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WO 2020/102621 A1   WO 2020/088815 A1
WO 2020/060332 A1   WO 2017/026760 A1
US 20190281491 A1   US 20180279319 A1

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INT CL H04L, H04W
Other: WPI, EPODOC

(54) Title of the Invention: **Improvements in and relating to QoS Handling**
Abstract Title: **Managing QoS based on a trigger derived from one or more of a remote UE, a ProSe UE to network relay, a RAN or an application server**

(57) A method of managing Quality of Service (QoS) in a telecommunication system comprising a User Equipment (UE) which is operable to communicate with a network via a UE to network relay. The QoS is managed in response to at least one trigger derived from one or more of (a) a remote UE, (b) Proximity Services (ProSe) UE to network relay, (c) Radio Access Network (RAN) and (d) Application Server. The trigger may be based on or derived from (a) link status between remote UE and ProSe UE to network relay, (b) Uu congestion status, (c) policy controls derived from application server either for public safety applications or for network-controlled interactive services (NCIS). The trigger from the remote UE or ProSe UE to network relay may be over a PC5 interface. If there is a degradation in channel state, either the remote UE or ProSe UE to network relay may identify that QoS requirements over the link between the remote UE and ProSe UE to network relay cannot be met, reflecting that end-to-end QoS requirements cannot be met. Also provided is apparatus to perform the disclosed method.
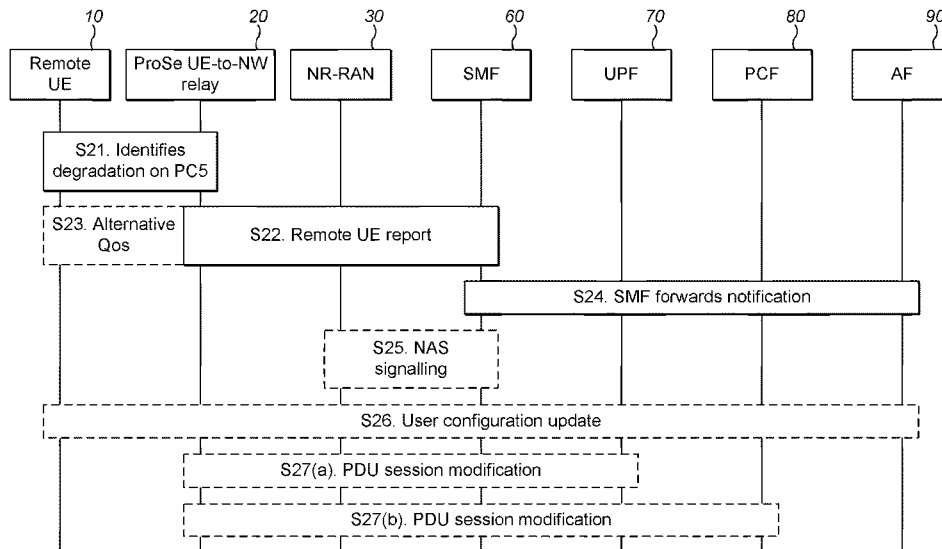

