**3GPP SA4 114-e S4-210841**

**19-28 May 2021**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Support of Network-Based Media Processing | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** |  | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** |  | | | | |  | ***Date:*** | | |  |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | |  |
|  | *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). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) Rel-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The current version of the technical report doesn’t include the use of NBMP with the FLUS specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | * Adding   + references   + assumptions and requirements   + use-cases   + Example FLUS call flow with Network-Based Media Processing (NBMP) + NBMP with FLUS using AF   + Gap analysis for each deployment scenario | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | TS26.939 doesn’t have any description of the use of NBMP while TS26.238 references the NBMP specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## \*\*\* Start change 1 \*\*\*

# 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 26.238: "Uplink streaming".

[3] ISO 14496-12: "Information technology – Coding of audio-visual objects – Part 12: ISO base media file format".

[4] ISO 23000-19: "Information technology – Coding of audio-visual objects – Part 19: Common media application format (CMAF) for segmented media".

[5] 3GPP TS 23.401: "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access".

[6] 3GPP TS 23.501: "System Architecture for the 5G System (5GS)".

[7] ISO 14496-12: "Information technology – Coding of audio-visual objects – Part 12: ISO base media file format".

[8] ISO 23008-1: "Information technology – High efficiency coding and media delivery in heterogeneous environments – Part 1: MPEG media transport (MMT) ".

[9] ISO 23008-1: 2nd Edition AMD2, "Enhancements for Mobile Environments".

[10] IETF RFC 6455: "The WebSocket Protocol".

[11] IETF RFC 5234 (2008): "Augmented BNF for Syntax Specifications: ABNF", D. Crocker, P. Overell.

[12] IETF RFC 6817: "Low Extra Delay Background Transport (LEDBAT) ".

[13] ISO 23000-19: "Common Media Application Format for Segmented Media (CMAF) ".

[14] IETF RFC 7230: "Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing".

[15] IETF RFC 7540: "Hypertext Transfer Protocol Version 2 (HTTP/2) ".

[16] 3GPP TS 26.114: "IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[17] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[18] 3GPP TS 26.244: "Transparent end-to-end packet-switched streaming service (PSS); 3GPP file format (3GP)".

[19] 3GPP TS 23.203: "Policy and Charging Control Architecture".

[20] DVB CM-AVC Report on Low-Latency Live Service with DASH.

[21] "Facebook (A)Live? Are live social broadcasts really broadcasts? ", by A. Raman, G. Tyson and N. Sastry, WWW 2018: The 2018 Web Conference, April 23-28, 2018, Lyon, France, <https://arxiv.org/pdf/1803.02791.pdf>.

[22] 3GPP TS 26.347: "Multimedia Broadcast/Multicast Service (MBMS); Application Programming Interface and URL".

[23] 3GPP TR 26.985: "Vehicle-to-everything (V2X) media handling and interaction".

[24] ISO/IEC 23090-8 Information technology — Coded representation of immersive media — Part 8: Network based media processing

## \*\*\* End change 1 \*\*\*

## \*\*\* Start change 2 \*\*\*

## 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].

FLUS Framework for Live Uplink Streaming

MCC Mobile Country Code

MNC Mobile Network Code

NBMP Network Based Media Processing

## \*\*\* End change 2 \*\*\*

## \*\*\* Start change 3 \*\*\*

## Use Case: Network Based Media Processing

In this scenario, the network-based media processing based on the NBMP standard [24] is used for media processing of the content in the network. The use-case consists of several use cases.

### Use Case Description

#### Live streaming

Kim is subscribed to an Application for live streaming of captured videos from her everyday life. Based on the previous number and diversity of Kim’s usual audience (e.g. close friends), Application has an “audience codecs-rates” profile which represents the typical number of stream needed based on Kim’s previous streaming sessions. Kim starts the session live stream session. While Kim is uploading a single stream using FLUS, the server Application is commanding the running of multiple transcoders based on Kim’s audience codec-rates profile. If new users join Kim’s streaming session which could not be supported with the current codecs-rates, the Application may add more transcoders to add to multirate streaming in the session.

##### Variations:

1. Capabilities:
   1. There are sufficient resources available at FLUS Sinks, so there is no need to check whether the picked FLUS Sink has the required real-time multi-rate transcoding capabilities.
   2. Available FLUS Sinks might have limited capabilities. The server application must find a Sink capable of running the transcoding session.
2. Server or Device Application
   1. The UE’s Application is responsible for setting up the FLUS and NBMP session, as well as managing the audience codecs-rates profile.
   2. The UE’s Application is responsible for setting up the FLUS session. The Sever Application is responsible for setting up the NBMP session.

##### Preconditions

###### On the device:

###### A 3GPP supported encoder is installed.

###### UE’s Application is installed which supports NBMP Source functionalities.

###### A 3GPP FLUS Source is installed.

###### On the network,

###### One or more FLUS Sinks are installed that one or more of them supports NBMP Workflow Manager functionality.

###### One or more FLUS Sinks are installed, that run various instances of decoding/encoding or transcoding, and the decoder/encoder/transcoder are described as NBMP Functions in an NBMP repository.

###### A FLUS Sink may have limited capabilities, i.e the codecs it supports and/or the number of concurrent transcoders.

###### The FLUS Sink’s load may vary dynamically due to the other parallel network processing sessions.

###### Network storage is available to store the encoded content for time-shifted streaming.

##### Requirements in terms of Capabilities and QoS/QoE Considerations

1. Capabilities

* Discovering of Sink’s network processing capabilities if needed
* Setting the FLUS and NBMP sessions
* Start the Sessions
* Change the workflow by adding more transcoders if needed during the session
* Real-time transcoding and packaging to different codecs and different bitrates
* Offloading an originally selected sink to a new sink to handle additional needed processing that cannot be accommodated by the original sink

1. KPI

* Supporting the use-case
* Minimum extension of FLUS and NBMP Standard, preferably none.

#### Rich on-demand video streaming

Khloe, Kim’s sister, is subscribed to an Application for uploading her videos, enhancing them, and adding rich features to them before publishing them as on-demand content. Example of enhancements and added rich features are:

1. Enhancing the quality of the video with e.g. noise removal, white balance correction, color correction, prebuilt filters, etc.

2. Indexing the content

3. Creating thumbnail navigation

4. Extracting subtitle from audio and add it to the video

5. Translation and adding multiple language subtitles

6. Adding interactive tags to the shops, restaurants and other service stores in the scene

7. Detecting any unintended improper shots and marking them for Khloe to review

Based on the previous number and diversity of Khloe’s usual audience (e.g. close friends), Application has an “audience codecs-rates” profile which represents the typical number of streams needed for streaming sessions. Depending on the service, the encoding can be done ahead of time, or on-fly when is requested by an audience. The on-demand content shall be available with a maximum delay from the end of upload. This maximum delay is defined by the Application in the Khloe’s profile.

##### Variations*:*

1. Capabilities:

a. There are sufficient resources available at FLUS Sinks, so there is no need to check whether the picked FLUS Sink has the required real-time multi-rate transcoding capabilities.

b. Available FLUS Sinks might have limited capabilities. The server application must find a Sink capable of running the transcoding session.

c. Required FLUS Sink resources vary based on the number and sophistication of rich features and the processing time defined by the user’s profile.

