JT-NM TESTED EVENT 08/19

RIEDEL Communications , Wuppertal, Germany - August 19 - 23, 2019

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- What tests did we perform?
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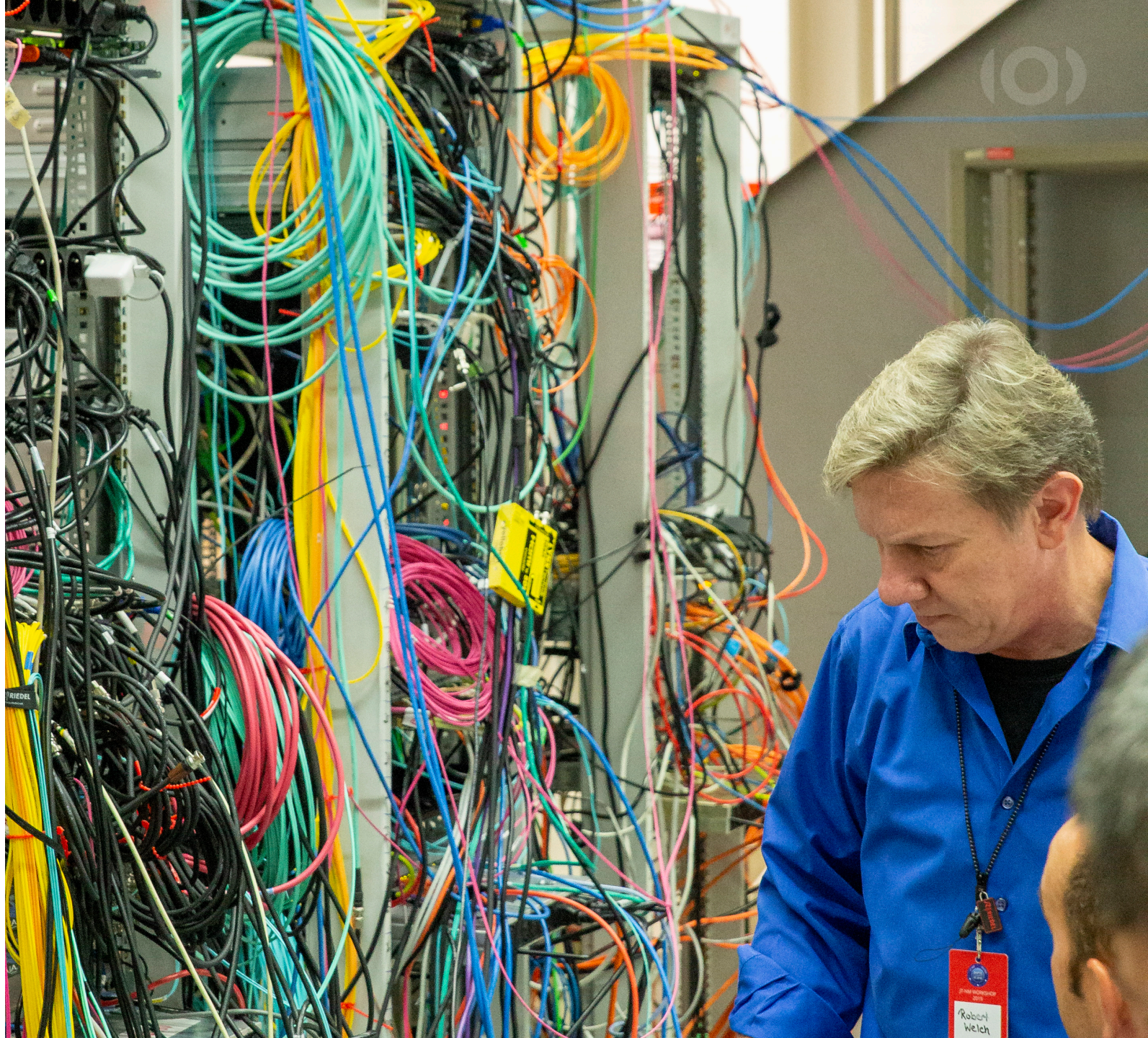

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JT-NM Tested Programme – What is it?

