IPMX Uncompressed Active Video Profile Requirements

AIMS
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1. Introduction (Informative)

This document defines the requirements for the **IPMX Uncompressed Active Video Profile**, ensuring predictable and interoperable behavior across IPMX devices that transmit or receive uncompressed video.

This profile builds upon:

- The IPMX baseline requirements defined in the IPMX Product Qualification and Certification Requirements The IPMX Product Qualification and Certification Requirements (PQCR) document.
- The VSF TR-10 family, particularly TR-10-2: Uncompressed Active Video
- NMOS baseline requirements defined in TR-10-8

This profile does not restate TR-10-2 or any of its second-level references. It:

- References the applicable TR-10 specifications
- Defines the specific uncompressed format combinations required for IPMX
- Specifies sender and receiver requirements
- Defines NMOS signaling expectations for interoperability

All uses of *shall*, *should*, and *may* follow RFC 2119.

2. Scope (Normative)

This profile defines:

- The required uncompressed video formats for IPMX devices
- Sender-specific requirements
- Receiver-specific requirements
- Optional features vendors may implement
- NMOS signaling requirements specific to this profile

Anything not defined here or in TR-10-2 is outside this profile's scope.

3. Normative References (Normative)

Devices conforming to this profile shall comply with:

- **VSF TR-10-1:** System Timing and Definitions
- **VSF TR-10-2:** Uncompressed Active Video (IPMX uncompressed video transport and Info Blocks)
- **VSF TR-10-8**: NMOS Requirements, referencing **NMOS IS-04** Discovery and Registration and **AMWA NMOS IS-05** Connection Management. TR-10-8 defines the NMOS baseline for IPMX; PQCR extends this with additional mandatory NMOS specifications.
- **AMWA NMOS IS-11:** NMOS Stream Compatibility Management
- **AMWA BCP-004-01:** NMOS Receiver Capabilities (required for devices that implement a Receiver)
- **AMWA BCP-004-02:** NMOS Sender Capabilities (required for devices that implement a Sender)
- **IPMX Product Qualification and Certification Requirements (PQCR)**: IPMX Baseline Requirements, including NMOS requirements, branding, and certification rules.

In addition, where implemented, devices shall comply with the following AMWA specifications, as already referenced by PQCR:

- **AMWA BCP-005-01:** EDID to Receiver Capabilities (where applicable)

Where this profile refers to NMOS parameter names or capability identifiers, it uses the NMOS Parameter Registers:

- **AMWA NMOS Parameter Registers – Formats**
- **AMWA NMOS Parameter Registers – Capabilities**

This profile does not redefine concepts such as packet pacing, network timing, SDP structures, or Info Blocks already defined elsewhere.

4. Terms and Definitions (Informative)

The terms used in this document are as defined in:

- VSF TR-10-1
- VSF TR-10-2

This profile introduces no additional terms.

5. General Provisions (Normative)

Parameter	Requirement
Essence Type	Uncompressed Active Video
Encoding	As defined in TR-10-2
Required Colorimetry	RGB 4:4:4 (8-bit) **and/or** YUV 4:2:2 (10-bit)
Resolution	Undefined / Any
Frame Rate	Undefined / Any

6. Profile Format Requirements (Normative)

The media essence for this profile shall be Uncompressed Active Video as defined in TR-10-2.

This profile introduces no additional essence-level constraints beyond those listed below.

6.1 Required Sender Behavior

A device declaring support for this profile as a **sender** shall implement all requirements in this section.

6.1.1 Required Sender Format Combinations

1. The sender shall encode uncompressed active video in accordance with TR-10-2.
2. At minimum, the sender shall support **at least one** of the following format combinations:
   - **Combination 1**
     - Color representation: RGB
     - Sampling: 4:4:4
     - Bit depth: 8-bit per component
   - **Combination 2**
     - Color representation: YUV (YCbCr)
     - Sampling: 4:2:2
     - Bit depth: 10-bit per component
3. For the purposes of this profile:
   - Resolution is Undefined / Any.
   - Frame rate is Undefined / Any.