2. Server or Device Application

a. The UE’s Application is responsible for setting up the FLUS and NBMP session, as well as managing the audience codecs-rates profile.

b. The UE’s Application is responsible for setting up the FLUS session. The Sever Application is responsible for setting up the NBMP session.

##### Preconditions

1. On the device:
   1. A 3GPP supported encoder is installed.
   2. UE’s Application is installed which supports NBMP Source functionalities.
   3. A 3GPP FLUS Source is installed.
2. On the network,
   1. One or more FLUS Sinks are installed that one or more of them supports NBMP Workflow Manager functionality.
   2. One or more FLUS Sinks are installed, that run various instances of decoding/encoding or transcoding, and the decoder/encoder/transcoder are described as NBMP Functions in an NBMP repository.
   3. A FLUS Sink may have limited capabilities, i.e. the codecs it supports and/or a limited number of concurrent encodings/transcodings.
   4. A FLUS Sink’s load may vary dynamically due to the other parallel network processing sessions.
   5. Network storage is available to store the encoded content for time-shifted streaming.

##### Requirements in terms of Capabilities and QoS/QoE Considerations

1. Capabilities

o Discovering of Sink’s network processing capabilities if needed

o Setting the FLUS and NBMP sessions

o Start the Sessions

o Change the workflow by adding more transcoders if needed during the session

o Real-time transcoding and packaging to different codecs and different bit-rates

o Offloading an originally selected sink to a new sink to handle additional needed processing that cannot be accommodated by the original sink

2. KPI

o Supporting the use-case

o Minimum extension of FLUS and NBMP Standard, preferably none.

### Assumptions and requirements

#### NBMP in the current FLUS architecture

This clause describes the use of NBMP [24] in the current FLUS architecture. An overview of NBMP architecture can be found at [2] Annex B.

##### Mapping between system components

Based on the functional definitions of different NBMP system components, the following mapping between NBMP components and FLUS system components can be made, as shown in Table 6.9-1.

**Table 6.9-1. Mapping from NBMP components to FLUS components**

|  |  |
| --- | --- |
| System Component | Description |
| NBMP Source | * FLUS control source inside FLUS source: The FLUS source uses F-C interface to setup workflows at the FLUS sink as described in TS26.238 and TR 26.939. F-C uses Workflow API as defined in ISO/IEC 23090-8 for this procedure * Non-colocated Control Source: The Non-colocated control source outside the FLUS source, described in clause A.1.3 of 3GPP TS26.238, can take the role of NBMP Source and use F-C interface to configure workflow at the FLUS sink. * Control Source inside Remote Control Device: The control source inside the control device described in TS26.238 clause A.2.2 can take the role of NBMP Source and use the F-C interface to configure workflow at the FLUS sink. * External Application Server: An Application Server in trusted DN or external DN can take the role of NBMP Source. * Application on UE (UA): An Application on UE (UA) can take the role of NBMP Source. |
| NBMP Media Source | * Media source inside FLUS source: The media source inside FLUS source assumes the role of NBMP Media Source. |
| NBMP Workflow Manager | * Control Sink inside FLUS Sink: The control sink inside FLUS sink can take the role of NBMP workflow manager.   The control sink sets up post-processing and distribution functions as described in TR 26.939 clause A.1 and A.2 in one or more NBMP media processing entities.   * External Application Server: An Application Server in trusted DN or external DN can take the role of NBMP Workflow Manager and receive a workflow description from an NBMP Source. |
| NBMP Task | * Media Sink inside FLUS Sink: The media sinks inside FLUS sinks assumes the role of NBMP Task to ingest content from FLUS source using the F-U interface.   The ingested content can then be sent to post-processing and distribution functions in other NBMP Tasks in the workflow setup by the workflow manager. |
| NBMP Function Repository | None |

##### API considerations

Table 6.9-2 shows the mapping between different NBMP API and FLUS API.

**Table 6.9-2. Mapping NBMP API to FLUS API**

|  |  |
| --- | --- |
| API | Description |
| Workflow API | * Uplink Streaming Control Interface as defined in TS26.238 clause 7 is to be used for NBMP Workflow API |
| Task API | * Currently out of the scope of FLUS specification |
| Function Discovery API | * Currently out of the scope of FLUS specification |

##### Procedures

In the case in which NBMP sessions are managed through FLUS control plane, the following procedures defined in TS26.238 can be used or updated.

* Workflow Manager Discovery: Clause 7.2 of TS26.238 describes the discovery procedure of FLUS sink. This procedure can be used to discover a FLUS sink that can act as an NBMP workflow manager as described in clause 4 of this contribution.
* Workflow Manager Capability Retrieval: Clause 7.3 of TS26.238 describes capability retrieval of a FLUS sink. This procedure can be used to retrieve workflow management capabilities at the FLUS sink as described in clause 4 of this contribution.
* Workflow Establishment: Clause 7.5 of TS26.238 is used for setting FLUS sessions between FLUS source and FLUS sink. This procedure can be used for setting up a workflow session at the FLUS sink.
* Workflow Termination: Clause 7.6 of TS26.238 is used for terminating FLUS sessions between FLUS source and FLUS sink. This procedure can be used for terminating a workflow session at the FLUS sink.
* Workflow Modification: Clauses 7.4.2 of TS26.238 is used for modification of FLUS sessions between FLUS source and FLUS sink. This procedure can be used for modifying a workflow at the FLUS sink.
* Workflow Retrieval: Clauses 7.4.1 of TS26.238 is used for retrieval of a FLUS session between FLUS source and FLUS sink. This procedure can be used for retrieving a workflow at the FLUS sink.

## \*\*\* End change 3 \*\*\*

## \*\*\*Change 4 \*\*\*

## Example FLUS call flow with Network Based Media Processing (NBMP)

## Overview

In this section, various deployment scenarios of NBMP with FLUS are described. Each scenario consists of the deployment architecture, the call flows, and the used interfaces. An overview of NBMP architecture can be found at [2] Annex B.

## NBMP in the Application Server (All-AP)

## Architecture

This scenario is shown in Figure 8.4.1.1-1. In this case, NBMP Source, Workflow Manager, and MPEs are located in the Application Server.

UE

Sink

FLUS Control Source

FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

External Application Server

F-C

F-U

F5

F8

F2

NBMP Source

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

N1

N2

F7

Figure 8.4.1.1-1: NBMP in Application Server

## Call flow

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:



Figure 8.4.1.2-1: Call flow of NBMP in Application Server

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA requests the list of FLUS Sinks from a FLUS Sink Discovery Server.
3. FLUS FLSink Discovery Server responds to EA’s request.
4. EA picks a Sink and finds its FLUS Media Sink address.
5. EA retrieves the user profile and identifies the resources needed to run the service.
6. EA requests NBMP Source to start an NBMP Workflow.
7. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow.
8. NBMP Workflow Manager discovers various MPEs and finds enough number of MPEs to run the workflow

NOTE: SA6 discovery may be considered to address this functionality.

