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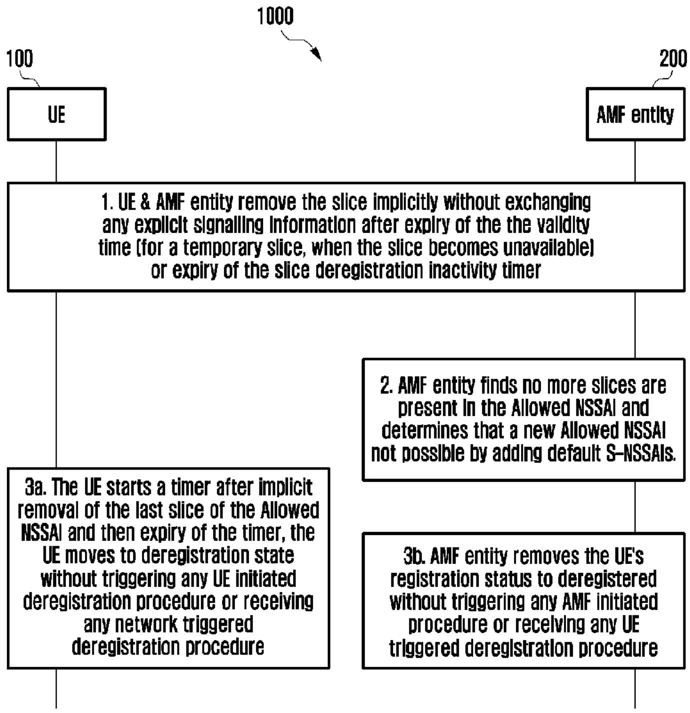

(57) Abstract: The disclosure relates to a 5G or 6G communication system for supporting a higher data transmission rate. Embodiments herein disclose methods for handling a deregistration procedure in a wireless network (1000) by an AMF entity (200). Based on the proposed methods, the network-initiated deregistration procedure is entirely skipped when only one temporary slice is present in the Allowed NSSAI and that is removed after the expiry of validity time. The proposed method can be used to reduce the signalling wastage and reduce the battery drainage at the UE and the AMF entity.

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Description

Title of Invention: HANDLING DEREGISTRATION PROCEDURE IN WIRELESS NETWORK

Technical Field

[1] Embodiments disclosed herein relate to wireless communication networks, and more particularly to managing network slicing in 3GPP.

Background Art

[2] 5G mobile communication technologies define broad frequency bands such that high transmission rates and new services are possible, and can be implemented not only in "Sub 6GHz" bands such as 3.5GHz, but also in "Above 6GHz" bands referred to as mmWave including 28GHz and 39GHz. In addition, it has been considered to implement 6G mobile communication technologies (referred to as Beyond 5G systems) in terahertz bands (for example, 95GHz to 3THz bands) in order to accomplish transmission rates fifty times faster than 5G mobile communication technologies and ultra-low latencies one-tenth of 5G mobile communication technologies.

[3] At the beginning of the development of 5G mobile communication technologies, in order to support services and to satisfy performance requirements in connection with enhanced Mobile BroadBand (eMBB), Ultra Reliable Low Latency Communications (URLLC), and massive Machine-Type Communications (mMTC), there has been ongoing standardization regarding beamforming and massive MIMO for mitigating radio-wave path loss and increasing radio-wave transmission distances in mmWave, supporting numerologies (for example, operating multiple subcarrier spacings) for efficiently utilizing mmWave resources and dynamic operation of slot formats, initial access technologies for supporting multi-beam transmission and broadbands, definition and operation of BWP (BandWidth Part), new channel coding methods such as a LDPC (Low Density Parity Check) code for large amount of data transmission and a polar code for highly reliable transmission of control information, L2 pre-processing, and network slicing for providing a dedicated network specialized to a specific service.

[4] Currently, there are ongoing discussions regarding improvement and performance enhancement of initial 5G mobile communication technologies in view of services to be supported by 5G mobile communication technologies, and there has been physical layer standardization regarding technologies such as V2X (Vehicle-to-everything) for aiding driving determination by autonomous vehicles based on information regarding positions and states of vehicles transmitted by the vehicles and for enhancing user convenience, NR-U (New Radio Unlicensed) aimed at system operations conforming to various regulation-related requirements in unlicensed bands, NR UE Power Saving,

Non-Terrestrial Network (NTN) which is UE-satellite direct communication for providing coverage in an area in which communication with terrestrial networks is unavailable, and positioning.

[5] Moreover, there has been ongoing standardization in air interface architecture/protocol regarding technologies such as Industrial Internet of Things (IIoT) for supporting new services through interworking and convergence with other industries, IAB (Integrated Access and Backhaul) for providing a node for network service area expansion by supporting a wireless backhaul link and an access link in an integrated manner, mobility enhancement including conditional handover and DAPS (Dual Active Protocol Stack) handover, and two-step random access for simplifying random access procedures (2-step RACH for NR). There also has been ongoing standardization in system architecture/service regarding a 5G baseline architecture (for example, service based architecture or service based interface) for combining Network Functions Virtualization (NFV) and Software-Defined Networking (SDN) technologies, and Mobile Edge Computing (MEC) for receiving services based on UE positions.

[6] As 5G mobile communication systems are commercialized, connected devices that have been exponentially increasing will be connected to communication networks, and it is accordingly expected that enhanced functions and performances of 5G mobile communication systems and integrated operations of connected devices will be necessary. To this end, new research is scheduled in connection with eXtended Reality (XR) for efficiently supporting AR (Augmented Reality), VR (Virtual Reality), MR (Mixed Reality) and the like, 5G performance improvement and complexity reduction by utilizing Artificial Intelligence (AI) and Machine Learning (ML), AI service support, metaverse service support, and drone communication.

[7] Furthermore, such development of 5G mobile communication systems will serve as a basis for developing not only new waveforms for providing coverage in terahertz bands of 6G mobile communication technologies, multi-antenna transmission technologies such as Full Dimensional MIMO (FD-MIMO), array antennas and large-scale antennas, metamaterial-based lenses and antennas for improving coverage of terahertz band signals, high-dimensional space multiplexing technology using OAM (Orbital Angular Momentum), and RIS (Reconfigurable Intelligent Surface), but also full-duplex technology for increasing frequency efficiency of 6G mobile communication technologies and improving system networks, AI-based communication technology for implementing system optimization by utilizing satellites and AI (Artificial Intelligence) from the design stage and internalizing end-to-end AI support functions, and next-generation distributed computing technology for implementing services at levels of complexity exceeding the limit of UE operation capability by utilizing ultra-high-performance communication and computing resources.

Disclosure of Invention

Technical Problem

[8] The principal object of the embodiments herein is to disclose methods, a UE and an AMF entity for managing slice removal in the network, where the UE and the AMF entity can handle the registration status implicitly on removal of the last slice from the Allowed NSSAI.

[9] Another object of the embodiments herein is to disclose that the AMF entity to remove the registration state for the UE and moves to a deregistered state implicitly without executing network-initiated deregistration procedure if the AMF entity removes the temporary slice after expiry of validity time or slice after expiry of a slice deregistration inactivity timer after finding that there is no Protocol Data Unit (PDU) session associated with the slice and there is no more default slice can be added.

