JT-NM TESTED AUGUST 2022

JT-NM Tested Board Report

IP Media Equipment Testing For Interoperable Future

CONTENT

- What is JT-NM Tested?

- What did we test and why?
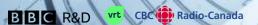
- Test plans and tools

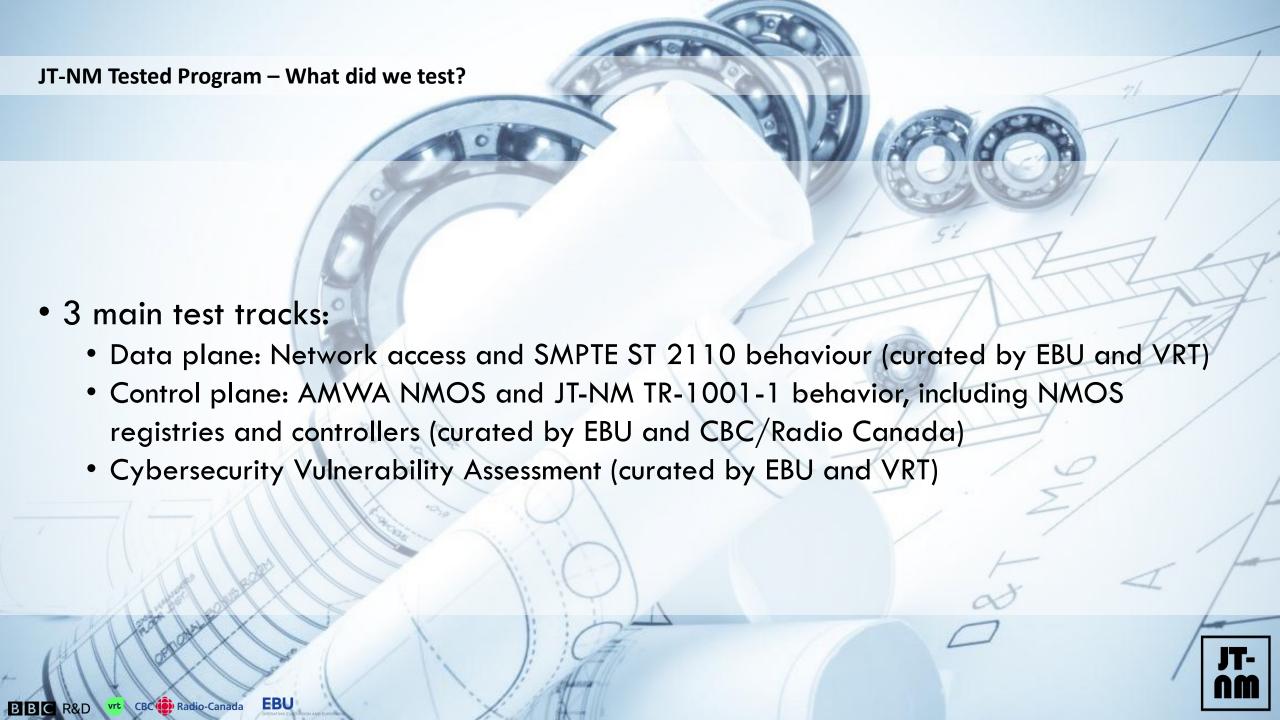- Network and Infrastructure

- Findings and results

- Conclusions

- The JT-NM Tested program offers documented insight into how vendor equipment conforms to specific SMPTE standards and AMWA NMOS specifications.

- Vendors who meet the testing criteria will have the opportunity to display badges and make public statements about their participation.

- The JT-NM Tested Catalog lists vendor results along with a detailed test plan.

- Anyone with the equipment listed in the test plan may execute the tests which were administered by the JT-NM test team, and you are encouraged to do so.

- It is important to note that the JT-NM Tested program is not a certification program; rather, it is a snapshot in time of how vendor equipment conforms to key parts of SMPTE standards and AMWA NMOS specifications.