1. NBMP Workflow Manager instantiates the workflow.
2. NBMP Workflow responds to NBMP Source with updated WDD.
3. NBMP Source acknowledge workflow instantiation to EA.
4. EA responds to UA with FLUS Control Sink and FLUS Media Sink information.
5. UA requests FLUS Control Source to establish the FLUS session.
6. FLUS Control Source establishes the FLUS session and acknowledges UA.
7. UA start ingesting the content.
8. The session runs.
9. UA requests EA to end the session.
10. EA request NBMP Source to stop the NBMP workflow.
11. NBMP Source acknowledges the stopping of the NBMP session.
12. EA acknowledges UA the stopping of the workflow.
13. UA requests FLUS Control Sink to stop the FLUS session.
    * + 1. Interfaces

Table 8.4.1.3-1 shows the required standard interfaces in this scenario:

Table 8.4.1.3-1: Required Standard APIs for NBMP in Application Server

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U, F1 |
| NBMP | N4, F2\* |

NOTE: The internal APIs inside green boxes are out of scope of this document.

[\*The FLUS specification currently does not define setting up an output for FLUS Media Sink. To support this scenario, the FLUS specification needs to be extended to either support setting up an output address for FLUS Media Sink, or provide an address for FLUS Media Sink’s output for data retrieval.]

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section 8.4.1.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.2.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks from a FLUS Sink Discovery Server. | Supported by FLUS discovery API. |
| 1. FLUS Sink Discovery Server responds to EA’s request. | Supported by FLUS discovery API. |
| 1. EA picks a FLUS Sink and finds its FLUS Media Sink address. | Not currently supported by FLUS. |
| 1. EA retrieves the user profile and identifies the resources needed to run the service. | Out of scope (Internal to application). |
| 1. EA requests NBMP Source to start an NBMP Workflow. | Out of scope (Internal to application). |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow Manager discovers various MPEs and finds enough number of MPEs to run the workflow   NOTE: SA6 discovery may be considered to address this functionality. | Supported by NBMP spec. |
| 1. NBMP Workflow Manager instantiates the workflow. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow responds to NBMP Source with updated WDD. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Source acknowledge workflow instantiation to EA. | Supported by NBMP or External Application Provider specific. |
| 1. EA responds to UA with FLUS Control Sink and FLUS Media Sink information. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session. | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA. | Out of scope (Internal to application). |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA request NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

* + - * 1. TS26.238 potential extensions

The FLUS specification currently does not define setting up an output for FLUS Media Sink. To support this scenario, the FLUS specification needs to be extended to either support setting up an output address for FLUS Media Sink, or provide an address for FLUS Media Sink’s output for data retrieval.

## NBMP in the Application Server, MPE in Sink (MPE-Sink)

## Architecture

This scenario is shown in Figure 8.4.2.1-1. In this case, NBMP Source and Workflow Manager are located in the Application Server, and MPEs are located in Sinks.

Sink

UE

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

External Application Server

F-C

F-U

F5

F8

F2

NBMP Source

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

N1

N2

F7

F11

Figure 8.4.2.1-1: NBMP in Application Server, MPE in Sink

## Call flow

There are two possibilities of discovering MPE capabilities:

1. EA discovers MPE capabilities through FLUS Control Sink (F1).
2. EA discovers MPE’s location through FLUS Control Sink (F1) and discover the MPE capabilities through N3.

The call flows for both cases are shown below.

#### Through F1 (MPE-Sink-F1)

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:



Figure 8.4.2.2.1-1: Call flow of NBMP in Application Server, MPE in Sink through F1

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service not shown).
3. EA requests the list of FLUS Sinks and their capabilities from FLUS Sink Discovery Server.
4. EA picks a FLUS Sink that can run the workflow in its MPE and find its MPE address and MPE APIs in its capabilities.
5. EA requests NBMP Source to start an NBMP Workflow by providing the NMBP Source with the FLUS Media Sink Address.
6. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the workflow with the assigned MPE.
7. NBMP Workflow Manager instantiates the workflow in the assigned MPE.
8. NBMP Workflow Manager responds to NBMP Source with updated WDD.
9. NBMP Source acknowledges workflow instantiation to EA.
10. EA responds to UA with FLUS Control Sink and FLUS Media Sink information.
11. UA requests FLUS Control Source to establish the FLUS session.
12. FLUS Control Source establishes the FLUS session and acknowledges UA.
13. UA start ingesting the content.
14. The session runs.
15. UA requests EA to end the session.
16. EA requests NBMP Source to stop the NBMP workflow.
17. NBMP Source acknowledges the stopping of the NBMP session.
18. EA acknowledges UA the stopping of the workflow.
19. UA requests FLUS Control Sink to stop the FLUS session.

#### Through N3 (MPE-Sink-N3)

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:



Figure 8.4.3.2.2-1: Call flow of NBMP in Application Server, MPE in Sink through N3

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service not shown).
3. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server.
4. EA picks a FLUS Sink that can run the workflow in its MPE and finds its Media Sink Address and MPE address.
5. EA request MPE for its capabilities.
6. MPE provides its capabilities to EA.
7. EA requests NBMP Source to start an NBMP Workflow by providing the NBMP Source with the FLUS Media Sink Address.
8. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow with the assigned MPE.
9. NBMP Workflow Manager instantiates the workflow in the assigned MPE and after establishing workflow, acknowdges to NBMP Source.
10. NBMP Source acknowledges workflow instantiation to EA.
11. EA responds to UA with FLUS Control Sink and FLUS Media Sink information.
12. UA requests FLUS Control Source to establish the FLUS session.
13. FLUS Control Source establishes the FLUS session and sends acknowledgment to the UA.
14. The FLUS session starts and UA sends uplink streaming content to the FLUS Media Sink.
15. The session runs.
16. UA requests EA to end the session.
17. EA requests NBMP Source to stop the NBMP workflow.
18. NBMP Source acknowledges the stopping of the NBMP session.
19. EA acknowledges UA the stopping of the workflow.
20. UA requests FLUS Control Sink to stop the FLUS session.
    * + 1. Interfaces

Table 8.4.2.3-1 shows the required standard interfaces in this scenario:

Table 8.4.2.3-1: Required Standard APIs for NBMP in Application Server, MPE in Sink

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U, F1 |
| NBMP | N4, N3\* |

\*May be a closed API implemented by Application provider-operator agreement.