[10] Another object of the embodiments herein is to disclose that the UE to remove the registration state and moves deregistered state implicitly without waiting for network-initiated deregistration procedure to receive if UE removes the temporary slice after expiry of validity time or slice after expiry of the slice deregistration inactivity timer after finding that there is no PDU session associated with the slice and there is no more slice UE wants to add by triggering a mobility registration update.

Solution to Problem

[11] Accordingly, the embodiments herein provide methods for handling a deregistration procedure in a wireless network. The method includes removing, by an AMF entity, a S-NSSAI from an Allowed NSSAI. Further, the method includes determining, by the AMF entity, that the S-NSSAI becomes unavailable, other S-NSSAIs are not present in an Allowed Network Slice Selection Assistance Information (NSSAI), and no default Single-Network Slice Selection Assistance Information (S-NSSAI) is provided in the Allowed NSSAI. Further, the method includes avoiding to initiate, by the AMF entity, a network-initiated deregistration procedure. Further, the method includes moving, by the AMF entity, a registration state for the UE implicitly to a RM-DEREGISTERED state implicitly.

[12] Accordingly, the embodiments herein provide methods for handling a deregistration procedure in a wireless network. The method includes determining, by a UE, that at least one S-NSSAI is not present in an Allowed NSSAI when the UE removes a slice. Further, the method includes determining, by the UE, that the UE does not receive a new Allowed NSSAI. Further, the method includes moving, by the UE, a deregistration state (i.e., registration state to a RM-DEREGISTERED state) without triggering a UE initiated deregistration procedure or receiving a network triggered deregistration procedure from an AMF entity implicitly.

[13] In an embodiment, the AMF entity moves the registration state for the UE to the RM-DEREGISTERED state based on an operator policy.

[14] In an embodiment, the AMF entity removes the S-NSSAI after a NSSAA re-authentication failure or based on expiry of a slice deregistration inactivity timer after finding that the UE does not have any PDU session associated with that S-NSSAI or the AMF entity removes the S-NSSAI after expiry of validity time for the slice when the slice is a temporary slice.

[15] In an embodiment, a behavior of the AMF entity for handling the registration status implicitly is applicable per access type (e.g., 3GPP access type, non-3GPP access type or the like) since the Allowed NSSAI and the registration status are maintained per access type.

[16] Accordingly, the embodiments herein provide an AMF entity including a slice managing controller coupled with a processor and a memory. The slice managing controller is configured to remove a S-NSSAI from an Allowed NSSAI. Further, the slice managing controller is configured to determine that the S-NSSAI becomes unavailable, other S-NSSAIs are not present in an Allowed Network Slice Selection Assistance Information (NSSAI), and no default S-NSSAI is provided in the allowed NSSAI. Further, the slice managing controller is configured to avoid to initiate a network-initiated deregistration procedure. Further, the slice managing controller is configured to move a registration state for the UE to a RM-DEREGISTERED state implicitly.

[17] Accordingly, the embodiments herein provide a UE including a slice managing controller coupled with a processor and a memory. The slice managing controller is configured to determine that at least one S-NSSAI does not present in an Allowed NSSAI when the UE removes a slice. Further, the slice managing controller is configured to determine that the UE does not receive a new Allowed NSSAI. Further, the slice managing controller is configured to move a deregistration state without triggering a UE initiated deregistration procedure or receiving a network triggered deregistration procedure from an AMF entity implicitly.

[18] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating at least one embodiment and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

Advantageous Effects of Invention

[19] According to an embodiment of present disclosure, the notification management client and the notification management server can efficiently perform a communication.

Brief Description of Drawings

[20] The embodiments disclosed herein are illustrated in the accompanying drawings, throughout which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[21] FIG. 1 illustrates a process of an AMF entity triggering a network-initiated deregistration procedure in a wireless network;

[22] FIG. 2 illustrates a procedure, wherein both the UE and the AMF entity implicitly remove the registration status in the wireless network, according to embodiments as disclosed herein;

[23] FIG. 3 illustrates various hardware components of the UE, according to the embodiments as disclosed herein;

[24] FIG. 4 illustrates various hardware components of the AMF entity, according to the embodiments as disclosed herein;

[25] FIG. 5 illustrates a flow chart illustrating a method, implemented by the UE, for handling a deregistration procedure in a wireless network, according to the embodiments as disclosed herein; and

[26] FIG. 6 illustrates a flow chart illustrating a method, implemented by the AMF entity, for handling a deregistration procedure in the wireless network, according to the embodiments as disclosed herein.

Mode for the Invention

[27] 3GPP Release 15 introduced the concept of network slicing, which allows service providers to deploy an exclusive network for a customer (for example, mobile virtual network operator (MVNO), Enterprise) or service (for example, Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low Latency Communications (URLLC), Massive Machine Type Communications (mMTC)), comprising of multiple network functions designed specifically to support the specialized service. A set of such Network Functions is called "Network Slice", identified using S-NSSAI (Single Network Slice Selection Assistance Information) inside a 3GPP network.

[28] When an operator deploys one slice (including slice instances) in the 3GPP network, it will follow the procedures, information and configuration as described in TS 23.501, TS 23.502, TS 23.503.

[29] An example procedure is listed below:

[30] 1. AN selection and AMF selection with help of NSSF during registration,

[31] 2. Session Management Function (SMF), Policy Control function (PCF), user plane function (UPF) selection during protocol data unit (PDU) session establishment,

[32] 3. Network Repository Function (NRF) registration & discovery for the supported slices, and

[33] 4. Network Slice Simultaneous Registration Group (NSSRG) configuration, User Equipment Routing Selection Policy (URSP) configuration, Configured S-NSSAIs.

[34] These configurations and procedures are executed before the UE (100) really gets the required services for the specific slices. These slices can be permanently or temporarily deployed by the operator.

[35] FIG. 1 illustrates a process of an AMF entity (200) triggering a network-initiated deregistration procedure in a wireless network.

[36] To enhance the procedure for seamless handling of temporary slice management, in the 3GPP Rel 18 TR 23.700-41 studied this temporary slice aspect and agreed to a solution in which the network will provide the temporary slice information such as time and location and the UE (100) will behave as such that during this time and location the services of temporary slice won't be available. This concept of solution is agreed and added to TS 23.501 and TS 23.502 as well.

[37] Similarly, the UE(s) (100) may register a particular slice but does not use it by triggering a PDU session. To address this, TR 23.700-41 studied the slice usage control and solution was agreed that both the UE (100) and the AMF entity (200) will remove the slice implicitly after waiting slice deregistration inactivity timers and does not see any PDU session being established using the slice within that time period.

[38] In all these cases, both the UE (100) and the AMF entity (200) remove the slice implicitly without exchanging any signalling explicitly with each other. This concept of solution is agreed and added to TS 23.501 and TS 23.502 as well.