6.1.2 Additional Sender Format Requirements

1. The sender shall follow all pixel packing, pixel-group, and active-image signaling rules defined in TR-10-2.
2. The sender may support additional format combinations defined in TR-10-2 (e.g., other bit depths or sampling structures), but these are not required by this profile.
3. All signaled parameters (colorimetry, transfer characteristics, sampling, bit depth, resolution, and frame rate) shall accurately reflect the transmitted stream.

6.1.3 Transport & Timing Requirements

1. The sender shall use RTP transport and system timing as defined in TR-10-1 and TR-10-2.
2. Packet pacing, timestamp behavior, and media clock vs RTP clock relationships shall conform to TR-10-1.

6.1.4 Required Sender Signaling

The sender shall populate the Uncompressed Video Media Info Block and associated SDP attributes as defined in TR-10-2, ensuring consistency between:

- Info Block contents
- SDP
- Actual stream behavior

6.2 Required Receiver Behavior

A device declaring support as a receiver shall implement all requirements in this section.

6.2.1 Required Receiver Format Combinations

1. The receiver shall decode uncompressed active video in accordance with **TR-10-2**.
2. At minimum, the receiver shall support **both** of the following format combinations:

   - **Combination 1**
     - Color representation: RGB
     - Sampling: 4:4:4
     - Bit depth: 8-bit per component
   - **Combination 2**
     - Color representation: YUV (YCbCr)
     - Sampling: 4:2:2
     - Bit depth: 10-bit per component
3. For the purposes of this profile:
   - Resolution is **Undefined / Any**.
   - Frame rate is **Undefined / Any**.

6.2.2 Additional Receiver Format Requirements

1. The receiver shall correctly interpret all TR-10-2 format parameters, including:
   - Sampling structure
   - Bit depth
   - Colorimetry and transfer characteristics
   - Active image dimensions

2. The receiver shall accept any resolution and frame rate signaled according to TR-10-2, subject to its advertised capabilities.
3. The receiver may support additional format combinations (e.g., additional bit depths or sampling structures), but these are not required by this profile. When supported, they shall be accurately advertised via SDP, Info Blocks, and NMOS.

6.2.3 Interpretation of Transport & Signaling

1. The receiver shall interpret RTP transport and timing behavior in accordance with TR-10-1 and TR-10-2.
2. The receiver shall correctly interpret the Uncompressed Video Media Info Block and associated SDP attributes as defined in TR-10-2.
3. The receiver shall handle reserved or unused fields according to TR-10-2; this profile does not redefine reserved values.

7. NMOS Representation (Normative)

Devices claiming support for this profile shall model and advertise their media resources through NMOS in a manner consistent with:

- All required NMOS specifications listed in Section 3 (including IS-04, IS-05, IS-11, BCP-004-01/02, and BCP-005-01 where applicable)
- TR-10-8 (the NMOS baseline for IPMX)
- The required format combinations and signaling defined in Section 6 of this document

This section defines only the profile-specific NMOS constraints and expectations.

7.1 Sender NMOS Representation

7.1.1 Flow Format & Media Type

- `urn:x-nmos:format:video`
- A media type consistent with uncompressed video as defined by TR-10-2

7.1.2 Transport Requirements

- RTP transports (`urn:x-nmos:transport:rtp or .mcast`)

- Parameters must match TR-10-2 signaling (sampling, bit depth, colorimetry, dimensions, frame rate)

7.1.3 Sender Capabilities (BCP-004-02)

A sender shall expose Sender Capabilities accurately describing the specific uncompressed video format combination(s) it supports, as defined in Section 6. A sender is required to support at least one of the required format combinations (Combination A or Combination B), and its Sender Capabilities shall reflect exactly the combinations it implements.

The Capability resource shall use the appropriate NMOS Parameter Register fields (e.g., sampling, component depth, color representation, frame dimensions, grain rate) to describe each supported format combination.