- 3 main test tracks:
  - Data plane: Network access and SMPTE ST 2110 behaviour (curated by EBU and VRT)
  - Control plane: AMWA NMOS and JT-NM TR-1001-1 behavior, including NMOS registries and controllers (curated by EBU and CBC/Radio Canada)
  - Cybersecurity Vulnerability Assessment (curated by EBU and VRT)

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- Test Plans:
  - SMPTE ST 2110 Test plan
  - NMOS/TR-1001-1 Test plan
  - Cybersecurity Test Plan
- Main testing tools:
  - EBU LIST + multiple T&M devices
  - AMWA NMOS Testing Tool

Joint Taskforce on Networked Media
JT-NM Tested August 2022 Program
NMOS/TR-1001 Test Plan v1.2

JT-NM Tested August 2022 Program
NMOS/TR-1001 Test Plan v1.2

September 2022

t update that reflects the changes introduced by the testing
outlines additional support equipment used during the

1 August 2022

ting Tool Configuration and an example of UserConfig.py
CA and generateCerts
ns with the NMOS Test Suite
Controller allowing embedded Registry in a Controller

M Tested March 2020 Program"
Plan v1.4", 11 July 2022

ogram" NMOS/TR-1001 Test Plan v1.4 is used as the basis

ay undergo changes ahead of the final version.
Tested events carefully familiarise themselves with the new

uities resolution throughout the text.
r Media Nodes' Discovery of System Parameters and the
omated test cases of the NMOS Testing Tool.
ure Communication
eiver Capabilities.
ng the new test suite for Controllers.

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Joint Task Force on Networked Media
"JT-NM Tested Program August 2022" - 27 August 2022 v1.2

"JT-NM Tested Program August 2022"
SMPTE ST 2110 Test Plan v.1.2

Changelog to v1.1

- This is a post-face-to-face event update that reflects the changes introduced by the testing and experts teams on-site and outlines additional support equipment used during the testing.

Changelog to v1.0

- Test 3.3 updated.

Changelog to "JT-NM Tested March 2020 Program" Test Plan v.1.3 (pre-COVID)

- Pre-COVID on-site test plan v.1.3. is used as the basis for this revision.
- Initial release. This document may undergo changes ahead of the final version.
- It is recommended that participants of previous JT-NM Tested events carefully familiarize themselves with the new revision of the test plan.
- Editorial corrections and ambiguities resolution throughout the text.
- PTP Testing simplified.
- Added ST 2110-22/JPEG-XS tests.
- Minor improvements to multiple tests.
- Clarified timestamp behavior in ST 2110-30 and ST 2110-31 tests and added sender jitter tests.

Notation used in the document

JT-NM Tested Catalog results are presented as a capability map. This allows readers, especially end users, to focus on the capabilities demonstrated by devices during the JT-NM Tested event. JT-NM Catalogs use the following terms to characterize test results:

Capable (green mark):
A test item marked as 'Capable' means a device has demonstrated a capability that was required as part of a test listed in a JT-NM Tested Test Plan.
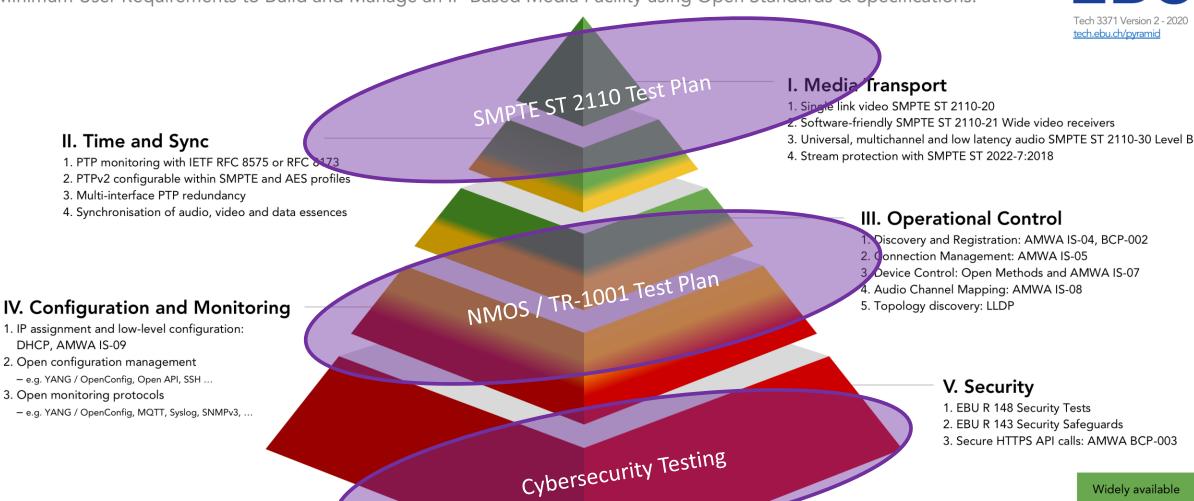
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THE TECHNOLOGY PYRAMID FOR MEDIA NODES