[39] The temporary slices, which the operator can deploy for a certain duration at a particular location to serve events (like Olympics, sport tournaments, etc.) and then will be terminated after the event. It may also happen that some slices will not be available for certain duration. 3GPP Rel 18 TR 23.700-41 provides a solution in which the network will provide the temporary slice information (such as time and location) and the UE (100) will behave as such that during this it can avail the services only when it matches the time and location criteria given by the network. As per TS 23.501, both the UE (100) and the AMF entity (200) will remove the slice implicitly without exchanging any explicit signalling information, if the slice becomes unavailable during a particular time period (validity time). But if there is only one slice present in the Allowed NSSAI for the UE (100), after slice removal, the AMF entity (200) determines a new Allowed NSSAI including some default slice. If no default slice could be added, the AMF entity (200) executes a network-initiated deregistration procedure

(as depicted in FIG. 1) for the UE (100) which is a waste of radio and network resources as the UE (100) itself has already removed the slice.

[40] As part of slice usage control, as per TS 23.501 both the UE (100) and the AMF entity (200) will remove the slice implicitly, if there is no PDU session and the slice deregistration inactivity timer expires. But if there is only one slice present in the Allowed NSSAI for the UE (100), then after slice removal, the AMF entity (200) determines a new Allowed NSSAI including some default slice. If no default slice could be added, then the AMF entity (200) executes a network-initiated deregistration procedure (as depicted in FIG. 1) for the UE (100) which is a waste of radio and network resources as the UE itself has already removed the slice.

[41] If the last slice from Allowed NSSAI is removed as part of NSSAA re-authentication failure, as per TS 23.501, the AMF entity (200) determines a new Allowed NSSAI including a default slice. If no default slice could be added, the AMF entity (200) executes the network-initiated deregistration procedure for the UE (100) which is a waste of radio and network resources as the UE (100) itself knows that NSSAA has been failed and can be removed on its own.

[42] Thus, when both the UE (100) and the AMF entity (200) remove the slice implicitly. When there is no more slice present in the Allowed NSSAI, sending explicit signalling through network deregistration procedure can be a waste of radio and network resources.

[43] At step 1, the UE (100) and the AMF entity (200) remove the slice implicitly without exchanging any explicit signalling information after expiry of the validity time (for a temporary slice, when the slice becomes unavailable) or expiry of the slice deregistration inactivity timer. At step 2, the AMF entity (200) finds that no more slices are present in the Allowed NSSAI and determines that a new Allowed NSSAI is not possible by adding default S-NSSAIs. At step 3, the network-initiated deregistration procedure is performed between the UE (100) and the AMF entity (200).

[44] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein can be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[45] For the purposes of interpreting this specification, the definitions (as defined herein) will apply and whenever appropriate the terms used in singular will also include the

plural and vice versa. It is to be understood that the terminology used herein is for the purposes of describing particular embodiments only and is not intended to be limiting. The terms "comprising", "having" and "including" are to be construed as open-ended terms unless otherwise noted.

[46] The words/phrases "exemplary", "example", "illustration", "in an instance", "and the like", "and so on", "etc.", "etcetera", "e.g.," , "i.e.," are merely used herein to mean "serving as an example, instance, or illustration." Any embodiment or implementation of the present subject matter described herein using the words/phrases "exemplary", "example", "illustration", "in an instance", "and the like", "and so on", "etc.", "etcetera", "e.g.," , "i.e.," is not necessarily to be construed as preferred or advantageous over other embodiments.

[47] Embodiments herein may be described and illustrated in terms of blocks which carry out a described function or functions. These blocks, which may be referred to herein as managers, units, modules, hardware components or the like, are physically implemented by analog and/or digital circuits such as logic gates, integrated circuits, microprocessors, microcontrollers, memory circuits, passive electronic components, active electronic components, optical components, hardwired circuits and the like, and may optionally be driven by a firmware. The circuits may, for example, be embodied in one or more semiconductor chips, or on substrate supports such as printed circuit boards and the like. The circuits constituting a block may be implemented by dedicated hardware, or by a processor (e.g., one or more programmed microprocessors and associated circuitry), or by a combination of dedicated hardware to perform some functions of the block and a processor to perform other functions of the block. Each block of the embodiments may be physically separated into two or more interacting and discrete blocks without departing from the scope of the disclosure. Likewise, the blocks of the embodiments may be physically combined into more complex blocks without departing from the scope of the disclosure.

[48] It should be noted that elements in the drawings are illustrated for the purposes of this description and ease of understanding and may not have necessarily been drawn to scale. For example, the flowcharts/sequence diagrams illustrate the method in terms of the steps required for understanding of aspects of the embodiments as disclosed herein. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the drawings by conventional symbols, and the drawings may show only those specific details that are pertinent to understanding the present embodiments so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein. Furthermore, in terms of the system, one or more components/modules which comprise the system may have been represented in the drawings by conventional

symbols, and the drawings may show only those specific details that are pertinent to understanding the present embodiments so as not to obscure the drawings with details that will be readily apparent to those of ordinary skill in the art having the benefit of the description herein.

[49] The accompanying drawings are used to help easily understand various technical features and it should be understood that the embodiments presented herein are not limited by the accompanying drawings. As such, the present disclosure should be construed to extend to any modifications, equivalents, and substitutes in addition to those which are particularly set out in the accompanying drawings and the corresponding description. Usage of words such as first, second, third etc., to describe components/elements/steps is for the purposes of this description and should not be construed as sequential ordering/placement/occurrence unless specified otherwise.

[50] The embodiments herein achieve methods for handling a deregistration procedure in a wireless network. The method includes removing, by an AMF entity, a S-NSSAI from an Allowed NSSAI. Further, the method includes determining, by the AMF entity, that the S-NSSAI becomes unavailable, other S-NSSAIs are not present in the allowed NSSAI, and no default S-NSSAI is provided in the allowed NSSAI. Further, the method includes avoiding to initiate, by the AMF entity, a network-initiated deregistration procedure. Further, the method includes moving, by the AMF entity, a registration state for the UE to a RM-DEREGISTERED state implicitly.

[51] The methods can be used for managing implicit slice removal in the network, wherein the UE and the AMF entity can handle the registration status implicitly on removal of the last slice from the Allowed NSSAI. Based on the proposed methods, the network-initiated deregistration procedure is entirely skipped when only one slice is present in the Allowed NSSAI and that is removed after the expiry of validity time. The proposed method can be used to reduce the signalling wastage and reduce the battery drainage at the UE and the AMF entity.

[52] In an embodiment, if the UE supporting temporary available network slices only got one S-NSSAI in the Allowed NSSAI with a validity time that is about to expire, and if the UE does not receive an updated Allowed NSSAI from the AMF entity, then the UE shall enter RM-DEREGISTERED state.

[53] In an embodiment, if there is no S-NSSAI present in the Allowed NSSAI or Partially Allowed NSSAI after the AMF entity removes the S-NSSAI locally and the AMF entity cannot determine a new Allowed NSSAI then based on an operator policy, the AMF entity shall either enter RM-DEREGISTERED state for the UE or execute the Network-initiated Deregistration procedure described in clause 4.2.2.3.3 of TS 23.502. The operator policy means either the AMF entity can use explicit network-initiated deregistration procedure or implicit deregistration procedure.

[54] The following abbreviations and definitions have been referred to herein in the patent disclosure:

[55] AMF: Access and Mobility Management Function.

[56] UE: User Equipment.

[57] 3GPP: 3rd Generation Partnership Project.

[58] NSSAI: Network Slice Selection Assistance Information.

[59] S-NSSAI: Single - Network Slice Selection Assistance Information.

[60] PLMN: Public Land Mobile Network.

[61] TA: Tracking Area.