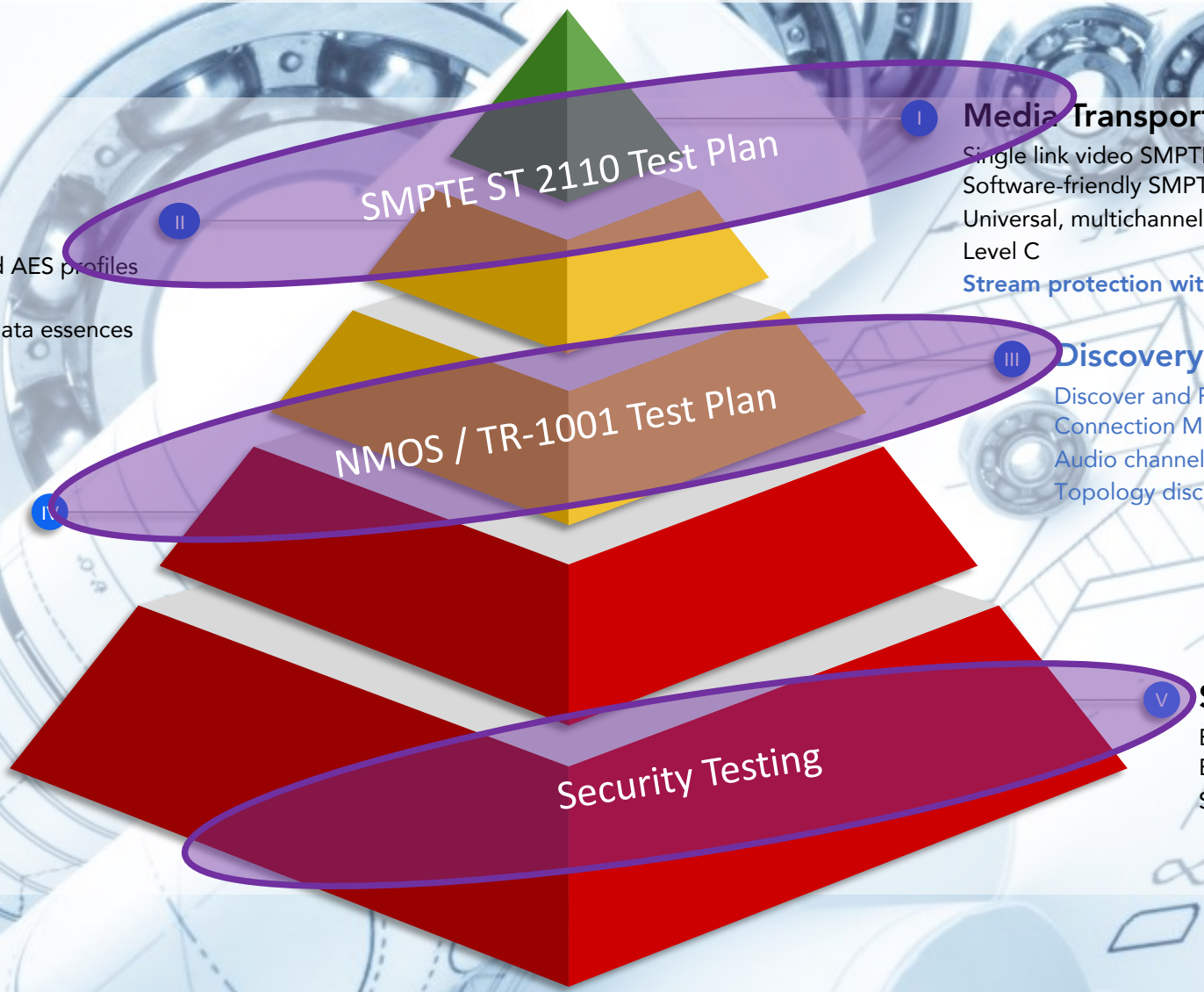
- Offers more documented insight into how vendor equipment aligns with the SMPTE ST-2110 and SMPTE ST-2059 standards.
- Added testing of JT-NM TR-1001-1 and AMWA NMOS specifications at this event
- Documents: the test procedures, test equipment and results.
- This program is not a certification program; it is a snapshot in time of how vendor equipment conforms to key parts of standards and specifications.

JT-NM Tested Programme – What did we test?