FIG. 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
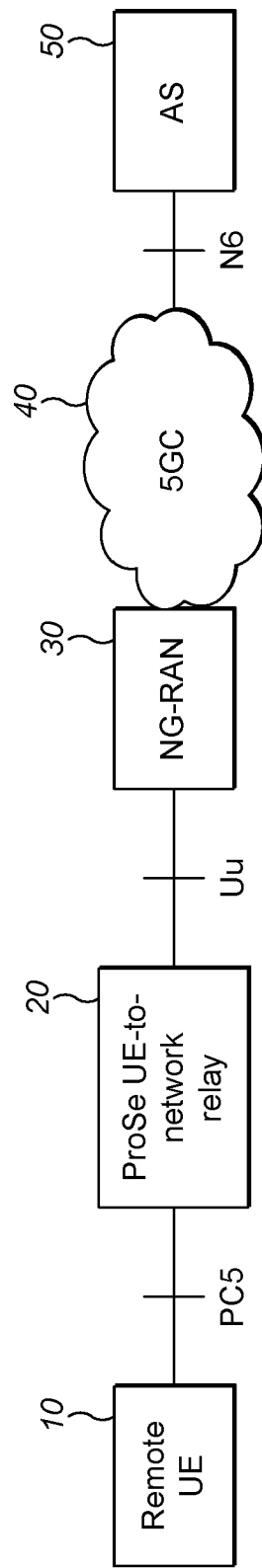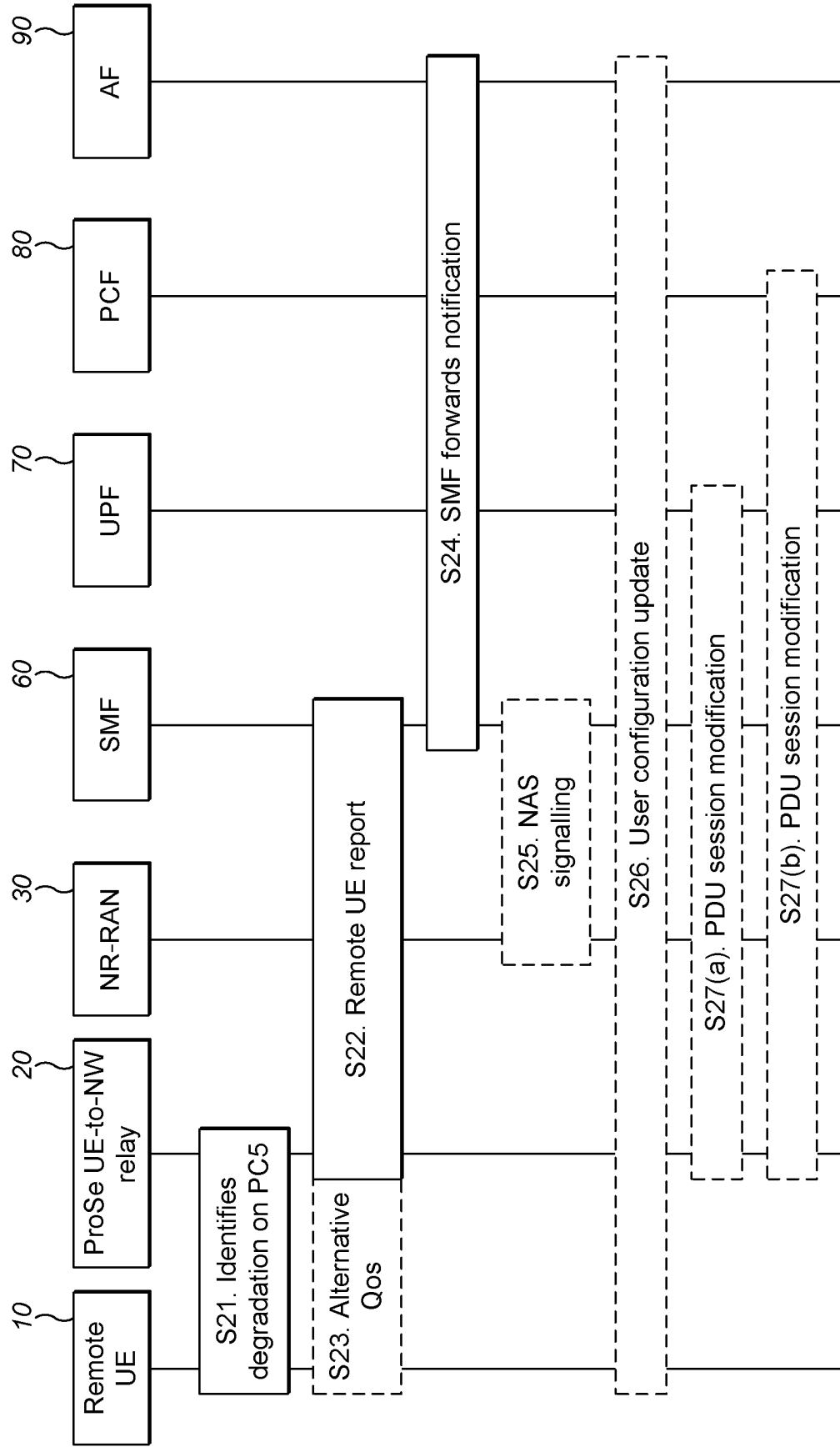
29 06 21

