DISABLING N1 MODE UPON RECEIVING A 5GMM CAUSE VALUE MESSAGE

FIELD

[0001] Various example embodiments relate generally to wireless networks and, more particularly, to disabling N1 mode upon receiving a 5G mobility management (5GMM) cause value message.

BACKGROUND

[0002] In order to engage in 5G mobility management (5GMM), a user equipment (UE) registers with the network using non-access stratum (NAS) protocol by transmitting a registration request message. The network informs the UE whether network slices are available, and allows registration of the UE if there are network slices available. If no network slices are available, the network responds to a request to register by the UE with a registration reject message, in which case the UE may disable N1 mode capability. However, unless another radio access technology (RAT) is provided to the UE, the UE will continue to re-enable N1 mode capability, and send the registration request to the same network indefinitely, potentially causing an excess of resources to be utilized.

SUMMARY

[0002A] In one aspect, the present disclosure provides a method, comprising: transmitting, by a user equipment (UE), a registration request message to a network node according to a non-access stratum (NAS) protocol, wherein the network node comprises an access and mobility function (AMF), and wherein the registration request message includes a request for one or more single-network slice selection assistance informations (S-NSSAIs) in a first network, wherein the first network is a public land mobile network (PLMN) or a stand-alone public network (SNPN); receiving, by the UE, a registration reject message from the network node, the registration reject message including a 5G system mobility management (5GMM) cause value #62 “no network slices available” indication, wherein the registration reject message includes as a cause for no network slices available the cause “S-NSSAI not available in the current PLMN or SNPN”; disabling, by the UE, N1 mode capability for the first network based upon the receiving the registration reject message; storing, by the UE, an identity of the first network; and after storing,

exploiting the stored identity of the first network, by the UE, during a network selection process; adding, by the UE, the identity of the PLMN or SNPN to a list of PLMNs or SNPNs for which the UE disabled N1 mode capability; deleting, by the UE, the identity of the PLMN or SNPN from the list upon receiving a registration accept message containing a network slicing indication information element (IE) that includes a network slicing subscription change indication set to "network slicing subscription changed".

[0003] In an example of the present disclosure, a method includes transmitting, by a user equipment (UE), a registration request message to a network node according to a non-access stratum (NAS) protocol, the registration request message including a request for one or more single-network slice selection assistance informations (S-NSSAIs) in a first network. The UE receives a registration reject message from the network node, the registration reject message including a 5G system mobility management (5GMM) cause value #62 "no network slices available" indication. The UE disables N1 mode capability for the first network based upon the receiving the registration reject message, stores an identity of the first network, and, after storing, exploits the stored identity of the first network, by the UE, during a network selection process.

[0004] In an example of the method, the 5GMM cause value #62 "no network slices available" indication includes a cause "S-NSSAI not available due the failed or revoked network slice-specific authentication" indication.

[0005] In an example of the method, the first network is a public land mobile network (PLMN) or a stand-alone public network (SNPN).

[0006] In an example of the method, the 5GMM cause value #62 “no network slices available” indication includes a cause "S-NSSAI not available in the current PLMN or SNPN" indication.

[0007] In an example of the method, the method further includes adding, by the UE, the identity of the PLMN to a list of PLMNs for which the UE disabled N1 mode capability.

[0008] In an example of the method, the method further includes starting a timer after disabling N1 mode capability.

[0009] In an example of the method, the timer is a T_{NSU} timer.

[0010] In an example of the method, a value of the timer T_{NSU} does not exceed a background timer value.

[0011] In an example of the method, the method further includes discarding, by the UE, the PLMN for which the identity was added to the list during the network selection process.

[0012] In an example of the method, the method further includes deleting, by the UE, the identity of the PLMN from the list upon the UE being switched off.

[0013] In an example of the method, the method further includes deleting, by the UE, the identity of the PLMN from the list upon removal of a universal subscriber identity module from the UE.

[0014] In an example of the method, the method further includes deleting, by the UE, the identity of the PLMN from the list upon receiving a registration accept message.

[0015] In an example of the method, the method further includes deleting, by the UE, the identity of the PLMN from the list upon removing an S-NSSAI from a rejected NSSAI for a failed or revoked network slice-specific authentication and authorization (NSSAA) service.

[0016] In an example of the method, the method further includes adding, by the UE, the identity of the SNPN to a list of SNPNs for which the UE disabled N1 mode capability.

[0017] In an example of the method, the method further includes starting a timer after disabling N1 mode capability.

[0018] In an example of the method, the timer is a T_{NSU_SNPN} timer.

[0019] In an example of the method, a value of the timer T_{NSU_SNPN} does not exceed a background timer value.

[0020] In an example of the method, the method further includes discarding, by the UE, the SNPN for which the identity was added to the list during the network selection process.

[0021] In an example of the method, the method further includes deleting, by the UE, the identity of the SNPN from the list upon the UE being switched off.

[0022] In an example of the method, the method further includes deleting, by the UE, the identity of the SNPN from the list upon removal of a universal subscriber identity module from the UE.