- 3 type of tests:
  - Data plane: Basic SMPTE 2110 behaviour
  - Control plane: AMWA NMOS and JT-NM TR-1001-1 behaviour
  - Cyber Security Vulnerability Assessment
- Who attended:
  - 32 different vendors attended at Riedel
  - 71 different products were tested for the data plane basics
  - a subset of 34 products for the control plane test

THE TECHNOLOGY PYRAMID FOR MEDIA NODES

Minimum User Requirements to Build and Manage an IP-Based Media Facility



Time and Sync

PTPv2 configurable within SMPTE and AES profiles
Multi-interface PTP redundancy
Synchronisation of audio, video and data essences

Configuration and Monitoring

IP assignment: DHCP
Open configuration management - e.g., API, config file, SSH CLI, etc.
Open monitoring protocol - e.g., syslog, agent, SNMPv3, etc.

Media Transport

Single link video SMPTE ST 2110-20
Software-friendly SMPTE ST 2110-21 Wide video receivers
Universal, multichannel and low latency audio SMPTE ST 2110-30 Level C
Stream protection with SMPTE ST 2022-7

Discovery and Registration

Discover and Registration: AMWA IS-04
Connection Management: AMWA IS-05
Audio channel mapping: AMWA IS-08
Topology discovery: LLDP

Security

EBU R 148 Security Tests
EBU R 143 Security Safeguards
Secure HTTPS API calls

Widely available
Partially available
Rarely available

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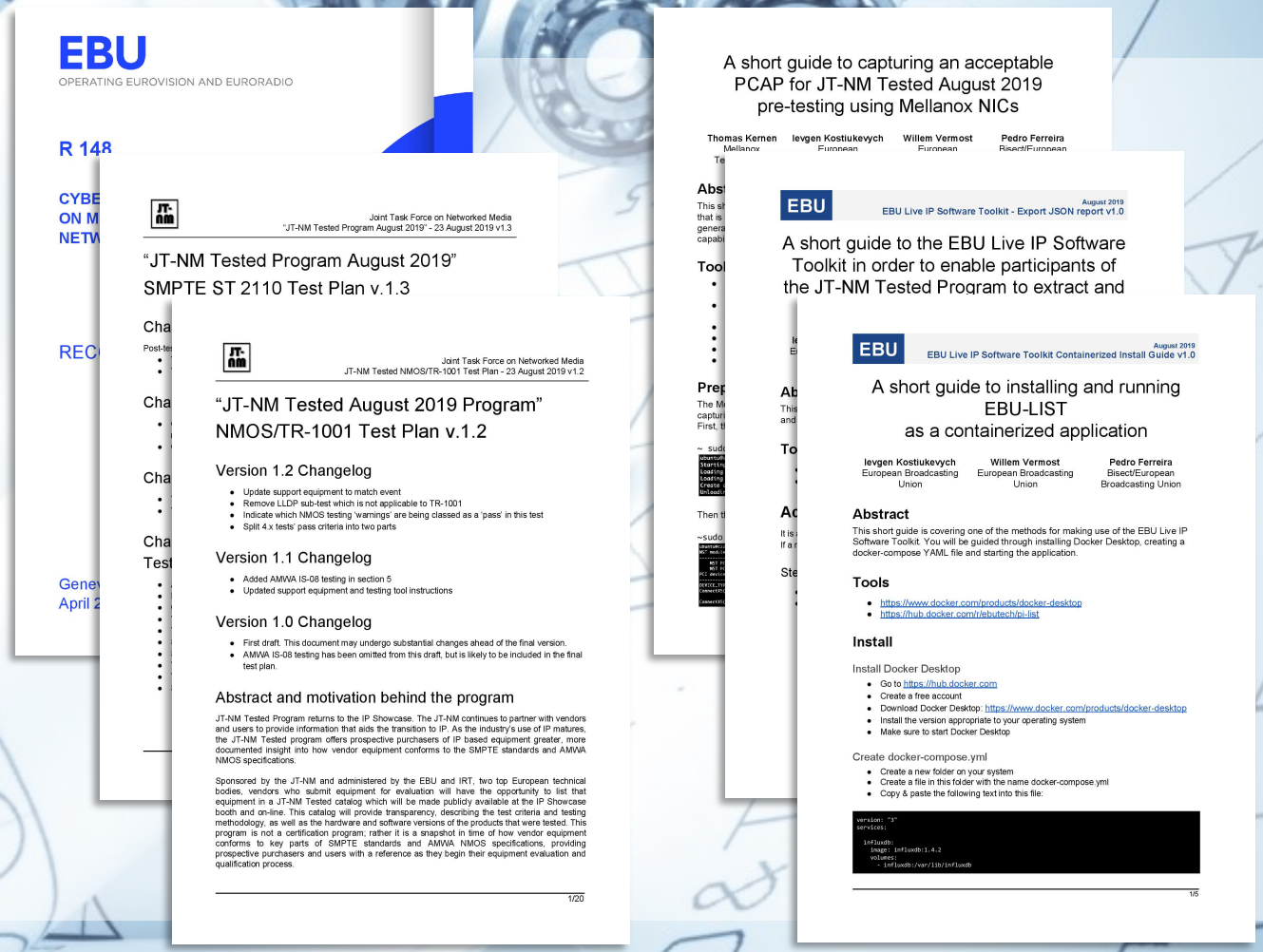
tech.ebu.ch/publications/tech3371

