

Joint Task Force on Networked Media

Technical Recommendation
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System Environment and Device Behaviors For SMPTE
ST 2110 Media Nodes in Engineered Networks -
Networks, Registration and Connection Management

29 November, 2018

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JT-NM TR1001-1

System Environment and Device Behaviors for ST 2110 Media Nodes in Engineered Networks – Networks, Registration, and Connection Management

Executive Summary

IP-based Media Systems are governed by a multitude of standards and specifications from different organizations, including AES, AMWA, EBU, IEEE, IETF, SMPTE, VSF. Each of the standards and specifications involved is conceived and developed to serve multiple use-cases across multiple industries; many are extremely flexible in nature.

For the purposes of engineering, constructing and maintaining professional media facility infrastructures (including OB vans), the industry requires the ability to easily integrate equipment from multiple vendors into a coherent system. This Technical Recommendation summarizes relevant standards and specifications, and documents some specific additional constraints related to this domain of use. In addition, certain device behaviors are documented which facilitate the deployment of a manageable system. In some cases, this document specifies behaviors or features more strictly than is specified in the underlying standards.

The goal of this document is to enable the creation of network environments where an end-user can take delivery of new equipment (compliant to this recommendation), connect it to their network, and configure it for use, with a minimum amount of human interaction. Specifically, the interaction ought to be limited to acknowledging the equipment's existence (for security reasons), assigning operational names to the signals the equipment generates, and defining any grouping relationships the signals might have with other existing signals. Technical configuration of the equipment in regards to timing, signal transport, and routing interactions is automated by the behaviors and management systems described in this recommendation.

The EBU has developed a TECH document titled, "The Technology Pyramid for Media Nodes"¹ which contains a helpful graphic titled, "Minimum User Requirements to Build and Manage an IP-Based Media Facility" which is included below. This Technical Recommendation addresses some of the elements listed in the graphic, but with a particular focus on the system environment and device behaviors for ST 2110 Media Nodes in engineered networks. It does not attempt to address all areas shown in the EBU graphic below. Specifically, this version of this document does not address security, monitoring, or configuration management; these remain as potential topics for future work across the organizations of

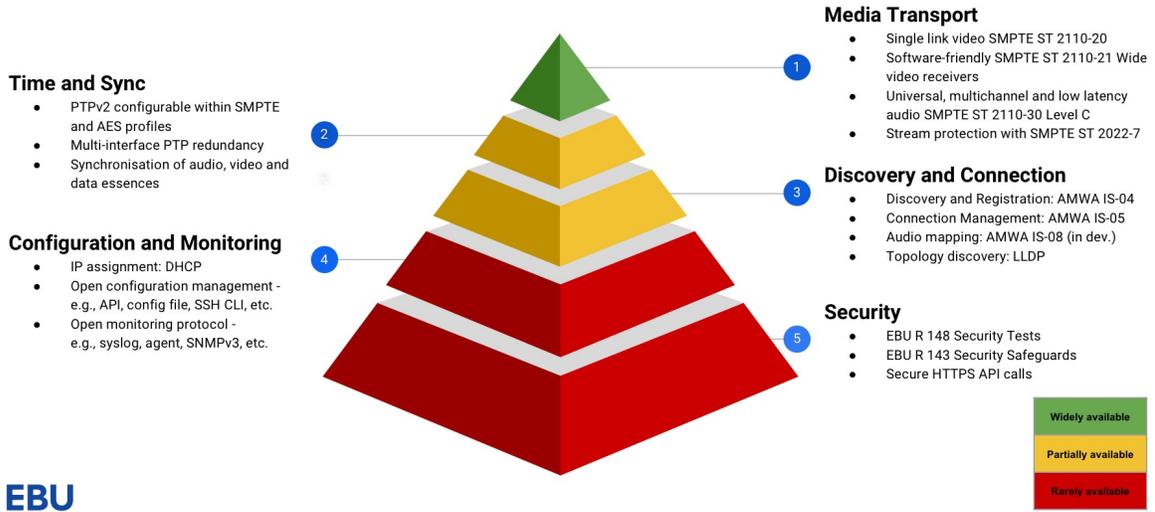
¹ EBU TECH 3371: The Technology Pyramid for Media Nodes – Minimum User Requirements To Build and Manage An IP-based Media Facility available at <https://tech.ebu.ch/publications/tech3371>



the JT-NM.

