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| 3GPP TR 26.805 V0.1.0 (2021-04) | |
| Technical Report | |
| 3rd Generation Partnership Project;  Technical Specification Group Services and System Aspects;  Study on Media Production over 5G NPN Systems  (Release 17) | |
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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document identifies standardization needs and potential standards gaps when using 5G Systems for media production. More specifically the following aspects are addressed in this document:

- To identify the relevant media production use cases (professional, semi-professional, production, contribution), based on existing use-cases from TR 22.827 as well as requirements from TS 22.263, that may benefit from 5G System functionalities. This includes collaboration use cases between media producers and 5G System operators.

- To develop one or several reference media production architectures and to map the variety of different media and control flows (such as uplink video, return video, tally, etc) involved in media production onto 5G System delivery components.

- To identify relevant QoS requirements for media production workflows, including required bit rates, loss rates, formats, latencies and jitter, and to identify their impact on the relevant KPIs for media production workflows (reliability, mean-time-between failure, service-level agreements, etc.).

- To identify relevant 5G System features like NPNs, Network Slicing, QoS classes, network event reporting and assistance, etc. that are useful for media production, and to clarify their usage for media production.

- To identify the suitability of existing media production content delivery protocols, codecs and service layers for 5G System usage, evaluate benefits and gaps, and recommend profiles or extensions in collaboration with organizations that develop and deploy existing protocols and codecs.

- To study media device and network orchestration solutions (such as AMWA NMOS), and their integration/interactions with the 5G exposure framework.

- To collaborate with relevant other 3GPP groups and external organizations (VSF, 5G-MAG, EBU, etc.) on media-related aspects of Media Production use cases.

- To identify potential normative work on media level for media production use cases in 5G Systems.

The document primarily focuses on the usage of 5G Systems including NPNs (both Standalone NPN and Public Network Integrated NPN).

# 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".

[2] 3GPP TS 22.261: "Service requirements for the 5G system"

[3] 3GPP TS 22.263: "Service requirements for Video, Imaging and Audio for Professional Applications (VIAPA)"

[4] 3GPP TS 22.827: "Study on Audio-Visual Service Production"

[5] M.P. Sharabayko, M.A. Sharabayko, J. Dube, JS. Kim, JW. Kim: "The SRT Protocol", draft-sharabayko-mops-srt-01

[6] VSF: "Reliable Internet Stream Transport (RIST) Activity Group", https://www.videoservicesforum.org/RIST.shtml

[7] VSF TR 06-1: "Reliable Internet Stream Transport (RIST) Protocol Specification – Simple Profile", <https://vsf.tv/download/technical_recommendations/VSF_TR-06-1_2018_10_17.pdf>

[8] VSF TR 06-2, "Reliable Internet Stream Transport (RIST) Protocol Specification – Main Profile", [https://www.vsf.tv/download/technical\_recommendations/VSF\_TR-06-2\_2020\_03\_24.pdf](https://protect2.fireeye.com/v1/url?k=cc406e56-93db577d-cc402ecd-866038973a15-a3187c63f11b10f6&q=1&e=1f3c54ba-abd4-4509-b7b2-0816901e7741&u=https%3A%2F%2Fwww.vsf.tv%2Fdownload%2Ftechnical_recommendations%2FVSF_TR-06-2_2020_03_24.pdf)

[9] NewTek: "NDI Encoding/Decoding", <https://support.newtek.com/hc/en-us/articles/218109667-NDI-Encoding-Decoding>

[10] NewTek: "NDI Network Bandwidth, <https://support.newtek.com/hc/en-us/articles/217662708-NDI-Network-Bandwidth>

[11] David Aleksandersen: "What is NDI® (Network Device Interface)?", <https://newsandviews.dataton.com/what-is-ndi-network-device-interface>

[12] Kieran Kunhya and Ciro Noronha: "RIST and SRT: What’s the difference?", <https://www.tvbeurope.com/ip-migration/rist-and-srt-whats-the-difference>

[13] Tofik Sonono: "Interoperable Retransmission Protocols with Low Latency and Constrained Delay: A Performance Evaluation of RIST and SRT", Masters Thesis, KTH Stockholm, 2019, http://kth.diva-portal.org/smash/get/diva2:1335907/FULLTEXT01.pdf

# 3 Definitions of terms, symbols and abbreviations

This clause and its three subclauses are mandatory. The contents shall be shown as "void" if the TS/TR does not define any terms, symbols, or abbreviations.