JT-NM Tested Programme – Test Plan & Tools

- Test Plans:
  - SMPTE ST 2110 Test plan
  - NMOS/TR-1001 Test plan
  - EBU R 148
- Pre-testing documents:
  - Capturing guide
  - How to use EBU LIST
  - How to use the NMOS test suite
- Tools:
  - EBU LIST
  - NMOS Testing Tool



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SMPTE ST 2110 Test Plan

- Basic management and media network configurability and behaviour
- ST 2059 Basic PTP configurability and behaviour
- ST 2110-10 testing, including IGMP and SDP and timestamping
- ST 2110-20 testing, including visual validation
- ST 2110-21 testing, C and VRX
- ST 2110-30 testing, including audible validation
- ST 2110-40 testing
- ST 2022-7 testing, both basic and recovery
- UHD testing

- Dynamic Host Configuration Protocol (DHCP)
- Link Layer Discovery Protocol (LLDP)
- TR-1001-1 System Resource (future IS-09)
  - PTP configuration discovery
- IS-04 Discovery & Registration
  - Using unicast DNS Service Discovery (DNS-SD)
- IS-05 Connection Management
  - Including stream tests
- IS-08 Audio Channel Mapping
  - Where implemented

FINDINGS AND RESULTS

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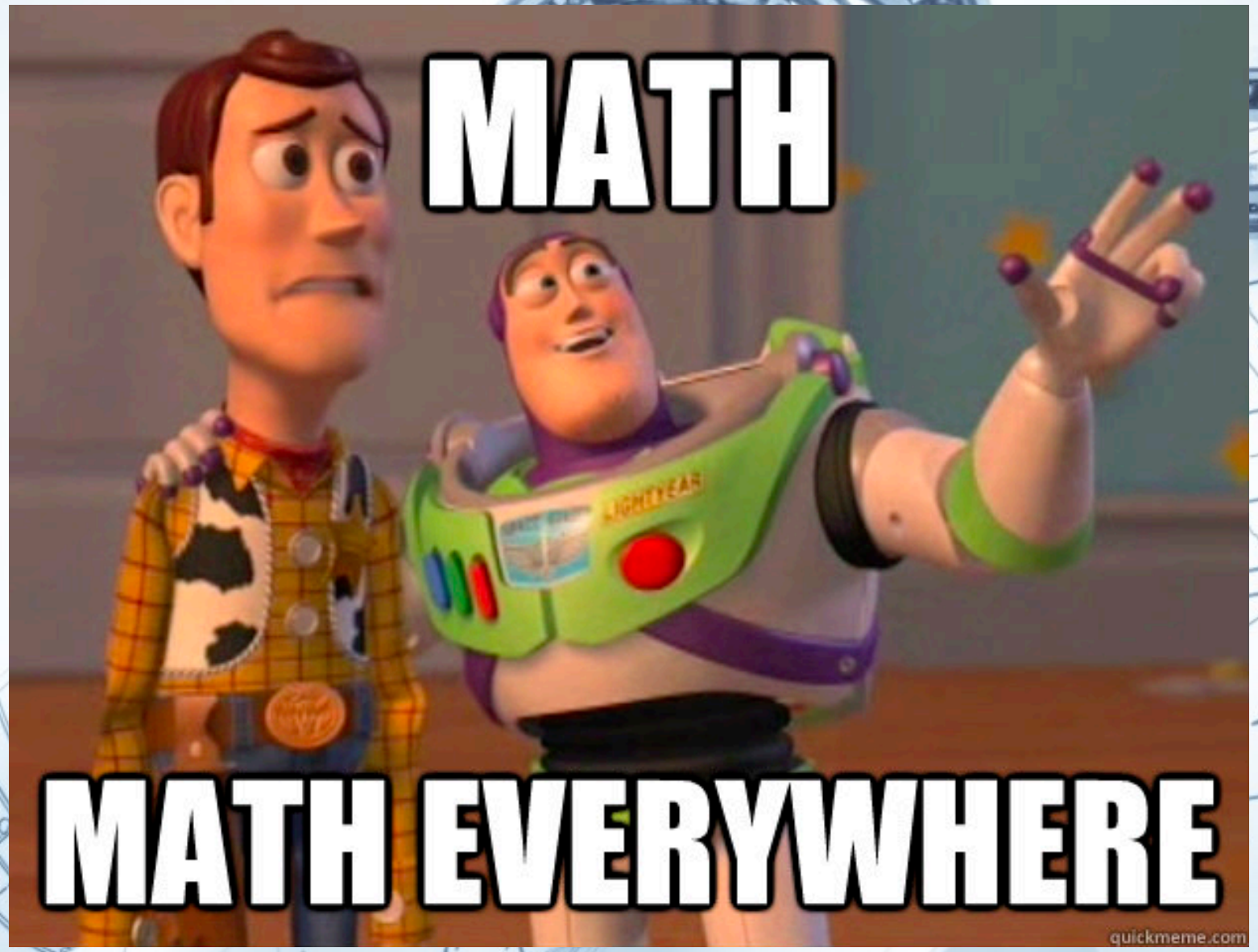