7.1.4 IS-11 Behavior

IS-11 data shall:

- Accurately describe supported format combinations
- Not contradict TR-10-2 signaling

7.2 Receiver NMOS Representation

7.2.1 Receiver Format Support

Receiver resources shall indicate support for:

- `urn:x-nmos:format:video`
- Uncompressed video with RGB 4:4:4 8-bit and YCbCr 4:2:2 10-bit

7.2.2 Receiver Capabilities (BCP-004-01)

Constraint Sets shall express support for:

- RGB 4:4:4 8-bit
- YUV 4:2:2 10-bit

Using appropriate Parameter Register identifiers.

7.2.3 IS-11 Behavior

IS-11 compatibility declarations shall match actual decode capabilities for both required formats.

7.2.4 Alignment With TR-10-2 Signaling

All NMOS properties must match:

- TR-10-2 Info Block
- SDP signaling for uncompressed active video

8. Optional Features (Normative)

There are no additional optional features defined for this version of the profile.

9. Interoperability Notes (Informative)

This section highlights how the IPMX Uncompressed Video Profile relates to ST 2110-20 and typical broadcast interoperability expectations.

9.1 Relationship to SMPTE ST 2110-20

ST 2110-20 transmitters and receivers:

- Require flows to be fully PTP-synchronous
- Operate within a constrained set of broadcast raster formats
- Typically use YCbCr 4:2:2 10-bit video exclusively

IPMX receivers remain compatible with ST 2110-20 as long as the transmitted format matches what the IPMX receiver supports (notably 4:2:2 10-bit YUV).

However:

- ST 2110-20 receivers typically do not accept RGB 4:4:4 8-bit
- IPMX TX devices producing RGB 8-bit should not expect 2110-20 receivers to ingest those flows

- ST 2110-20 receivers require PTP-synchronous timing; IPMX TX devices using internal media clocks may need resampling or timing adaptation

9.2 Resolution and Frame-Rate Flexibility

IPMX intentionally does not prescribe resolutions or frame rates.

This supports Pro AV use cases such as:

- LED walls
- Non-standard aspect ratios
- High-refresh-rate displays
- Custom canvas sizes

By contrast, 2110-20 ecosystem expectations are strongly shaped by broadcast norms.

9.3 Why IPMX Leaves Formats Undefined

Broadcast and television environments rely on decades of industry coordination through:

- CEA/CTA video format specifications
- UHD Alliance certification programs
- HD/UHD interoperability marks
- Broad industry conventions for "1080p," "4K," "720p," etc.

These provide standardized raster formats and timing models that broadcasters and consumers depend on.

IPMX serves a much broader market, where display technology, creative layouts, LED canvases, and Pro AV workflows are far more diverse. In these markets:

- Vendor product strategy
- Market expectations
- Customer requirements
- Compatibility with anchor ecosystems (e.g., UHD Alliance formats)

…are better mechanisms for determining which resolutions and rates are appropriate.

11

Vendors may choose to adopt CEA/CTA or UHD Alliance format definitions where relevant to their market, but IPMX does not mandate these constraints.

10. Compliance Statement (Normative)

A device claiming compliance with this profile:

1. Shall implement all mandatory sender requirements in Section 6.1 if it supports transmission.
2. Shall implement all mandatory receiver requirements in Section 6.2 if it supports reception.
3. Shall comply with all NMOS baseline requirements defined in TR-10-8 and the IPMX PQCR.
4. Shall implement BCP-004-01 if it implements a receiver.
5. Shall implement BCP-004-02 if it implements a sender.
6. Shall implement BCP-005-01 only if it exposes EDID-derived display semantics.
7. Shall correctly model and advertise its media resources through NMOS in accordance with Section 7.
8. Shall comply with all applicable TR-10 documents.

Appendix A: Revision History (Informative)

Version	Date	Summary of Changes
1.0	2025-12-01	Public Release
0.1	2025-11	Initial Draft