EBU

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TECH 3371

THE TECHNOLOGY PYRAMID FOR MEDIA NODES

MINIMUM USER REQUIREMENTS TO BUILD AND MANAGE AN IP-BASED MEDIA FACILITY.

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Abstract

This document presents the requirements of the EBU user community regarding IP-based facilities. The document deals in particular with the ensemble of technologies that a *Media Node*[1] needs to support to enable them to design and build, operate and maintain an IP architecture based on the SMPTE ST 2110 Standards.

The document is aimed at broadcasters and system integrators who need to define and design their requirements for a live IP infrastructure. In addition, the document provides the industry with a clear understanding of what users expect from mature IP Studio equipment.

The structure of the document follows the concept of the Media Node Technology Pyramid that sets out the minimum stack of technologies needed to build and manage an IP-based media facility.

The work involved in this document was conducted by the experts of the EBU Strategic Programme on Production Infrastructure, and it is based on the lessons learned from the first IP-based facility projects within the EBU membership. It is subject to future updates, as best practices get refined by deployments over the next few years.

Acknowledgement

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Conformance Notation

This document contains both normative text and informative text.

All text is normative except for that in the Introduction, any section explicitly labelled as 'Informative' or individual paragraphs which start with 'Note:'.

Normative text describes indispensable or mandatory elements. It contains the conformance keywords 'shall', 'should' or 'may', defined as follows:

'Shall' and 'shall not':	Indicate requirements to be followed strictly and from which no deviation is permitted in order to conform to the document.
'Should' and 'should not':	Indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others.
	OR indicate that a certain course of action is preferred but not necessarily required.
	OR indicate that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.
'May' and 'need not':	Indicate a course of action permissible within the limits of the document.

Default identifies mandatory (in phrases containing "shall") or recommended (in phrases containing "should") presets that can, optionally, be overwritten by user action or supplemented with other options in advanced applications. Mandatory defaults shall be supported. The support of recommended defaults is preferred, but not necessarily required.

Informative text is potentially helpful to the user, but it is not indispensable and it does not affect the normative text. Informative text does not contain any conformance keywords.

A conformant implementation is one which includes all mandatory provisions ('shall') and, if implemented, all recommended provisions ('should') as described. A conformant implementation need not implement optional provisions ('may') and need not implement them as described.

[1] A Media Node has one or more physical or software based device(s) that can send (Sender) and/or receive (Receiver) media streams.

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The Technology Pyramid For Media Nodes
Minimum User Requirements
to build and manage an IP-based Media Facility;

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Keywords: IP-based, media facility, Media Node, Media stream, Technology stack, 2110, NMOS.

1. Introduction

The following are the requirements of the EBU user community regarding IP-based facilities. The document deals in particular with the ensemble of technologies that a *Media Node* needs to support to enable broadcasters and vendors to design, build, operate and maintain an IP architecture based on the SMPTE ST 2110 Standards.

The target audiences are broadcasters and system integrators who need to define and design their requirements for a live IP infrastructure. In addition, the document provides the industry with a clear understanding of what users expect from mature IP Studio equipment.

The document assumes that the reader is familiar with the terms and nomenclatures used in SMPTE ST 2110, together with general IP architecture and design rules.