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in clause 8.4.2.2.1 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.3.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service not shown). | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from FLUS Sink Discovery Server. | Supported by FLUS discovery API. |
| 1. EA picks a FLUS Sink that can run the workflow in its MPE and find its MPE address and MPE APIs in its capabilities. | Partially supported by FLUS.  The EA discovers the locations and optionally the capabilities of each FLUS Sink. The FLUS Sink can list its NBMP MPE identifier (URI) and optionally the MPE capabilities description in the Sink capabilities, but including the URL address of the MPE is not currently supported by FLUS. |
| 1. EA requests NBMP Source to start an NBMP Workflow by providing the NBMP Source with the FLUS Media Sink Address. | Out of scope (Internal to application). |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the workflow with the assigned MPE. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow Manager instantiates the workflow in the assigned MPE. | Supported by NBMP spec/ the exact API is MNO specific. |
| 1. NBMP Workflow Manager responds to NBMP Source with updated WDD. | Supported by NBMP spec. |
| 1. NBMP Source acknowledges workflow instantiation to EA. | Out of scope (Internal to application). |
| 1. EA responds to UA with FLUS Control Sink and FLUS Media Sink information. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session. | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA. | Supported by FLUS |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA requests NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

The call flow presented in clause 8.4.2.2.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.3.4.1-2 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service not shown). | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server. | Supported by FLUS discovery API. |
| 1. EA picks a Sink that can run the workflow in its MPE and find its MPE address. | Partially supported by FLUS.  The EA discovers locations and optionally the capabilities of each sink. The sink can list the NBMP MPE identifier (URI) and optionally the MPE capabilities description in the Sink capabilities, but including the URL address of MPE is not currently supported by FLUS. |
| 1. EA request MPE for its capabilities. | Supported by NBMP. |
| 1. MPE provides its capabilities to EA. | Supported by NBMP. |
| 1. EA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address. | Out of scope (Internal to application). |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE. | Supported by NBMP spec or External Application Provider specific. |
| 1. NBMP Workflow Manager instantiates the workflow in the assigned MPE and after establishing workflow, acknowdges to NBMP Source. | Supported by NBMP spec/ the exact API is MNO specific. |
| 1. NBMP Source acknowledges workflow instantiation to EA. | Out of scope (Internal to application). |
| 1. EA responds to UA with Control Sink and Media Sink information. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session. | Supported by FLUS |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA. | Supported by FLUS. |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP. |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA requests NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

* + - * 1. TS 26.238 potential extensions

As is shown in clause 8.4.2.4.1, only step 4 of Tables 8.4.2.4.1-1 and 8.4.4.1-2 is not fully supported by TS 26.238. The capabilities of the FLUS Sink is defined in Table 8.4.3.4.2-1 below (copy of Table 7.1.1.1-1 in TS 26.238):

Table 8.4.3.4.2-1 Properties of Sink Resource

|  |  |  |
| --- | --- | --- |
| **Property Name** | **Description** | **Example Values** |
| capabilities | List of supported features and instantiations by the FLUS sink. Each capability is to be expressed using an object element of an array. The object has the following attributes:  - A scheme URN to identify the capability  - An optional location URL, from which a description for the capability can be retrieved. The format of description is defined by the scheme URN.. | { “scheme” : urn:vnd:xzy:capability-name, “location” : “<http://vnd.com/xzy/capability-name>”  } |

As indicated in the above table, the support of the NMBP can be signalled using the “scheme” item. The optional “location” provides the description for the capability to be retrieved. However, to directly access the NBMP Workflow Manager (WM), the location of WM must be signaled. Therefore, we need to either:

1. Add the URL location of WM to the description
2. Add another item in the capabilities array item for the actual address

An Example for adding the support for NBMP Workflow Manager, with a description of NBMP Workflow Manager:

{ “scheme” : “urn:mpeg:mpegi:nbmp:workflowmanager: 2020”,

“location”: “http://vnd.com/xzy/nbmpwm\_description.json”

}

The document nbmpwm\_description shall contain the description information about the WM. Currently, the ISO/IEC 23090-8 doesn’t define a description for WM. The MPEG NBMP CDAM2 defines a description of MPE, i.e. MPE capabilities. Therefore, either

1. Solution 1: a standard object for NBMP Workflow description must be created that has the WM address such as:

{

“url”: “<http://10.20.30.40>”,

“name”: “vnd-workflow-manager-1”,

“description”: “the workflow manager provided by VND, version 1, 2021”,

…..

}

1. Or, solution 2: a new item must be added in the capabilities:

{ “scheme” : “urn:mpeg:mpegi:nbmp:workflowmanager: 2020”,

“location”: “http://vnd.com/xzy/nbmpwm\_description.json”,

“url”: “http://10.20.30.40”

}

## NBMP Source in the Application Server, NBMP Workflow Manager, and MPE in Sink (WM-MPE-Sink)

## Architecture

This scenario is shown in Figure 8.4.4.1-1.

Sink

UE

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

External Application Server

F-C

F-U

F5

F8

F11

F2

NBMP Source

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

N1

N2

F7

Figure 8.4.4.1-1: NBMP Source in Application Server, NBMP Workflow Manager and MPE in Sink

## Call flow

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:



Figure 8.4.3.2-1: Call flow for NBMP Source in Application Server, NBMP Workflow Manager and MPE in Sink

Same variations (discovering the entire MPE capabilities through FLUS Control Sink vs discovering MPE location through FLUS Control Sink) are possible here.

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service (not shown).
3. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server.
4. EA picks a Sink that can run the workflow in its MPE and find its NBMP Workflow Manager and Media Sink address in the Sink capabilities.
5. EA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address.
6. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE.
7. NBMP Workflow Manager instantiates the workflow in the assigned MPE.
8. NBMP Workflow responds to NBMP Source with updated WDD.
9. NBMP Source acknowledges workflow instantiation to EA.
10. EA responds to UA with Control Sink and Media Sink information.
11. UA requests FLUS Control Source to establish the FLUS session
12. FLUS Control Source establishes the FLUS session and acknowledges UA
13. UA start ingesting the content.
14. The session runs.
15. UA requests EA to end the session.
16. EA request NBMP Source to stop the NBMP workflow.
17. NBMP Source acknowledges the stopping of the NBMP session.
18. EA acknowledges the stopping of the workflow to the UA.
19. UA requests FLUS Control Sink to stop the FLUS session.
    * + 1. Interfaces

Table 8.4.3.3-1 shows the required standard interfaces in this scenario.

Table 8.4.3.3-1: NBMP Source in Application Server, NBMP Workflow Manager and MPE in Sink

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U, F1 |
| NBMP | N2, N4 |

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section 8.4.3.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.3.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service. | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server (not shown). | Supported by FLUS discovery API from the FLUS discovery server. |
| 1. EA picks a Sink that can run the workflow in its MPE and find its NBMP Workflow Manager and Media Sink address in the Sink capabilities. | Partially supported by FLUS.  The EA discovers locations and optionally the capabilities of each sink. The sink can list the NBMP MPE identifier (URI) and optionally the MPE capabilities description in the Sink capabilities, but including the URL address of NBMP Workflow Manager is not currently supported by FLUS. |
| 1. EA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address. | Out of scope (Internal to application). |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow Manager instantiates the workflow in the assigned MPE. | Supported by NBMP spec/ the exact API is MNO specific. |
| 1. NBMP Workflow responds to NBMP Source with updated WDD. | Supported by NBMP spec. |
| 1. NBMP Source acknowledges workflow instantiation to EA. | Out of scope (Internal to application). |
| 1. EA responds to UA with Control Sink and Media Sink information. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA | Supported by FLUS. |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP. |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA request NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges the stopping of the workflow to the UA. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

* + - * 1. TS26.238 potential extensions

As is shown in clause 8.4.3.4.1, the necessary extension of FLUS is the ability to discover the NBMP Workflow Manager’s address. Section 8.4.2.4.2 also addresses this deployment scenario.