The Media Node Pyramid

The Minimum Stack of endpoint technologies to build and manage an IP-based media facility



2. The JT-NM

The JT-NM (Joint Taskforce on Networked Media) is a self-coordinating group of industry bodies working together on the development of IP technologies for professional media systems.² Admin Group Members include the Advanced Media Workflow Association (AMWA), the European Broadcasting Union (EBU), the Society of Motion Picture and Television Engineers (SMPTE©), and the Video Services Forum (VSF). This document was developed by an ad-hoc group of industry experts including both manufacturers and broadcasters in order to provide guidance and drive towards common solutions for deployment of SMPTE ST 2110-based media networks.

3. JT-NM Documents

This work is the product of several independent groups, coming together under the JT-NM banner with the goal to create an ecosystem that allows end users to build functioning professional media facilities. It is the intent of the JT-NM Admin group that due process standards bodies, trade associations and other industry bodies will undertake work to develop and stabilize the concepts and proposals in JT-NM documents to realize this goal.

This first JT-NM document is created to address the EBU pyramid of user requirements shown above. This document addresses the urgent need for agreement and coordination between the various standards, specifications, open source deployments and work in progress that the industry is currently

² See <http://www.jt-nm.org> for more information



embarked on. This document lays out an approach to the behavior of Media Devices and the network environment that will be tested and, no doubt improved with time.

The JT-NM counts more than 300 participants from 175 organizations. More information on the JT-NM including its scope and previously published works may be found on our website jt-nm.org.

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5. IPR Policy

This work was developed under, and is covered by the AMWA IPR Policy Version 3.0. A copy of this policy may be obtained at <https://www.amwa.tv>.

Recipients of this work are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the AMWA Specification set forth in this document, and to provide supporting documentation. Please make these submissions to info@jt-nm.org.

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6. Scope

This Technical Recommendation enumerates Standards and Specifications, and defines operational behaviors, for Media Nodes, and for the network interfaces and Network Services which form the environment within which these Nodes operate. The domain of intended use of this specification is engineered fixed professional media infrastructures utilizing the SMPTE ST 2110 and AMWA NMOS family of standards. Detailed configuration of Networks and Network Services is outside the scope of this recommendation.

7. Conformance Notation

Normative text is text that describes elements of the design that are indispensable or that contain the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative", or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that 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.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.



8. Normative References

- [1] AMWA NMOS IS-04 version 1.2.1 STABLE - NMOS Discovery and Registration Specification³
- [2] AMWA NMOS parameter register⁴
- [3] AMWA NMOS IS-05 version 1.0.1 STABLE - NMOS Device Connection Management Specification⁵
- [4] IEEE 802.1AB Station and Media Access Control Connectivity Discovery (LLDP)
- [5] IEEE 802.1AX-2014 Link Aggregation
- [6] IEEE 1588-2008 Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
- [7] IETF RFC 1034 DOMAIN NAMES - CONCEPTS AND FACILITIES
- [8] IETF RFC 2131 Dynamic Host Configuration Protocol
- [9] IETF RFC 5771 IANA Guidelines for IPv4 Multicast Address Assignments
- [10] IETF RFC 6763 DNS-Based Service Discovery
- [11] SMPTE ST 2059-1:2015 Generation and Alignment of Interface Signals to the SMPTE Epoch
- [12] SMPTE ST 2059-2:2015 SMPTE Profile for Use of IEEE-1588 Precision Time Protocol in Professional Broadcast Applications
- [13] SMPTE ST 2110-10:2017 Professional Media over Managed IP Networks: System Timing and Definitions
- [14] SMPTE ST 2110-20:2017 Professional Media over Managed IP Networks: Uncompressed Active Video
- [15] SMPTE ST 2110-21:2017 Professional Media over Managed IP Networks: Traffic Shaping and Delivery Timing for Video
- [16] SMPTE ST 2110-30:2017 Professional Media over Managed IP Networks: PCM Digital Audio
- [17] SMPTE ST 2110-31:2018 Professional Media over Managed IP Networks: AES3 Transparent Transport
- [18] SMPTE ST 2110-40:2018 Professional Media over Managed IP Networks: SMPTE ST 291-1 Ancillary Data