2. The Technology Pyramid For Media Nodes

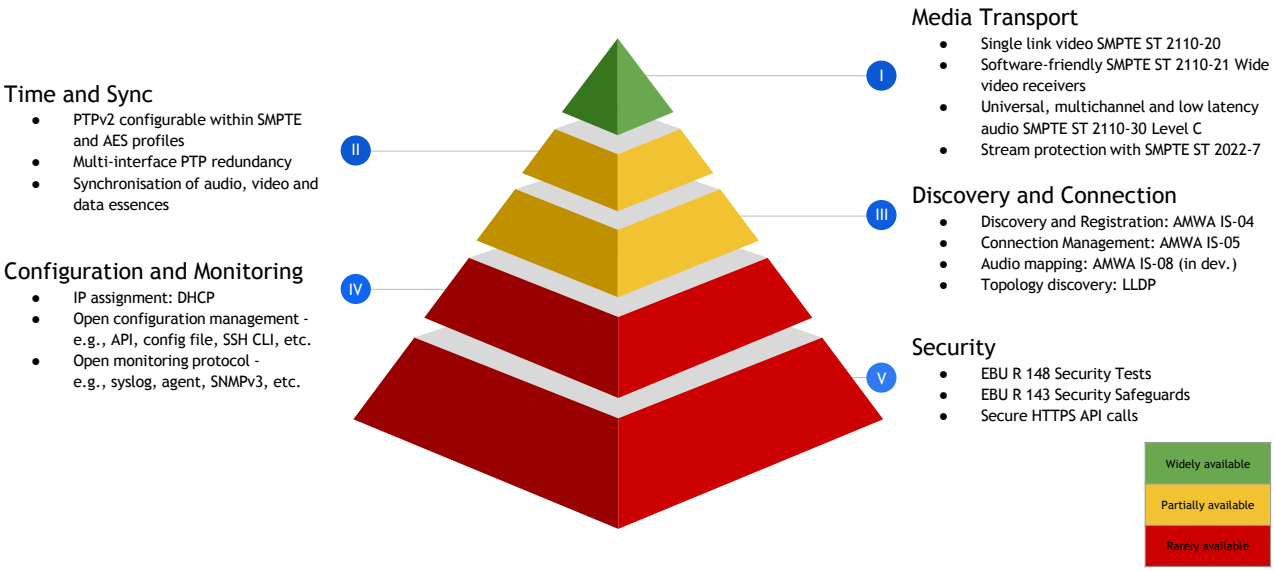

Figure 1: Minimum user requirements to build and manage an IP-based media facility

3. General Principles

All the technologies and standards used to compose the Media Node Pyramid:

- Shall be designed following best practice cybersecurity principles to reduce the risks of vulnerabilities;
- Should be implementable in software running on standard IT servers, so enabling flexible, agile and scalable infrastructure;
- Should strive to reuse as much as possible existing IT and Internet Standards (e.g., IETF, IEEE, W3C, etc.) in order to leverage the R&D investment of this much wider industry.

4. Media Transport

The tip of the Media Node Pyramid comprises of Standards necessary for encapsulating and transporting media essences, based on the SMPTE ST 2110 *Professional Media Over Managed IP Networks* suite. However, 2110 is a necessary but insufficient technology to deploy media over IP at the scale of a facility. 2110 is just the tip of the Pyramid!

4.1 Single link video; SMPTE ST 2110-20

- For simplicity of operation and troubleshooting, and optimal density use of network, video Media Nodes should use single link streams. For instance, a single 59.94 Hz UHD stream requires a 25 GbE[2] port and a high-density device (like a multiviewer or a vision mixer) should take benefit of bi-directional 100 GbE.

4.2 Software-friendly SMPTE ST 2110-21 Wide video Receivers

In order to get the flexibility expected from IP-based media:

- Receivers shall support SMPTE ST 2110-21 Wide type so they can receive Wide streams that are generated by pure software Senders, in addition to Narrow Senders.

4.3 Universal, multichannel, low latency audio; SMPTE ST 2110-30 Level C

- In addition to SMPTE ST 2110-30 Level A that is compatible with all AES67 and 2110-30 devices, audio Senders and Receivers shall support Level C to support low latency applications and larger bundling of channels;
- Receivers shall be compatible with AES67 including random RTP clock offset so that they can be used with all AES67 Senders on the market;
- AES67 Senders shall provide a mode for 2110-30 compatibility - e.g., zero RTP clock offset - so that they can be used across TV, radio and online media production systems;
- Media Nodes often need multiple Senders and Receivers so that users can group audio channels that belong together in the same stream: e.g., 5.1 programme into a 6-channel stream, stereo audio description into a 2-channel stream, 1-channel for a microphone, etc.

4.4 Stream protection with SMPTE ST 2022-7:2018

- For protection of streams, Media Nodes shall provide at least two separate Ethernet media interfaces using SMPTE ST 2022-7:2018 *Seamless Protection Switching of RTP Datagrams*;
- Receivers shall support SMPTE ST 2022-7:2018 Class D with Ultra Low-Skew 150 µs that is adapted to engineered LAN with adding minimal latency;
- Receivers shall report late or lost packets on each redundant stream so that degraded protection can be diagnosed.

[2] Abbreviation for Gigabit Ethernet

5. Time and Sync

Real-time media requires synchronisation in many use cases. SMPTE ST 2110 systems rely on IEEE 1588-2008 (PTPv2) as clock synchronization mechanism with media-specific profiles and behaviours.

5.1 PTPv2 configurable within SMPTE and AES profiles

- PTP parameters of Media Nodes shall be configurable within the union of the ranges covered by the both SMPTE ST 2059-2 profile, the AES67 media profile and the IEEE-1588 default profile so that we can use the Media Nodes for the full range of possible operational scenarios;
- However, it is recommended to the users to select an operational point within the range of AES-r16-2016 so that it is compatible with equipment previously delivered on the market that might be limited to one of the two profiles;
- PTP Master capable Media Nodes shall be set to slave-only mode by default so that there is no risk it becomes the grandmaster the first time it is used.