[62] RA: Registration Area.

[63] Referring now to the drawings, and more particularly to FIG. 2 through FIG. 6, where similar reference characters denote corresponding features consistently throughout the figures, there are shown at least one embodiment.

[64] FIG. 2 illustrates a procedure, wherein both a UE (100) and an AMF entity (200) implicitly update registration status for the UE (100) in a wireless network (1000), according to embodiments as disclosed herein. The UE (100) can be, for example, but not limited to a laptop, a smart phone, a desktop computer, a notebook, a Device-to-Device (D2D) device, a vehicle to everything (V2X) device, a foldable phone, a smart TV, a tablet, an immersive device, and an internet of things (IoT) device. The wireless network (1000) can be, for example, but not limited to a fourth generation (4G) network, a fifth generation (5G) network, a 6G network, an Open Radio Access Network (ORAN) or the like.

[65] In an embodiment, when the AMF entity (200) removes the slice implicitly after expiry of validity time for a temporary slice, when the slice becomes unavailable and no more slices are present in an Allowed NSSAI and a new Allowed NSSAI is not possible by adding default S-NSSAIs, then the AMF entity (200) does not initiate a network-initiated deregistration procedure. The AMF entity (200) removes the registration status for the UE (100) implicitly.

[66] In an embodiment, when the AMF entity (200) removes the slice implicitly (after expiry of the slice deregistration inactivity timer) and no more slices are present in the Allowed NSSAI and the new Allowed NSSAI is not possible by adding the default S-NSSAIs then, the AMF entity (200) does not initiate the network-initiated deregistration procedure. The AMF entity (200) removes the registration status for the UE (100) implicitly.

[67] In an embodiment, when the AMF entity (200) removes the slice after NSSAA re-authentication failure, and no more slices are present in the Allowed NSSAI and the new Allowed NSSAI is not possible by adding the default S-NSSAIs, then the AMF entity (200) does not initiate the network-initiated deregistration procedure. The AMF

entity (200) removes the registration status for the UE (100) implicitly.

[68] In an embodiment, when the UE (100) removes the slice implicitly after expiry of validity time for the slice (when the slice becomes unavailable) and no more S-NSSAIs are present in the Allowed NSSAI, then the UE (100) optionally waits for a pre-defined time period. During this time period, if the UE (100) receives a new Allowed NSSAI, from the AMF entity (200), then UE (100) updates the Allowed NSSAI. After expiry of this new time period, if the UE (100) does not receive any new Allowed NSSAI, then the UE (100) implicitly treats it as deregistered and moved to the deregistered state. In an embodiment, the UE (100) can directly move to deregistered state after removing the slice even without waiting pre-defined timer period.

[69] In an embodiment, when the UE (100) removes the slice implicitly after expiry of slice deregistration inactivity timer and no more S-NSSAIs are present in the Allowed NSSAI, then the UE (100) optionally waits for the pre-defined time period. During this time period, if the UE (100) receives the new Allowed NSSAI, from the AMF entity (200), then the UE (100) updates the Allowed NSSAI. After expiry of this new time period, if the UE (100) does not receive any new Allowed NSSAI, then the UE (100) implicitly treats as deregistered and moved to the deregistered state. In an embodiment, the UE (100) can directly move to deregistered state after removing the slice even without waiting pre-defined timer period.

[70] In an embodiment, when the UE (100) removes the slice after NSSAA re-authentication failure and no more slices are present in the Allowed NSSAI, then the UE (100) optionally waits for the pre-defined time period. During this time period, if the UE (100) receives the new Allowed NSSAI, from the AMF entity (200), then the UE (100) updates the Allowed NSSAI. After expiry of this new time period, if the UE (100) does not receive any new Allowed NSSAI, then the UE (100) implicitly treats as deregistered and moved to deregistered state. In an embodiment, UE can directly move to deregistered state after removing the slice even without waiting pre-defined timer period.

[71] In an embodiment, the new timer (for which the UE (100) waits to receive any new Allowed NSSAI) and after expiry of the timer, the UE (100) goes to a deregistered state can be provided by AMF entity (200) or can be UE implementation specific.

[72] In an embodiment, the behaviour of the UE (100) and the AMF entity (200) for handling the registration status implicitly is applicable per Access Type (e.g., 3GPP access type, non-3GPP access type or the like) as both the Allowed NSSAI and registration is maintained per access type.

[73] At step 1, the UE (100) and the AMF entity (200) remove the slice implicitly without exchanging any explicit signalling information after expiry of the validity time (for a temporary slice, when the slice becomes unavailable) or expiry of the slice dereg-

istration inactivity timer. At step 2, the AMF entity (200) finds that no more slices are present in the Allowed NSSAI and determines that the new Allowed NSSAI is not possible by adding the default S-NSSAIs. At step 3a, the UE (100) starts a timer after implicit removal of the last slice of the Allowed NSSAI and then expiry of the timer, the UE (100) moves to the deregistration state without triggering any UE initiated deregistration procedure or receiving any network triggered deregistration procedure. At step 3b, the AMF entity (200) removes the UE's registration status to deregistered without triggering any AMF entity (200) initiated procedure or receiving any UE triggered deregistration procedure.

[74] For example, consider, the allowed NSSAI is having just one slice (i.e. S-NSSAI-1). The S-NSSAI-1 is related to temporary slice which is not available after 10 am and this validity time information is already provided by the AMF entity (200) to the UE (100). At 10 am, both the AMF entity (200) and UE (100) will remove the S-NSSAI-1 from the Allowed NSSAI. Now, the Allowed NSSAI is empty. If the UE (100) does not have any default S-NSSAI in the subscription and the AMF entity (200) cannot add any S-NSSAI to the Allowed NSSAI then it will implicitly move the UE's registration status to deregistered state without triggering any deregistration procedure to the UE (100). At 10 am, after the UE (100) remove the S-NSSAI-1 from the allowed NSSAI, if the UE (100) does not receive any Allowed NSSAI from the AMF entity (200), then the UE (100) will implicitly move the UE's registration status to deregistered state.

[75] In another example, consider, the allowed NSSAI is having just one slice (i.e. S-NSSAI-1). There is slice deregistration inactivity timer associated with the S-NSSAI-1 and this is already provided by the AMF entity (200) to the UE (100). This Slice deregistration inactivity timer is running at both the UE (100) and the AMF entity (200). The UE (100) didn't trigger any PDU session associated with S-NSSAI-1 within that time and after timer expiry, both UE (100) and the AMF entity (200) will remove the S-NSSAI-1 from the Allowed NSSAI. Now, the allowed NSSAI is empty. If the UE (100) does not have any default S-NSSAI in the subscription and the AMF entity (200) cannot add any S-NSSAI to the Allowed NSSAI then it will implicitly move the UE's registration status to deregistered state without triggering any deregistration procedure to the UE (100). After the UE (100) remove the S-NSSAI-1 from Allowed NSSAI, if the UE (100) does not receive any Allowed NSSAI from the AMF entity (200), then the UE (100) will implicitly move the UE's registration status to the deregistered state.

