[0006] In some ~~embodiments~~examples, the message is a reject message that includes a cause of a rejection and a transaction identifier, the reject message indicates that the identifier is rejected by the network device for communication with the first communication device, and the method further comprises: receiving, from the first communication device and in response to the sending, a second message that includes a subscription concealed identifier (SUCI). In some embodiments, the message is an identity request message that includes a transaction identifier, and the method further comprises: receiving, from the first communication device and in response to the sending, a second message that includes a subscription concealed identifier (SUCI). In some embodiments, the second communication device is authorized to act as a relay between the first communication device and a communication network that includes the network device. In some embodiments, the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID). In some embodiments, the network device includes a remote access and mobility management function (AMF) device.

[0007] In a first aspect, ~~A~~ a wireless communication method (a second wireless communication method) is provided in the present disclosure, comprising ~~includes~~ receiving, by a first network device from a second network device, a first request message that includes an identifier associated with a first communication device; transmitting, by the first network device to a third network device, a second request message that includes the identifier; and receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

[0008] In some ~~embodiment~~example, the third network device is determined by the first network device based on the identifier. In some embodiment, after the receiving and prior to the transmitting, the method further comprises: transmitting, by the first network device, a third request to the third network device, wherein the third request includes the identifier; and receiving, from the third network device, another identifier that identifies the third network device. In some embodiment, the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID) that includes a routing identifier or a routing indicator (RID), and wherein the relay key includes 5G PRUK. In some embodiment, the 5G PRUK ID includes a first part that includes the RID and a prose temporary user equipment identifier (P-TID), and a second part that includes a home network identifier, and the first part precedes the second part.

[0009] In some ~~embodiment~~example, a second communication device is authorized to act as a relay between the first communication device and a communication network that includes any one or more of first network device, the second network device, and the third network device. In some ~~embodiment~~example, the first network device includes an authentication server function (AUSF) device, the second network device includes a remote access and mobility management function (AMF) device, and the third network device includes a prose anchor function (PAnF).

[0010] A third wireless communication method includes transmitting, by a second network device to a third network device, a request message that includes an identifier associated with a first communication device; and receiving, by the second network device and in response to the request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

[0011] In some ~~embodiments~~examples, the third network device is determined by the second network device based on the identifier. In some ~~embodiments~~examples, prior to the transmitting, the method further comprises: transmitting, by the second network device, a second request to the third network device, wherein the third request includes the identifier; and receiving, from a first network device, another identifier that identifies the third network device, wherein the first network device includes an authentication server function (AUSF) device. In some ~~embodiments~~examples, the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID) that includes a routing identifier or a routing indicator (RID), and wherein the relay key includes 5G PRUK. In some ~~embodiments~~examples, the 5G PRUK ID includes a first part that includes the RID and a prose temporary user equipment identifier (P-TID), and a second part that includes a home network identifier, and the first part precedes the second part.

[0012] In some ~~embodiments~~examples, a second communication device is authorized to act as a relay between the first communication device and a communication network that includes any one or more of the second network device, and the third network device. In some ~~embodiments~~examples, the second network device includes a remote access and mobility management function (AMF) device, and the third network device includes a prose anchor function (PAnF).

[0013] A fourth wireless communication method includes receiving, by a first network device from a second network device, a first request message that includes first identifier

associated with a first communication device and a second identifier; transmitting, by the first network device to a third network device, a second request message that includes the first

identifier; and receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device authenticated the first communication device.

[0014] In some ~~embodiments~~examples, the first identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID), and the second identifier includes a subscription concealed identifier (SUCI). In some ~~embodiments~~examples, a second communication device is authorized to act as a relay between the first communication device and a communication network that includes any one or more of the first network device, the second network device, and the third network device. In some ~~embodiments~~examples, the first network device includes an authentication server function (AUSF) device, the second network device includes a remote access and mobility management function (AMF) device, and the third network device includes a unified data management (UDM).