## NBMP Source in the FLUS Control Source, NBMP Workflow Manager and MPE in Sink (NBMPSource-FLUSSource)

## Architecture

This scenario is shown in Figure 8.4.4.1-1.

Sink

UE

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

External Application Server

F-C

F-U

F5

F8

F11

F2

NBMP Source

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

F7

Figure 8.4.4.1-1: NBMP Source in FLUS Control Source, NBMP Workflow Manager and MPE in Sink

## Call flow

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:



Figure 8.4.4.2-1: Call flow for NBMP Source in FLUS Control Source, NBMP Workflow Manager and MPE in Sink

In this case, the UE can either

1. provide NBMP Workflow’s location, so that NBMP Source can discover the MPE capabilities through that API as well as establishing the workflow, or
2. discover capabilities of Sink during the sink discovery process, so that NBMP Source doesn’t need to discover capabilities of a sink’s MPE in a different step.

The steps of establishing, operating, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service (not shown).
3. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server.
4. EA picks a Sink that can run the workflow in its MPE and find its NBMP Workflow Manager and Media Sink address in the Sink capabilities.
5. EA responds to UE with the NBMP Workflow Manager's full URL or a relative URL through FLUS Control Sink.
6. UA requests FLUS Control Source to establish the FLUS session.
7. FLUS Control Source establishes the FLUS session and acknowledges UA.
8. EA requests NBMP Source start the workflow.
9. NBMP Source builds WDD, and requests NBMP Workflow Manager (directly or through FLUS Control Sink) to instantiate the Workflow.
10. NBMP Workflow Manager instantiates the workflow in the MPE.
11. NBMP Workflow responds to NBMP Source with updated WDD.
12. NBMP Source acknowledges workflow instantiation to UA.
13. UA start ingesting the content.
14. The session runs.
15. UA requests FLUS Control Source to end the session.
16. NBMP Source request NBMP Workflow Manager to stop the workflow.
17. FLUS Control Source request to end the FLUS Session.
    * + 1. Interfaces

Table 8.4.4.3-1 shows the required standard interfaces in this scenario:

Table 8.4.4.3-1: NBMP Source in FLUS Control Source, NBMP Workflow Manager and MPE in Sink

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C\*, F-U, F1 |
| NBMP | N4 |

\*With the support of NBMP Workflow Manager APIs

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section ‎8.4.4.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.4.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service. | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server (not shown). | Supported by FLUS discovery API from the FLUS discovery server. |
| 1. EA picks a Sink that can run the workflow in its MPE and find its NBMP Workflow Manager and Media Sink address in the Sink capabilities. | Partially supported by FLUS.  The EA discovers locations and optionally the capabilities of each sink. The sink can list the NBMP MPE identifier (URI) and optionally the MPE capabilities description in the Sink capabilities, but including the URL address of MPE is not currently supported by FLUS. |
| 1. EA responds to UE with the NBMP Workflow Manager's full URL or a relative URL through FLUS Control Sink. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA | Supported by FLUS spec. |
| 1. EA requests NBMP Source start the workflow. | Out of scope (Internal to application). |
| 1. NBMP Source builds WDD, and requests NBMP Workflow Manager (directly or through FLUS Control Sink) to instantiate the Workflow | Directly: Supported by NBMP Spec  Through FLUS sink: Supported by FLUS spec |
| 1. NBMP Workflow Manager instantiates the workflow in the MPE. | Out of scope (Internal to application). |
| 1. NBMP Workflow responds to NBMP Source with updated WDD. | Directly: Supported by NBMP Spec  Through FLUS sink: Partially supported by FLUS Spec. |
| 1. NBMP Source acknowledges workflow instantiation to UA. | Out of scope (Internal to application). |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP. |
| 1. UA requests FLUS Control Source to end the session. | Out of scope (Internal to application). |
| 1. NBMP Source request NBMP Workflow Manager to stop the workflow | Supported in NBMP. |
| 1. FLUS Control Source request to end the FLUS Session. | Supported in FLUS. |

* + - * 1. TS26.238 potential extensions

The sink capability discovery of TS26.238 is adequate for the discovery of NBMP WM support by FLUS Sink.

The communication of the WDD or the URL is achieved through the Sink resource:

Table 5.3.6-1 (of TS26.238): List of FLUS Sink Configuration properties

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Property Name** | **Property Description** | **C I** | **C O** | **G I** | **G O** | **U I** | **U O** | **T I** |
| id | Identifier of the FLUS Sink Configuration resource.  Note that "id" is only provided within an HTTP body during the Create FLUS session response. Otherwise, "id" should be present in the message URL to identify the resource in the FLUS sink.   |  |  |  | | --- | --- | --- | | Type | Unit | Default | | Integer | None | N/A | |  | M |  |  |  |  |  |
| fu\_instantiation | Identifier of the FLUS media instantiation that is used by this FLUS session.  Vendor specific enumeration values shall start with "vnd-" followed by a unique vendor name and optionally followed by additional characters.  The F-U instantiation shall be provided as a globally unique URN.   |  |  |  | | --- | --- | --- | | Type | Unit | Default | | URI | None | All | |  |  |  | M | O |  |  |
| entrypoint\_URL | Entry point URL information (e.g., SIP URL) for establishing the F-U connection to start the Media streaming. Details on the Entrypoint URL is F-U instantiation specific. |  |  |  |  |  |  |  |
| processing\_description | This object provides a media processing description document that defines the post processing pipeline that the FLUS sink shall apply to received media components. The pipeline description may also set the distribution target (incl FLUS sink storage) for the media.  The Object has the following properties:  - type: the MIME type of the media processing description document  - document: the media processing document may be embedded in this element. The document may be base64 encoded depending on the MIME type.  - url: the URL to the media processing document.  The type and either the document property or the url property shall be provided.  The following formats are supported:  - The MPEG NBMP Workflow Resource, UTF-8 encoded,, as defined in [17], which describes the requested media processing and the desired distribution mechanism after the processing has been performed. The type field shall be set to "application/mpeg-nbmp-wdd+json" See Annex X on use of NBMP in FLUS. | **O** | **O** |  | O | O |  |  |

The ‘url’ item provides the location of NBMP WM. Therefore, the NBMP Source can interact with NBMP WM directly. However, if NBMP Source is expected to interact with NBMP WM through FLUS F-C link, then sending WDD and receiving it possible in the NBMP Workflow API’s synchronous mode only. The asynchronous mode may suboptimally work if the response includes the NBMP WM URL, which means that the retrieval of the WDD must be direct. Also, the wait-time for retrieving the WDD is not provided in this case.

For complete support of NBMP Workflow API asynchronous mode, the Sink configuration needs to be extended to include HTTP headers in the response in addition to the already included resource (WDD).

