**3GPP TSG-S4 ad hoc post Meeting #116-e *S4aI221304***

**Online, , 2 December 2021–3 February 2022** revision of S4aI221292

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| *CR-Form-v12.0* | | | | | | | | |
| **PSEUDO CHANGE REQUEST** | | | | | | | | |
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|  | **TR 26.805** | **CR** | **–** | **rev** |  | **Current version:** | **1.0.1** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | Tunnelling RTP media sessions over QUIC | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | BBC | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_NPN4AVProd | | | | |  | ***Date:*** | | | 2022-02-03 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | |  | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Document potentially useful technology. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Brief description of QRT and QUIC over RTP. * Usage of QRT in the potential solution as an alternative to RIST Main Profile. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | A potentially useful technolgoy will not be documented in the Feasibility Study. | | | | | | | | |
| ***Q*** | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.3, 4.2.5 (inserted), 4.2.6 (renumbered), 4.2.7 (renumbered), 4.2.8 (renumbered and enhanced), 4.2.9 (renumbered), 4.2.10 (renumbered), 4.5.5 (cross-reference adjusted), 6.3.4.3. | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

FIRST CHANGE

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

(SNIPPED)

[51] IETF RFC 9000: "QUIC: A UDP-Based Multiplexed and Secure Transport".

[52] IETF Internet-Draft draft-ietf-quic-datagram-08: "An Unreliable Datagram Extension to QUIC", 14th January 2022, <https://www.ietf.org/archive/id/draft-ietf-quic-datagram-08.html>.

[53] IETF Internet-Draft draft-gruessing-moq-requirements-00: "QUIC Encapsulation for Media over RTP – Requirements and Use Cases", October 2021, https://www.ietf.org/id/draft-gruessing-moq-requirements-00.html.

[54] IETF Internet-Draft draft-hurst-quic-rtp-tunnelling-01: "QRT: QUIC RTP Tunnelling", 28th January 2021, <https://datatracker.ietf.org/doc/html/draft-hurst-quic-rtp-tunnelling-01>.

[55] IETF Internet-Draft draft-engelbart-rtp-over-quic-00: "RTP over QUIC", 12th July 2021, https://www.ietf.org/archive/id/draft-engelbart-rtp-over-quic-01.html.

[56] IETF Internet-Draft draft-ietf-quic-http-34: "Hypertext Transfer Protocol Version 3 (HTTP/3)", February 2021, https://www.ietf.org/archive/id/draft-ietf-quic-http-34.html.

[57] IETF RFC 2543: "SIP: Session Initiation Protocol", March 1999.

[58] IETF Internet-Draft draft-dawkins-avtcore-sdp-rtp-quic-00: "SDP Offer/Answer for RTP using QUIC as Transport", 28th January 2022, <https://www.ietf.org/archive/id/draft-dawkins-avtcore-sdp-rtp-quic-00.html>.

[59] IETF RFC 4588: "RTP Retransmission Payload Format".

[60] IETF Internet-Draft draft-ietf-quic-multipath-00: "Multipath Extension for QUIC", February 2022, https://www.ietf.org/archive/id/draft-ietf-quic-multipath-00.html.

NEXT CHANGE

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

(SNIPPED)

PTZ Pan, Tilt, Zoom

QRT QUIC RTP Tunnelling

RIST Reliable Internet Stream Transport

(SNIPPED)

NEXT CHANGE

### 4.2.5 Tunnelling RTP media sessions over QUIC

RTP media sessions [44] can be carried over the QUIC transport protocol specified in RFC 9000 [51] using the unreliable datagram extension specified in [52]. A survey of some recent proposals to standardise this usage is found in [53], along with relevant use cases and requirements. Of particular interest in the present document, the QUIC RTP Tunnelling (QRT) [54] and RTP over QUIC [55] proposals both specify a means to multiplex RTP media over a QUIC transport connection, allowing for secure transmission of media flows over lossy IP networks (including the Internet) with tuneable latency and quality parameters.

QRT [54] and RTP over QUIC [55] specify a mutually interoperable lightweight multiplexing layer on top of the QUIC unreliable datagram extension [52], allowing multiple RTP sessions to be multiplexed together into a single encrypted packet flow.

In addition, reliable streams may be multiplexed into the same QUIC connection as the RTP media flows to exchange data using application protocols requiring reliability, such as HTTP/3 [56] and/or the Session Initiation Protocol (SIP) specified in RFC 2543 [57] used in combination with appropriate session announcements [58]. The former may be used, for example, to convey NMOS configuration and control messages as introduced in clause 4.5.2.

NOTE: The use of SIP or NMOS may be convenient for in-band call control in certain scenarios, such as remote production contribution links.

Using RTP as the basis for media transport, QRT and RTP over QUIC can leverage the substantial existing feature set of already-deployed RTP solutions, including:

- Support for any codec and packaging format that has an associated RTP payload format.

