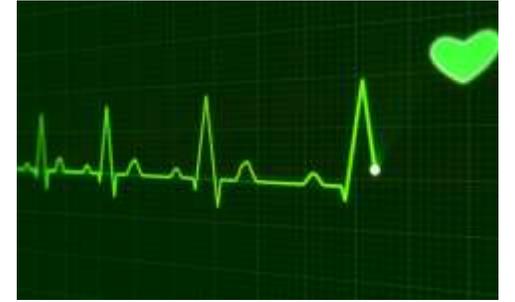
- Ethernet switch output ports might only support a limited number of media flows before they start dropping packets
 - This is different to what happens in a typical SDI router
 - Which means corrupted video and audio

How does it work?

- “Northbound” API from network fabric’s controller
- Provides topology discovery, flow authorization and assurances of flow bandwidth



AMWA IS-07 v1.0 Event and Tally



What does it do?

- Provides an IP-friendly mechanism to carry time-sensitive information
- For example: camera tally information, audio levels, control panel status

Why does it matter?

- ST 2110 does not provide an equivalent to GPI functionality
- Danger of multiple proprietary approaches
- Consistency with other NMOS specifications

How does it work?

- Media Nodes emit and consume state and state change info
- Lightweight messages sent using WebSockets or MQTT
- Message flows connected using IS-05

```
{
  "identity": {
    "source_id": "1ea39324-a32b-4e1d-86e9-33f9956ebc60"
  },
  "event_type": "string",
  "timing": {
    "creation_timestamp": "1532504241:104000200"
  },
  "payload": {
    "value": "ok"
  },
  "message_type": "state"
}
```

An IS-07 message

AMWA IS-08 v1.0 Audio Channel Mapping

What does it do?

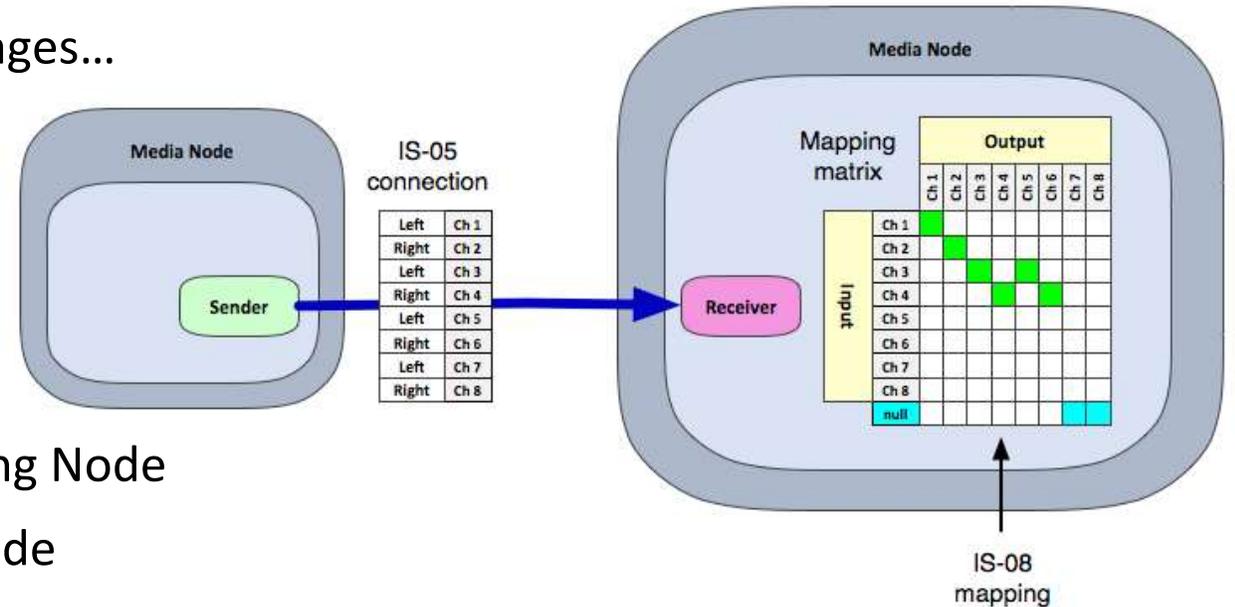
- Allows channel-level operations within NMOS environments
- For example: muting channels, swapping languages...

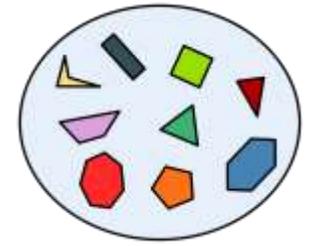
Why does it matter?

- Expected functionality for real world use
- Not included in IS-05's functionality

How does it work?

