



AMWA NMOS: State of Play and What's Next

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In this presentation...

- Introduction to **NMOS**
 - why, what, who
- The specifications:
 - IS-04, -05, -06, -07
- State of play
- New work
- NMOS in the “full stack”





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...

Specifications: github.com/AMWA-TV/nmos-*

Documentation: amwa-tv.github.io/nmos

Wiki: github.com/AMWA-TV/nmos/wiki



Technical challenges in an all-IP infrastructure

Transport
ST 2110



Timing
ST 2059



Resilience
ST 2022-7



Discovery



Security



Connection



Monitoring

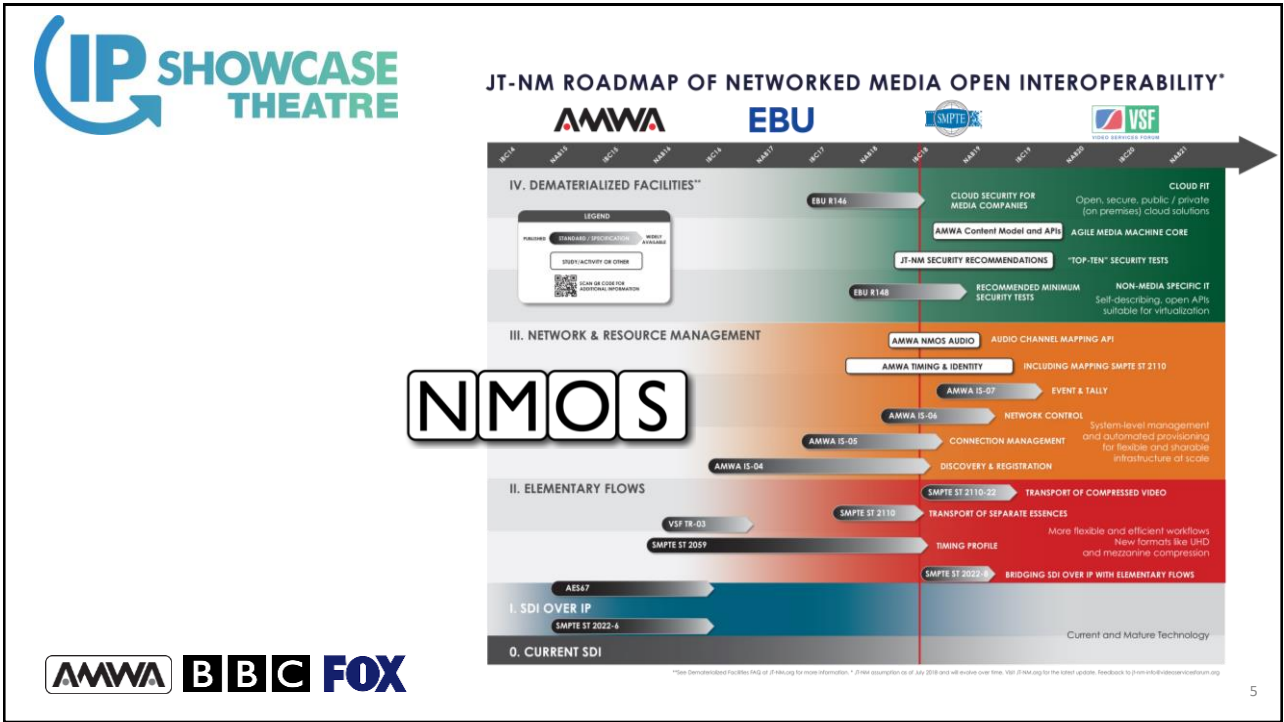


Control



Automation