FIG. 1

29 06 21

FIG. 2

29 06 21

FIG. 3

29 06 21

90

AF

S41(a). Remote
UE mobility

S41(b).
Requirement
changes

S41(c). Network
analytics

80

PCF

70

UPF

60

SMF

30

NR-RAN

20

ProSe UE-to-NW
relay

10

Remote
UE

S42. User configuration update

S43(a). PDU session modification

S43(b). PDU session modification

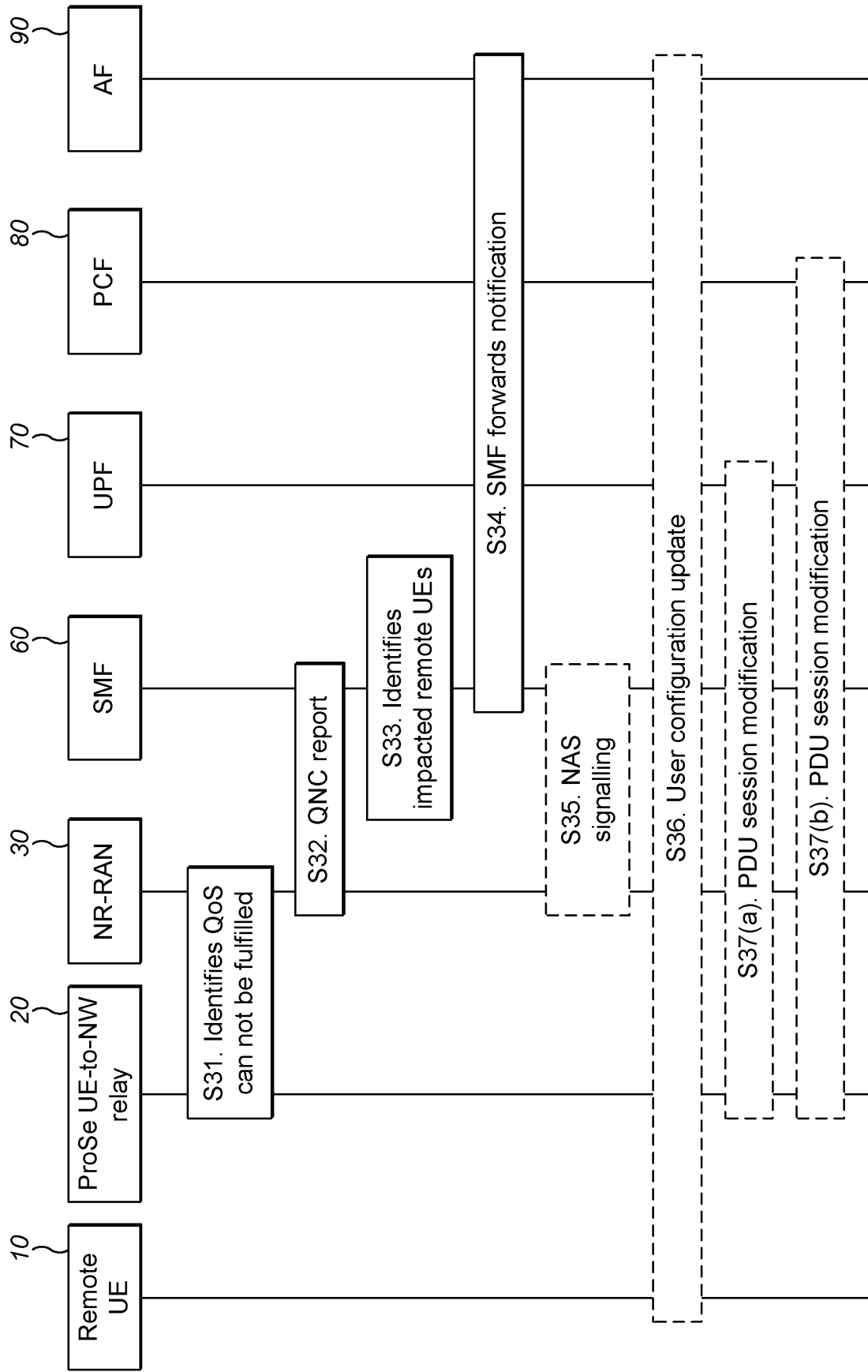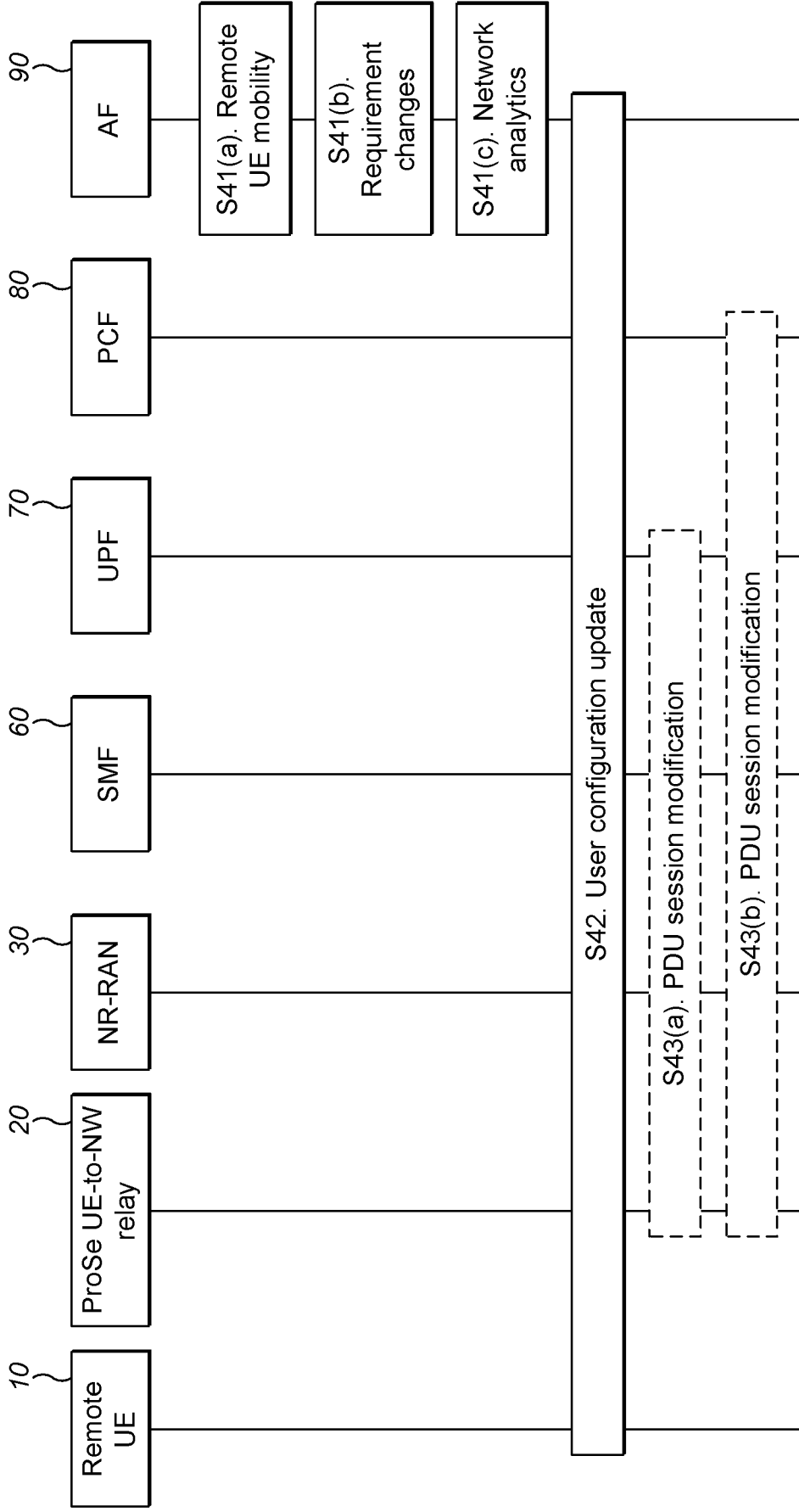*FIG. 4*