³ <https://www.amwa.tv/projects/IS-04.shtml>

⁴ <https://github.com/AMWA-TV/nmos-parameter-registers>

⁵ <https://www.amwa.tv/projects/IS-05.shtml>



9. Defined Terms

9.1 Sender - entity which generates a media stream (or redundant pair of streams) compliant to SMPTE ST 2110-20, ST 2110-30, ST 2110-31, or ST 2110-40

9.2 Receiver – entity which potentially consumes a media stream (or redundant pair of streams) compliant to SMPTE ST 2110-20, ST 2110-30, ST 2110-31, or ST 2110-40

9.3 Network Services - services which reside in the network environment, which support the Media Nodes, such as DHCP or PTP

9.4 Media Node - physical or Logical collection which includes zero or more Senders and zero or more Receivers, represented as a single Node under AMWA IS-04



10. System Overview

10.1 Network Environment

For the purpose of this document, the logical network environment of Figure 1 will be used to illustrate the environment for the Media Node, including the Network Services.

Media Nodes shall be connected to at least one Media Network, and may have connections to two or more media networks. If more than one Media Network is used (such as “Amber” and “Blue” in the figure) then the active-active redundancy model of SMPTE ST 2022-7 shall be supported by the Media Node.

Media Nodes may have zero or more connections to the Control Network. This Control Network may be a single subnet or a routed environment. If a Media Node has more than one connection to the Control Network, those connections shall, by default, be configured to form a single (link-aggregated) network interface using LACP (IEEE 802.1AX) and are considered a single “interface” for the purposes of this document.

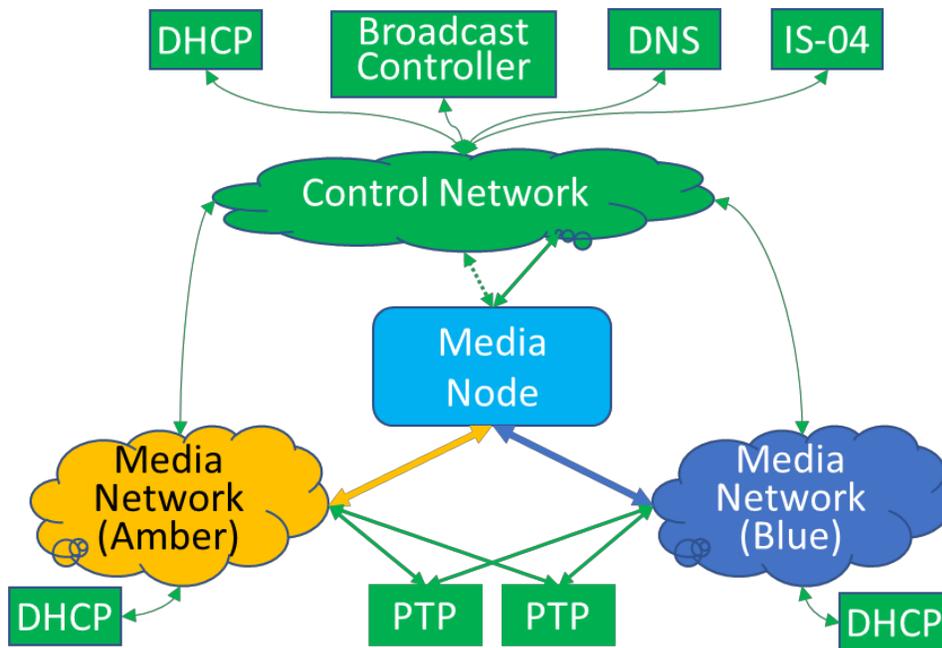


Figure 1 – Abstract Network Environment Diagram

All media traffic (including multicast and unicast essence transports) shall be confined to the Media Networks. Unicast control traffic shall be supported in the Media Networks, including unicast routing connectivity between the Media and Control networks.