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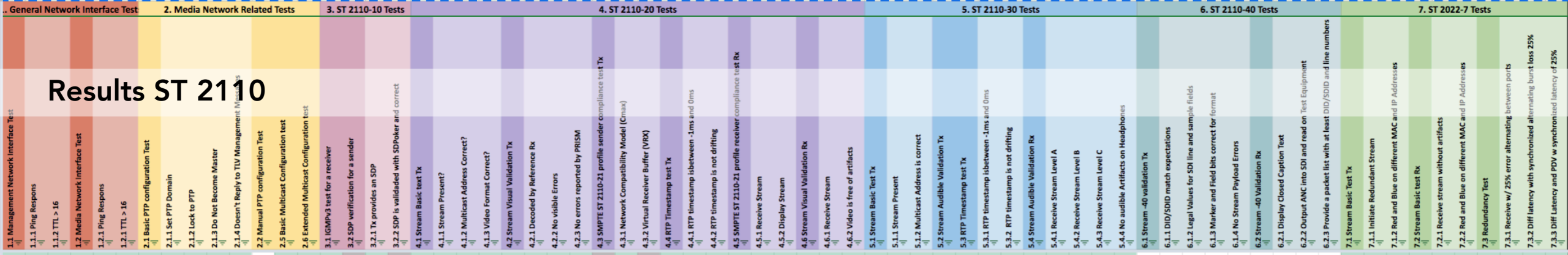

Data plane: Basic SMPTE 2110 behaviour

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JT-NM TESTED SMPTE ST 2110 08 / 19

