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MULTI-PARTY VIDEO CALL SUPPORT IN 5G NETWORKS USING 5G DEVICES SUPPORTING A DEFAULT NUMBER OF FILTERS

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ABSTRACT

A Third Generation Partnership Project (3GPP) Fifth Generation (5G) network environment offers a rich universe of features and capabilities. One such capability, a multi-party video call, is of particular value and importance to both enterprise customers (who for example may not be willing to use over-the-top (OTT)) and individual consumers. However, variability in user equipment (UE) may tend to limit or otherwise negatively impact multi-party video call capabilities. Techniques are presented that address these challenges through the creative and efficient management of packet filters.

DETAILED DESCRIPTION

In a 3GPP 5G network environment, a particular instance of a UE may offer varying degrees of standards compliance vis-a-vis its particular interactions with a network. For example, a UE may not necessarily support reflective Quality of Service (QoS), a UE may not necessarily populate certain Information Elements (IEs) in different Protocol Data Unit (PDU) exchanges, etc.

Such UE variability may tend to limit or otherwise negatively impact the availability and operation of various features and capabilities. One capability that may be so limited is a multi-party video call. The limitation may be described with reference to Figure 1, below.

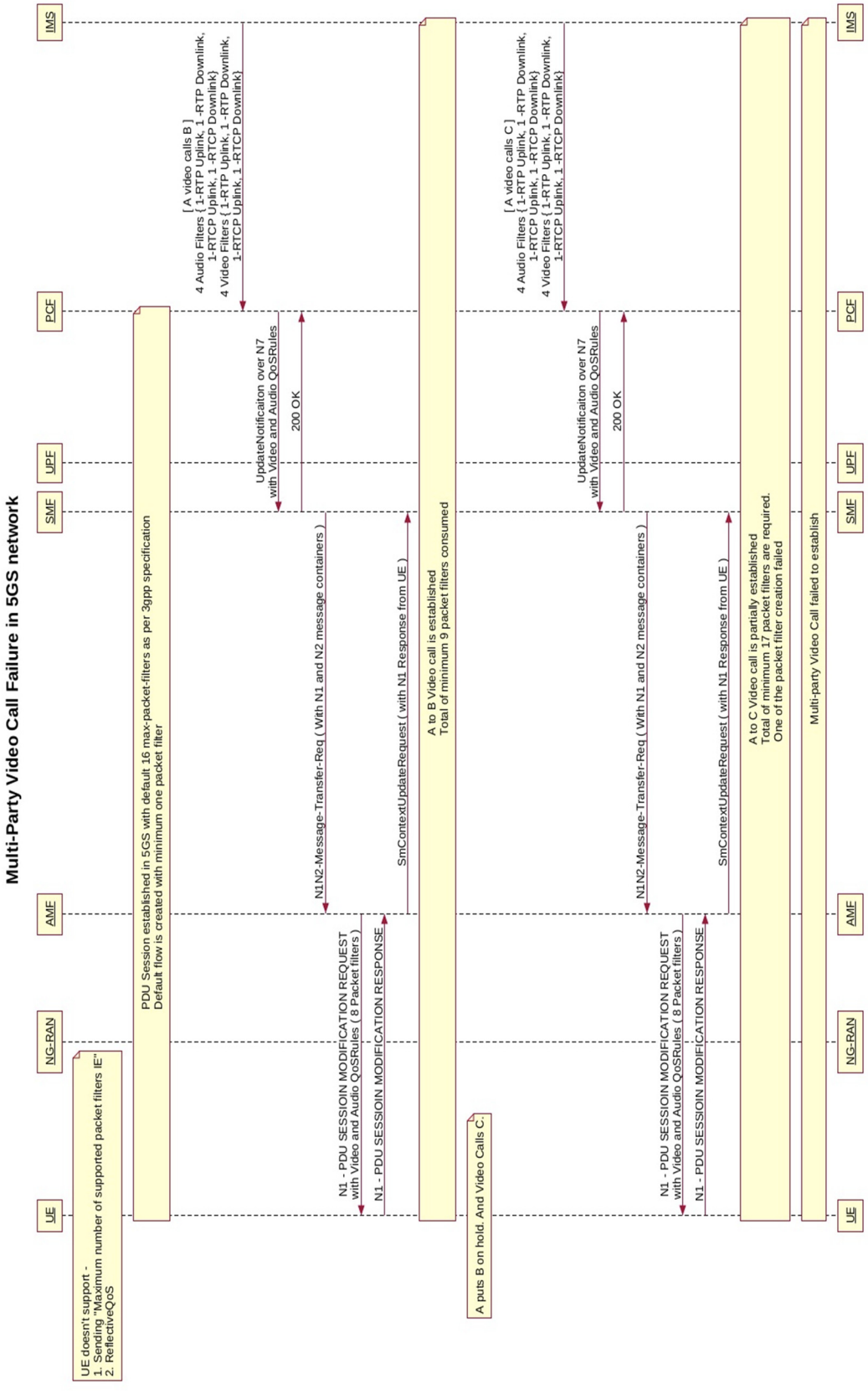

Multi-Party Video Call Failure in 5GS network
UE
NG-RAN
AMF
SMF
UPF
PCF
IMS
UE doesn't support -
1. Sending "Maximum number of supported packet filters IE"
2. ReflectiveQoS
PDU Session established in 5GS with default 16 max-packet-filters as per 3gpp specification
Default flow is created with minimum one packet filter
[A video calls B]
4 Audio Filters { 1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink}
4 Video Filters { 1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink}
UpdateNotificaiton over N7 with Video and Audio QoSRules
200 OK
N1N2-Message-Transfer-Req (With N1 and N2 message containers)
N1 - PDU SESSIOIN MODIFICATION REQUEST with Video and Audio QoSRules (8 Packet filters)
N1 - PDU SESSIOIN MODIFICATION RESPONSE
SmContextUpdateRequest (with N1 Response from UE)
A to B Video call is established
Total of minimum 9 packet filters consumed
A puts B on hold. And Video Calls C.
[A video calls C]
4 Audio Filters { 1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink}