## NBMP Source in the UA, NBMP Workflow Manager in the Application Server, and MPE in Sink (NBMPSourceUA-NBMPWMAS)

## Architecture

In this scenario as shown in Figure 8.4.5.1-1, NBMP Source is in the UA, NBMP WM is located in the Application Server and MPE is in Sink.

Sink

UE

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

External Application Server

F-C

F-U

F5

F8

F11

F2

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

F7

N2’

NBMP Source

Figure 8.4.5.1-1: NBMP Source in the UA, NBMP Workflow Manager in the Application Server and MPE in Sink

## Call flow

This scenario is similar to the case when NBMP Source and NBMP WM are in the Application Server and MPE is in Sink as described in Section 8.4.2. There are two possibilities of discovering MPE capabilities:

1. EA discovers MPE capabilities through FLUS Control Sink (F1).
2. EA discovers MPE’s location through FLUS Control Sink (F1) and discover the MPE capabilities through N3.

The call flows for both cases are shown below.

#### Through F1

Figure 8.4.5.2.1-1 demonstrates the call flow through F1.



Figure 8.4.5.2.1-1: Call flow for NBMP Source in the UA, NBMP Workflow Manager in the Application Server and MPE in Sink through F1

The steps of establishing, operation, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service (no shown).
3. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server.
4. Sink Discovery Server responds to EA’s request.
5. EA picks a Sink that can run the workflow in its MPE and find its MPE address and MPE APIs in its capabilities.
6. EA responds to UA with Control Sink and Media Sink information.
7. UA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address.
8. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE.
9. NBMP Workflow Manager instantiates the workflow in the assigned MPE.
10. NBMP Workflow responds to NBMP Source with updated WDD.
11. NBMP Source acknowledges workflow instantiation to EA.
12. UA requests FLUS Control Source to establish the FLUS session .
13. FLUS Control Source establishes the FLUS session and acknowledges UA
14. UA start ingesting the content.
15. The session runs.
16. UA requests EA to end the session.
17. EA request NBMP Source to stop the NBMP workflow.
18. NBMP Source acknowledges the stopping of the NBMP session.
19. EA acknowledges UA the stopping of the workflow.
20. UA requests FLUS Control Sink to stop the FLUS session.

#### Through N3

Figure 8.4.5.2.2-1 demonstrates the call flow through F1.



Figure 8.4.5.2.2-1: Call flow for NBMP Source in the UA, NBMP Workflow Manager in the Application Server and MPE in Sink through N3

The steps of establishing, operation, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service (no shown).
3. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server and receives it.
4. EA picks a Sink that can run the workflow in its MPE and request its capabilities.
5. FLUS Sink provides its capabilities to EA including the address of MPE.
6. EA requests the MPE capabilities.
7. MPE provides its capabilities to EA.
8. EA responds to UA with Control Sink and Media Sink information.
9. UA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address.
10. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE.
11. NBMP Workflow Manager instantiates the workflow in the assigned MPE and acknowledges NBMP Source.
12. NBMP Source acknowledges workflow instantiation to EA.
13. UA requests FLUS Control Source to establish the FLUS session .
14. FLUS Control Source establishes the FLUS session and acknowledges UA
15. UA start ingesting the content.
16. The session runs.
17. UA requests EA to end the session.
18. EA request NBMP Source to stop the NBMP workflow.
19. NBMP Source acknowledges the stopping of the NBMP session.
20. EA acknowledges UA the stopping of the workflow.
21. UA requests FLUS Control Sink to stop the FLUS session.
    * + 1. Interfaces

Table 8.4.5.3-1 shows the required standard interfaces in this scenario.

Table 8.4.5.3-1: Required Standard APIs for NBMP in Application Server, MPE in Sink

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U, F1 |
| NBMP | N4, N3\* |

\*May be a closed API implemented by Application provider-operator agreement.

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section 8.4.5.2.1 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.5.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service (no shown). | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server. | Supported by FLUS discovery API. |
| 1. Sink Discovery Server responds to EA’s request. | Supported by FLUS discovery API. |
| 1. EA picks a Sink that can run the workflow in its MPE and find its MPE address and MPE APIs in its capabilities. | Partially supported by FLUS.  TheURL address for using a capabilities is not currently provide in FLUS. |
| 1. EA responds to UA with Control Sink and Media Sink information. | Out of scope (optional and application dependent.) |
| 1. UA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address. | Out of scope (optional and application dependent.) |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE. | For the level of support, please refer to 8.4.4. |
| 1. NBMP Workflow Manager instantiates the workflow in the assigned MPE. | Supported by NBMP/exact implementation is MNO specific. |
| 1. NBMP Workflow responds to NBMP Source with updated WDD. | Supported by NBMP. |
| 1. NBMP Source acknowledges workflow instantiation to EA. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session . | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA | Supported by FLUS. |
| 1. UA start ingesting the content. | Supported in FLUS and NBMP |
| 1. The session runs. | Out of scope (Internal to application). |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA request NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

The call flow presented in section 8.4.2.2.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.2.4.1-2 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service (no shown). | Out of scope (optional and application dependent.) |
| 1. EA requests the list of FLUS Sinks and their capabilities from Sink Discovery Server and receives it. | Supported by FLUS discovery API. |
| 1. EA picks a Sink that can run the workflow in its MPE and request its capabilities. | Supported by FLUS. |
| 1. FLUS Sink provides its capabilities to EA including the address of MPE. | Partially supported by FLUS.  TheURL address for using a capabilities is not currently provide in FLUS. |
| 1. EA requests the MPE capabilities. | Supported by NBMP. |
| 1. MPE provides its capabilities to EA. | Supported by NBMP. |
| 1. EA responds to UA with Control Sink and Media Sink information. | Out of scope (optional and application dependent.) |
| 1. UA requests NBMP Source to start an NBMP Workflow with FLUS Media Sink Address. | Out of scope (optional and application dependent.) |
| 1. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow, with the assigned MPE. | For the level of support, please refer to 8.4.4. |
| 1. NBMP Workflow Manager instantiates the workflow in the assigned MPE and acknowledges NBMP Source. | Supported by NBMP/exact implementation is MNO specific. |
| 1. NBMP Source acknowledges workflow instantiation to EA. | Out of scope (optional and application dependent.) |
| 1. UA requests FLUS Control Source to establish the FLUS session . | Out of scope (optional and application dependent.) |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA | Supported in FLUS. |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs. | Supported in FLUS and NBMP. |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA request NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |

* + - * 1. TS26.238 potential extensions

The above tables indicate that the missing features of 8.4.3.4.2 and 8.4.4.4.2 are needed to support this deployment scenario.

## NBMP Source in the UA, NBMP Workflow Manager and MPE in the Application Server (NBMPSourceUA-NBMPWMSINK)

## Architecture

In this scenario as shown in Figure 8.4.6.1-1, NBMP Source is in the UA, NBMP WM and MPE are located in the Application Server.

Sink

UE

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUSMedia Sink

External Application Server

F-C

F-U

F5

F8

F2

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

F1

F7

N2’

NBMP Source

Figure 8.4.6.1-1: NBMP Source in the UA, NBMP Workflow Manager and MPE in the Application Server

## Call flow

This scenario is similar to the case when all of NBMP entities are located the Application Server as described in Section 8.4.2. The call flow is shown in Figure 8.4.6.2-1.