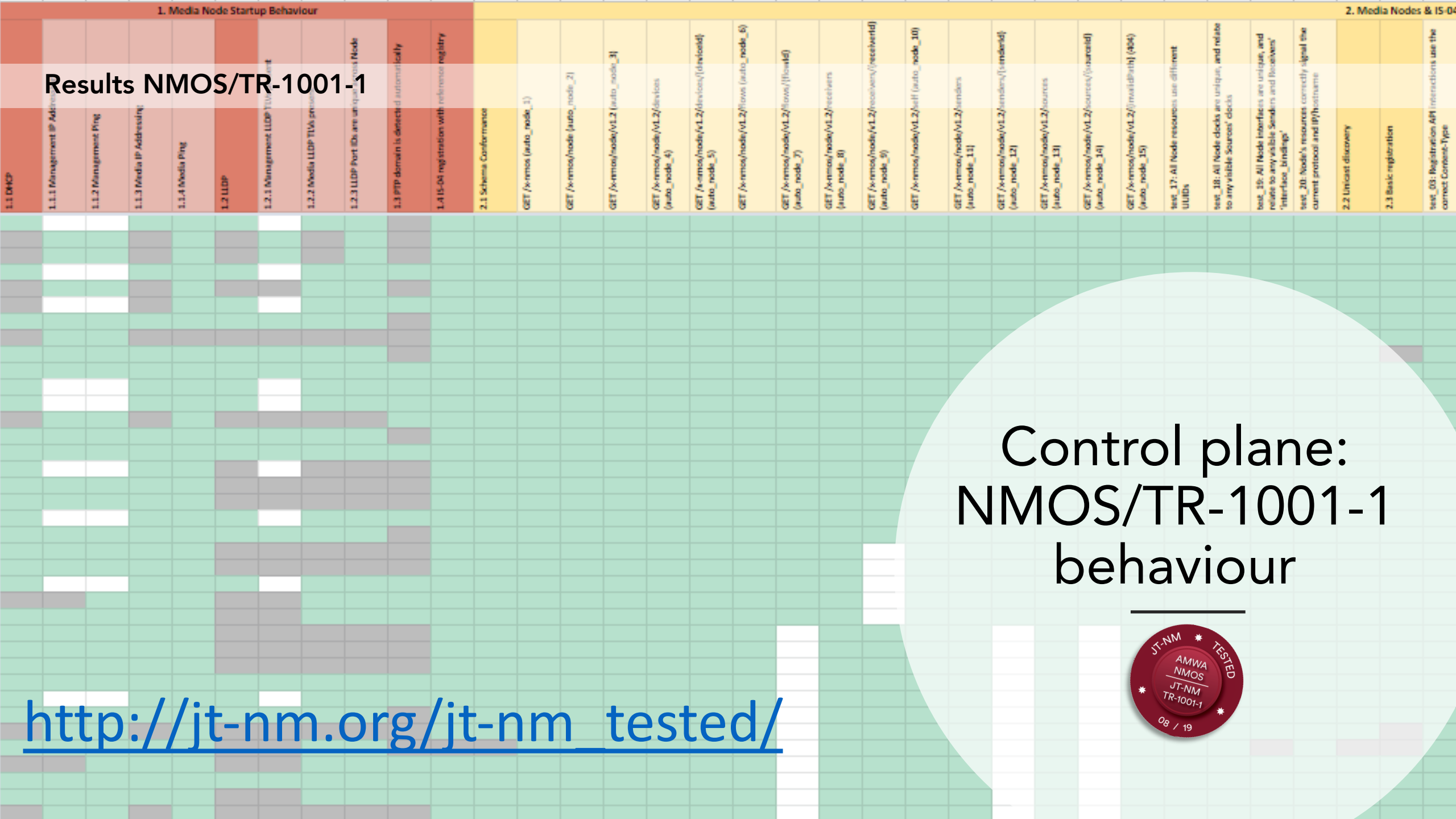
Findings – SMPTE ST 2110 Test Plan

- 100% pass rate: 31 out of 71 devices
- All but 22 devices achieved > 90% pass rate across the board
- The worst test results were 2022-7 related
- Video Tx devices (34):
  - KPI should be 0 devices failing these critical tests:
    - 21% (7) fail the 2110-21 test. This is critical in order to have interoperability and reliability.
    - 26% (9) fail to deliver an SDP file or deliver a faulty SDP file

Common Issues – ST 2110

- Biggest fail rate was in ST 2022-7 testing
- Disturbing fail rate in ST 2110-21 and ST 2110-10 which are fundamental
- A lot of products are still struggling with RTP timestamping – can be linked to the ambiguity in the standard
- Still not a lot of UHD-capable products

- Overall the success rate is much better than last time
- Vendors recognized the need and value of mandatory self-testing
- PTP stability was much better this time
- Pod testing can be optimized
- It is critically important to feed the results and findings back into SMPTE for ambiguities resolution


Results NMOS/TR-1001-1
1. Media Node Startup Behaviour
2. Media Nodes & IS-04
1.1 DHCP
1.1.1 Management IP Address
1.1.2 Management Ping
1.1.3 Media IP Addressing
1.1.4 Media Ping
1.2 LLDP
1.2.1 Management LLDP TLVs present
1.2.2 Media LLDP TLVs present
1.2.3 LLDP Port IDs are unique across Node
1.3 PTP domain is detected automatically
1.4 IS-04 registration with reference registry
2.1 Schema Conformance
GET /x-nmos (auto_node_1)
GET /x-nmos/node (auto_node_2)
GET /x-nmos/node/v1.2 (auto_node_3)
GET /x-nmos/node/v1.2/devices (auto_node_4)
GET /x-nmos/node/v1.2/devices/{deviceId} (auto_node_5)
GET /x-nmos/node/v1.2/flows (auto_node_6)
GET /x-nmos/node/v1.2/flows/{flowId} (auto_node_7)
GET /x-nmos/node/v1.2/receivers (auto_node_8)
GET /x-nmos/node/v1.2/receivers/{receiverId} (auto_node_9)
GET /x-nmos/node/v1.2/self (auto_node_10)
GET /x-nmos/node/v1.2/senders (auto_node_11)
GET /x-nmos/node/v1.2/senders/{senderId} (auto_node_12)
GET /x-nmos/node/v1.2/sources (auto_node_13)
GET /x-nmos/node/v1.2/sources/{sourceId} (auto_node_14)
GET /x-nmos/node/v1.2/{invalidPath} (404) (auto_node_15)
test_17: All Node resources use different UUIDs
test_18: All Node clocks are unique, and relate to any visible Sources' clocks
test_19: All Node Interfaces are unique, and relate to any visible Senders and Receivers' 'interface_bindings'
test_20: Node's resources correctly signal the current protocol and IP/hostname
2.2 Unicast discovery
2.3 Basic registration
test_03: Registration API interactions use the correct Content-Type
Control plane: NMOS/TR-1001-1 behaviour
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Findings – NMOS / TR-1001-1 Test Plan (Results: Andrew Bonney, James Gibson)