4 Video Filters { 1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink}
UpdateNotificaiton over N7 with Video and Audio QoSRules
200 OK
N1N2-Message-Transfer-Req (With N1 and N2 message containers)
N1 - PDU SESSIOIN MODIFICATION REQUEST with Video and Audio QoSRules (8 Packet filters)
N1 - PDU SESSIOIN MODIFICATION RESPONSE
SmContextUpdateRequest (with N1 Response from UE)
A to C Video call is partially established
Total of minimum 17 packet filters are required.
One of the packet filter creation failed
Multi-party Video Call failed to establish

Figure 1

As one specific example of possible UE variability, it is observed that some 5G devices only support 16 packet filters. For example, these devices do not include a 'Maximum Number of Supported Packet Filters' IE in a PDU session establishment request to let the network know about the number of packet filters that the UE supports. In the absence of such an IE a network may assume that the UE supports only a default number of packet filters, such as 16. Further, these devices also do not support reflective QoS.

The Authorized QoS Rules IE is a mandatory parameter in a PDU session establishment accept and hence one/two packet filters get utilized for a default flow. So for a device not sending this IE, the network can send only 15/14 filters across all flows of the PDU session for the device.

For a multi-party video call 24 packet filters are required for the initiator during an establishment phase. Under a circumstance where a UE supports only 15 packet filters an attempt at establishing a multi-party video call fails.

Consider the illustrative scenario wherein Party A wishes to establish a multi-party video call between themselves, Party B, and Party C. Under this scenario:

Party A calls Party B, resulting in an allocation of eight packet filters:

- Two packet filters for Real-time Transport Protocol (RTP) audio (one for uplink and one for downlink) and two packet filters for RTP Control Protocol (RTCP) audio (one for uplink and one for downlink).
- Two packet filters for RTP video (one for uplink and one for downlink) and two packet filters for RTCP video (one for uplink and one for downlink).

Party A places Party B on hold and then calls Party C, resulting in an allocation of eight packet filters:

- Two packet filters for RTP audio (one for uplink and one for downlink) and two packet filters for RTCP audio (one for uplink and one for downlink).