## 3.1 Terms

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

Definition format (Normal)

**<defined term>:** <definition>.

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

Symbol format (EW)

<symbol> <Explanation>

## 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].

NPN Non Public Network

# 4 Review of existing orchestration solutions

Editor’s Note: (text from the SID) To study media device and network orchestration solutions (such as AMWA NMOS), and their integration/interactions with the 5G exposure framework

<This should include a short overview of NMOS, specifically IS-04 and IS-05. It should also contain an overview of protocols used for other IS-0x parts.>

<@All: Is there another NMOS like setup, which should be considered?>

# 5 Review of existing media protocol solutions

## 5.1 General

Editor’s Note: (text from the SID) To identify the suitability of existing media production content delivery protocols, codecs and service layers for 5G System usage, evaluate benefits and gaps, and recommend profiles or extensions in collaboration with organizations that develop and deploy existing protocols and codecs.

<This should include a short overview of relevant SMPTE solutions, like ST 2110, ST 2022. It should also include an overview of the different RIST profiles. We should also review NDI and SRT from a connectivity usage perspective.>

Editor’s Note: This is a placeholder for some general introduction.

Editor’s Note: Explain that NACK refers to Negative ACKnowledgement.

Editor’s Note: Existing media protocols are used between different production functions in various combinations. The protocol end-points are deployment specific and will be clarified.

## 5.2 Secure Reliable Transport (SRT)

Secure Reliable Transport (SRT) [5] is an open-source media transport protocol that uses the UDP transport protocol. SRT provides connection and control, reliable transmission similar to TCP at the application layer. It supports packet recovery while maintaining low latency. SRT also supports encryption using AES.

The protocol was derived from the UDT project, designed for fast file transmission. UDT provides its reliability mechanism by using similar methods for connection, sequence numbers, acknowledgements and retransmission of lost packets. UDT uses selective and immediate (NACK-based) retransmission.

SRT has all these features, but also adds several more to support live streaming mode:

1. Controlled latency, with source time transmission (timestamp-based packet delivery).

2. Sender bandwidth control.

3. Conditional "too late" packet dropping (prevents head-of-line blocking caused by a lost packet that wasn't recovered on time).

4. Eager packet re-transmission (periodic NACK report).

## 5.3 Reliable Internet Stream Transport (RIST)

Reliable Internet Stream Transport [6] is an open source, open specification transport protocol designed for reliable transmission of media over lossy networks (including the internet) with low latency and high quality. It is currently being developed and maintained by the Video Services Forum (VSF).

Technically, RIST seeks to provide reliable, high performance media transport by using RTP/UDP at the transport layer to avoid the limitations of TCP. Reliability is achieved by using NACK-based retransmissions to realise an Automatic Repeat Query (ARQ) capability. SMPTE-2022 Forward Error Correction can be combined with RIST but is known to be significantly less effective than ARQ.

RIST Simple Profile [7] was published by the VSF in October 2018 and includes the following features:

- The base stream uses RTP for compatibility with existing equipment.

- Retransmission requests use RTCP. Two types of retransmission requests are defined:

- A Bitmask-based NACK, defined in RFC 4585.

- A Range-based NACK, defined as an application-specific (APP) RTCP packet.

- Bonding of multiple links for load sharing.

- Seamless switching using SMTPE-2022-7.

- Out-of-band transmission of protection data (retransmissions may use a separate link).

RIST Main Profile [8] was published in March 2020 and adds the following features to Simple Profile:

- GRE-in-UDP encapsulation based on RFC 8086, with bidirectional send/receive in the same tunnel.