[0014a] In a second aspect, the present disclosure provides an apparatus for wireless communication comprising a processor, configured to implement a method comprising: receiving, by a first network device from a second network device, a first request message that includes an identifier associated with a first communication device; transmitting, by the first network device to a third network device, a second request message that includes the identifier; and receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

[0015] In yet another exemplary ~~aspect~~example, the above-described methods are embodied in the form of processor-executable code and stored in a non-transitory computer-readable storage medium. The code included in the computer readable storage medium when executed by a processor, causes the processor to implement the methods described in this patent document.

[0015a] In a third aspect, the present disclosure provides a non-transitory computer readable program storage medium having code stored thereon, the code, when executed by a processor, causing the processor to implement a method according to the first aspect.

[0016] In yet another exemplary ~~embodiment~~example, a device that is configured or operable to perform the above-described methods is disclosed.

[0017] The above and other aspects and their implementations are described in greater detail in the drawings, the descriptions, and the claims.

BRIEF DESCRIPTION OF THE DRAWING

[0018] FIG. 1 shows an architecture for 5G Core Network.

[0019] FIGS. 2A-2B show a security procedure over control plane.

[0020] FIGS. 3A-3B show an example flowchart of a security procedure where the Remote user equipment (UE) uses either subscription concealed identifier (SUCI) or 5G ProSe Relay User Key (PRUK) identifier (ID) without prose anchor function (PAnF) and authentication server function (AUSF) store the 5G PRUK.

[0021] FIGS. 4A-4B shows an example flowchart of a security procedure where the Remote UE uses either SUCI or 5G PRUK ID and AUSF generates K_{NR_Prose} and unified data management (UDM) stores 5G RPUK.

CLAIMS

What is claimed is:

1. A wireless communication method, comprising:

receiving, by a network device, a request message that includes an identifier associated with a first communication device;

determining, by the network device in response to the receiving, that the first communication device is authenticated based on a local policy of the network device; and

sending, by the network device in response to the determining, a message to a second communication device to relay to the first communication device,

wherein the message indicates that the identifier is rejected by the network device for communication with the first communication device, or

wherein the message indicates that the first communication device is triggered to send another identifier.

2. The method of claim 1,

wherein the message is a reject message that includes a cause of a rejection and a transaction identifier,

wherein the reject message indicates that the identifier is rejected by the network device for communication with the first communication device, and

wherein the method further comprises:

receiving, from the first communication device and in response to the sending, a second message that includes a subscription concealed identifier (SUCI).

3. The method of claim 1,

wherein the message is an identity request message that includes a transaction identifier, and

wherein the method further comprises:

~~receiving, from the first communication device and in response to the sending, a second message that includes a subscription concealed identifier (SUCI).~~

~~4. The method of claim 1, wherein the second communication device is authorized to act as a relay between the first communication device and a communication network that includes the network device.~~

~~5. The method of any one of claims 1 to 4, wherein the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID).~~

~~6. The method of any one of claims 1 to 4, wherein the network device includes a remote access and mobility management function (AMF) device.~~

~~7.~~1. A wireless communication method, comprising:

receiving, by a first network device from a second network device, a first request message that includes an identifier associated with a first communication device;

transmitting, by the first network device to a third network device, a second request message that includes the identifier; and

receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

~~8.~~2. The method of claim ~~7~~1, wherein the third network device is ~~determined~~ selected by the first network device based on the identifier.

~~9. The method of claim 7, wherein after the receiving and prior to the transmitting, the method further comprises:~~

~~transmitting, by the first network device, a third request to the third network device, wherein the third request includes the identifier; and~~

~~receiving, from the third network device, another identifier that identifies the third network device.~~

~~10.~~3. The method of claim ~~7~~1, wherein the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID) that includes a routing identifier or a routing indicator (RID), and wherein the relay key includes 5G PRUK.

~~11.~~4. The method of claim ~~10~~3,

wherein the 5G PRUK ID includes a first part that includes the RID and a prose temporary user equipment identifier (P-TID), and a second part that includes a home network identifier~~, and~~

~~wherein the first part precedes the second part~~.