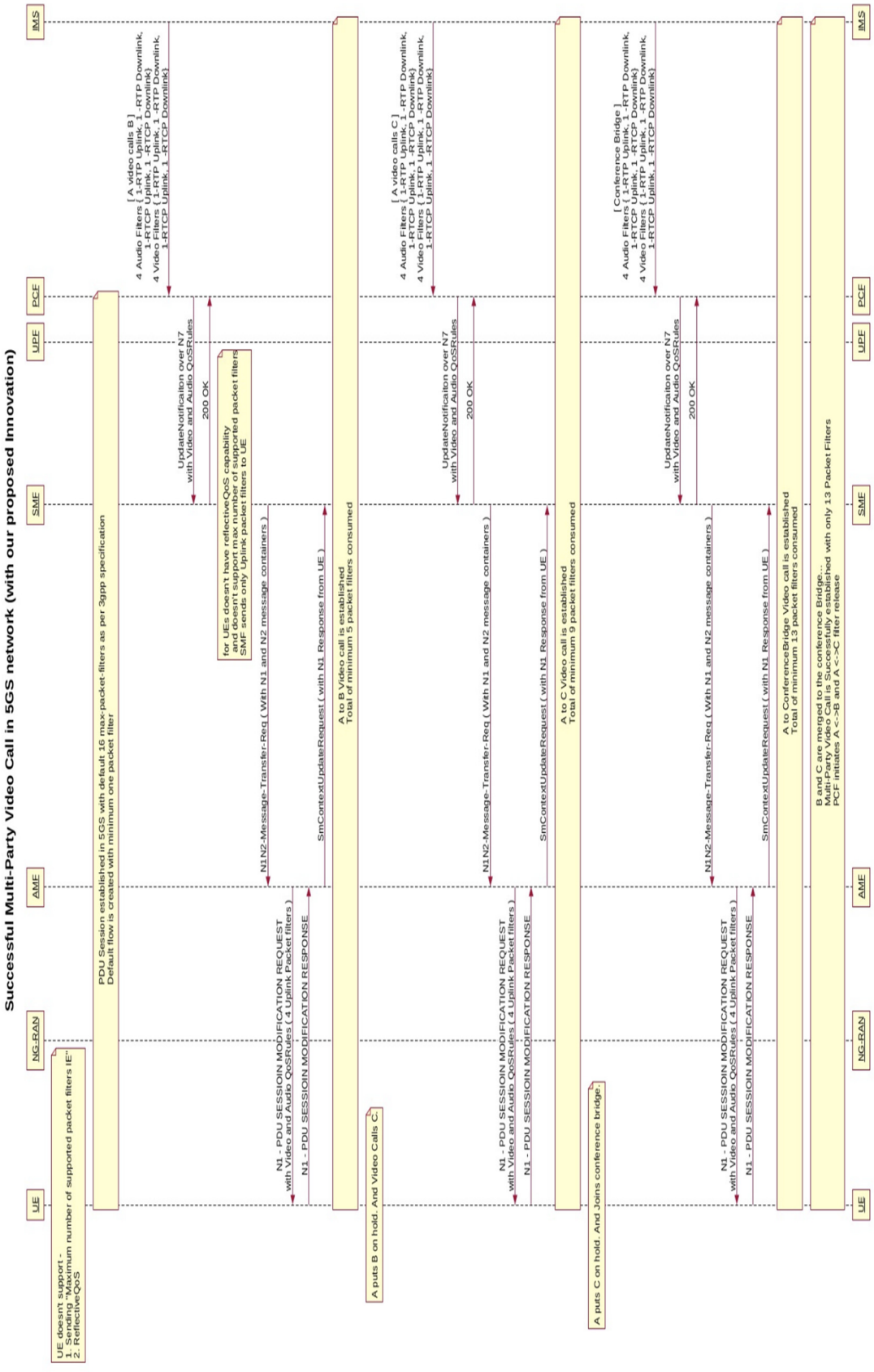
- Two packet filters for RTP video (one for uplink and one for downlink) and two packet filters for RTCP video (one for uplink and one for downlink).

Party A places Party C on hold and then connects to a conference bridge, resulting in an allocation of eight packet filters:

- Two packet filters for RTP audio (one for uplink and one for downlink) and two packet filters for RTCP audio (one for uplink and one for downlink).
- Two packet filters for RTP video (one for uplink and one for downlink) and two packet filters for RTCP video (one for uplink and one for downlink).

The exchanges that were described above necessitate a total of 24 packet filters – 12 uplink and 12 downlink – for a multi-party video call. Additionally, there are use-cases involving real time text (RTT) while multi-party video call establishment is in progress; thus, the filter requirement could be more than 24 in some instances. As depicted in Figure 1, with only 15 packet filters available (a consequence of the previously discussed limitation arising from UE variability) the attempt to establish a multi-party video call fails, resulting in among other things a diminished user experience.