Improvements in and relating to QoS handling

The present invention relates to the Quality of Service (QoS) handling for Proximity Services
5   (ProSe) where a UE-to-Network Relay entity provides the functionality to support connectivity to
the network for Remote UEs.

Proximity Services (ProSe) (specifically the direct communication) have been enhanced to
support V2X services over LTE. For Fifth Generation Systems (5GS), the proximity services are
10   expected to be an important system-wide enabler to support various applications and services.

Another class of commercial services has recently emerged known as Network-controlled
Interactive services (NCIS) that share some commonality of requirements with public safety
services and applications. NCIS refers to a kind of service which needs at least 2 UEs to join
15   and share data, e.g. interactive gaming or data sharing. Those UEs in the same NCIS session
are grouped together as one NCIS group, and the group is determined by application layer (i.e.
NCIS application server).

In order to guarantee service requirements, QoS parameters are derived based on proximity
20   application requirements; QoS flows and corresponding QoS rules are created accordingly.
However, in the presence of a relay, this is not trivial and involves performing QoS control for
PC5 interface between Remote UE and UE-to-Network Relay as well as QoS control over PDU
session established between the UE-to-Network Relay and the Network via Uu interface.

25   Figure 1 shows an example of how ProSe UE-to-Network Relay 20 relays traffic (UL and DL)
between the Remote UE 10 and the Network (comprising NG-Radio Access Network (RAN) 30,
5G Core (5GC) 40 and Application Server (AS) 50).

The terms ProSe UE-to-Network Relay and UE-to-Network Relay or, simply, relay are used
30   interchangeably throughout the present invention, as will be understood by the skilled person.

Embodiments of the present invention aim to address shortcomings in the prior art, whether
mentioned herein or not.