- Automatic Repeat Query (ARQ) requests by means of in-band RTCP packets using the bitmap-based RTP Retransmission payload format specified in RFC 4588 [59].

- RIST’s range-based NACK retransmission mechanism [7] (as described in clause 4.2.4) may additionally or alternatively be used in this context.

- Support for Forward Erasure Correction (FEC), including SMPTE 2022-1 [23].

In this respect, QRT and RTP over QUIC offer a similar feature set to RIST Main Profile, as described in clause 4.2.4.

By using QUIC, which has a predominant use in underpinning HTTP/3, QRT also inherits the following features:

- It is well understood by many application firewalls and proxies.

- Because connections are identified by a pair of abstract connection identifiers (rather than by a traditional 5‑tuple) active QUIC connections can be migrated between network endpoints without performing the security connection handshake again and without interrupting application-level flows.

- By probing additional network links before performing a connection migration, minimal delay and/or interruption is incurred.

A draft multipath extension [60] recently adopted by the IETF QUIC Working Group allows a pair of QUIC endpoints to use multiple network paths simultaneously (i.e. "link bonding"), either to increase the aggregate capacity of a connection, or to improve the robustness/resilience of the connection, or a combination of these.

NEXT CHANGE

### 4.2.6 Network Device Interface NDI

Network Device Interface (NDI®) [11] is a software solution developed by NewTek™ to enable video-compatible products to communicate, deliver, and receive high-definition video over a network in a high-quality, low-latency manner that is frame-accurate and suitable for switching in a live production environment. In contrast to SRT and RIST, NDI is intended to transfer media streams within a facility, not for contribution over the public networks.

NDI is designed to run over gigabit Ethernet. The table below lists the approximate bandwidth required by NDI codec [x6] for different video streams.

Table 4.2.6-1:

|  |  |
| --- | --- |
| Video stream | Approximate bit rate required by NDI codec |
| 2160p60 | 250 Mbps |
| 2160p30 | 200 Mbps |
| 1080p60 | 125 Mbps |
| 1080i60 | 100 Mbps |
| 720p60 | 90 Mbps |
| SD | 20 Mbps |

By default, NDI uses the multicast DNS (mDNS) discovery mechanism to advertise sources on a Local Area Network (LAN), although two other discovery modes (NDI Access, NDI Discovery Server) allow for operations across different subnets. When a source is requested, a TCP connection is established on the appropriate port with the NDI receiver connecting to the NDI sender. NDI 3.x has options to use UDP multicast or unicast with Forward Error Correction (FEC) instead of TCP, and can load balance streams across multiple Network Interface Controllers (NICs) without using link aggregation. NDI 4.0 introduces multi-TCP connections.

NDI carries video, multichannel uncompressed audio and metadata in XML form. Metadata messages can be sent in both directions allowing the sender and receiver to message one another over the connection with arbitrary metadata. This directional metadata system allows for functionality such as active tally information (on-air program/preview). NDI Receivers can opt to connect to various combinations of streams, to support things like audio-only or metadata-only connections where video is not required.

NEXT CHANGE

### 4.2.7 IP Media eXperience (IPMX)

IPMX (IP Media eXperience) is a recent initiative of the Alliance for IP Media Solutions (AIMS) to provide a standards-based approach for “Pro-AV” IP applications, such as in conference rooms, for digital signage etc., which might otherwise use HDMI or an Ethernet- (rather than IP-) based protocol such as SDVoE or HDBaseT.

IPMX adapts the SMPTE ST 2110 [21] specifications to provide a lower-cost approach to synchronisation – it still uses PTP but does not require boundary switches – and a timing model that is possibly better suited to software implementation. It uses mezzanine compression (JPEG-XS [50]) and NMOS discovery and connection (see below). It supports HDCP content protection.

At this time IPMX is still in development with few products available and it is too soon to comment on its interoperability.