- Multiplexing of multiple streams into the same tunnel.

- In-band data support in the tunnel, useful for remote management.

- Client/Server architecture.

- Firewall traversal.

- DTLS encryption or Pre-Shared Key encryption, with multicast support, access control, and authentication.

- Advanced authentication options using either public key certificates or TLS-SRP.

- Bandwidth optimization based on NULL packet deletion.

- Support for high bit-rate streams by extending the size of the RTP sequence number space.

## 5.4 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 5.4-1:

|  |  |
| --- | --- |
| 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.

## 5.5 Comparison Table

Table 5.5-1: Comparison

| Parameter | SRT | RIST | NDI |
| --- | --- | --- | --- |
| Intended use | Contribution over unreliable links (e.g., public internet) | Contribution over unreliable links (e.g., public internet) | Transfer of media streams within a facility |
| Proprietary/Opensource | Opensource | Opensource | Proprietary |
| Based on protocol | UDT | RTP, e.g. TS-over-IP | TCP/UDP |
| Interoperability | Can be limited between different vendors | Good | Partially limited due to proprietary nature |
| Latency | Configurable, 4 × RTT of the link is recommended | Configurable, 4 × RTT of the link is recommended | Practically one field latency, might be as low as 8 scan lines |
| Error correction | FEC/ARQ | FEC/ARQ | TCP or FEC |
| Encryption | Supported | Supported | Not supported natively |
| Authentication | Supported, PSK based | Supported, PSK and DTLS based | Not supported natively |
| Multicast | Not supported | Supported | Supported |
| Multiple links | Not supported | Supported | Supported |
| Codec | Codec agnostic | Codec agnostic | Built in |

# 6 Relevant media production use cases

## 6.x Use-Case X

### 6.x.1 Description

Editor’s Note: (text From the SID) To identify the relevant media production use cases (professional, semi-professional, production, contribution), based on existing use-cases from TR 22.287 as well as requirements from TS 22.163, that may benefit from 5G System functionalities. This includes collaboration use cases between media producers and 5G System operators.

<Use-cases from TR 22.827 are preferably broken down into smaller use-cases such as

* Multi-camera aspects like synachronization
* Usage and purpose of different per-camera flows (like return video)

>

State of the art (current issues in content production)

o Focus on multiple cameras for live video production controlled remotely

o Focus on multiple microphone for live audio production

Workflows/architectures/deployment scenarios

o Live video

o Live Audio

### 6.x.2 Collaboration models and deployment architectures

Editor’s Note: (text from the SID) To develop one or several reference media production architectures and to map the variety of different media and control flows (such as uplink video, return video, tally, etc) involved in media production onto 5G System delivery components.

### 6.x.3 Identified 5G System features

Editor’s Note: (text from the SID) To identify relevant QoS requirements for media production workflows, including required bit rates, loss rates, formats, latencies and jitter, and to identify their impact on the relevant KPIs for media production workflows (reliability, mean-time-between failure, service-level agreements, etc.).

Editor’s Note: (text from the SID) To identify relevant 5G System features like NPNs, Network Slicing, QoS classes, network event reporting and assistance, etc. that are useful for media production, and to clarify their usage for media production.

< e.g. TSN in future 3GPP releases, QoS, Network Slicing>

### 6.x.4 High level call flows

Editor’s Note: (text from the SID) To identify the suitability of existing media production content delivery protocols, codecs and service layers for 5G System usage, evaluate benefits and gaps, and recommend profiles or extensions in collaboration with organizations that develop and deploy existing protocols and codecs.

### 6.x.5 Potential issues

# 7 Candidate Solutions

< this section should describe, how identified 5G features are used in context of media production>

# 8 Summary and Conclusions

Annex <X> (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| Apr 2021 | SA4#113 | S4-210519 |  |  |  | Initial version | 0.0.1 |
| Apr 2021 | SA4#113 | S4-210678 |  |  |  | S4-210527: Structure of the technical report  S4-210641: Description of existing media protocols in media production | 0.1.0 |