35   According to a first aspect of the present invention, there is provided a method of managing
Quality of Service, QoS, in a telecommunication system comprising a User Equipment, UE ,
which is operable to communicate with a network via a UE to network relay , wherein the QoS
is managed in response to at least one trigger derived from one or more of:

a) a remote UE;

b) ProSe UE to network Relay;

c) Radio Access Network, RAN ; and

d) Application Server.

In an embodiment, the at least one trigger is based on, or derived from, one or more of:

a) Link status between Remote UE and ProSe UE-to-Network Relay;

b) Uu Congestion status or other indications on QoS fulfilment from RAN ; and

c) Policy controls derived from Application Sever , either for public safety applications or for network-controlled interactive services, NCIS.

In an embodiment, the QoS management is in response to a trigger from either the remote UE or ProSe UE to network Relay over a PC5 interface.

In an embodiment, a QoS mapping configuration is preconfigured on one or more of the UE and ProSe UE to network Relay or is provisioned by a User Configuration Update via PCF.

In an embodiment, the QoS mapping configuration indicates how Uu-level QoS flows are mapped to PC5 QoS flows and/or vice-versa.

In an embodiment, an entry in the QoS mapping configuration includes an adjustment factor to be applied per individual QoS characteristics when mapping is performed.

In an embodiment, if there is a degradation in a channel state, either the UE or ProSe UE to network Relay identifies that QoS requirements over the link between the UE and ProSe UE to network Relay cannot be met, reflecting that end-to-end QoS requirements cannot be met.

In an embodiment, the ProSe UE to network Relay initiates a remote UE report to SMF including Remote User ID, IP information or any other relevant address information, indicating the highest priority Alternative QoS profile that can be fulfilled, meeting end-end QoS requirements.

In an embodiment, the UE or ProSe UE to network Relay uses Layer-2 link modification procedure to modify PC5 QoS flow in line with the Alternative QoS Profile adopted.

In an embodiment, as part of the Layer-2 link modification procedure, PC5 QoS rules are updated with additional information elements either implicitly or explicitly, reflecting a change in the end-to-end QoS requirements.

In an embodiment, the SMF forwards the remote UE report to PCF

In an embodiment, the SMF initiates a transparent Network Access Stratum, NAS, update towards RAN to amend Uu-level QoS flows treatment between RAN and ProSe UE-to-Network Relay or to change PC5-level cap on link transmission based on new ProSe configuration and policy parameters or Alternative QoS profile over PC5.

In an embodiment, on ProSe AF request, UE or ProSe UE to network Relay receives a User configuration update from PCF (80) to notify new ProSe configuration and policy parameters.

In an embodiment, either:
ProSe UE to network Relay establishes a new PDU session or modifies an existing PDU session for relaying; or
PCF initiates a PDU session modification.

According to a second aspect of the present invention, there is provided apparatus arranged to perform the method of the first aspect.

Although a few preferred embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example only, to the accompanying diagrammatic drawings in which:

Figure 1 shows an example traffic relay system, according to an embodiment of the present invention;

Figure 2 shows a representation of a call flow according to an embodiment of the present invention;

Figure 3 shows a representation of a call flow according to an embodiment of the present invention;

Figure 4 shows a representation of a call flow according to an embodiment of the present invention;

Figure 2, and the following figures, show various network functions and/or entities, whose functions and definitions are known in the art in at least: 3GPP TS 23.501, 3GPP TS 23.502 and 3GPP TS 23.503. The various known functions of these network functions/entities is varied and/or enhanced as set out in the following description.

5

For completeness, the various functions/entities shown are:

User Equipment: UE (10)
Next Generation Radio Access Network: NG-RAN (30)
10 Session Management Function: SMF (60)
User Policy Function, UPF (70)
Policy Control Function: PCF (80)
Application Function: AF (90)

15 In Figure 2, SMF (60), UPF (70), PCF (80) are constituent parts of 5GC (40). AF (90) is equivalent to AS (50)

Unless explicitly indicated, PCF 80 refers to the policy control function utilised for UE policy and Access and Mobility (AM) policy association. Otherwise, when stated (Session Management, 20 SM, Policy) PCF 80 refers to the policy control function utilised for SM policy association. Both policy functions may be co-located dependent on the deployment and the selection criteria.