Figure 8.4.6.2-1: Call flow for NBMP Source in the UA, NBMP Workflow Manager and MPE in the Application Server

The steps of establishing, operation, and tearing down a FLUS-NBMP session are as the following:

1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session.
2. EA retrieves the user profile and identifies the resources needed to run the service (not shown).
3. EA requests the list of FLUS Sinks from a Sink Discovery Server.
4. Sink Discovery Server responds to EA’s request.
5. EA picks a Sink and finds its FLUS Media Sink address.
6. EA responds to UA with Control Sink and Media Sink information.
7. UA requests NBMP Source to start an NBMP Workflow.
8. NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow.
9. NBMP Workflow Manager discovers various MPEs and finds enough number of MPEs to run the workflow
10. NBMP Workflow Manager instantiates the workflow.
11. NBMP Workflow responds to NBMP Source with updated WDD.
12. NBMP Source acknowledge workflow instantiation to EA.
13. UA requests FLUS Control Source to establish the FLUS session.
14. FLUS Control Source establishes the FLUS session and acknowledges UA.
15. UA start ingesting the content.
16. The session runs
17. UA requests EA to end the session.
18. EA request NBMP Source to stop the NBMP workflow.
19. NBMP Source acknowledges the stopping of the NBMP session.
20. EA acknowledges UA the stopping of the workflow.
21. UA requests FLUS Control Sink to stop the FLUS session.
    * + 1. Interfaces

Table 8.4.6.3-1 shows the required standard interfaces in this scenario:

Table 8.4.6.3-1: Required Standard APIs for NBMP in Application Server, MPE in Sink

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U, F1 |
| NBMP | N4, N2 |

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section 8.4.1.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.1.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. UE Application (UA) makes a request through F8 to Application (EA) to start a live session. | Out of scope (optional and application dependent.) |
| 1. EA retrieves the user profile and identifies the resources needed to run the service (not shown). | Supported by FLUS discovery API. |
| 1. EA requests the list of FLUS Sinks from a Sink Discovery Server. | Supported by FLUS discovery API. |
| 1. Sink Discovery Server responds to EA’s request. | Supported by FLUS. |
| 1. EA picks a Sink and finds its FLUS Media Sink address. | Not currently supported by FLUS. |
| 1. EA responds to UA with Control Sink and Media Sink information. | Out of scope (Internal to application). |
| 1. UA requests NBMP Source to start an NBMP Workflow. | Supported by NBMP or External Application Provider specific. |
| NBMP Source builds the WDD, and requests NBMP Workflow Manager to instantiate the Workflow. | For the level of support, please refer to 8.4.5.4. |
| 1. NBMP Workflow Manager discovers various MPEs and finds enough number of MPEs to run the workflow | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow Manager instantiates the workflow. | Supported by NBMP or External Application Provider specific. |
| 1. NBMP Workflow responds to NBMP Source with updated WDD. | For the level of support, please refer to 8.4.5.4. |
| 1. NBMP Source acknowledge workflow instantiation to EA. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Source to establish the FLUS session. | Out of scope (Internal to application). |
| 1. FLUS Control Source establishes the FLUS session and acknowledges UA. | Support by FLUS. |
| 1. UA start ingesting the content. | Out of scope (Internal to application). |
| 1. The session runs | Supported in FLUS and NBMP |
| 1. UA requests EA to end the session. | Out of scope (Internal to application). |
| 1. EA request NBMP Source to stop the NBMP workflow. | Out of scope (Internal to application). |
| 1. NBMP Source acknowledges the stopping of the NBMP session. | Out of scope (Internal to application). |
| 1. EA acknowledges UA the stopping of the workflow. | Out of scope (Internal to application). |
| 1. UA requests FLUS Control Sink to stop the FLUS session. | Out of scope (Internal to application). |

* + - * 1. TS26.238 potential extensions

As shown in the Table above, the needed extensions are addressed in 8.4.1.4.2 and 8.4.5.4.2.

* + 1. NBMP-enabled FLUS Session Establishment using 5GMSu AF (WM-MPE-Sink-AF)

## Architecture

This deployment scenario is based on the deployment scenario of sections 8.4.3 (WM-MPE-Sink) or 8.4.4 (NBMPSource-FLUSSource). However, there exists one or more 5GMS AF that are utilized for provisioning and helping to set up the service. All other deployment scenarios (8.4.2, 8.4.5, 8.4.6, and 8.4.7) may be extended similarly by utilizing 5GMS AF.

This scenario is shown in Figure 8.4.7.1-1. In this figure, interfaces M1 and M2 indicate the corresponding 5GMSu AF’s M1 and M2 interfaces that is defined by TS26.501, respectively.

UE

External Application Server

Sink

FLUS Control Source

NBMP/FLUS

Media Source

Application (UA)

FLUS Control Sink

FLUS

Media Sink

F-C

F-U

F5

F8

F11

F2

NBMP Source

NBMP Workflow Manager

Application (EA)

Application Server (MPE)

Origin Server

(NBMP Media Sink)

N3

N4

F3

M3

N1

N2

F7

5GMSu

AF

M1

Figure 8.4.7.1-1: NBMP-enabled FLUS Session Establishment using 5GMSu AF

## Call flow

The FLUS session establishment with NBMP processing is shown in Figure 8.4.7.2-1.

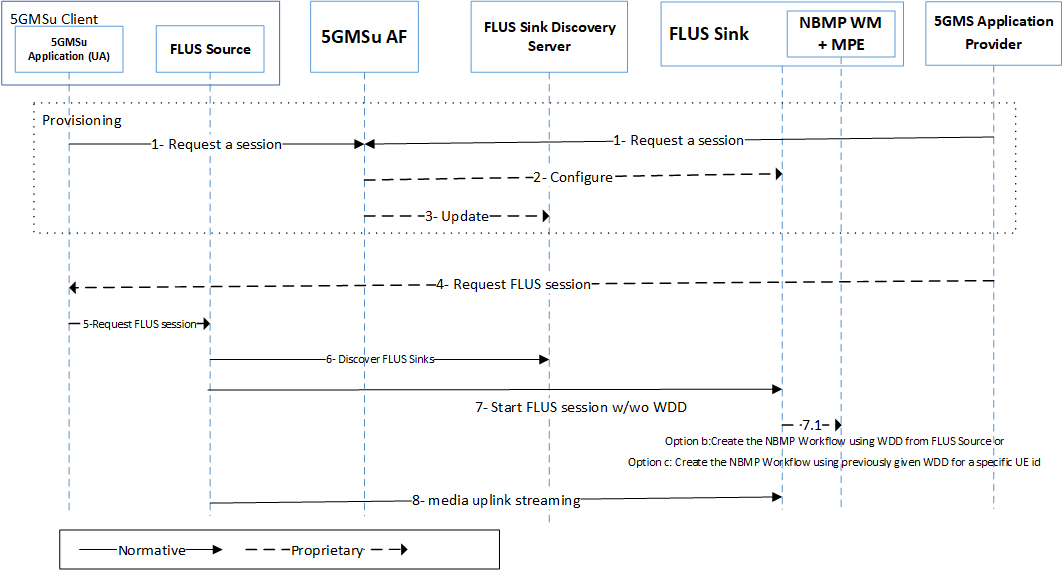


Figure 8.4.7.2-1: NBMP-enabled FLUS Session Establishment using 5GMSu AF

The steps are as follows:

1. The application/application provider establishes a Provisioning session with the AF, in which it configures QoS and Processing templates.
2. The AF configures the FLUS Control Sink(s).
   1. AF may request a FLUS Control Sink to create the NBMP Workflow by providing the WDD to the FLUS Control Sink (option a).
3. The AF updates the FLUS Sink Discovery Server with configured FLUS Sink(s) information.