- Controller gets channel information from sending Node
- ...and sends mapping matrix to the receiving Node
- Can also do sender-side matrixing





What does it do?

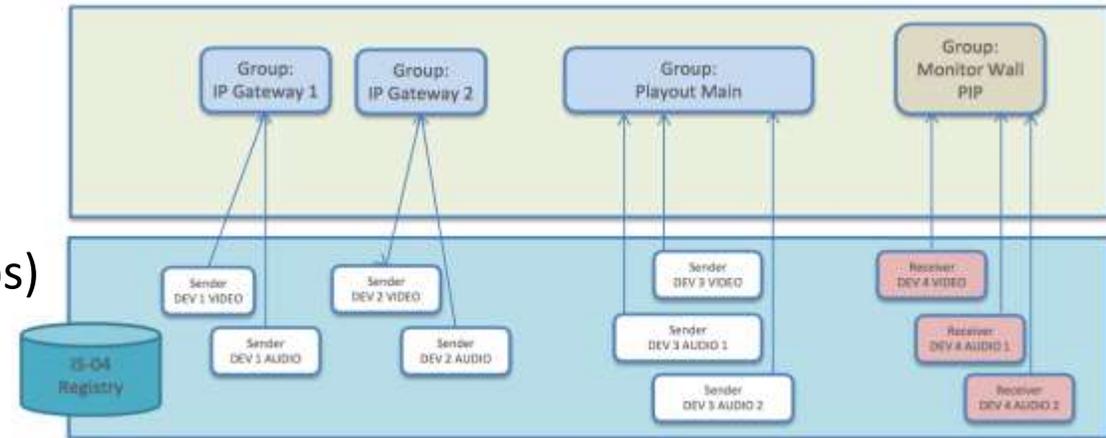
- Defines best practice for tagging groups of resources based on the function of a device, for example:
 - 2110-20, -30, -40 senders within a camera
 - 2110-20 receivers for multiviewer panes

Why does it matter?

- Can simplify “bulk” connections (often made on groups)
- Not defined in IS-04 or IS-05
- Avoid different vendors taking different approaches

How does it work?

- Specifies a “grouphint” tag for NMOS JSON
- Types of tags are maintained in a **parameter register**



```

"tags": {
  "urn:x-nmos:tag:grouphint/v1.0": [
    "MV PIP 1:Video"
  ]
}
    
```



What does it do?

- Defines best practice for securing API communications
 - Confidentiality, Integrity, Identification, Authentication, Authorization

Why does it matter?

- Users don't want our IP systems hacked
 - So are demanding security in the control plane
- IS-04 etc can use HTTPS but don't say enough about how to do that in an interoperable and secure way

How does it work?

- BCP-003-01 specifies best practice for encrypting HTTP and WebSocket messages
 - TLS 1.3 preferred, TLS 1.2 allowed. Recommends appropriate cipher suites
 - Recommendations for X.509 PKI
- BCP-003-02 specifies best practice for authorization of API access
 - OAuth 2.0 and JSON Web Tokens

AMWA MS-04

Identity and Timing Model

FD648C53-1026-47B6-BA6C-148B527E275B
D0E278E1-1AEF-4894-A9B0-AEC72B2FC794
2377E68F-7ECE-4BE1-AC30-71FE02646741
BDB635CF-B722-4857-A194-33FA1832CC63
3811495E-5F49-4491-A842-55FB17CD0E67
F3429E18-9B29-43A3-9F82-D02541E18319



What does it do?

- Formalizes concepts such as Source, Flow, Time Value...
 - Re-examines the JT-NM reference architecture model taking into account many typical workflows
- Provides a basis for new specifications

Why does it matter?

- Increased content reuse means increased reliance on end-to-end models
- ST 2110's RTP timestamps are insufficient, so we need a model for future extensions

How does it work?

- Separate content with business value (Sources, Flows) from the systems that process it
- Explain through scenarios, formalize with UML

What will it do?

- Provide Media Nodes with “global” information about their environment
 - e.g. PTP settings

Why does it matter?

- We need systems to start working asap after (re)connection or power-up
- DNS, DHCP, etc. provide a lot of what a Media Node needs... but not everything

How does it work?

- Read-only JSON resource

```
{
  "id": "3b8be755-08ff-452b-b217-c9151eb21193",
  "version": "1441700172:318426300",
  "label": "ZBQ System",
  "description": "System Global Information for ZBQ",
  "caps": {},
  "tags": {},
  "is04": {
    "heartbeat_interval": 8
  },
  "ptp": {
    "announce_receipt_timeout": 2,
    "domain_number": 57
  },
  "syslogv2": {
    "hostname": "biglogger.ebu.ch",
    "port": 3477
  }
}
```

NMOS Core



What will it do?