10.2 Network Services within the Environment

10.2.1 Unicast Routing

IPv4 Unicast Routing shall be available between and amongst hosts on the Control Network and the Media Network(s). The Broadcast Controller shall be able to communicate with any network interface on any Media Node, and any Media Node shall be able to communicate with the IS-04 registry services and broadcast controllers via unicast from any of its management-enabled network interfaces – Media or Control.

Media Nodes shall not bridge or forward traffic from one network to another under any circumstance.

Each network interface of a Media Node shall have a unique MAC address and a different IP Host Address from the other interfaces on the Media Node. Control Network interfaces, if present, shall be on a separate subnet from Media Network interfaces. The network interfaces to each Media Network shall also be on separate subnets from other Media Network(s). Media Nodes with more than one connection to the same Media Network shall allow the same subnet across the connections to the same Media Network, but shall also allow each interface to be on a different subnet.

Media Nodes shall support ICMP “Echo Request” (a/k/a PING) on all network interfaces.

10.2.2 Precision Time Protocol (PTP)

PTP service compliant to IEEE 1588-2008 and compliant to the profile defined in SMPTE ST 2059-2 shall be available on each Media Network. PTP service is neither required nor prohibited on the control network. Media Nodes are not required to use PTP from the control network for any purpose, even in systems where it is present.

All Network-provided PTP services across all networks shall comply with the frequency accuracy provisions of SMPTE ST 2059-2 for master references. Where multiple master clocks are implemented, these should be derived from a consistent source of time and shall be within an absolute timing accuracy of +/-100ms to International Atomic Time (TAI) when the PTP timescale is in use. Typically, GPS-locked PTP is far tighter than this requirement.

Note: the arbitrary PTP timescale (ARB) might be used in some circumstances. While Media Nodes might synchronize their logging message times to PTP when the PTP timescale is used, if the arbitrary timescale is in use care should be exercised in this regard.

By default, Media Nodes shall not assume the role of PTP grandmaster in normal operation.

Media Nodes which connect to more than one Media Network should carefully choose the best source of PTP across all of their Media Network interfaces.

Media Nodes shall use the PTP parametric values and domain number specified in the System Resource defined in Annex A. If the System Resource is not available, stored values from the last successful operational experience should be used.

Media Nodes should ensure that their internal timebase maintains usable stability during transitions between grandmasters. In the holdover case, Media Nodes should continue to meet their interface specifications for several minutes (20 minutes is a suggested target).



Note: It is critical that Media Nodes apply a careful method across the Media Network interfaces, and not just a simple fail-over -- properly utilizing the clock dataset values from each interface. A common failure case is that one media network, operating in boundary clock mode, might lose its PTP grandmaster connection – in which case its clock dataset values will change to reflect this. Another media network may still have a good PTP grandmaster, in which case its clock dataset values would reflect that, and a correctly operating media node would choose the better interface’s time source. Based on feedback from the SMPTE 2059 interoperability events, the SMPTE is developing additional guidance on operation of PTP across multiple Media Network interfaces.

10.2.3 Link-Layer Discovery Protocol (LLDP)

Media Nodes shall implement IEEE 802.1AB “LLDP” protocol on each Media Network connection in order to identify themselves to the Media Network switches, and also to report their interface neighbor information as required under AMWA NMOS IS-04. LLDP on Control Network interfaces is encouraged but not mandated.

10.2.4 Dynamic Host Configuration Protocol (DHCP)

IETF RFC 2131 DHCP service shall be available on the Control Network and the Media Networks, either directly or via DHCP Relay Agents.

The DHCP service shall provide host configuration information to the Media Node for the network interfaces which request it. Table 1 enumerates the minimum DHCP options which shall be available to all Media Nodes. Facilities are permitted to support additional options as needed.