NOTE: The Provisioning procedures associated with steps 1-3 is typically performed in advance and not in real time of the FLUS session establishment.

1. The Application Provider signals the Application on UE to start the FLUS Session.

NOTE: Alternatively, the Application on UE may start the FLUS Session on its own.

1. The Application requests FLUS Control Source to start a FLUS Session.
2. The FLUS Control Source discovers a FLUS Sink that can perform NBMP workflows.

NOTE: Alternatively, a FLUS Control Source may discover the FLUS Sink from 5GMSu AF through the Media Session Handler of the 5GMSu Client.

1. The FLUS Control Source establishes a connection with the selected FLUS Control Sink.
   1. If NBMP Workflow has been already instantiated by an AF (in 2.a), it only established the FLUS session (i.e., no WDD is sent to the FLUS Sink),
   2. If NBMP Workflow instantiation is requested by Application, then FLUS Control Sink creates the NBMP Workflow according to the WDD received from FLUS Control Source as defined in clause 8.4.4, or
   3. If the FLUS Control Sink already has the UE identifier (such as the GPSI (Generic Public Subscription Identifier)), FLUS Control Source only requests establishing the FLUS session. The FLUS Sink, upon receiving the request, instantiates the Workflow with the previously given WDD.
2. The uplink media streaming starts.

NOTE: In this deployment architecture, the FLUS Sink is assumed to also include the MPE, and the streaming media output upon NBMP processing by the MPE is provided to the “Distribution” function (see TS26.238) that is identified by Application Provider/Application.

NOTE: In the above call flow, only one 5GMSu AF is shown for simplicity. In actual deployment, multiple AF instances may be used for different steps of the call flow, e.g. one instance for provisioning, and another instance may be used for setting up other steps.

## Interfaces

Table 8.4.7.3-1 shows the required standard interfaces in this scenario:

Table 8.4.7.3-1: Required Standard APIs for FLUS-NBMP deployment using 5GMS AF

|  |  |  |
| --- | --- | --- |
| Standard | FLUS | F-C, F-U |
| NBMP | N4, N2\* |
| 5GMS | M1, M3 |

\*M3 may be used instead of N2.

NOTE: The internal APIs inside green boxes are out of scope of this document.

* + - 1. Gap analysis

This section provide a gap analysis for the above deployment scenario.

* + - * 1. Mapping call flow to the standard APIs

The call flow presented in section 8.4.1.2 is mapped to the FLUS and NBMP APIs in the following table:

Table 8.4.1.4.1-1 Mapping call flow to FLUS and NBMP APIs

|  |  |
| --- | --- |
| Call flow step | Support in FLUS or NBMP |
| 1. The application/application provider establishes a Provisioning session with the AF, in which it configures QoS and Processing templates. | Supported by TS26.512 |
| 1. The AF configures the FLUS Control Sink(s). | Out of scope (Internal to MNO) |
| * 1. AF may request a FLUS Control Sink to create the NBMP Workflow by providing the WDD to the FLUS Control Sink (option a). | Supported by NBMP or internal MNO’s API) |
| 1. The AF updates the FLUS Sink Discovery Server with configured FLUS Sink(s) information. | Out of scope (Internal to MNO) |
| 1. The Application Provider signals the Application on UE to start the FLUS Session. | Out of scope (Internal to application). |
| 1. The Application requests FLUS Control Source to start a FLUS Session. | Out of scope (Internal to application). |
| 1. The FLUS Control Source discovers a FLUS Sink that can perform NBMP workflows. | Supported by FLUS. |
| 1. The FLUS Control Source establishes a connection with the selected FLUS Control Sink. | Supported By FLUS. |
| * 1. If NBMP Workflow has been already instantiated by an AF (in 2.a), it only established the FLUS session (i.e., no WDD is sent to the FLUS Sink), | Supported by FLUS. |
| * 1. If NBMP Workflow instantiation is requested by Application, then FLUS Control Sink creates the NBMP Workflow according to the WDD received from FLUS Control Source as defined in clause 8.4.4, or | For the level of support, please refer to 8.4.4.4. |
| * 1. If the FLUS Control Sink already has the UE identifier (such as the GPSI (Generic Public Subscription Identifier)), FLUS Control Source only requests establishing the FLUS session. The FLUS Sink, upon receiving the request, instantiates the Workflow with the previously given WDD. | Supported by FLUS. |
| 1. The uplink media streaming starts. | Support by FLUS and NBMP. |

* + - * 1. TS26.238 potential extensions

As shown in the Table above, the needed extensions are addressed in 8.4.4.4.2.

## Summary of the deployment scenarios

Table 8.4.8-1 shows a summary of deployment scenarios.

Table 8.4.8-1: Summary of the deployment scenarios

|  |  |  |
| --- | --- | --- |
| Scenario | Standard | API |
| NBMP in Application Server | FLUS | F-C, F-U, F1 |
| NBMP | N4, F2\* |
| NBMP in Application Server, MPE in Sink | FLUS | F-C, F-U, F1 |
| NBMP | N4, N3\*\* |
| NBMP Source in Application Server, NBMP Workflow Manager and MPE in Sink | FLUS | F-C, F-U, F1 |
| NBMP | N2, N4 |
| NBMP Source in FLUS Control Source, NBMP Workflow Manager and MPE in Sink | FLUS | F-C\*\*\*, F-U, F1 |
| NBMP | N4 |
| NBMP Source in the UA, NBMP Workflow Manager in the Application Server and MPE in Sink | FLUS | F-C, F-U, F1 |
| NBMP | N4, N3\*\* |
| NBMP Source in the UA, NBMP Workflow Manager and MPE in the Application Server | FLUS | F-C, F-U, F1 |
| NBMP | N4, N2 |
| NBMP-enabled FLUS Session Establishment using 5GMSu AF | FLUS | F-C, F-U |
| NBMP | N4, N2\*\*\*\* |
| 5GMS | M1, M3 |

\*Need an extension to FLUS spec to define output mechanism for FLUS Media Sink.

\*\*May be a closed API implemented by Application provider-operator agreement.

\*\*\*With the support of NBMP Workflow Manager APIs.

\*\*\*\*M3 may be used instead of N2.

## \*\*\* End change 4 \*\*\*

## \*\*\* End of changes \*\*\*