Figure 2 shows a first scenario according to an embodiment of the present invention. This embodiment relates to QoS control based on a trigger from Remote UE / ProSe UE-to-Network 25 Relay over the PC5 Interface. In this scenario, it is assumed that ProSe configuration and policy parameters including QoS mapping configuration have been pre-configured on the Remote UE 10 (and UE-to-Network Relay 20) or provisioned by User Configuration Update via PCF e.g. based on ProSe AF request. A QoS mapping table indicates how Uu-level QoS flows (i.e. 5G QoS Identifiers – 5QIs) can be mapped to PC5 QoS flows (i.e. PC5 QoS Identifiers – PQIs) or 30 vice versa. Each entry in the table may also include an adjustment factor to be applied per individual QoS characteristics (e.g. packet delay budget) within 5QIs and / or PQIs when mapping 5QIs to PQIs or vice versa.

Details of each step shown in Figure 2 are:

35

S21. Due to degradation in the channel state, based on L1/L2 measurements or other indications on PC5-U/PC5-S (e.g. due to a change of service, resulting in a new end-to-end QoS requirement), either Remote UE 10 or UE-to-Network Relay 20 identifies that the QoS requirements over PC5 cannot be fulfilled anymore.

S22. UE-to-Network Relay 20 may initiate a Remote UE report to SMF 60 (e.g. via NG-RAN 30) including Remote User ID, IP information or any other relevant information, indicating that the QoS profile cannot be fulfilled. A further Remote UE report to SMF 60 can be initiated in case the QoS profile can be fulfilled again in future.

S23. [Conditional in support of an Alternative QoS over PC5, or depending on the implementation] UE-to-Network Relay 20 may initiate a Remote UE report to SMF 60 (e.g. via NG-RAN 30) including Remote User ID, IP information or any other relevant address information, indicating the highest priority Alternative QoS profile that can be fulfilled meeting end-to-end QoS requirements. Remote UE 10 (and/or UE-to-Network Relay 20) may use Layer-2 link modification procedure to modify PC5 QoS flow(s) in line with the Alternative QoS Profile adopted. If no Alternative QoS profile matches the current channel state, the procedure would be similar to step S22, described above.

As part of Layer-2 link modification to PC5 QoS flow(s), the PC5 QoS rules can be updated with additional information elements either implicitly or explicitly (to be stored as part of UE PC5 QoS context), reflecting change in end-to-end QoS requirements e.g. updated PQI/5QI, updated adjustment factor per QoS characteristics within PQI/5QI, updated end-to-end Packet delay budget, updated priority level, updated packet error rate, updated averaging window, updated maximum data burst volume or any other PC5 QoS characteristics. Such additional information may override the default QoS characteristics.

S24. SMF 60 may forward the notification to (SM Policy) PCF 80. ProSe AF 90 may also be notified based on a former subscription to (SM Policy) PCF 80. ProSe AF 90 may update the relevant ProSe configuration and policy parameters.

S25. Unless notified differently by (SM Policy) PCF 80, SMF 60 may initiate a transparent Network Access Stratum (NAS) update towards NG-RAN 30, e.g. to amend Uu-level QoS flows treatment between NG-RAN 30 and UE-to-Network Relay 20 (e.g. to update Packet Delay Budget) or to change PC5-level cap on link transmission based on new ProSe configuration and policy parameters or Alternative QoS profile over PC5 (if supported, or depending on the implementation).

S26. On ProSe AF request, Remote UE 10 (and/ or UE-to-Network Relay 20) may receive a User Configuration Update (via PCF 80) to notify on new ProSe configuration and policy parameters. Remote UE 10 (and/or UE-to-Network Relay 20) may use Layer-2 link modification procedure to modify PC5 QoS flow(s) in line with Configuration Update.

S27. (a) UE-to-Network Relay 20 may establish a new PDU session or modify an existing PDU session for relaying. (b) Alternatively, PCF 80 may initiate PDU session modification.

Figure 3 shows a second scenario according to an embodiment of the present invention. This embodiment relates to a Network-Assisted QoS control over Uu interface. In this scenario, it is assumed that ProSe configuration and policy parameters including QoS mapping configuration have been pre-configured on Remote UE 10 (and UE-to-Network Relay 20) or provisioned by User Configuration Update via PCF 80 e.g. based on ProSe AF request. It is also assumed that Remote User ID is already registered in SMF 60 via a Remote UE report.

Details of each step in Figure 3 are:

S31. NG-RAN 30 detects QoS requirements cannot be fulfilled for one or more QoS Flows (towards UE-to-Network Relay 20 via Uu interface).

S32. NG-RAN 30 may initiate a QoS notification (QNC) to SMF 60. (If an Alternative QoS can be supported over Uu), the highest priority Alternative QoS profile can be indicated.

S33. Based on Remote User ID(s) implicated by this QNC, SMF 60 may identify that ProSe configuration parameters or QoS Profile (e.g. over PC5) should be changed.