Table 1 – DHCP Options

Option #	Name	Description
1	Subnet Mask	Subnet Mask
3	Router	Available routers on this subnet, in preference order
6	DNS	DNS Servers
15	DNS Domain	Domain Name
28	Broadcast Address	Broadcast Address
50	Requested Address	Requested IP Address
51	Lease Time	DHCP Lease Time
58	Renewal Time	DHCP Lease Renewal Time (T1)
59	Rebinding Time	DHCP Lease Rebinding Time (T2)
81	Hostname	Client provides FQDN to the server
82	Relay Info	DHCP Relay Agent Information

Media Nodes shall request option 12 (wherein the DHCP server provides a hostname) and if the DHCP server returns a hostname with option 12 the Media Node shall use it. The Media Node shall create its



own unique host name in the event that the DHCP server does not reply with a hostname under option 12. Using a textual representation of the MAC address as part of the name is one way to accomplish this.

Media Nodes shall support DHCP option 81, wherein the DHCP server can request the client to return its FQDN to the DHCP server.

10.2.5 Domain Name Service (DNS)

The Network Environment shall include one or more unicast DNS servers; the addresses of these servers shall be distributed to Media Nodes via DHCP option 6.

Media Nodes may attempt to register their hostname in DNS; however system security settings might prevent this action from succeeding. In systems which are secured in this manner, the DHCP server may be configured to perform a secure DNS Dynamic Update on behalf of the Media Node.

10.2.6 NMOS IS-04 Registry

The Network Environment shall contain one or more registries implementing AMWA NMOS IS-04 Registration and Query APIs, v1.2 STABLE or higher.

The Network Environment shall provide one or more instances of the System Resource as defined in Annex A. This may be hosted by the registry providing the IS-04 APIs or elsewhere.

Media Nodes shall use unicast DNS Service Discovery (DNS-SD) to locate the registration APIs as described in IS-04.

If DNS-SD is not available or does not return a usable registration API endpoint, Media Nodes should attempt registration in the API endpoint used in previous operation (if available). When operating in this manner, Media Nodes shall periodically re-query DNS-SD for a registry service, but not more than once per minute.

Media Nodes should, through product-specific means, provide a status parameter indicating which registration service is currently in use.

Media Nodes shall use the registry heartbeat_interval value specified in the System Resource defined in Annex A when maintaining their registration.

10.2.7 Network Time Protocol (NTP)

NTP service may be available in the control and/or media networks, and if available should be advertised by the DHCP server using the standard DHCP option (option 42). Any provided NTP service should reflect the same time value as the PTP (after accounting for the differences between UTC and TAI time).

10.3 Multicast Media Streams

Media Nodes shall support IPv4 multicast streams, with packet sizes compliant to the Standard UDP Size Limit specified in SMPTE ST 2110-10.

Media Nodes shall support IGMP V3, and shall use the source-specific method if the source address information is provided in the SDP. Notwithstanding the provisions of IETF RFC 5771, Senders and Receivers shall support the entire range of multicast addresses as noted in section 11.3, including the ability to request SSM across this whole range.



Senders should include source address information in the SDP.

Note: Networks which have specific limitations on multicast ranges for SSM can implement those restrictions through their control systems.

Note: Support of IGMPv3 includes the ability to support IGMP V2 and to dynamically determine which version to use.

11 Requirements and Behaviors of Media Nodes

11.1 Media Node Requirements

Media Nodes shall comply with SMPTE ST 2110-10.

Media Nodes which generate or consume two streams for redundancy purposes shall implement SMPTE ST 2022-7:2018, and shall expose two `interface_bindings` entries in their IS-04 sender or receiver objects. The first entry of the IS-05 `transport_params` array shall relate to the first entry of the IS-04 `interface_bindings` array, and likewise the second entries shall relate.

Media nodes which generate or consume their redundant streams on the SAME Media Network interface shall still expose two (identical) entries in the IS-04 `interface_bindings` array, referring to the same interface.

Media Nodes which generate or consume video streams shall comply with SMPTE ST 2110-20 and ST 2110-21.

Media Nodes which generate or consume PCM audio streams shall comply with SMPTE ST 2110-30.

Media Nodes which generate or consume non-PCM audio signals mapped into AES3 transport shall comply with SMPTE ST 2110-31.

