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**Title: KI#7, Update sol: Update to solution #22**

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*Abstract: This paper proposes to update solution #22 in FS\_NG\_RTC\_Ph2 TR.*

# Introduction

This paper updates solutions 22 of TR 23.700-77.

# Discussion

This solution describes how to support data channel multiplexing for bootstrap and application data channel with same or different endpoint, including the following aspects:

- Capability discovery mechanism between UE and its network during registration procedure.

- Data channel multiplexing and de-multiplexing for media resource management and SDP handling during the bootstrap and application data channel establishment procedure.

This paper updates the solution with following changes:

- Add a summary of the whole solution description in clause 6.22.1.3.

- Add the IMS AS and MF services updates in clause 6.22.2.

- Remove the clause 6.22.2.3, replace the discovery mechanism between the originating network and terminating network with local configuration on the originating network, and update the call flow in clause 6.22.2.2.2 accordingly.

- Correct some editorial errors.

# 3. Text Proposal

It is proposed to capture the following changes vs. TR 23.700-77.

[In R01, Merge proposal S2-2403951 into S2-2404758]

This paper proposes to update Solution#22 by resolving the following EN.

Editor's note: The impact on the services of related NF, i.e. DCSF, IMS AS and MF/MRF is FFS.

To address above EN, mainly, the following clarifications are added:

* When the IMS AS receives a SDP offer, which contains multiple DC stream IDs and/or multiple application ids within a single m line, it is the IMS AS who determines that the received SDP offer is for a multiplexing instead of DCSF. It is clarified to align with the existing Nimsas\_SessionEventControl\_Notify service operation.
* Based on the event control notification from IMS AS, the DCSF is responsible for media proxy configuration for single SCTP connection at MF, to the media flows of the multiplexed DC applications, in originating side and terminating side.

\* \* \* \* First change \* \* \* \*

## 6.22 Solution #22: Multiplexing multiple DC streams over single SCTP connection

### 6.22.1 Description

#### 6.22.1.1 General

This solution addresses Key Issue #7 Support multiplexing multiple DC applications over single SCTP connection.

The solution supports the following scenarios:

* Multiplexing a SDP media description by local bootstrap data channel and remote bootstrap data channel during IMS session setup;
* Multiplexing a SDP media description originally used by bootstrap data channel with newly established application data channels during IMS session modification;
* Multiplexing a SDP media description originally used by an application data channel with newly established application data channels used by other applications during IMS session modification.

The media streams of these applications may have different remote endpoint, i.e.

* the remote endpoints of different DC applications are different ones, for example, one is the local MF, the other is the remote MF;
* the remote endpoints of different DC applications are the same one, for example, both are the peer UE.

This multiplexing of multiple data channels is not supported in the following scenarios:

* Multiple data channels with different QoS requirement due to the QoS policy control is media level.
* Multiple data channels contain the same DC stream ID, which indicates the SCTP stream identifier within the SCTP association and must be unique in media level.

Editor's note: The criteria of determining whether data channels can be multiplexed is FFS.

#### 6.22.1.2 Example scenarios for multiplexing and de-multiplexing

There are different scenarios for multiplexing and de-multiplexing due to different capabilities of UE and IMS network or the different types of data channels with different remote endpoints. This clause provides some example scenarios of multiplexing and de-multiplexing to demonstrate where and how the data for different data channels are multiplexing and de-multiplexed.

Figure 6.22.1.2-1 demonstrates the multiplexing and de-multiplexing of different types of bootstrap data channels.

 

Figure 6.22.1.2-1 multiplexing and de-multiplexing for bootstrap data channel

In this scenario the UEs and IMS networks for originating and terminating network support data channel multiplexing.

For uplink data, the UE multiplex local bootstrap data channel and remote bootstrap data channel in one SCTP connection. Because the two data channels have different remote endpoint, MF/MRF de-multiplex the streams of the two data channels and routes data of the bootstrap data channels to local DCSF and remote MF/MRF accordingly.