Minimum User Requirements to Build and Manage an IP-Based Media Facility using Open Standards & Specifications.

SMPTE ST 2110 Test Plan

NMOS / TR-1001 Test Plan

Cybersecurity Testing

I. Media Transport

1. Single link video SMPTE ST 2110-20
2. Software-friendly SMPTE ST 2110-21 Wide video receivers
3. Universal, multichannel and low latency audio SMPTE ST 2110-30 Level B
4. Stream protection with SMPTE ST 2022-7:2018

II. Time and Sync

1. PTP monitoring with IETF RFC 8575 or RFC 8173
2. PTPv2 configurable within SMPTE and AES profiles
3. Multi-interface PTP redundancy
4. Synchronisation of audio, video and data essences

III. Operational Control

1. Discovery and Registration: AMWA IS-04, BCP-002
2. Connection Management: AMWA IS-05
3. Device Control: Open Methods and AMWA IS-07
4. Audio Channel Mapping: AMWA IS-08
5. Topology discovery: LLDP

IV. Configuration and Monitoring

1. IP assignment and low-level configuration: DHCP, AMWA IS-09
2. Open configuration management
   – e.g. YANG / OpenConfig, Open API, SSH …
3. Open monitoring protocols
   – e.g. YANG / OpenConfig, MQTT, Syslog, SNMPv3, …

V. Security

1. EBU R 148 Security Tests
2. EBU R 143 Security Safeguards
3. Secure HTTPS API calls: AMWA BCP-003

Endorsed by:

Widely available

Partially available

Rarely available

NETWORK AND INFRASTRUCTURE

Objectives:
- Provide a "real-world" scenario
- Highlight ST 2110 network design best practice
- Resilience and Reliability through design

Solution:
- Spine-leaf topology, Amber and Blue media networks
- Routed access
- BGP Dynamic routing
- Full multicast routing (IGMP / PIM)
- Multiple management VLANs for general use and NMOS testing
- Dual resilient PTP GMs
- Routable OOB network for switch management