NEXT CHANGE

### 4.2.8 Comparison Table

Table 4.2.8-1: Comparison of media transport protocols

| Parameter | ST 2110 | SRT | RIST | QRT | NDI | IPMX |
| --- | --- | --- | --- | --- | --- | --- |
| Intended use | High quality facility and OB operations | Contribution over unreliable links (e.g., public internet) | Contribution over unreliable links (e.g., public internet) | Contribution over unreliable links (e.g., public Internet) | Transfer of media streams within a facility | “Pro-AV” applications such as conference rooms, digital signage, etc |
| Proprietary/‌Opensource | Open standard | Opensource | Opensource | Opensource | Proprietary | Standards |
| Based on protocol | RTP | UDT | RTP, e.g. TS-over-IP | RTP, QUIC | TCP/UDP | RTP |
| Interoperability | wider vendor support and community of practice | Can be limited between different vendors | Good | Experimental | Partially limited due to proprietary nature | Too soon to comment |
| Latency | uncompressed very low  compressed under 2 lines | Configurable, 4 × RTT of the link is recommended | Configurable, 4 × RTT of the link is recommended | Configurable | Practically one field latency, might be as low as 8 scan lines | “Sub frame” |
| Error correction |  | FEC/ARQ | FEC/ARQ | FEC/ARQ | TCP or FEC |  |
| Security | Designed for closed networks | Transport encryption | Transport encryption | Transport encryption | Designed for closed networks | Support for HDCP |
| Authentication | NMOS | Supported, PSK based | Supported, PSK and DTLS based | TLS client certificate | Not supported natively |  |
| Multicast | Supported | Not supported | Supported | Not yet specified | Supported | Supported |
| Multiple links | Supported | Not supported | Supported | Supported, using multipath extension | Supported | Supported |
| Codec | Uncompressed, JPEG XS, ST 2042-1 (VC-2), potentially more in future | Codec agnostic | Codec agnostic | Codec-agnostic | Built in | JPEG XS or other |

Editor’s Note: it would be excellent of we can add an idea on reliability requirements.

NEXT CHANGE

### 4.2.9 Other Protocols

A number of other protocols exist for the carriage of audio and video data such as ST 2022-6 (encapsulated SDI) as well as various proprietary solutions. There are also solutions such as HDBaseT, AVLC, SDVoE Dante AV which support other workflows such as conference and event production.

NEXT CHANGE

### 4.2.10 Audio Networking Solutions

DANTE, RAVENNA, QLAN, LiveWire+, WheatNet-IP can be considered as complete audio networking solutions, i.e. offering a complete networked audio systems. While each audio networking solution offers in-system connectivity, previous to the appearance of AES67 there was no standard to provide inter-system connectivity, thus leading to incompatibility between devices implementing different audio networking solutions.

AES67 is not a complete audio networking solution but it does specify a mode of operation that allows interoperability between audio devices implementing different audio networking technologies (or audio “complete” networking solutions). Thus, AES67 is a complement to the existing audio networking technologies but not in direct competition with them.

AES67 defines a set of common protocols and standards to achieve that compatibility/interoperability. Like ST 2110 it uses RTP streams, and (with care) AES67 and ST 2110-320 audio systems can interoperate.

NEXT CHANGE

### 4.5.5 Other Protocols

NDI (see clause 4.2.6) provides discovery on a local network using multicast DNS-SD or between networks using NDI Acces or NDI Discovery Server. NDI also provides an API for camera pan/tilt/zoom (PTZ) control.

A number of control/management standards and specifications are used with audio devices, including:

- AES70 aka OCA (Open Control Alliance), a full-featured control architecture developed by Bosch.

- IEEE 1722.1 provides Discovery, Enumeration, Connection management and Control for AVB applications.

- MIDI and OSC, in particular for music applications. MIDI 2.0 provides significant enhancements over 1.0.

- SNMP is used in some applications.

However, none of these are universally adopted, and in practice many networked audio environments rely on the control layer provided with Dante.

Recently, there has been interest in use of YANG and NetConf for device control.

NEXT CHANGE

#### 6.3.4.3 Solution Example B: Fine-grained separation with separated media

In this example, a finer-grained separation of media is used:

- Within Group 1, the audio elementary stream has a higher priority than the video elementary stream.

- Talkback (Group 2) audio has a lower priority than Group 1 traffic.

- In Group 3, tally light control has a higher priority than general camera control.

As result, the individual media flows should be separated into separate application flows, e.g. UDP/IP flows or TCP/IP flows.

In order to enable the 5G System to prioritise the audio elementary stream higher than the video elementary stream in Group 1, the elementary streams need to be carried as individual UDP/IP media flows.

- RIST Simple profile (see clause 4.2.4) allows usage of separated RTP sessions for different elementary streams, when a native RTP payload format (like RFC 7798 [47] for HEVC or RFC 6416 [49] for AAC) is used.

- RIST Main profile (see clause 4.2.4) uses GRE tunnelling to encapsulate all media flows in order to simplify NAT/firewall traversal. QRT [54] and RTP over QUIC [55] (see clause 4.2.5) both achieve the same multiplexing effect using QUIC [51] as an alternative tunnelling protocol.

NOTE: The usage of a tunnelling protocol prevents the 5G System from differentiating individual media flows, and thus inhibits its ability to apply different network QoS to the flows multiplexed inside a tunnel.

The talkback audio flow needs to be separated from the main output using dedicated TCP/IP or UDP/IP transmission resources.

If tally light control requires a higher priority than other camera control messages, the event messages should be carried using uniquely identifiable network resources. When MQTT is used for carrying control event messages, the camera needs to set up two MQTT/TCP connections, which can then be clearly prioritized by the 5G System. When WebSockets are used for carrying the event message, the camera should set up two WebSocket/TCP connections to enable separate message prioritization.

END OF CHANGES