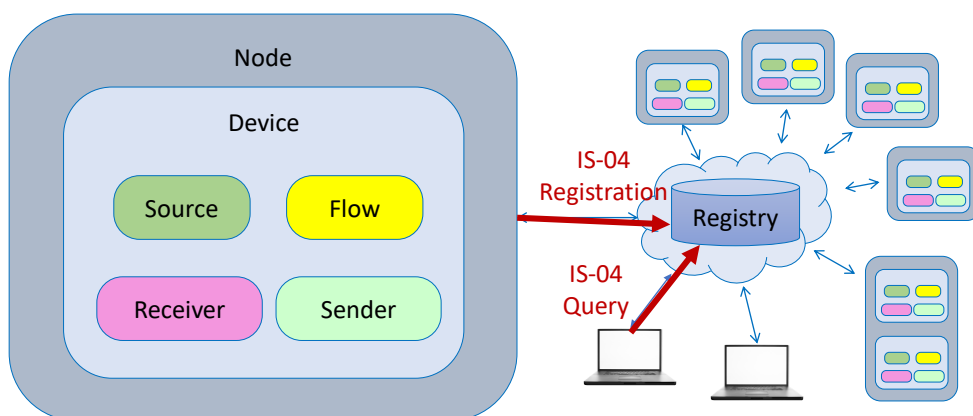
AMWA IS-04: Discovery and Registration

- Discovery is essential for automation at scale
 - Especially in a dynamically changing environment
- Avoid tie-in to proprietary discovery mechanism
- Defines APIs for registering and querying resources

github.com/AMWA-TV/nmos-discovery-registration



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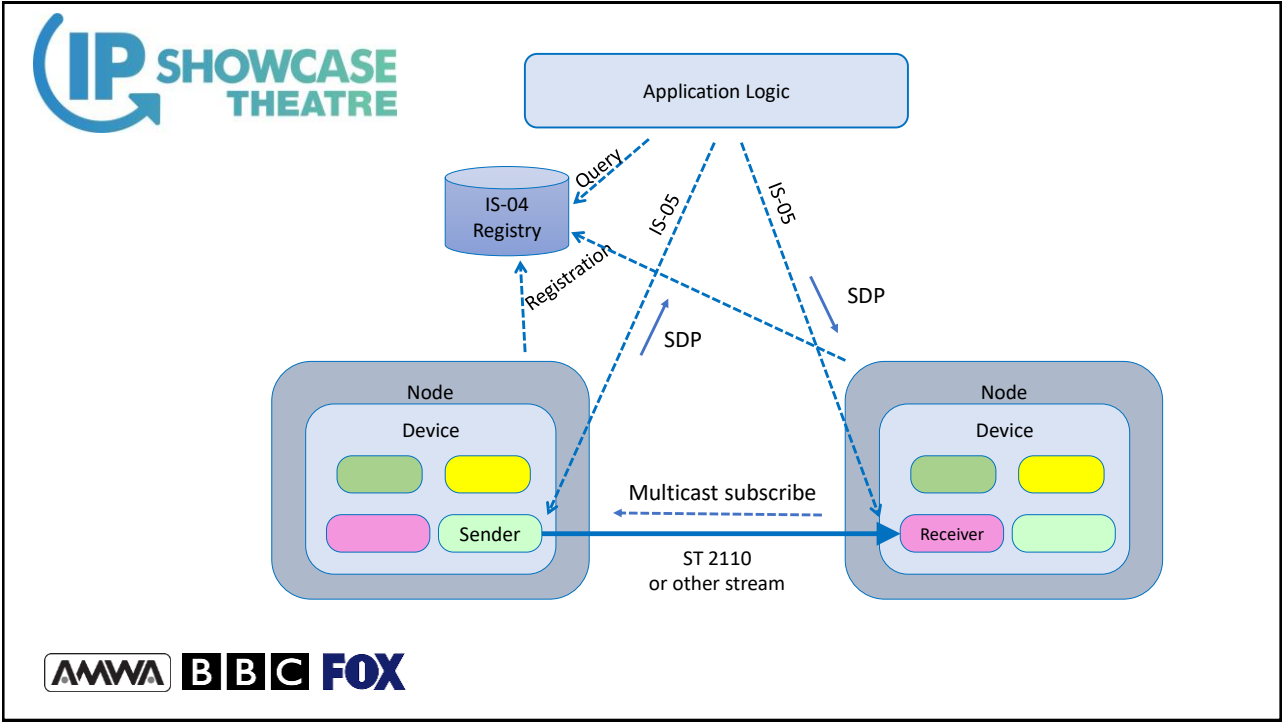




AMWA IS-05 Device Connection Management

- Remove dependencies on proprietary and legacy routing protocols
- Support dynamic deployment and configuration
- Connect senders and receivers
- Not tied to particular transport or format