- 100% pass rate: 6 out of 34 devices - global
- 100% pass rate: 20 out of 34 devices - NMOS IS-04 and IS-05
- All but 4 devices achieved >90% pass rate across the board
- LLDP had the worst results
  - 39% pass rate for management interfaces
- DHCP support was better
  - 92% support on management interfaces
  - 78% support for media interfaces
- Almost 8000 individual tests carried out, with around 90% carried out using automated means

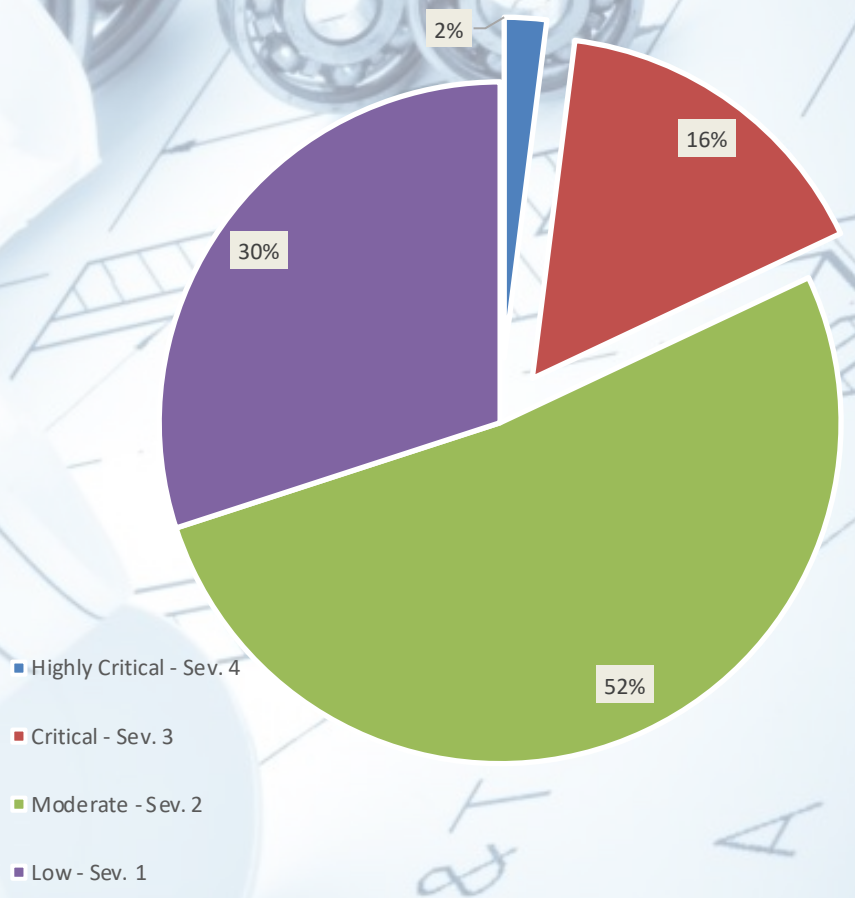
Common Issues – NMOS / TR-1001-1

- Very few common failures across devices beyond items which simply hadn't been implemented
- There were some issues with:
  - IS-04 UUID consistency
  - IS-05 changes taking effect in streams & use of IGMPv3 source filters
- We observed DHCP configuration confusion across Nodes with multiple network interfaces