For downlink data, MF/MRF multiplex the local bootstrap data channel and remote bootstrap data channel in one SCTP connection. The UE de-multiplex the downlink data and routes to different instances of bootstrap data channel.

NOTE: The remote data channels between originating MF/MRF and terminating MF/MRF can also be multiplexed.

Figure 6.22.1.2-2 demonstrates the multiplexing and de-multiplexing of application data channels when both originating and terminating networks support data channel multiplexing.



Figure 6.22.1.2-2 multiplexing and de-multiplexing for application data channels, both network supporting multiplexing

In this scenario the UEs and IMS networks for originating and terminating network support data channel multiplexing.

It is assumed there are 3 applications included in a IMS session, targeting to DC AS#1, DC AS#2 and UE#2.

In originating network, the traffic for all applications are multiplexed between UE#1 and originating MF/MRF. For uplink data traffic, the UE#1 multiplex all 3 data channels in one SCTP connection. The MF/MRF de-multiplex the streams of app#1 and routes the data to DC AS#1 via MDC2 interface. For downlink data traffic, the MF/MRF multiplex all 3 data channels in one SCTP connection. The UE#1 de-multiplex the streams of all data channels and routes the data to different applications.

Since both originating and terminating network support data channel multiplexing, the data channels for app#2 and #3 are multiplexed between originating MF/MRF and terminating MF/MRF. MF/MRF de-multiplex incoming streams and multiplex outgoing streams.

In terminating network, since streams for app#2 and #3 have different endpoints, terminating MF/MRF de-multiplex the streams of app#2 and #3 and routes the data to DC AS#2 and UE#2 accordingly.

Figure 6.22.1.2-3 demonstrates the multiplexing and de-multiplexing of application data channels when only originating networks support data channel multiplexing.



Figure 6.22.1.2-3 multiplexing and de-multiplexing for application data channels, originating network supporting multiplexing

In this scenario the UEs and IMS networks for originating support data channel multiplexing but the terminating network does not support data channel multiplexing.

In originating network, the traffics for all applications are multiplexed between UE#1 and originating MF/MRF, the same with the previous procedure. In this scenario the originating MF/MRF terminates the data channel multiplexing and de-multiplex all the streams towards terminating network.

#### 6.22.1.3 Solution Description

The data channel multiplexing feature can be used between UE and its IMS network, originating network and terminating network. The UE can discover its network’s capability during registration procedure, the originating network can discover the terminating network’s capability by local configuration.

The UE or IMS network can send call request with multiplexed SDP for data channel media only when having detected that the peer support data channel multiplexing.

When data channel multiplexing is used in IMS session, the UE and IMS network should support SDP negotiation to multiplex multiple data channel streams into a single m line and transport streams of different purposes in the same SCTP connection. The UE and IMS network also need to support data channel de-multiplexing. If the UE receives streams targeting to different applications over a single SCTP connection, it identifies the applications and delivers the data of the streams to corresponding applications. If the multiplexed streams have different remote endpoints, e.g. a local bootstrap data channel and a remote bootstrap data channel, the IMS network i.e. MF/MRF identifies the multiplexed streams and sends different streams to corresponding endpoints.

When the multiplexed data channels need to be de-multiplexed, the corresponding data channels will be always anchored at MF/MRF, even for the P2P application data channels.

On reception of call request with multiplexed SDP offer, the network should allocate data channel media resource for the received multiplexed SDP offer and responses with multiplexed SDP answer, no matter whether the endpoint on the other side support data channel multiplexing or not.

For the call request sent to the peer endpoint, the network decides whether to use data channel multiplexing based on the capability of the peer endpoint:

- If the peer endpoint support data channel multiplexing, the network should multiplex the stream id(s) that can be multiplexed into the same media stream descriptor and allocates data channel media resource. Then the network instructs the call request towards the peer endpoint with the modified multiplexed SDP.

- If the peer endpoint doesn’t support data channel multiplexing, the network should de-multiplex the stream ids and allocates data channel media resource separately. Then the network instructs the call request towards the peer endpoint with the modified de-multiplexed SDP.