[76] In another example, consider, the allowed NSSAI is having just one slice, i.e. S-NSSAI-1. The network triggered Slice re-authentication for the S-NSSAI-1 and re-authentication fails. As per existing procedure the S-NSSAI-1 is removed from Allowed NSSAI and if some default S-NSSAI is present for the UE (100), the AMF entity (200) adds the default S-NSSAI to Allowed NSSAI and S-NSSAI-1 is added to

Rejected S-NSSAI by the AMF entity (200) and sent to the UE (100) using the UE configuration update procedure. But if there is no default S-NSSAI present for the UE (100), then Allowed NSSAI will be empty. Hence, the AMF entity (200) cannot add any S-NSSAI to the Allowed NSSAI then it will implicitly move the UE's registration status to deregistered state without triggering any deregistration procedure to the UE (100). The UE (100) already knows that slice re-authentication fails and hence it can remove the S-NSSAI-1 from Allowed NSSAI. Then, the Allowed NSSAI can become empty. If the UE (100) does not receive any Allowed NSSAI from the AMF entity (200), then the UE (100) will implicitly move the UE's registration status to deregistered state.

[77] The Allowed NSSAI are maintained per access type, i.e. there will be different Allowed NSSAI content for each access type. Hence, the deregistration will be applicable for the corresponding access type for which Allowed NSSAI has become empty.

[78] FIG. 3 illustrates various hardware components of the UE (100), according to the embodiments as disclosed herein. In an embodiment, the UE (100) includes a processor (110), a communicator (120), a memory (130) and a slice managing controller (140). The processor (110) is coupled with the communicator (120), the memory (130) and the slice managing controller (140).

[79] The slice managing controller (140) may determine that the S-NSSAI does not present in the Allowed NSSAI when the UE (100) removes the slice. Further, the slice managing controller (140) may determine that the UE (100) does not receive the new Allowed NSSAI. Further, the slice managing controller (140) may move the deregistration state without triggering the UE initiated deregistration procedure or receiving the network triggered deregistration procedure from the AMF entity (200) implicitly.

[80] The slice managing controller (140) may be implemented by analog and/or digital circuits such as logic gates, integrated circuits, microprocessors, microcontrollers, memory circuits, passive electronic components, active electronic components, optical components, hardwired circuits and the like, and may optionally be driven by firmware.

[81] The processor (110) may include one or a plurality of processors. The one or the plurality of processors may be a general-purpose processor, such as a central processing unit (CPU), an application processor (AP), or the like, a graphics-only processing unit such as a graphics processing unit (GPU), a visual processing unit (VPU), and/or an AI-dedicated processor such as a neural processing unit (NPU). The processor (110) may include multiple cores and is configured to execute the instructions stored in the memory (130).

[82] Further, the processor (110) may be configured to execute instructions stored in the

memory (130) and to perform various processes. The communicator (120) may be configured for communicating internally between internal hardware components and with external devices via one or more networks. The memory (130) may also store instructions to be executed by the processor (110). The memory (130) may include non-volatile storage elements. Examples of such non-volatile storage elements may include magnetic hard discs, optical discs, floppy discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable (EEPROM) memories. In addition, the memory (130) may, in some examples, be considered a non-transitory storage medium. The term "non-transitory" may indicate that the storage medium is not embodied in a carrier wave or a propagated signal. However, the term "non-transitory" should not be interpreted that the memory (130) is non-movable. In certain examples, a non-transitory storage medium may store data that can, over time, change (e.g., in Random Access Memory (RAM) or cache).

[83] Although the FIG. 3 illustrates various hardware components of the UE (100) but it is to be understood that other embodiments are not limited thereon. In other embodiments, the UE (100) may include less or more number of components. Further, the labels or names of the components are used only for illustrative purposes and does not limit the scope of the invention. One or more components can be combined together to perform the same or substantially similar function in the UE (100).

[84] FIG. 4 illustrates various hardware components of the AMF entity (200), according to the embodiments as disclosed herein. In an embodiment, the AMF entity (200) includes a processor (210), a communicator (220), a memory (230) and a slice managing controller (240). The processor (210) is coupled with the communicator (220), the memory (230) and the slice managing controller (240).

[85] The slice managing controller (240) may remove the S-NSSAI from the Allowed NSSAI. Further, the slice managing controller (240) may determine that the S-NSSAI becomes unavailable, the other S-NSSAIs are not present in the Allowed NSSAI, and no default S-NSSAI is provided in the Allowed NSSAI. Further, the slice managing controller (240) may avoid to initiate the network-initiated deregistration procedure. Further, the slice managing controller (240) may move the registration state for the UE (100) to the RM-DEREGISTERED state implicitly.

[86] The slice managing controller (240) may be implemented by analog and/or digital circuits such as logic gates, integrated circuits, microprocessors, microcontrollers, memory circuits, passive electronic components, active electronic components, optical components, hardwired circuits and the like, and may optionally be driven by firmware.

[87] The processor (210) may include one or a plurality of processors. The one or the plurality of processors may be a general-purpose processor, such as a central

processing unit (CPU), an application processor (AP), or the like, a graphics-only processing unit such as a graphics processing unit (GPU), a visual processing unit (VPU), and/or an AI-dedicated processor such as a neural processing unit (NPU). The processor (210) may include multiple cores and is configured to execute the instructions stored in the memory (230).

[88] Further, the processor (210) may be configured to execute instructions stored in the memory (230) and to perform various processes. The communicator (220) may be configured for communicating internally between internal hardware components and with external devices via one or more networks. The memory (230) may also store instructions to be executed by the processor (210). The memory (230) may include non-volatile storage elements. Examples of such non-volatile storage elements may include magnetic hard discs, optical discs, floppy discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable (EEPROM) memories. In addition, the memory (230) may, in some examples, be considered a non-transitory storage medium. The term "non-transitory" may indicate that the storage medium is not embodied in a carrier wave or a propagated signal. However, the term "non-transitory" should not be interpreted that the memory (230) is non-movable. In certain examples, a non-transitory storage medium may store data that can, over time, change (e.g., in Random Access Memory (RAM) or cache).

[89] Although the FIG. 4 illustrates various hardware components of the AMF entity (200) but it is to be understood that other embodiments are not limited thereon. In other embodiments, the AMF entity (200) may include less or more number of components. Further, the labels or names of the components are used only for illustrative purposes and does not limit the scope of the invention. One or more components can be combined together to perform the same or substantially similar function in the AMF entity (200).

[90] FIG. 5 illustrates a flow chart (S500) illustrating a method, implemented by the UE (100), for handling the deregistration procedure in the wireless network (1000), according to the embodiments as disclosed herein. The operations (S502-S506) are handled by the slice managing controller (140).

[91] At S502, the method includes determining that the S-NSSAI is not present in the Allowed NSSAI when the UE (100) removes the slice. At S504, the method includes determining that the UE (100) does not receive the new Allowed NSSAI. At S506, the method includes moving the registration state to the RM-DEREGISTERED state without triggering the UE (100) initiated deregistration procedure or receiving the network triggered deregistration procedure from the AMF entity (200) implicitly.

[92] FIG. 6 illustrates a flow chart (S600) illustrating a method, implemented by the AMF entity (200), for handling the deregistration procedure in the wireless network (1000),

according to the embodiments as disclosed herein. The operations (S602-S608) are handled by the slice managing controller (240).