S34. SMF 60 may forward the QoS notification to (SM Policy) PCF 80. ProSe AF 90 may also be notified based on a former subscription to (SM Policy) PCF 80 to update relevant ProSe configuration and policy parameters.

S35. Unless notified differently by (SM Policy) PCF 80, SMF 60 may initiate a transparent NAS update towards NG-RAN 30, e.g. to amend Uu-level QoS flows treatment between NG-RAN 30 and UE-to-Network Relay 20 (e.g. to update Packet Delay Budget) or to change PC5-level cap on link transmission based on new ProSe configuration and policy parameters or an Alternative QoS profile adopted over Uu (if supported).

S36. On ProSe AF 90 request, Remote UE 10 (and/ or UE-to-Network Relay 20) may receive a User Configuration Update (via PCF 80) to notify on new ProSe configuration and policy parameters. Remote UE 10 (and/ or UE-to-Network Relay 20) may use Layer-2 link modification procedure to modify PC5 QoS flow(s).

S37. (a) UE-to-Network Relay 20 may establish a new PDU session or modify an existing PDU session for relaying. (b) Alternatively PCF 80 may initiate PDU session modification.

Figure 4 shows a third scenario according to an embodiment of the present invention. This embodiment relates to an AF-assisted QoS control. It is assumed that ProSe configuration and policy parameters including QoS mapping configuration have been pre-configured on Remote UE 10 (and UE-to-Network Relay 20) or provisioned by User Configuration Update via PCF 80 e.g. based on ProSe AF request. Furthermore, ProSe AF 90 may access analytics data from NWDAF 100 (not shown).

Details of each step in Figure 4 are:

S41. ProSe AF 90 identifies all QoS requirements cannot be fulfilled for one or more QoS Flows e.g. based on (a) Remote UE mobility, (b) topology or requirement changes or (c) any analytics notification (either as statistics or prediction) from NWDAF 100 (e.g. on QoS sustainability or service experience).

S42. On ProSe AF 90 request, Remote UE 10 (and/or UE-to-Network Relay 20) may receive a User Configuration Update (via PCF 80) to notify on new ProSe configuration and policy parameters or an alternative QoS profile to use over PC5 (if supported or depending on the implementation). Remote UE 10 (and/or UE-to-Network Relay 20) may use Layer-2 link modification procedure to modify PC5 QoS flow(s).

S43. (a) UE-to-Network Relay 20 may establish a new PDU session or modify an existing PDU session for relaying. (b) Alternatively PCF 80 may initiate PDU session modification.

Note that in all embodiments described above, based on new ProSe configuration and policy parameters, Remote UE 10 may alternatively decide to run a new discovery procedure to find another UE-to-Network Relay 20'. Remote UE 10 may use Layer-2 link modification procedure to remove PC5 QoS flow(s). If so, a Remote UE Report may be sent (e.g. via existing UE-to-Network Relay 20) to inform the SMF 60 that the Remote UE 10 is going to leave. Corresponding PDU session (of existing UE-to-Network Relay 20) can be modified or released dependent on implementation criteria.

Although presented in terms of ProSe and 5GC, the skilled person will readily appreciate that other network topologies and/or protocols which rely on direct communication between UEs and also network-assisted communication between the same devices will benefit from embodiments of the invention.

At least some of the example embodiments described herein may be constructed, partially or wholly, using dedicated special-purpose hardware. Terms such as 'component', 'module' or 'unit' used herein may include, but are not limited to, a hardware device, such as circuitry in the form

of discrete or integrated components, a Field Programmable Gate Array (FPGA) or Application Specific Integrated Circuit (ASIC), which performs certain tasks or provides the associated functionality. In some embodiments, the described elements may be configured to reside on a tangible, persistent, addressable storage medium and may be configured to execute on one or more processors. These functional elements may in some embodiments include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. Although the example embodiments have been described with reference to the components, modules and units discussed herein, such functional elements may be combined into fewer elements or separated into additional elements. Various combinations of optional features have been described herein, and it will be appreciated that described features may be combined in any suitable combination. In particular, the features of any one example embodiment may be combined with features of any other embodiment, as appropriate, except where such combinations are mutually exclusive. Throughout this specification, the term "comprising" or "comprises" means including the component(s) specified but not to the exclusion of the presence of others.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1.   A method of managing Quality of Service, QoS, in a telecommunication system comprising a User Equipment, UE (10), which is operable to communicate with a network via a UE to network relay (20), wherein the QoS is managed in response to at least one trigger derived from one or more of:

        a) a remote UE (10);

        b) ProSe UE to network Relay (20);

        c) Radio Access Network, RAN (30); and

        d) Application Server (50).