#### 6.22.1.4 Capability Discovery

##### 6.22.1.4.1 Capability Discovery between UE and network

It is needed to discover the capability of supporting data channel multiplexing between UE and network and between originating and terminating network, in order to decide where and how to multiplex and de-multiplex as demonstrated in clause 6.22.1.2.

The UE and the IMS network mutually discover their capabilities of data channel multiplexing during registration procedure. P-CSCF as media processing functional entity also need to indicate its capability of data channel multiplexing since DC multiplexing requires enhancements to SDP negotiation and media identification.

If the UE and P-CSCF support data channel multiplexing, when the UE registers on the IMS network, the UE and P-CSCF include a Contact header field indicating its capability of supporting data channel multiplexing in the REGISTER request.

If the home IMS network supports this feature, the S-CSCF includes a Feature-Caps header field indicating its capability of supporting data channel multiplexing in the 200 OK response to the initial and any subsequent REGISTER request.

##### 6.22.1.4.2 Capability Discovery between originating and terminating network

The originating IMS network should discovery the capability of the terminating IMS network by local configuration. If terminating IMS’s domain name is configured supporting data channel multiplexing, the originating IMS includes the multiplexed SDP in initial INVITE or re-INVITE requests.

#### 6.22.1.5 Determination of multiplexing and de-multiplexing

When the IMS AS receives the INVITE request with data channel multiplexing, it reports the event to the DCSF for data channel management. The DCSF determines whether the data channel multiplexing is allowed and whether serving network needs to de-multiplex the data channel traffic. If the data channel traffic needs to be de-multiplexed, e.g. the local bootstrap data channel and the remote bootstrap data channel are multiplexed, the DCSF instructs the IMS AS to de-multiplex the specific data channel media components on the MF or MRF.

Based on the instruction of the DCSF, the IMS AS further indicates the MF/MRF to modify the media resource to de-multiplex the data channel traffic.

#### 6.22.1.6 Media management for multiplexing and de-multiplexing

If the UE decides to use data channel multiplexing, when the UE generates SDP offer in INVITE or re-INVITE request, the DC stream IDs associated with the data channels to be multiplexed and the application ids combined with the data channels are included in the SDP offer for a single m line.

NOTE 1: How the application id and the DC stream IDs are included in the SDP is specified in SA4. Coordination with SA4 is needed.

When the IMS AS receives a SDP offer, which contains multiple DC stream IDs and/or multiple application ids within a single m line, the IMS AS determines that the received SDP offer is for a multiplexed offer and notifies the event to the DCSF. The IMS AS derives the event notifications for each application id and decides to send to DCSF. In Nimsas\_SessionEventControl\_Notify message, based on clause AA.2.4.2.2 of TS 23.228 [5], IMS AS further provides following information to the DCSF:

* Application id(s);
* Application DC type (e.g. P2P, P2A (routed in local network/or in remote network), P2A2P (routed in local network/or in remote network)).

Based on the event notifications from the IMS AS, the DCSF determines whether the application(s) needs to be de-multiplexed from the others, or whether the some DC applications are allowed to be multiplexed in between the local MF/MRF and the remote MF/MRF.

When the DCSF determines that some DC applications are allowed to be multiplexed, it instructs the IMS AS to multiplex the specific data channel streams, which are associated with the DC application ids to be multiplexed, to the same m line and the same SCTP connection on the MF/MRF. In Nimsas\_MediaControl\_MediaInstruction, based on clause AA.2.4.3.2 of TS 23.228 [5], DCSF further provides following information to the IMS AS:

* Media proxy configuration of SCTP connection applicable to the media flows of the multiplexing applications for originating side and terminating side: e.g. the same SCTP proxy configuration is applied to the media flow of app#1, app#2, and app#3 for originating side, and the same SCTP proxy configuration is applied to the media flow of app#2 and app#3 for terminating side (in case of Figure 6.22.1.2-2).