[93] At S602, the method includes removing the S-NSSAI from the Allowed NSSAI. At S604, the method includes determining that the S-NSSAI becomes unavailable, the other S-NSSAIs are not present in the Allowed NSSAI, and the no default S-NSSAI is provided in the allowed NSSAI. At S606, the method includes avoiding to initiate the network-initiated deregistration procedure. At S608, the method includes moving the registration state for the UE (100) to the RM-DEREGISTERED state implicitly.

[94] Based on the proposed methods, the network-initiated deregistration procedure is entirely skipped when only one temporary slice is present in the Allowed NSSAI and that is removed after the expiry of validity time. The proposed method can be used to reduce the signalling wastage and reduce the battery drainage at the UE (100) and the AMF entity (200).

[95] The various actions, acts, blocks, steps, or the like in the flow charts (S500 and S600) may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some of the actions, acts, blocks, steps, or the like may be omitted, added, modified, skipped, or the like without departing from the scope of the invention.

[96] The embodiments disclosed herein can be implemented through at least one software program running on at least one hardware device and performing network management functions to control the elements. The elements can be at least one of a hardware device, or a combination of hardware device and software module.

[97] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of at least one embodiment, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

Claims

[Claim 1] A method performed by an access and mobility management function (AMF) entity for handling a deregistration procedure in a wireless network, the method comprising:
removing a single-network slice selection assistance information (S-NSSAI) from an allowed NSSAI;
identifying whether at least one S-NSSAI presents in the allowed NSSAI;
determining that a new allowed NSSAI is not possible, in case that the at least one S-NSSAI is not preset in the allowed NSSAI; and
determining a registration state for a terminal to a RM-DEREGISTERED state.

[Claim 2] The method of claim 1, wherein the registration state for the terminal to the RM-DEREGISTERED state implicitly without a network-initiated deregistration procedure.

[Claim 3] The method of claim 1, wherein the S-NSSAI is removed based on an expiry of a validity time.

[Claim 4] A method performed by a terminal for handling a deregistration procedure in a wireless network, the method comprising:
identifying that a single-network slice selection assistance information (S-NSSAI) does not present in an allowed NSSAI;
identifying whether a new allowed NSSAI is received from an access and mobility management function (AMF) entity; and
determining a registration state to a RM-DEREGISTERED state in case that the new allowed NSSAI is not received.

[Claim 5] The method of claim 4, wherein the registration state to the RM-DEREGISTERED state implicitly without a network-initiated deregistration procedure.

[Claim 6] The method of claim 4, wherein the S-NSSAI is removed based on an expiry of a validity time.

[Claim 7] The method of claim 4, wherein the terminal supports temporary available network slices.

[Claim 8] An access and mobility management function (AMF) entity for handling a deregistration procedure in a wireless network, the AMF entity comprising:
a transceiver; and
at least one processor configured to:

remove a single-network slice selection assistance information (S-NSSAI) from an allowed NSSAI,
identify whether at least one S-NSSAI presents in the allowed NSSAI,
determine that a new allowed NSSAI is not possible, in case that the at least one S-NSSAI is not preset in the allowed NSSAI, and
determine a registration state for a terminal to a RM-DEREGISTERED state.

[Claim 9] The AMF entity of claim 8, wherein the registration state for the terminal to the RM-DEREGISTERED state implicitly without a network-initiated deregistration procedure.

[Claim 10] The AMF entity of claim 8, wherein the S-NSSAI is removed based on an expiry of a validity time.

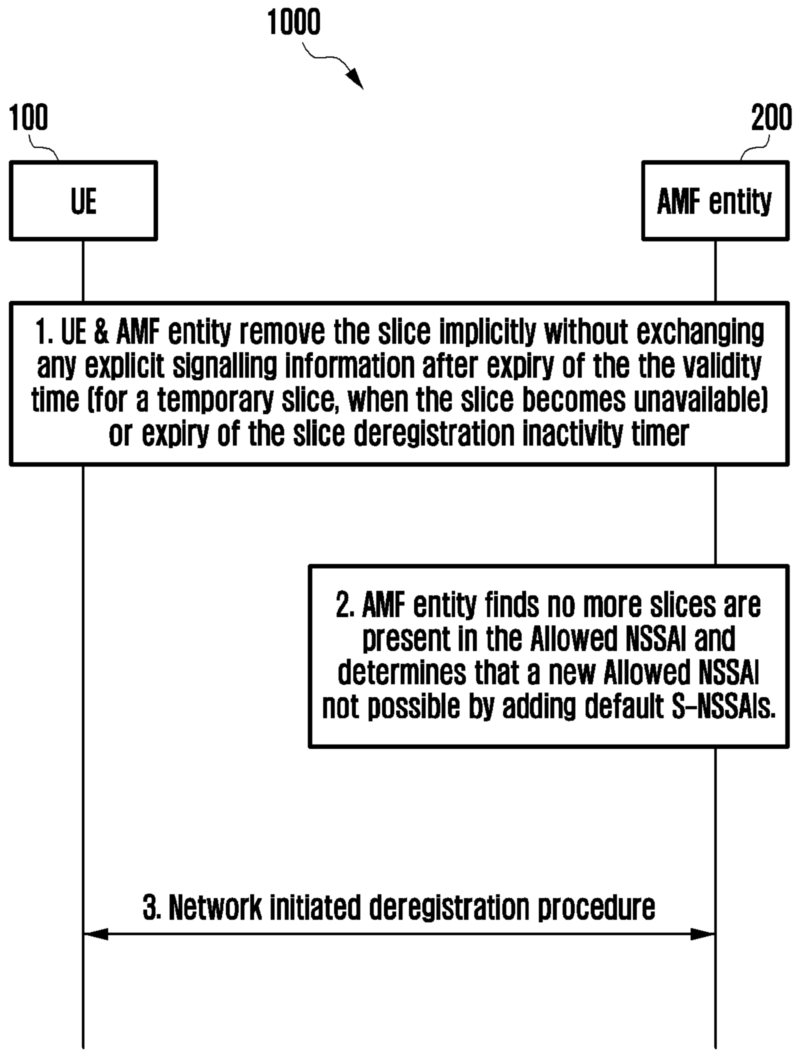
[Claim 11] A terminal for handling a deregistration procedure in a wireless network, the terminal comprising:
a transceiver; and
at least one processor configured to:
identify that a single-network slice selection assistance information (S-NSSAI) does not present in an allowed NSSAI,
identify whether a new allowed NSSAI is received from an access and mobility management function (AMF) entity, and
determine a registration state to a RM-DEREGISTERED state in case that the new allowed NSSAI is not received.

[Claim 12] The terminal of claim 11, wherein the registration state to the RM-DEREGISTERED state implicitly without a network-initiated deregistration procedure.