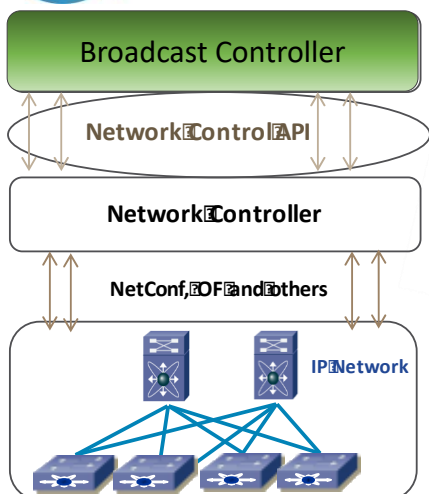


Why should I care about IP Media “Network Control”?

- Enterprise Ethernet switches don’t drop packets...
- Unless flows converging on an output port add up to more bandwidth than the port can handle...
- Then you lose packets...
- And your media flows become corrupted!



AMWA IS-06: Network Control API



“Northbound” API of Network Controller to:

- Control how flows move on the network,
- Discover network topology,
- Assure bandwidth for media flows,
- Ensure network security by only allowing authorized flows, senders and destinations,
- “No packet moves on the network without authorization”





AMWA IS-07* Event & Tally API

- Provide a modern approach to GPI-type functionality
 - E.g. camera tally event information
- Event messages sent over WebSocket or Message Queue
- Builds on AMWA's "source-flow-grain" model
- Further information: 3.30 pm today (Monday 17th)

*AMWA have reserved "IS-07" for this Work In Progress.



A large graphic with the word "Scalability" in the center, surrounded by a dense grid of small, repeating text "This is a placeholder for a large-scale visualization or data set." The text is arranged in a grid pattern, creating a textured background. The word "Scalability" is prominently displayed in a large, black, sans-serif font in the center of the image.

Scalability

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Scalability studies

- Testing IS-04 and IS-05 operates correctly with thousands of nodes
- Mininet simulator
- Further information: 4 pm today (Monday 17th)

*NB: IS-04 does **not** depend on multicast DNS*





State of specifications

- IS-04, IS-05, IS-06 are published AMWA Specifications
- IS-07 is Work In Progress

IS-04 Version	Core functions	Peer-to-peer	Support HTTPS, WSS	Advanced queries	Paged queries	ST 2110 Flow attributes	Multiplexed Flows (ST 2022-6)	Support basic connections	Support IS-05 connections
1.0	✓	✓	X	X	X	X	X	✓	X
1.1	✓	✓	✓	✓	✓	✓	✓	✓	X
1.2	✓	✓	✓	✓	✓	✓	✓	(✓)	✓



NMOS Wiki

- How to find the specs and docs
- Information about available implementations and tools
- Resources for developers
- Resources for users

github.com/AMWA-TV/nmos/wiki




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



Company	Product	Supported Specifications	Comments
BBC R&D	NMOS Joint IP Explorer	IS-04 and IS-05 registry and APIs (used as reference in AMWA workshops)	Broadcast Control & Monitoring System
Sony	NMOS-CP	IS-04 and IS-05 registry and APIs	Broadcast SDN Controller
Stratopunk	Media Linger	IS-04 v1.0 APIs	IP Gateway converters
Hybrid	Hybrid IP Accelerator	IS-04 v1.2, IS-05 v1.0	General purpose Video IP Accelerator: IP Gateway, Multi-channel capture processing and playout of ST2110 streams.
Hybrid	Hybrid IP Gateway device	IS-04 v1.2, IS-05 v1.0	IP Gateway device
Hybrid	Hybrid IPSD Gateway	IS-04 v1.2, IS-05 v1.0	IPSD Gateway
Hybrid	Hybrid IPSD Monitoring Instrument	IS-04 v1.2, IS-05 v1.0	Hybrid IPSD Monitoring Instrument



Multi-Query Mode [http://192.168.20.178:8888/omniquery/v1.2](#)