The IMS AS further instructs MF/MRF to reserve a single media termination for the streams to be multiplexed. In Nmf\_MediaResourceManagement, based on clause AA.2.5.2 of TS 23.228 [5], the Media proxy configuration of SCTP connection to the media flows of the multiplexing applications for originating side and terminating side are further included.

If the DCSF determines that a data channel needs to be de-multiplexed from a multiplexing SCTP connection, it instructs the IMS AS to de-multiplex the specific data channel stream(s), which is associated with the application(s) needs to be de-multiplexed, with the separate connection on the MF/MRF. Based on the instruction of the DCSF, the IMS AS further indicates the MF/MRF to reserve separate media termination for the de-multiplexed stream instead of using the same media termination with other multiplexed streams.

If the DCSF determines that remote network does not support multiplexing, it instructs the IMS AS to de-multiplexing all the multiplexed data channel streams from single m line and allocate m lines for each de-multiplexed data channel stream.

If the IMS AS is instructed by DCSF to use data channel multiplexing, when IMS AS generates SDP offer in INVITE or re-INVITE request to remote network, the DC stream IDs associated with the data channels to be multiplexed and the application ids combined with the data channels are included in the SDP offer for a single m line.

NOTE 2: How the application id and the DC stream IDs are included in the SDP are specified in SA4. Coordination with SA4 is needed.

If the session is successfully established with data channel multiplexing, the UE and MF/MRF send the media flows of corresponding data channels in the same SCTP connection.

#### 6.22.1.7 MF/MRF selection

If a MF or MRF needs to be selected, the IMS AS selects a MF or MRF supporting data channel multiplexing by including data channel multiplexing indication in the Nnrf\_NFDiscovery\_Request service operation.

### 6.22.2 Services enhancements

#### 6.22.2.1 IMS AS Services enhancements

##### 6.22.2.1.1 Nimsas\_MediaControl\_MediaInstruction service operation

**Service operation name:** Nimsas\_MediaControl\_MediaInstruction

**Inputs, Required:** The existing parameters defined in AC 2.4.3.2 of 23.228 remain the same except for the following parameter updates:

- Media instruction: This parameter includes instructions of handling the media for each ‘m=’ line, it should be updated to support instructions of handling the media for each stream id.

- DC Media Specification:

- MDC1/MDC2 media endpoint address of the application layer: For different P2A applications, the MDC2 media endpoint address is different, so when data channel multiplexing for different P2A applications is used, this parameter should support multiple MDC2 media endpoints corresponding to P2A application stream id(s) in one media instruction.

**Inputs, Conditional:** No change.

**Inputs, Optional:** No change.

**Outputs, Required:** No change.

**Outputs, Optional:** The existing parameters defined in AC 2.4.3.2 of 23.228 remain the same except for the following parameter updates:

- DC Media Specification:

- MDC1/MDC2 media endpoint address of the application layer: This parameter should include the same number and same order as the input parameter “MDC1/MDC2 media endpoint address of the application layer”.

#### 6.22.2.2 MF Services enhancements

##### 6.22.2.2.1 Nmf\_MediaResourceManagement (MRM) service

**Service operation name:** Nmf\_MRM\_Create/Update

**Inputs, Required:** The existing parameters defined in AC 2.5.2 of 23.228 remain the same except for the following parameter updates:

- Media Function Specifications: Specification of the media function to be applied to the media stream as requested by the application layer, which includes:

- Remote MDC1/MDC2 media endpoint address of the application layer: For different P2A applications, the MDC2 media endpoint address is different, so when data channel multiplexing for different P2A applications is used, this parameter should support multiple MDC2 media endpoints corresponding to P2A application stream id(s) in the same Media Function Specification.

- Data Channel Mapping and Configuration information: When data channel multiplexing is used, this parameter should support different instructions for stream id(s) in the same Media Function Specification.

**Inputs, Optional:** No change.

**Outputs, Required:** No change.

**Outputs, Optional:** The existing parameters defined in AC 2.5.2 of 23.228 remain the same except for the following parameter updates:

Media Stream Descriptor Resource information includes:

- MDC1/MDC2 media point information: This parameter should include the same number and same order as the input parameter “Remote MDC1/MDC2 media endpoint address of the application layer”.