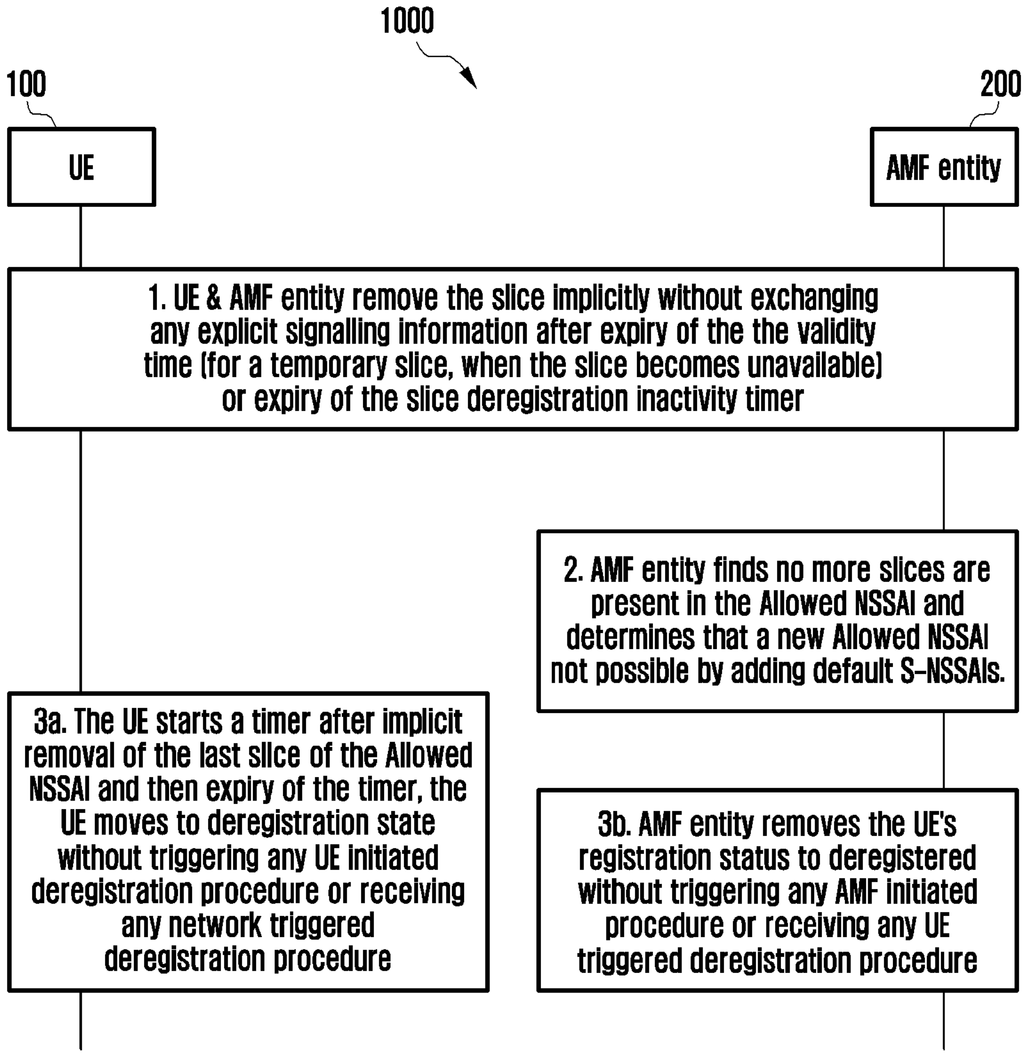
[Claim 13] The terminal of claim 11, wherein wherein he S-NSSAI is removed based on an expiry of a validity time.

[Claim 14] The terminal of claim 11, wherein the terminal supports temporary available network slices.

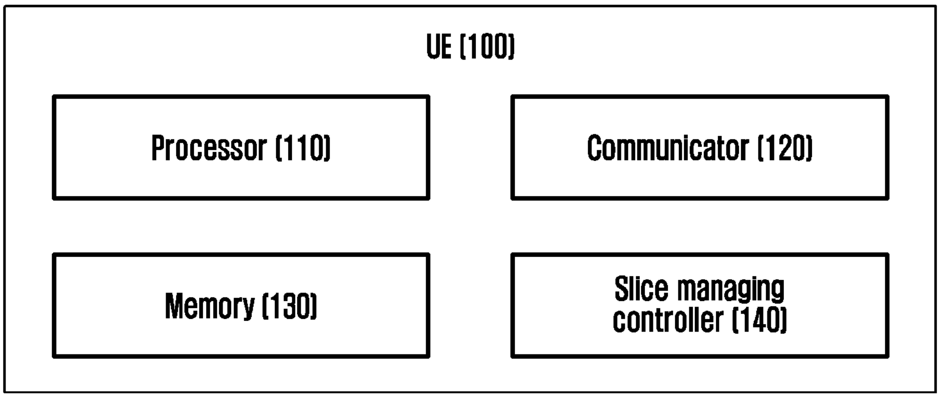
[Fig. 1]


1000
100
200
UE
AMF entity
1. UE & AMF entity remove the slice implicitly without exchanging any explicit signalling information after expiry of the the validity time (for a temporary slice, when the slice becomes unavailable) or expiry of the slice deregistration inactivity timer
2. AMF entity finds no more slices are present in the Allowed NSSAI and determines that a new Allowed NSSAI not possible by adding default S-NSSAIs.
3. Network initiated deregistration procedure

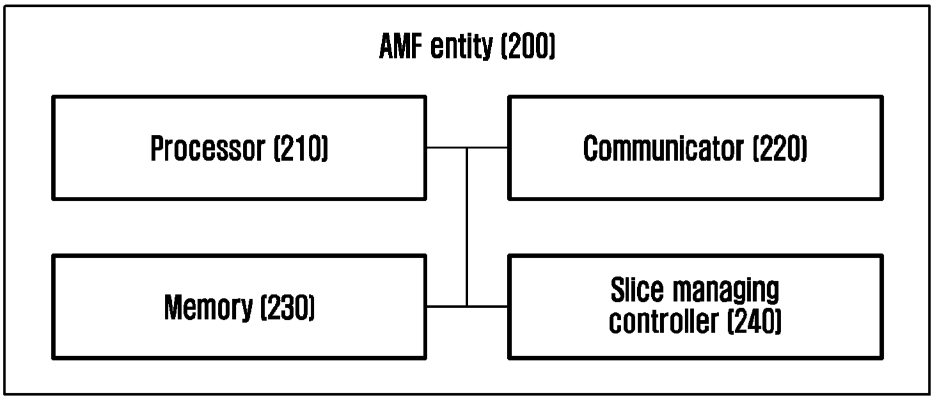
[Fig. 2]


1000
100
200
UE
AMF entity
1. UE & AMF entity remove the slice implicitly without exchanging any explicit signalling information after expiry of the the validity time (for a temporary slice, when the slice becomes unavailable) or expiry of the slice deregistration inactivity timer
2. AMF entity finds no more slices are present in the Allowed NSSAI and determines that a new Allowed NSSAI not possible by adding default S-NSSAIs.
3a. The UE starts a timer after implicit removal of the last slice of the Allowed NSSAI and then expiry of the timer, the UE moves to deregistration state without triggering any UE initiated deregistration procedure or receiving any network triggered deregistration procedure
3b. AMF entity removes the UE's registration status to deregistered without triggering any AMF initiated procedure or receiving any UE triggered deregistration procedure