~~12.~~5. The method of claim ~~7~~1, wherein the first network device verifies whether a second communication device is authorized to provide a UE-to-network relay service to ~~act as a relay between~~ the first communication device ~~and a communication network that includes any one or more of first network device, the second network device, and the third network device~~.

~~13.~~6. The method of any one of claims ~~7~~1 to ~~12~~5,

wherein the first network device includes an authentication server function (AUSF) device,

wherein the second network device includes a remote access and mobility management function (AMF) device, and

wherein the third network device includes a prose anchor function (PAnF).

7. An apparatus for wireless communication comprising a processor, configured to implement a method comprising:

receiving, by a first network device from a second network device, a first request message that includes an identifier associated with a first communication device;

transmitting, by the first network device to a third network device, a second request message that includes the identifier; and

receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

8. The apparatus of claim 7, wherein the third network device is selected by the first network device based on the identifier.

9. The apparatus of claim 7, wherein the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID) that includes a routing identifier or a routing indicator (RID), and wherein the relay key includes 5G PRUK.

10. The apparatus of claim 9, wherein the 5G PRUK ID includes a first part that includes the RID and a prose temporary user equipment identifier (P-TID), and a second part that includes a home network identifier.

11. The apparatus of claim 7, wherein the first network device verifies whether a second communication device is authorized to provide a UE-to-network relay service to the first communication device.

12. The apparatus of any one of claims 7 to 11,

wherein the first network device includes an authentication server function (AUSF) device,

wherein the second network device includes a remote access and mobility management function (AMF) device, and

wherein the third network device includes a prose anchor function (PAnF).

14. A wireless communication method, comprising:

transmitting, by a second network device to a third network device, a request message that includes an identifier associated with a first communication device; and

receiving, by the second network device and in response to the request message, a response message from the third network device, wherein the response message indicates whether the third network device identifies a relay key using the identifier.

15. The method of claim 14, wherein the third network device is determined by the second network device based on the identifier.

16. The method of claim 14, wherein prior to the transmitting, the method further comprises:

transmitting, by the second network device, a second request to the third network device, wherein the third request includes the identifier; and

receiving, from a first network device, another identifier that identifies the third network device, wherein the first network device includes an authentication server function (AUSF) device.

17. The method of claim 14, wherein the identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID) that includes a routing identifier or a routing indicator (RID), and wherein the relay key includes 5G PRUK.

18. The method of claim 17,

wherein the 5G PRUK ID includes a first part that includes the RID and a prose temporary user equipment identifier (P-TID), and a second part that includes a home network identifier, and

wherein the first part precedes the second part.

19. The method of claim 14, wherein a second communication device is authorized to act as a relay between the first communication device and a communication network that includes any one or more of the second network device, and the third network device.

20. The method of any one of claims 14 to 19,

wherein the second network device includes a remote access and mobility management function (AMF) device, and

wherein the third network device includes a prose anchor function (PAnF).

21. A wireless communication method, comprising:

receiving, by a first network device from a second network device, a first request message that includes first identifier associated with a first communication device and a second identifier;

transmitting, by the first network device to a third network device, a second request message that includes the first identifier; and

receiving, by the first network device and in response to the second request message, a response message from the third network device, wherein the response message indicates whether the third network device authenticated the first communication device.

22. The method of claim 21,

wherein the first identifier includes a 5G ProSe Relay User Key (PRUK) identifier (ID), and

wherein the second identifier includes a subscription concealed identifier (SUCI).

23. The method of claim 21, wherein a second communication device is authorized to act as a relay between the first communication device and a communication network that includes any one or more of the first network device, the second network device, and the third network device.

~~24. The method of any one of claims 21 to 23,~~

~~wherein the first network device includes an authentication server function (AUSF) device,~~

~~wherein the second network device includes a remote access and mobility management function (AMF) device, and~~

~~wherein the third network device includes a unified data management (UDM).~~

~~25. An apparatus for wireless communication comprising a processor, configured to implement a method recited in one or more of claims 1 to 24.~~

~~26.~~13. A non-transitory computer readable program storage medium having code stored thereon, the code, when executed by a processor, causing the processor to implement a method recited in one or more of claims 1 to ~~24~~6.