### 6.22.3 Procedures

#### 6.22.3.1 Bootstrap data channel establishment

##### 6.22.3.1.1 Bootstrap data channels multiplexing in originating network



Figure 6.22.3.1.1-1 multiplexing bootstrap data channels in originating network

1. When the UE wants to multiplex its bootstrap data channels, e.g. local bootstrap data channel and remote bootstrap data channel, the UE includes multiplexed SDP media description in initial INVITE request as described in clause 6.22.1.5.

2-3. The IMS AS selects and report event to DCSF.

4. The DCSF determines based on stream id in the SDP that local bootstrap and remote bootstrap data channels need to be de-multiplexed.

5. The DCSF generates data channel media information for originating side and terminating side.

6. The DCSF instructs the IMS AS to reserve resources on MF/MRF.

7. The IMS AS selects MF/MRF supporting data channel multiplexing.

8. The IMS AS instructs MF/MRF to reserve media resources for multiplexed data channel streams and other media resources based on instructions from DCSF, as described in clause 6.22.1.5.

9-12. The session continues after the media resource is reserved successfully. The SDP offer in the INVITE request may also be multiplexed if needed.

13-16. The terminating network responds and the session is established successfully.

The streams of local data channel and remote data channel are transported in the same SCTP connection between UE#1 and MF/MRF and are routed to DCSF and remote network correspondingly.

##### 6.22.3.1.2 Bootstrap data channel multiplexing in terminating network



Figure 6.22.2.1.2-1 multiplexing bootstrap data channels in terminating network

1. The originating network sends initial INVITE request with SDP offer for remote bootstrap data channel to UE#2.

2-3. The IMS AS selects and reports event to DCSF.

4. The DCSF determines that local bootstrap and remote bootstrap data channels to UE#2 need to be multiplexed.

5. The DCSF generates data channel media information for originating side and terminating side.

6. The DCSF instructs the IMS AS to reserve resources on MF/MRF.

7. The IMS AS selects MF/MRF supporting data channel multiplexing.

8. The IMS AS instructs MF/MRF to reserve media resources for multiplexed data channel streams and other media resources based on instructions from DCSF, as described in clause 6.22.1.5.

9-12. The session continues after the media resource is reserved successfully.

13-16. The UE#2 responds and the session is established successfully.

The streams of local data channel and remote data channel are transported in the same SCTP connection to UE#2.

#### 6.22.3.2 Application data channel establishment

##### 6.22.3.2.1 Application data channel multiplexing when both originating and terminating networks support data channel multiplexing

 

Figure 6.22.2.2.1-1 Application data channel multiplexing when both originating and terminating networks support data channel multiplexing

1. When the UE#1 wants to multiplex its application data channels for app#1, #2 and #3, the UE includes multiplexed SDP media description in initial INVITE request as described in clause 6.22.1.5.

2. The IMS AS report event to DCSF.

3. The DCSF determines based on application id in the SDP that data channel for app#1 needs to be de-multiplexed.

4. The DCSF generates multiplexed data channel media information for originating side, and multiplexed data channel media information for terminating side if the terminating network support data channel multiplexing based on the local configuration.

5. The DCSF instructs the IMS AS to reserve resources on MF/MRF.

6. The IMS AS instructs MF/MRF to reserve media resources for multiplexed data channel streams and other media resources based on instructions from DCSF, as described in clause 6.22.1.6.

7-8. The session continues after the media resource is reserved successfully.

9-10. The IMS AS generates reINVITE request to terminating network. The reINVITE request includes the SDP offer for multiplexed data channels of app#2 and #3.

11. The terminating network supports data channel multiplexing. The IMS AS in terminating network reports event to DCSF.

12. The DCSF in terminating network determines based on application id in the SDP that data channel for app#2 needs to be de-multiplexed.