- Provide common building blocks for new and updated NMOS specs

Why does it matter?

- Overhead of maintaining an increasing portfolio of specifications
- Interactions between specifications makes updating complex

How will it work?

- “Factor out” repeated content from existing specifications
 - RAML and JSON Schema definitions
 - Type definitions
 - URL schemes
 - Documentation

State of specifications

Published

- IS-04 v1.0, v1.1, v1.2
- IS-05 v1.0
- IS-06 v1.0
- IS-07 v1.0
- IS-08 v1.0
- BCP-003-01

Final Approval (as of March 29)

- BCP-002-01
- MS-01

In progress

- IS-04 v1.4
- NMOS Core and IS revisions
- BCP-003-02 API Authorization
- IS-09 System API

Testing

- New work Incubated at AMWA workshops
 - With VPN available for testing APIs in advance
- AMWA now provides an automated test suite
 - Python, open source, extensible
 - Allows vendors to start testing in advance
 - Saves time at events



Pass

Fail

Warning

Test Disabled

Could Not Test

Not Implemented

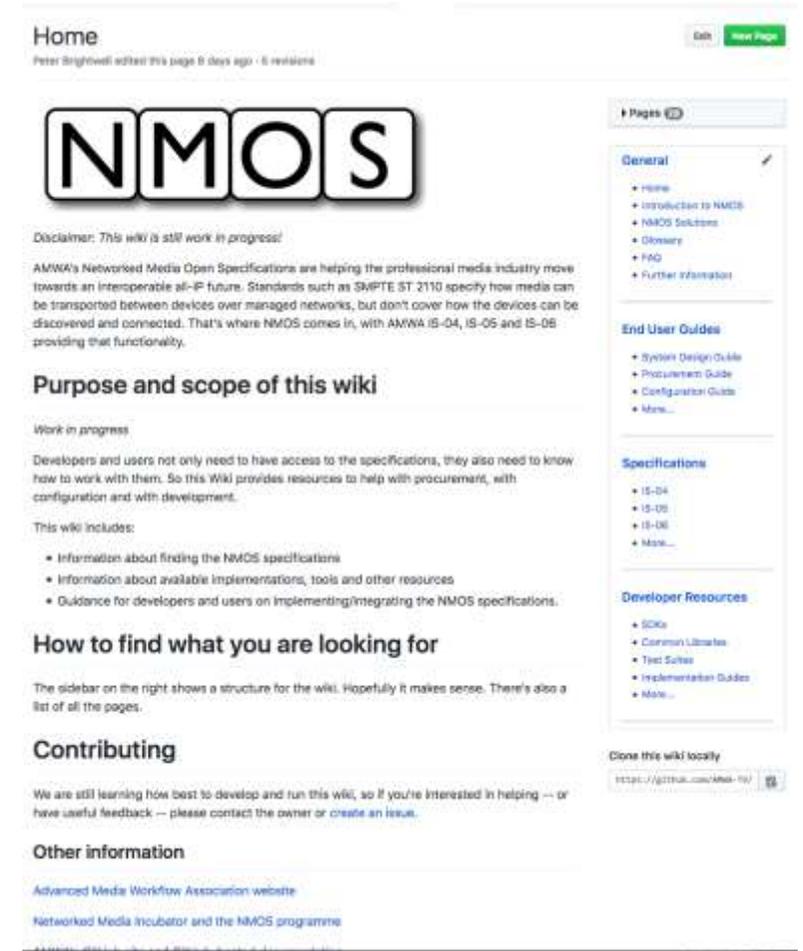
Manual

Not Applicable

NMOS Wiki

- Help with the specs and docs
- Information about available implementations and tools
- Resources for developers
- Resources for users