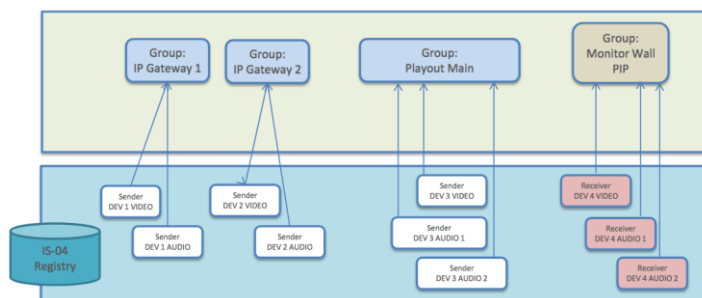
Nodes	Devices	Senders	Receivers
<ul style="list-style-type: none"> EMB 192.168.20.198 #2110 node Sony IPXC RX1 Sony IPXC TX2 Ross Covalex Board Node Sony IPXC TX1 Sony IPXC TX1 EMB 192.168.20.178 #2110 node mpgcenter IPB-100-HDMI-ENG014-Node Minid MicroM IP 3 ipcam-04-01 VC-MHON-006 @192.168.1.139 Minid MicroM IP 2 RSC-Node Ross Board Node ipcam-06-mhona 	<ul style="list-style-type: none"> EMB 192.168.20.198 Device CH1 Sony IPXC RX1 Sony IPXC TX2 Ross Covalex Board [708309438A] device Sony IPXC TX1 EMB 192.168.20.178 Device CH1 RSS Aha 2110 (RC Showcase) IPB-100-HDMI-ENG014-Device1 Minid MicroM IP 1 Device Device on vpl-nova-sendir_C030913 Minid MicroM IP 2 Device Ross Newel [00F98037A2] device OV Kaha0-IP-C-IP-13 OV Kaha0-IP-C-IP-14 OV Kaha0-IP-C-IP-10 	<ul style="list-style-type: none"> EMB 192.168.20.178 VidSender 000 EMB 192.168.20.178 AusSender 016 EMB 192.168.20.178 AusSender 020 EMB 192.168.20.178 AusSender 028 EMB 192.168.20.178 AusSender 030 EMB 192.168.20.178 AusSender 040 EMB 192.168.20.178 AusSender 048 EMB 192.168.20.178 AusSender 070 EMB 192.168.20.178 AusSender 076 EMB 192.168.20.178 AusSender 080 2110-00 out 1 2110-00 out 2 Minid 2110 080 2110 Out 1 2110 	<ul style="list-style-type: none"> Ross NEWTY Audio sub-audio CH 91 Ross NEWTY Audio sub-audio CH 46 Ross NEWTY Audio sub-audio CH 50 Ross NEWTY Audio sub-audio CH 47 Ross NEWTY Audio sub-audio CH 48 Ross NEWTY Audio sub-audio CH 46 Ross NEWTY Audio sub-audio CH 42 Ross NEWTY Audio sub-audio CH 44 Ross NEWTY Audio sub-audio CH 43 Ross NEWTY Audio sub-audio CH 43 Ross NEWTY Audio sub-audio CH 43





Grouping

- Current work: represent “natural groups” created by Device functionality
- Further work: represent human- or automation-created groups



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Audio Channel Mapping

- Correct typical problems encountered today
 - E.g. swapped languages on incoming feeds
- Proposal to add basic capability to NMOS specification set
- Technical approach currently in discussion in Incubator



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Identity & Timing

- **Model** end-to-end through production
- Build upon JT-NM reference architecture
- Help steer representation into transport
- Next presentation!

```
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Automated testing

- Provide open-source test suites to check IS-xx interoperability.
 - Bring together previous activity
- Make it easier for developers, users, workshop organisers!



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API Security

- Maybe we don't want our IP broadcast systems hacked?
- Recommendations for interoperable secure use of NMOS APIs
 - Confidentiality, identification, integrity, authentication and authorisation
- HTTP / TLS, PKI, OAuth, JWT
- Avoids having incompatible security frameworks between vendors
- Draft specification available on GitHub:

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



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The Promise...



Swipe credit card...



Spin up broadcast channels....





NMOS in the full stack

Systems that when you “plug them in”:

- Get DHCP IP Address
- Find registry & register themselves with IS-04
- Obey IS-05 Connection Management
- Emit LLDP to ensure IS-06 Network Control functionality



Minimum Stack for IP endpoints necessary to build and manage a full scale facility