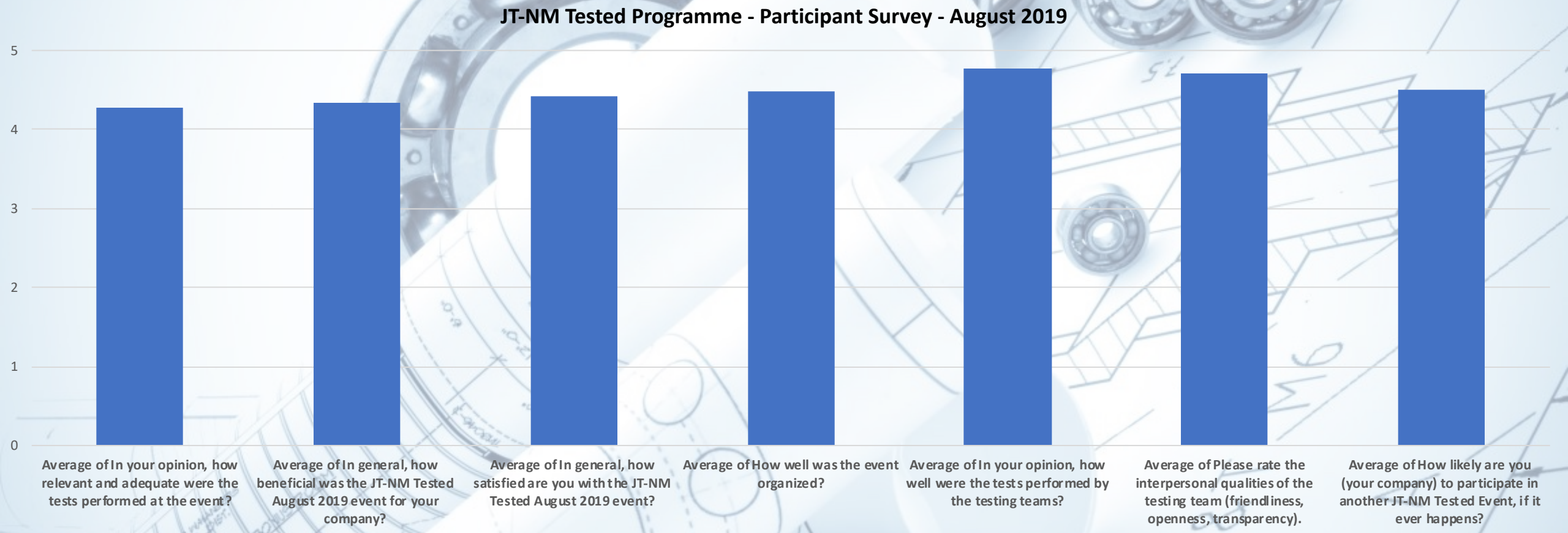
- Stream and discovery testing
  - Slow, but valuable – some of the most important test results to observe
  - We aim to further automate this process
- Pre-testing makes a big difference!
  - Vendors could work on issues well in advance and become familiar with the process
  - Issues were quickly identified if devices failed to match their pre-testing results
- Fully featured implementations were quick to test
  - Proving the principles of JT-NM TR-1001-1

Findings – Cyber Security Vulnerability Assessment (Results: Gerben Dierick, Alvaro Santos, Adi Kouadio)

- 387 Vulnerabilities found
  - 18% of the vulnerabilities are critical to highly critical and shall be handled immediately by the 10 vendors concerned
  - 80% of the vulnerabilities found are moderated but can be exploited to cause harm. Can be fixed by following traditional IT best practices.
- More info in the report!



Participants Feedback Survey



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Potential Future Tests

- ST 2110
  - ST 2110-31, ST 2110-22
- NMOS/TR-1001-1
  - IS-04 registry and client testing
  - IS-08 stream testing
  - Configuration consistency between vendors' UIs, IS-0X and SDP files
- More serious PTP testing has to be considered
- Pod approach can be deprecated in favour of fully routed network

Conclusion

- Improved results compared to the first test event
- The industry starts to see the need for a common control plane
- Mandatory self-testing is essential for implementations improving
- This event needs to be repeated in order:
  - To get better quality implementations
  - To get for more of the needed features of the pyramid
- Value Created for the industry:
  - Getting the current state of implementations
  - Improving the implementations
  - Safeguarding the investments for new facilities

Thank you!

Willem Vermost, Ievgen Kostiukevych – EBU

Andrew Bonney – BBC R&D

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