13. The DCSF generates data channel media information for originating side and terminating side.

14. The DCSF instructs the IMS AS to reserve resources on MF/MRF.

15. The IMS AS instructs MF/MRF to reserve media resources for multiplexed data channel streams and other media resources based on instructions from DCSF, as described in clause 6.22.1.6.

16-17. The session continues after the media resource is reserved successfully.

18-19. The IMS AS generates reINVITE request to UE#2.

20-21. The UE#2 replies 18X response with SDP answer for app#3.

22-23. The IMS AS replies 18X response with SDP answer for multiplexed data channels for app#2 and #3 to the originating network.

24. The IMS AS replies 18X response with SDP answer for multiplexed data channels for app#1, #2 and #3 to UE#1.

25-26. The IMS AS reports event to DCSF.

27. The session is established successfully. The streams of app#1, #2 and #3 are transported in the same SCTP connection between UE#1 and originating MF/MRF. The stream of app#1 is routed to DC AS and streams of app#2 and #3 are transported in the same SCTP connection between MF/MRFs of originating and terminating networks and are routed to DC AS and UE#2 accordingly.

##### 6.22.3.2.2 Application data channel multiplexing when terminating network does not support data channel multiplexing

 

Figure 6.22.2.2.2-1 Application data channel multiplexing when terminating network does not support data channel multiplexing

1. When the UE#1 wants to multiplex its application data channels for app#1, #2 and #3, the UE includes multiplexed SDP media description in initial INVITE request as described in clause 6.22.1.5.

2. The IMS AS report event to DCSF.

3. The DCSF determines based on application id in the SDP that data channel for app#1 needs to be de-multiplexed.

4. The DCSF generates multiplexed data channel media information for originating side, and de-multiplexed data channel media information if the terminating network does not support data channel multiplexing based on the local configuration.

5. The DCSF instructs the IMS AS to reserve resources on MF/MRF.

6. The IMS AS instructs MF/MRF to reserve media resources for multiplexed data channel streams of originating side and media resources for de-multiplexed data channel streams of the terminating side based on instructions from DCSF, as described in clause 6.22.1.6.

7-8. The session continues after the media resource is reserved successfully.

9-10. The IMS AS generates reINVITE request to terminating network. The reINVITE request includes the SDP offer for de-multiplexed data channels of app#2 and #3.

11-12. The terminating network replies 200 OK with SDP answer for de-multiplexed data channels of app#2 and #3.

13. The IMS AS reports event to the DCSF.

14. The DCSF instructs the IMS AS and the IMS AS further requests the MF/MRF to modify media resources for streams of app#2 and #3, as described in clause 6.22.1.6.

15-16. The IMS AS replies 200 OK response with SDP answer for multiplexed data channels for app#1, #2 and #3 to UE#1.

17. The session is established successfully. The streams of app#1, #2 and #3 are transported in the same SCTP connection between UE#1 and originating MF/MRF. The stream of app#1 is routed to DC AS and streams of app#2 and #3 are transported to terminating network and are routed to DC AS and UE#2 accordingly.

### 6.22.4 Impacts on existing nodes and functionality

This solution has impacts to the existing IMS nodes and UE below:

UE:

- includes a Contact header field indicating its capability of supporting data channel multiplexing in the REGISTER request;

- includes the DC stream IDs associated with the data channels to be multiplexed and the application ids combined with the data channels in the SDP offer for a single m line in INVITE request;

- sends and receives multiplexed data channel streams in the same SCTP connection;

S-CSCF:

- includes a Feature-Caps header field indicating its capability of supporting data channel multiplexing in the REGISTER request;

DCSF:

- determines data channel streams to be multiplexed or de-multiplexed;

- instructs IMS AS to reserve media resources for multiplexed or de-multiplexed data channel streams;

IMS AS:

- includes the DC stream IDs associated with the data channels to be multiplexed and the application ids combined with the data channels in the SDP offer for a single m line in INVITE request;

- instructs MF/MRF to reserve media resources for multiplexed or de-multiplexed data channel streams;

- determines if the terminating network supports data channel multiplexing by local configuration;

NRF:

- discovers MF/MRF supporting data channel multiplexing.

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