github.com/AMWA-TV/nmos/wiki



The screenshot shows the homepage of the NMOS Wiki. At the top, it says "Home" and "Peter Brightwell edited this page 8 days ago · 6 revisions". Below this is the "NMOS" logo in large, bold, black letters. A disclaimer states: "Disclaimer: This wiki is still work in progress! AMWA's Networked Media Open Specifications are helping the professional media industry move towards an interoperable all-IP future. Standards such as SMPTE ST 2110 specify how media can be transported between devices over managed networks, but don't cover how the devices can be discovered and connected. That's where NMOS comes in, with AMWA IS-04, IS-05 and IS-06 providing that functionality." The main content area is titled "Purpose and scope of this wiki" and includes a "Work in progress" section. It explains that developers and users need to know how to work with the specifications, and provides resources for procurement, configuration, and development. A "This wiki includes:" section lists: "Information about finding the NMOS specifications", "Information about available implementations, tools and other resources", and "Guidance for developers and users on implementing/integrating the NMOS specifications." Below this is a "How to find what you are looking for" section, which notes that the sidebar on the right shows a structure for the wiki. The "Contributing" section states: "We are still learning how best to develop and run this wiki, so if you're interested in helping -- or have useful feedback -- please contact the owner or create an issue." The "Other information" section includes links to the "Advanced Media Workflow Association website" and "Networked Media Incubator and the NMOS programme". On the right side, there is a sidebar with a "Pages" section containing a tree view of the wiki's structure: "General" (Home, Introduction to NMOS, NMOS Solutions, Glossary, FAQ, Further information), "End User Guides" (System Design Guide, Procurement Guide, Configuration Guide, More...), "Specifications" (IS-04, IS-05, IS-06, More...), and "Developer Resources" (SDKs, Common Libraries, Test Suites, Implementation Guides, More...). At the bottom right, there is a "Clone this wiki locally" button with the URL "https://github.com/AMWA-TV/nmos".



Available NMOS Solutions

AMWA is compiling lists of:

- Open source implementations
 - Python, C++, Javascript...
- Freeware tools
- Support in commercial products

github.com/AMWA-TV/nmos/wiki/NMOS-solutions

Disclaimer: listing on Wiki does not represent an AMWA endorsement or certification



Open Source & Freeware

Name	Language	License	Description
NOC N&D NMOS v1.0e R1	Python	Apache 2.0	S-04 and S-05 registry and APIs based on Minerva in AMWA workshop.
NOC N&D NMOS Web Router	Javascript	Apache 2.0	S-04 and S-05 web-based client application
Node NMOS Zapper	JSX	Freeware	S-04 and S-05 client application for Windows and Linux
Opennms-cpp	C++	Apache 2.0	S-04 and S-05 API implementations, registry and node applications
Opennms-js	Javascript	Apache 2.0	S-04 and S-05 web-based client application
StreamPure Media Ledger	Javascript (NodeJS)	Apache 2.0	S-04 v1.0 APIs

Note that inclusion in this list is not an endorsement by AMWA or a guarantee of conformance to the specifications.



Commercial Hardware & Software

This section will list commercial implementations of the NMOS specifications available from AMWA members. It will include information about which NMOS specifications, versions and features are supported, and provide links to the manufacturer's product pages. (Note to manufacturers: the linked product page must include information about NMOS support)

Note that inclusion in this list is not an endorsement by AMWA or a guarantee of conformance to the specifications.

The following table is still being populated by the AMWA community.

Company	Product	Supported Specifications	Comments
Atis	tc	S-04 v1.2 S-05 v1.0	Broadcast Control & Monitoring System
AVC	AVC-NET	S-04 v1.2 S-05 v1.0	Broadcast CDN Controller
Bitstream	emULBON emNEW tc	S-04 v1.2 S-05 v1.0	IP Gateway converters
Macnica	VMA	S-04 v1.2 S-05 v1.0	General purpose Video IP Accelerator, IP Gateway, Multi-channel capture processing and playout of SD/HD streams
Node	Video IP App	S-04 v1.2 S-05 v1.0	IP Gateway device
Open	Raptor Next SDP	S-04 v1.2 S-05 v1.0	IPSCo Gateway IPSCo/HDMI Gateway MSSE7 / MMS gateway
Techno, inc.	HySM	S-04 v1.2 S-05 v1.0	Hybrid IPSCo Monitoring system
Mediatek	SX2000 Series SX3000 Series	S-04 v1.2 S-05 v1.0 S-05 v1.0	Spectrum and Spectrum-2 Ethernet Switches including on-switch S-04 registry
Linear	L8000 L5700	S-04 v1.2 S-05 v1.0	IP and SD Hybrid waveform Monitor
ALIA	PR-1003-HDMI PR-1002-SD PR-1001-HDMI eDns-IP	S-04 v1.2 S-05 v1.0	IP Converters and interfaces
Neonix Video	NMOS Software Zone	S-04 v1.2 S-05 v1.0	Software core for FPGA embedded in ZedBoard processor

NMOS at the IP Showcase

Demonstrations

- IS-07 Event and Tally
- IS-08 Audio Channel Mapping
- BCP-003 Authorization
- TR-1001

Presentations

- Mon 3.00pm: The Whole Story
- Mon 3.30pm: Scalability & Performance
- Mon 5.00pm: Things You Might Not Know
- Tues noon: Audio Transport & Routing
- Wed 9.30 – 11.00: API Security (3x present.)
- Wed 11.30: GPI Replacement and Much More

Some of those who have made NMOS happen...