5.2 Multi-interface PTP redundancy

- Media Nodes shall be capable of selecting its master clock across all of its media interfaces so that is can use PTP redundancy.

5.3 Synchronisation of audio, video and data essences

- To maintain high production quality, the synchronization of audio, video and/or other data streams that have been captured together and have passed separately through a number of Media Nodes, it shall be possible to easily realign them at key points in the production process. This is an active topic of standardisation at the time of writing.

6. Discovery and Connection

The ability to discover media sources and connect them to destinations easily and securely is a key requirement to enabling basic operation.

6.1 Discovery and Registration; AMWA IS-04

- Media Nodes shall support AMWA IS-04 *NMOS Discovery and Registration* v1.2.1 (stable) or later;
- They shall support IS-04 *Node API* with unicast announce so they can be discovered in large-scale routed networks;
- They shall support IS-04 *Registration API* calls so that they can register themselves in the registry;
- Sources that send essences (video, audio and ancillary data) that belong together - should use the *group hints* tag to get registered as a group, according to the AMWA BCP-002 (upcoming at the time of publication);
- Senders shall provide their SDP information through the IS-04 *transport file*.
- When a Sender format configuration is modified (e.g., resolution, colour space, number of channels in an audio stream, etc.), the Sender Media Node shall signal the change through IS-04 to allow a Broadcast Controller to remake the connection if required.

6.2 Connection Management; AMWA IS-05

- Receivers shall support AMWA IS-05 *NMOS Connection Management* v1.0.1 (stable) or later so that they can be connected to Senders that are registered in the IS-04 registry;
- Receivers shall support single and bulk connections and immediate, staged and scheduled activation so that they can do salvos and automated connection scenarios;

- Senders shall support IS-05 for configuration of their Multicast groups so they can be assigned and managed via a controller.

6.3 Audio mapping; AMWA IS-08

- Audio Receivers with a matrix capability should use AMWA IS-08 *NMOS Audio Channel Mapping API* specification (about to be published at time of writing) so that a Broadcast Controller can select the channel arrangement within a stream to be used by the Receivers.

6.4 Topology discovery; LLDP

- Media Nodes shall support *Link Layer Discovery Protocol* (LLDP) - part of IEEE 802.1AB so that it can announce on which switch and interface it is connected to inform a Network Controller using AMWA IS-06 *NMOS Network Control* or another proprietary API.

7. Configuration and Monitoring

Ease of configuration, monitoring and alarming is key to successfully operate and maintain an IP based facility.

7.1 IP assignment: DHCP

- Media Nodes shall support DHCP for static or dynamic IP assignment on all its interfaces so that it can be brought to the network with a proper management of IP address.

7.2 Open configuration management

- Media Nodes shall be configurable by an open method so that configuration can be managed by a common tool enabling change management, firmware updates, rollback, etc. Preferably, this should be done by providing an open API, or at least by a remote config file or an SSH command line.▫

7.3 Open monitoring protocol

- Media Nodes shall provide sufficient Alarming for key fault indicators so that it brings the attention of the operator quickly to solve the issue;
- Media Nodes shall provide Telemetry with detailed logging information and measurements on timing, media streams and control in a way that a monitoring tool can provide assistance to diagnostic and foresee system degradation before an outage occurs. This shall be done using open methods - e.g., syslog, OS that can run an agent, SNMPv3, etc.

8. Security

IP networking of real-time media devices brings additional cybersecurity risk compared to isolated SDI connections. All IP devices, including Media Nodes, shall take care to follow cybersecurity best practices. This is an area that still requires work and education in the industry and the user community.

8.1 EBU R 148 Security Tests

- Media Node vendors shall provide a report of their products' compliance with the security tests list from the EBU R148 *Minimum Security Tests for Networked Media Equipment* (or agreed equivalent)
  - for the proposed version of the equipment when bidding on RFPs;
  - when releasing an update of the product [https://tech.ebu.ch/publications/r148].

8.2 EBU R 143 Security Safeguards

- Media Node vendors shall declare their ability to comply with the list of security safeguards from EBU R 143 *Cybersecurity for media vendor systems, software & services* [https://tech.ebu.ch/publications/r143].

8.3 Secure HTTPS API calls

- The AMWA is working on security recommendations for AMWA NMOS APIs at the time of writing this document [https://amwa-tv.github.io/nmos-api-security/best-practice-tls-pki.html].