[0023] In an example of the method, the method further includes deleting, by the UE, the identity of the SNPN from the list upon receiving a registration accept message.

[0024] In an example of the method, the method further includes deleting, by the UE, the identity of the SNPN from the list upon removing an S-NSSAI from a rejected NSSAI for a failed or revoked network slice-specific authentication and authorization (NSSAA) service.

[0025] In an example of the method, the network node comprises an access and mobility function (AMF).

[0026] In an example of the present disclosure, a user equipment includes at least one processor, and at least one memory storing instructions which, when executed by the at least one processor, cause the user equipment at least to perform at least to perform any of the foregoing methods.

[0027] In an example of the present disclosure, a processor-readable medium storing instructions which, when executed by at least one processor of an apparatus, cause the apparatus at least to perform any of the foregoing methods.

[0028] According to some examples, there is provided the subject matter of the independent claims. Some further examples are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] Some example embodiments will now be described with reference to the accompanying drawings.

[0030] FIG. 1 is a diagram of an example embodiment of wireless networking between a network system and a user equipment (UE), according to one illustrated aspect of the disclosure;

[0031] FIG. 2 is a diagram of example components of a network system, according to one illustrated aspect of the disclosure;

[0032] FIG. 3 is a diagram of an example embodiment of signals and operations among a UE and an AMF, according to one illustrated aspect of the disclosure; and

[0033] FIG. 4 is a diagram of an example embodiment of components of a UE or of a network apparatus, according to one illustrated aspect of the present disclosure.

WHAT IS CLAIMED IS:

1. A method, comprising:

transmitting, by a user equipment (UE), a registration request message to a network node according to a non-access stratum (NAS) protocol, wherein the network node comprises an access and mobility function (AMF), and wherein the registration request message includes a request for one or more single-network slice selection assistance informations (S-NSSAIs) in a first network, wherein the first network is a public land mobile network (PLMN) or a stand-alone public network (SNPN);

receiving, by the UE, a registration reject message from the network node, the registration reject message including a 5G system mobility management (5GMM) cause value #62 “no network slices available” indication, wherein the registration reject message includes as a cause for no network slices available the cause “S-NSSAI not available in the current PLMN or SNPN”;

disabling, by the UE, N1 mode capability for the first network based upon the receiving the registration reject message;

storing, by the UE, an identity of the first network; and

after storing, exploiting the stored identity of the first network, by the UE, during a network selection process;

adding, by the UE, the identity of the PLMN or SNPN to a list of PLMNs or SNPNs for which the UE disabled N1 mode capability;

deleting, by the UE, the identity of the PLMN or SNPN from the list upon receiving a registration accept message containing a network slicing indication information element (IE) that includes a network slicing subscription change indication set to “network slicing subscription changed”.

2. The method of claim 1, wherein exploiting, during a network selection process, comprises not considering, in automatic PLMN and/or SNPN selection, the first network as PLMN and/or SNPN selection candidate for NG-RAN access technology.

3. The method of claim 1, further comprising starting a timer after disabling N1 mode capability.

4. The method of claim 3, wherein the timer is a T_{NSU} timer.

5. The method of claim 4, wherein a value of the timer T_{NSU} does not exceed a background timer value.

6. The method as in any of claims 1 to 5, further comprising discarding, by the UE, the PLMN for which the identity was added to the list during the network selection process.

7. The method as in any of claims 1 to 5, further comprising deleting, by the UE, the identity of the PLMN from the list upon the UE being switched off.

8. The method as in any of claims 1 to 5, further comprising deleting, by the UE, the identity of the PLMN from the list upon removal of a universal subscriber identity module from the UE.

9. The method as in any of claims 1 to 5, further comprising deleting, by the UE, the identity of the PLMN from the list upon removing an S-NSSAI from a rejected NSSAI for a failed or revoked network slice-specific authentication and authorization (NSSAA) service.

10. The method of claim 3, wherein the timer is a T_{NSU_SNPN} timer.

11. The method of claim 10, wherein a value of the timer T_{NSU_SNPN} does not exceed a background timer value.

12. The method as in any of claims 3, 10 or 11, further comprising discarding, by the UE, the SNPN for which the identity was added to the list during the network selection process.

13. The method as in any of claims 3, 10 or 11, further comprising deleting, by the UE, the identity of the SNPN from the list upon the UE being switched off.

14. The method as in any of claims 3, 10 or 11, further comprising deleting, by the UE, the identity of the SNPN from the list upon removal of a universal subscriber identity module from the UE.

15. The method as in any of claims 3, 10 or 11, further comprising deleting, by the UE, the identity of the SNPN from the list upon removing an S-NSSAI from a rejected NSSAI for a failed or revoked network slice-specific authentication and authorization (NSSAA) service.

16. A user equipment (UE), comprising:

at least one processor; and

at least one memory storing instructions which, when executed by the at least one processor, cause the user equipment at least to perform a method as in any of claims 1-15.

17. A processor-readable medium storing instructions which, when executed by at least one processor of an apparatus, cause the apparatus at least to perform a method as in any one of claims 1-15.