Media Nodes which generate or consume SMPTE ST 291-1 ANC data streams over IP shall comply with SMPTE ST 2110-40.

Media Nodes shall expose an AMWA NMOS IS-05 1.0.2 STABLE or higher device connection management API.

Media Nodes shall expose an AMWA NMOS IS-04 1.2 or higher node API, and shall register using the IS-04 registration API as described in section 10.2.6. Media Nodes shall maintain their registration as documented in AMWA IS-04 including periodic “health” check-ins.

Media Nodes should implement the IS-04 “x-nmos:grouphint” tag as defined in the AMWA NMOS parameter register.

Media Nodes shall support IEEE 1588:2008 PTP timing, compliant to the range of values specified in SMPTE ST 2059-2. Where applicable Media Nodes shall also comply with SMPTE ST 2059-1.

Media Nodes shall expose unique, immutable, and consistent UUIDs in the IS-04 registry over the life of the product, including consistency over reboots, power cycles, and software upgrades.



Media Nodes shall expose some kind of unit-specific identifying characteristic (such as a serial number or VM identifier) as part of their IS-04 node or device description field, in order to facilitate locating the specific unit or instance that corresponds to each registry entry.

All Receivers shall support modification of the `transport_params`, `transport_file`, and `master_enable`, via AMWA IS-05.

All connection management via IS-05 under this document shall use the RTP `transport_params` schema, utilizing IPv4 Multicast addressing for streams.

11.2 Media Node Startup and Multicast Addresses

Media Nodes shall by default utilize DHCP on all of their network interfaces. In any case where they do not utilize DHCP, they shall provide a manual means of configuration of all of the information which would have been delivered via DHCP.

Media Nodes shall, at startup, read the System Resource defined in Annex A and use the values from that resource in place of any stored configuration values for the same parameters. If the System Resource is not available, stored values from previous operation may be used.

All Senders shall support configuration of their Sender `transport_params` and `master_enable` through IS-05.

Note: Typical behavior of professional media equipment is to store current operating settings in a non-volatile manner, and to restore those settings after loss-of-power, so that a whole system can re-start quickly after an outage. In the case of Media Nodes in a networked environment, it is important to distinguish between a device re-starting within the same system environment (such as a reset of one device) and the case of a device being moved from one system environment to another (such as a rental camera at a new job). The situation is made harder by a third case – equipment which has been stored (perhaps in a spares closet) for a long period of time such that its settings are outdated, and then is re-introduced to the environment.

The System Resource defined in Appendix A includes a System ID, which shall be assigned randomly (and uniquely) in each facility. Media Nodes shall store the System ID and their DHCP-assigned address as part of their current operating settings, and shall check at re-start, before generating any multicast outputs, that the current Network Environment's System ID and DHCP-assigned address match the previously stored values. If the current system ID and address are the same as before, then recalling the previous operating settings might be appropriate and safe, subject to the clause below.

In addition to checking the System ID and DHCP-assigned address, Media Nodes shall compare the timestamp of their last stored parameter information against the version timestamp of the System Resource. If the Media Node's timestamp is newer than the prevailing System Resource version, then the Media Node can use its previous operating settings without further checks.

If the System ID and address do not match the stored values, or the System Resource version is newer than the stored settings, then the Media Node shall implement the following behavior:

- Any RTP Transmitter which would be active in the current configuration shall be disabled from transmitting (`master_enable` set to false), but shall remain advertised in IS-04 and configurable via IS-05



- Any RTP Receiver which would be active in the current configuration shall be “disconnected” as defined in section 11.4
- Any stored registry location information shall be invalidated

If the System Resource is not available, Media Nodes shall behave as if the System Resource had supplied a matching ID and an earlier version timestamp, in order to maintain compatibility with current behavior.

11.3 Multicast Address Allocation and Stream Transmit Enable

When a Sender Media Node is added to a new system, a management entity will use AMWA IS-05 to configure the multicast transmit information (transport_params) before or in the same transaction as enabling the transmitter (master_enable = true).

Allocation of multicast addresses and avoidance of conflicts is the responsibility of the management system.

Media Nodes shall support the entire range of multicast addresses from 224.0.2.0 through 239.255.255.255.