The failure that was described above may be addressed through the creative and efficient management of packet filters as provided by techniques described herein. Specifically, techniques herein provide for the ability to not include downlink packet filters for UEs which do not include a "Maximum number of supported packet filters" IE in a PDU session establishment request. As noted above, out of the 24 filters coming from the PCF, 12 are uplink filters and 12 are downlink filters. A UE needs only uplink filters to perform traffic to bearer mapping in an uplink direction. With this approach only 12 filters are sent to the UE, thereby providing for the ability to facilitate multi-party video calls for the UE. Aspects of such a solution may be described with reference to Figure 2, below.


Successful Multi-Party Video Call in 5GS network (with our proposed Innovation)
UE
NG-RAN
AME
SMF
UPF
PCF
IMS
UE doesn't support -
1. Sending "Maximum number of supported packet filters IE"
2. ReflectiveQoS
PDU Session established in 5GS with default 16 max-packet-filters as per 3gpp specification
Default flow is created with minimum one packet filter
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4 Video Filters (1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink)
UpdateNotificaiton over N7 with Video and Audio QoSRules
200 OK
for UEs doesn't have reflectiveQoS capability and also to support max number of supported packet filters SMF sends only Uplink packet filters to UE
N1N2-Message-Transfer-Req (With N1 and N2 message containers)
N1 - PDU SESSIOIN MODIFICATION REQUEST with Video and Audio QoSRules (4 Uplink Packet filters)
N1 - PDU SESSION MODIFICATION RESPONSE
SmContextUpdateRequest (with N1 Response from UE)
A to B Video call is established
Total of minimum 5 packet filters consumed
A puts B on hold. And Video Calls C.
[A video calls C]
4 Audio Filters (1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink)
4 Video Filters (1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink)
UpdateNotificaiton over N7 with Video and Audio QoSRules
200 OK
N1N2-Message-Transfer-Req (With N1 and N2 message containers)
N1 - PDU SESSIOIN MODIFICATION REQUEST with Video and Audio QoSRules (4 Uplink Packet filters)
N1 - PDU SESSION MODIFICATION RESPONSE
SmContextUpdateRequest (with N1 Response from UE)
A to C Video call is established
Total of minimum 9 packet filters consumed
A puts C on hold. And Joins conference bridge.
[Conference Bridge]
4 Audio Filters (1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink)
4 Video Filters (1-RTP Uplink, 1 -RTP Downlink, 1-RTCP Uplink, 1 -RTCP Downlink)
UpdateNotificaiton over N7 with Video and Audio QoSRules
200 OK
N1N2-Message-Transfer-Req (With N1 and N2 message containers)
N1 - PDU SESSIOIN MODIFICATION REQUEST with Video and Audio QoSRules (4 Uplink Packet filters)
N1 - PDU SESSION MODIFICATION RESPONSE
SmContextUpdateRequest (with N1 Response from UE)
A to ConferenceBridge Video call is established
Total of minimum 13 packet filters consumed
B and C are merged to the conference Bridge...
Multi-Party Video Call is Successfully established with only 13 Packet Filters
PCF initiates A <-/B and A <-/C filter release

Figure 2

Commonly an operator may advertise support for a maximum of six UEs in a multi-party video call.

After Party A establishes a connection to a conference bridge using 12 uplink filters, the Party A → Party B connection (consuming four packet filters) and the Party A → Party C connection (consuming four packet filters) may be torn down resulting in a need for just four uplink filters after that.

Every time a new UE (up to a maximum of five UE other than Party A) joins a conference, Party A needs an additional four uplink filters. So when Party D joins a conference another four filters are used, taking the total number up to eight uplink filters. When Party D gets merged into the conference bridge the four uplink filters are freed.

The same sequence of events (as just described for Party D) takes place when Party E joins the conference. Consuming both uplink and downlink filters results in 16 filters needed when Party D or Party E joins a conference which cannot be achieved since (as described above) a minimum of one packet filters is used while creating a default flow.

In summary, a 3GPP 5G network environment offers a rich universe of features and capabilities. One such capability, a multi-party video call, is of particular value and importance to both individual consumers and enterprise customers. However, variability in UE may tend to limit or otherwise negatively impact multi-party video call capabilities. The techniques presented above address these challenges through the creative and efficient management of packet filters.