- 16 switches in total:
  - 2x spine
  - 10x leaf
  - 4x OOB management

- PTP:
  - 2x grandmasters by Telestream

- DHCP:
  - 577x scopes
  - Over 5000x lines in the config file

- DNS:
  - DNS-SD for NMOS registry discovery

- NMOS registry:
  - Easy-NMOS by Richard Hastie

- Number of ports:
  - 48x 100G
  - 8x 40G
  - 116x 25G
  - 75x 10G
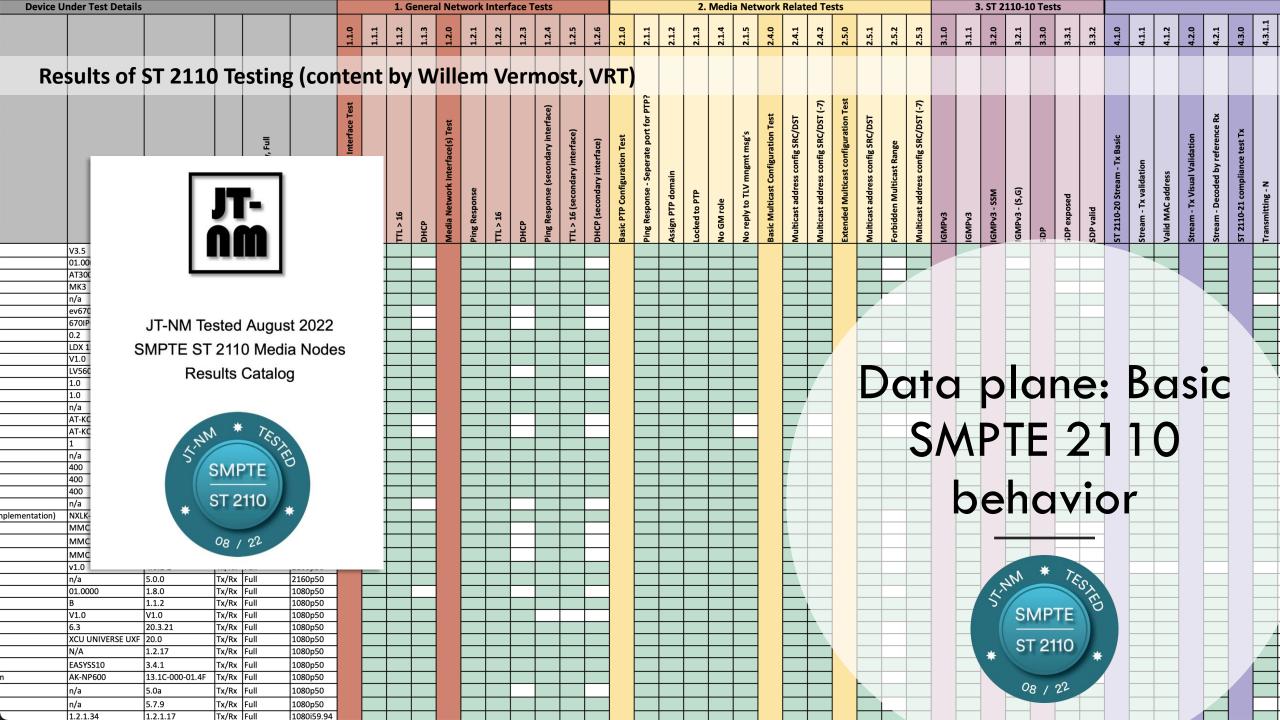 - 215x 1G (Both media and management)

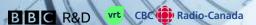A strong move from 10G to 25G, and from 40G to 100G.

FINDINGS AND RESULTS

https://jt-nm.org/jt-nm_tested/

Results of ST 2110 Testing (content by Willem Vermost, VRT)

Data plane: Basic SMPTE 2110 behavior

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JT-NM Tested August 2022
SMPTE ST 2110 Media Nodes
Results Catalog

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SMPTE ST 2110
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Device Under Test Details

| 1. General Network Interface Tests | 2. Media Network Related Tests | 3. ST 2110-10 Tests |

| 1.1.0 | 1.1.1 | 1.1.2 | 1.1.3 | 1.2.0 | 1.2.1 | 1.2.2 | 1.2.3 | 1.2.4 | 1.2.5 | 1.2.6 | 2.1.0 | 2.1.1 | 2.1.2 | 2.1.3 | 2.1.4 | 2.1.5 | 2.4.0 | 2.4.1 | 2.4.2 | 2.5.0 | 2.5.1 | 2.5.2 | 2.5.3 | 3.1.0 | 3.1.1 | 3.2.0 | 3.2.1 | 3.3.0 | 3.3.1 | 3.3.2 | 4.1.0 | 4.1.1 | 4.1.2 | 4.2.0 | 4.2.1 | 4.3.0 | 4.3.1.1 |

Interface Test
Media Network Interface(s) Test
Basic PTP Configuration Test
Basic Multicast Configuration Test
Extended Multicast configuration Test