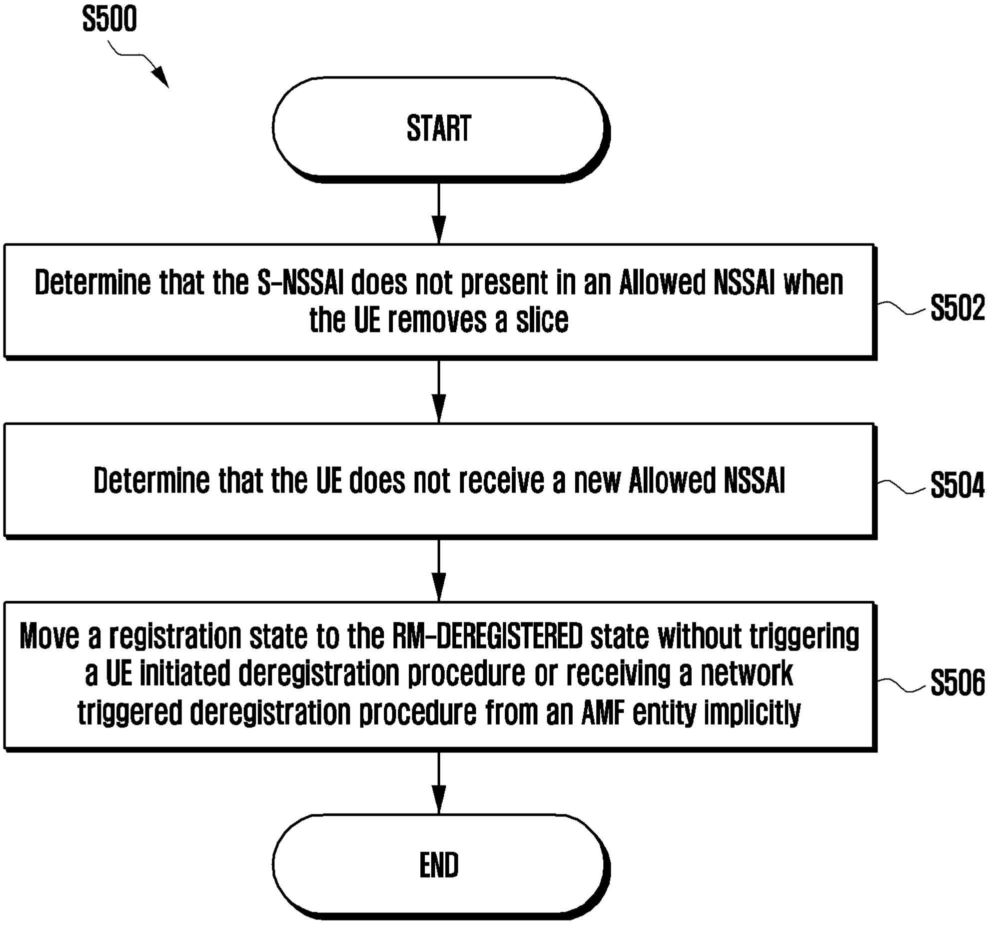
[Fig. 3]


UE (100)
Processor (110)
Communicator (120)
Memory (130)
Slice managing controller (140)

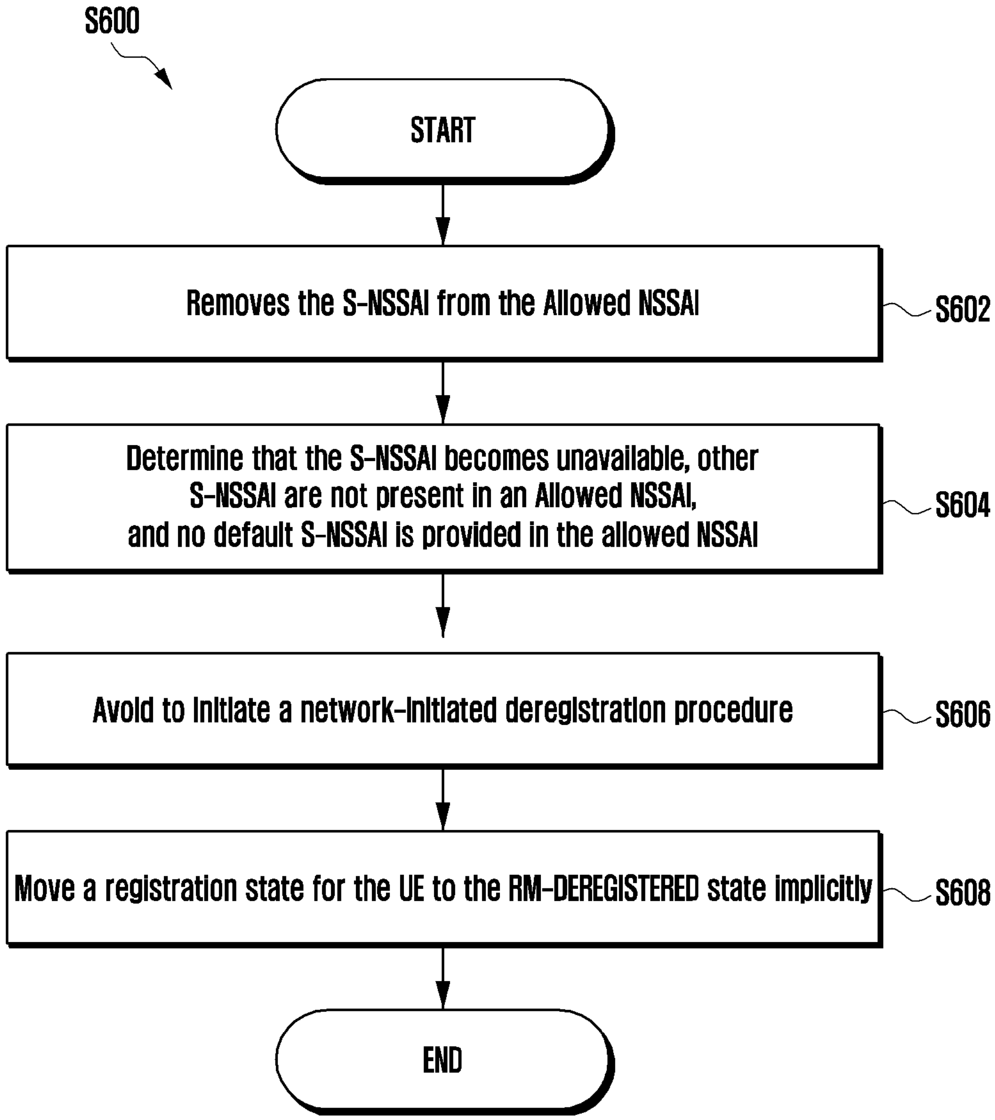
[Fig. 4]


AMF entity (200)
Processor (210)
Communicator (220)
Memory (230)
Slice managing controller (240)

[Fig. 5]


S500
START
Determine that the S-NSSAI does not present in an Allowed NSSAI when the UE removes a slice
S502
Determine that the UE does not receive a new Allowed NSSAI
S504
Move a registration state to the RM-DEREGISTERED state without triggering a UE initiated deregistration procedure or receiving a network triggered deregistration procedure from an AMF entity implicitly
S506
END

[Fig. 6]


S600
START
Removes the S-NSSAI from the Allowed NSSAI
S602
Determine that the S-NSSAI becomes unavailable, other
S-NSSAI are not present in an Allowed NSSAI,
and no default S-NSSAI is provided in the allowed NSSAI
S604
Avoid to initiate a network-initiated deregistration procedure
S606
Move a registration state for the UE to the RM-DEREGISTERED state implicitly
S608
END