2.   The method of claim 1 wherein the at least one trigger is based on, or derived from, one or more of:

        a) Link status between Remote UE (10) and ProSe UE-to-Network Relay (20);

        b) Uu Congestion status or other indications on QoS fulfilment from RAN (30); and

        c) Policy controls derived from Application Sever (50), either for public safety applications or for network-controlled interactive services, NCIS.

3.   The method of claim 2 wherein the QoS management is in response to a trigger from either the remote UE (10) or ProSe UE to network Relay (20) over a PC5 interface.

4.   The method of claim 3 wherein a QoS mapping configuration is preconfigured on one or more of the UE (10) and ProSe UE to network Relay (20) or is provisioned by a User Configuration Update via PCF (80).

5.   The method of claim 4 wherein the QoS mapping configuration indicates how Uu-level QoS flows are mapped to PC5 QoS flows and/or vice-versa.

6.   The method of claim 5 wherein an entry in the QoS mapping configuration includes an adjustment factor to be applied per individual QoS characteristics when mapping is performed.

7.   The method of any of claims to 6 wherein, if there is a degradation in a channel state, either the UE (10) or ProSe UE to network Relay (20) identifies that QoS requirements over the link between the UE (10) and ProSe UE to network Relay (20) cannot be met, reflecting that end-to-end QoS requirements cannot be met.

8. The method of claim 7 wherein the ProSe UE to network Relay (20) initiates a remote UE report to SMF (60) including Remote User ID, IP information or any other relevant address information, indicating the highest priority Alternative QoS profile that can be fulfilled, meeting end-end QoS requirements.

9.The method of claim 8 wherein the UE (10) or ProSe UE to network Relay (20) uses Layer-2 link modification procedure to modify PC5 QoS flow in line with the Alternative QoS Profile adopted.

10. The method of claim 9 wherein as part of the Layer-2 link modification procedure, PC5 QoS rules are updated with additional information elements either implicitly or explicitly, reflecting a change in the end-to-end QoS requirements.

11. The method of any of claims 8 to 10 wherein the SMF (60) forwards the remote UE report to PCF (80)

12. The method of claim 11 wherein the SMF (60) initiates a transparent Network Access Stratum, NAS, update towards RAN (30) to amend Uu-level QoS flows treatment between RAN (30) and ProSe UE-to-Network Relay (20) or to change PC5-level cap on link transmission based on new ProSe configuration and policy parameters or Alternative QoS profile over PC5.

13. The method of claim 12 wherein on ProSe AF (90) request, UE (10) or ProSe UE to network Relay (20) receives a User configuration update from PCF (80) to notify new ProSe configuration and policy parameters.

14. The method of claim 13 wherein either:
ProSe UE to network Relay (20) establishes a new PDU session or modifies an existing PDU session for relaying; or
PCF (80) initiates a PDU session modification.

15. Apparatus arranged to perform the method of any preceding claim.

Intellectual Property Office

Application No: GB2106639.4 **Examiner:** Usman Asghar

Claims searched: 1 (option a) and 2-15 (in part) **Date of search:** 18 October 2021

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-7, 15	US 2019/281491 A1 (QUALCOMM) see fig. 7 and pars. [0109-0115]
X	1-3, 7, 15	US 2018/279319 A1 (NOKIA) see pars. [0030-0033]
X	1, 2, 7, 15	EP 3328124 A1 (HUAWEI) see fig. 3 and pars. [0094-0095]
X	1-3, 7, 15	WO 2017/026760 A1 (SAMSUNG) see fig. 20 and pars. [0217-0220]
X	1-3, 7, 15	WO 2020/088815 A1 (HUAWEI) see fig. 4
X	1-2, 7, 15	WO 2020/060332 A1 (LG) see fig. 13
X,E	1, 15	EP 3900279 A1 (LENOVO) see fig. 8 and pars. [0076-0084]
X,E	1-3, 7, 15	WO 2020/102621 A1 (IDAC) see fig. 3 and pars. [0085-0086]
X,E	1-3, 7, 15	WO 2021/183920 A1 (QUALCOMM) see fig. 12
X,E	1-3, 7, 15	WO 2021/183907 A1 (QUALCOMM) see fig. 5

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of	P	Document published on or after the declared priority date but before the filing date of this invention.

	same category.		
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X :

Worldwide search of patent documents classified in the following areas of the IPC

H04L; H04W

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
H04W	0088/04	01/01/2009
H04W	0028/02	01/01/2009
H04W	0028/24	01/01/2009
H04W	0076/23	01/01/2018
H04W	0004/40	01/01/2018