TTL > 16
DHCP
Ping Response
TTL > 16
DHCP
Ping Response (secondary interface)
TTL > 16 (secondary interface)
DHCP (secondary interface)
Ping Response - Seperate port for PTP?
Assign PTP domain
Locked to PTP
No GM role
No reply to TLV mngmt msg's
Multicast address config SRC/DST
Multicast address config SRC/DST (-7)
Multicast address config SRC/DST
Forbidden Multicast Range
Multicast address config SRC/DST (-7)
IGMPv3
IGMPv3
IGMPv3 - SSM
IGMPv3 - (S,G)
SDP
SDP exposed
SDP valid
ST 2110-20 Stream - Tx Basic
Stream - Tx validation
Valid MAC address
Stream - Tx Visual Validation
Stream - Decoded by reference Rx
ST 2110-21 compliance test Tx
Transmitting - N

Full

| V3.5 |
| 01.000 |
| AT300 |
| MK3 |
| n/a |
| ev670 |
| 670IP |
| 0.2 |
| LDX 1 |
| V1.0 |
| LV560 |
| 1.0 |
| 1.0 |
| n/a |
| AT-KC |
| AT-KC |
| 1 |
| n/a |
| 400 |
| 400 |
| 400 |
| n/a |
| NXLK- (plementation) |
| MMC |
| MMC |
| MMC |
| v1.0 |

n/a	5.0.0	Tx/Rx	Full	2160p50
01.0000	1.8.0	Tx/Rx	Full	1080p50
B	1.1.2	Tx/Rx	Full	1080p50
V1.0	V1.0	Tx/Rx	Full	1080p50
6.3	20.3.21	Tx/Rx	Full	1080p50
XCU UNIVERSE UXF	20.0	Tx/Rx	Full	1080p50
N/A	1.2.17	Tx/Rx	Full	1080p50
EASYSS10	3.4.1	Tx/Rx	Full	1080p50
AK-NP600	13.1C-000-01.4F	Tx/Rx	Full	1080p50
n/a	5.0a	Tx/Rx	Full	1080p50
n/a	5.7.9	Tx/Rx	Full	1080p50
1.2.1.34	1.2.1.17	Tx/Rx	Full	1080i59.94

Network Tests

SMPTE ST 2110-20

SMPTE ST 2110-22

SMPTE ST 2110-30

SMPTE ST 2110-31

SMPTE ST 2110-40

SMPTE ST 2022-7

Download results and test plan!

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SMPTE
ST 2110
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- **35 vendors** published their results in the final catalog.
  - +1 compared to the previous event
- A few newcomers were welcomed
- **84 products** were tested against the ST 2110 test plan (142% compared to previous catalog)
- 63 Video devices
  - 44 devices were presented as a UHD capable
  - 39 Tx/Rx devices
  - 13 Rx devices
  - 11 Tx devices
- 17 Audio only devices
  - 13 Tx/Rx devices
- **11K tests executed in total!**

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- **Network Interface Tests**
  - <mark style="background:yellow">67%</mark> use DHCP on management network interface
  - <mark style="background:yellow">61%</mark> use DHCP on Media network interface
  - <mark style="background:lime">99%</mark> respect the GM role when in "slave only"
  - <mark style="background:lime">96%</mark> properly react to PTP TLVs
  - <mark style="background:yellow">57%</mark> warn or prohibit the use of the restricted multicast range (224.0.0.0-224.0.1.255)

- **ST 2110-10**
  - <mark style="background:lime">100%</mark> support and use IGMPv3 (*,G)
  - *NEW* <mark style="background:yellow">67%</mark> support IGMPv3 SSM (S,G)

- ## ST 2110-10
  - 67% expose and SDP
  - 93% of exposed SDPs were valid

- ## ST 2110-20
  - 94% produce a valid stream
  - 94% produce a stream within the profile limits of N, NL or W
  - 86% Produce a stream within the boundaries of the VRX limits.
  - 92% can receive Wide streams

- ## ST 2110-22
  - 25% of the devices demonstrated the ST 2110-22 capabilities

- **ST 2110-30**
  - 96% of the devices demonstrated capabilities for the ST 2110-30 tests
  - 77% have recommended DSCP values according to AES67
- **ST 2110-31**
  - 39% of the devices demonstrated capabilities for the ST 2110-31 tests
- **ST 2110-40**
  - 82% of the devices demonstrated capabilities for the 2110-40 tests
- **ST 2022-7**
  - 88% of the devices demonstrated capabilities for 2022-7 tests
  - 58% had valid Seamless Protection Switching, critical for designing a resilient facility!