11.4 Receiver Disconnect Convention

At times, the Broadcast Controller might seek to disconnect a receiver – such that the receiver receives no signal and takes a receiver-dependent action.

In order to avoid doubt and to maximize interoperability, controllers shall take the following actions, concurrently, when asking for a disconnect:

- Transport_file (SDP) with one media section, specifying in the c= line a multicast address of 0.0.0.0 for the network signal, or Transport_file (SDP) with two media sections, specifying in the c= line a multicast address of 0.0.0.0 for both (Amber and Blue) network signals, or Transport_file (SDP) of null or an empty string
- And Transport_params with multicast_ip equal to 0.0.0.0 in each element of the array.
- And Master_enable value of “false”.

When responding to a “get” operation for active parameters, a receiver in disconnect shall return a master_enable value of false. This value is the definitive indication that the receiver has been disconnected.



Annex A

System Resource Specification (NORMATIVE)

A.1 General

In a system deployment there are a number of “system-wide” constants that need to be distributed to all of the Media Nodes. This annex defines a System Resource according to the schema in A.2. This resource shall be read-only (no PATCH or PUT operations are defined). Media Nodes shall obtain the “global” branch of the System Resource by performing an HTTPS GET at the following URL:

`http://<system-ip-port>/x-nmos/system/v1.0/global/`

Where <system-ip-port> is advertised through DNS-SD using the service name “_nmos-system._tcp”.

The following sections of AMWA IS-04 shall also apply to the System Resource:

- Common Keys
- Client Side Implementation Notes
- Server Side Implementation Notes
- Load Balancing & Redundancy
- Discovery (substituting the service name defined above)

The text of this Annex may be superseded by a formal AMWA Interface Specification for the System Resource.

A2 System Resource Schema

The JSON schema for the global branch of the system resource shall be as follows:

```
{
  "$schema": "http://json-schema.org/draft-04/schema#",
  "type": "object",
  "description": "Defines the Global System Constants",
  "title": "System resource - global",
  "allOf": [
    { "$ref": "resource_core.json" },
    {
      "type": "object",
      "required": [
        "is04",
        "ptp"
      ],
      "additionalProperties": true,
      "properties": {
        "is04": {
          "description": "Constants relating to AMWA NMOS IS-04",
          "type": "object",
          "required": [
            "heartbeat_interval"
          ],
          "properties": {
            "heartbeat_interval": {
              "description": "How often a Node should re-assert its registration (in seconds)",
              "type": "integer",
              "default": 5,
              "minimum": 1,
              "maximum": 1000
            }
          }
        },
        "ptp": {
          "description": "Constants relating to IEEE1588 PTP",
          "type": "object",
          "required": [
            "announce_receipt_timeout",
            "domain_number"
          ],
          "properties": {
            "announce_receipt_timeout": {
              "description": "Number of announce intervals that must pass before declaring timeout",
              "type": "integer",
              "minimum": 2,
              "maximum": 10
            },
            "domain_number": {
              "description": "The PTP domain number",
              "type": "integer",
              "minimum": 0,
              "maximum": 127
            }
          }
        }
      }
    }
  ],
  "syslogv2": {
    "description": "Constants relating to syslog v2 servers",
    "type": "object",
    "additionalProperties": true,
    "properties": {
      "hostname": {
        "description": "Hostname or IP of a syslog v2 server (optional)",
        "type": "string",
        "format": "hostname"
      }
    }
  }
}
```

```
    },
    "port": {
      "description": "destination port number for syslog v2 messages",
      "type": "integer",
      "minimum": 1,
      "maximum": 65535,
    }
  }
},
"syslog": {
  "description": "Constants relating to syslog v1 servers",
  "type": "object",
  "additionalProperties": true,
  "properties": {
    "hostname": {
      "description": "Hostname or IP of a syslog v1 server (optional)",
      "type": "string",
      "format": "hostname"
    },
    "port": {
      "description": "destination port number for syslog v1 messages",
      "type": "integer",
      "minimum": 1,
      "maximum": 65535,
    }
  }
}
}
}
]
}
```