Results of NMOS/TR-1001-1 testing (content by Felix Poulin, CBC/Radio Canada)

Control plane: NMOS/TR-1001-1 behavior

JT-NM Tested August 2022
NMOS/TR-1001-1 Media Nodes, Registries and Controllers
Results Catalog

JT-NM ★ TESTED
AMWA NMOS
JT-NM
TR-1001-1
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Startup Behaviour

Secure Communication (BCP-003-01)

Node API & Registration Behavior (IS-04)

Connection Management (IS-05)

Audio Channel Mapping (IS-08)

System Parameters (IS-09)

Receiver Capabilities (BCP-004-01)

NMOS Registry Tests

Download results and test plan!

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AMWA NMOS
JT-NM TR-1001-1
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- **17K tests executed - 92% automated!**
- **Nodes**
  - 74 Media Nodes +118% from 2020
  - from 35 vendors + 75% from 2020
  - 87% of ST 2110 Devices tested for NMOS
  - **Growing adoption!**

Capabilities
- 90% tests passed IS-04 Reg. and Discovery
- 65% do Natural Grouping (BCP-002-01)
- *NEW* 8% do Receiver Capabilities (BCP-004-01)
- 91% tests passed IS-05 Connection Management
- **Maturity of most of IS-04 and IS-05 implementations!**

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- *NEW* 12% do basic or full Secure Communication (BCP-003-01)
    - **A beginning, but long way to go!**
- 59% do System Parameters (IS-09)
- 19% do Audio Channel Mapping (IS-08)
- 76% do LLDP

Controllers and Registries
- 9 Controllers and Registries +29% from 2020

Capabilities
- 94% of Controller tests passed
- *NEW* 66% of Registries partially supporting secured communication (BCP-003-01)
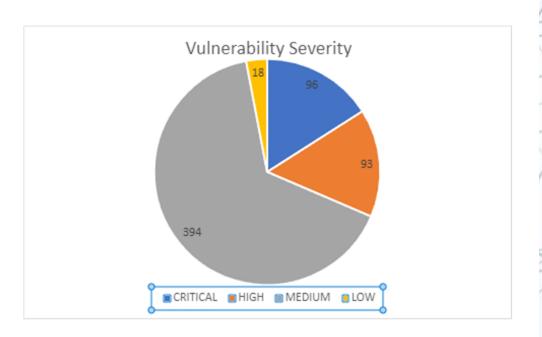- 79% Registry tests passed (IS-04)

CYBERSECURITY ASSESSMENT FINDINGS AND RESULTS

http://jt-nm.org/jt-nm_tested/

7841 findings

Severity > 0?

2145 Potential vulnerabilities

Quality of Detection > 30?

777 Potential vulnerabilities

Not a duplicate?

601 Potential vulnerabilities

Automated Scanning Results

Vulnerability Severity

- 18
- 96
- 93
- 394

CRITICAL   HIGH   MEDIUM   LOW

EARLY CONCLUSIONS AND OUTCOMES

http://jt-nm.org/jt-nm_tested/

- It's time for the EBU Pyramid revision.

- JT-NM will look for a way to make the testing more automated and sustainable.

- Extensive NMOS support is essential for future automatable testing. The value of the Badge must be revised and increased

- The industry needs networking and PTP interop.

- The cybersecurity situation hasn't improved a lot – needs additional attention.

- Another round of testing may take place in the Summer of 2023, with preparatory exercises to start soon.

Thank you from the JT-NM Tested Team

https://jt-nm.org/jt-nm_tested/