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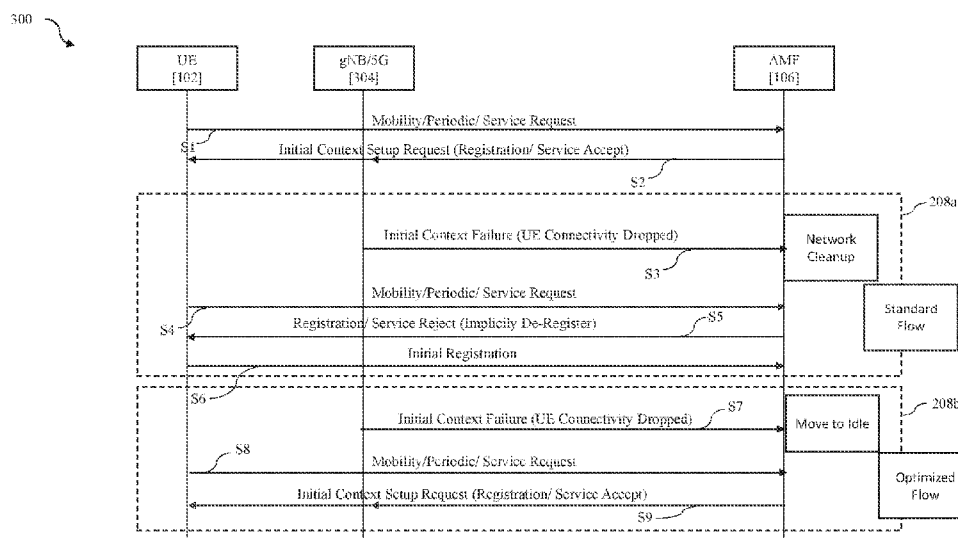


FIG. 3

(57) **Abstract:** The present disclosure relates to a method and a system for handling initial context setup (ICS) request failure message. The disclosure encompasses: receiving, by an AMF module [106] from a user equipment (UE) [102], an ICS request; sending, by the AMF module [106] to a processing unit [202] at a connected network, the ICS request with one of a registration accept NAS message and a service accept NAS message, wherein the connected network is a wireless communication network with which the UE [102] is connected; receiving, by the AMF module [106] from the processing unit [202] at the connected network, one of a connection success indication and a connection failure indication; and performing, by the AMF module [106], one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure in an event the AMF module [106] receives the connection failure indication.

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METHOD AND SYSTEM FOR HANDLING INITIAL CONTEXT SETUP FAILURE MESSAGE

FIELD OF THE DISCLOSURE

[0001] The present disclosure relates generally to the field of wireless communication systems. More particularly, the present disclosure relates to methods and systems for handling initial context setup (ICS) request failure message.

BACKGROUND

[0002] The following description of related art is intended to provide background information pertaining to the field of the disclosure. This section may include certain aspects of the art that may be related to various features of the present disclosure. However, it should be appreciated that this section be used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of prior art.

[0003] Wireless communication technology has rapidly evolved over the past few decades, with each generation bringing significant improvements and advancements. The first generation of wireless communication technology was based on analog technology and offered only voice services. However, with the advent of the second-generation (2G) technology, digital communication and data services became possible, and text messaging was introduced. 3G technology marked the introduction of high-speed internet access, mobile video calling, and location-based services. The fourth-generation (4G) technology revolutionized wireless communication with faster data speeds, better network coverage, and improved security. Currently, the fifth-generation (5G) technology is being deployed, promising even faster data speeds, low latency, and the ability to connect multiple devices simultaneously. With each generation, wireless communication technology has become more advanced, sophisticated, and capable of delivering more services to its users.

[0004] Existing technologies in the mobile communication networks, especially those transitioning between different network generations such as 4G and 5G, often face significant challenges with user equipment (UE) re-registration procedures. One of the primary issues in the prior art is the inefficient handling of the initial context setup (ICS) failures, which frequently occur due to fluctuating network signal strengths and the subsequent movement of UE between

networks with varying coverage qualities. When a UE attempts to connect to the network through mobility, periodic, or service requests and transitions between 4G and 5G coverage due to differential signal strengths, ICS failures can be prompted. These failures traditionally lead to the network (specifically, the Access and Mobility Management Function, or AMF) initiating a cleanup process across multiple network functions, such as the Policy Control Function (PCF), the Short Message Service Function (SMSF), and the Session Management Function (SMF).

[0005] This cleanup process is not only resource-intensive but also results in the UE being considered unreachable for mobile terminated (MT) data during the purge timer's duration. Consequently, when the UE reinitiates a service request, the AMF might respond with a rejection, compelling the UE to undergo a re-registration process. This repeated re-registration is not only a significant overhead in terms of signalling but also deteriorates the user experience by potentially causing service delays and interruptions. Furthermore, this approach does not optimally utilize network resources, as it involves unnecessary reiterations of registration processes that could otherwise be avoided.

[0006] The existing approach thus lacks efficiency in handling transitions between network generations, especially in scenarios of signal variation, which is a common occurrence given the nature of mobile networks and their coverage areas. The emphasis on network cleanup and re-registration under such circumstances highlights a need for a more adaptable and resource-efficient method of managing ICS failures and UE state transitions, one that can maintain service continuity and optimize signalling in the face of network variability.

[0007] Therefore, considering the foregoing discussion, there exists a need to overcome the aforementioned drawbacks. Thus, there exists an imperative need in the art to provide a method and system for handling initial context setup (ICS) request failure message.

OBJECTS OF THE INVENTION

[0008] Some of the objects of the present disclosure, which at least one embodiment disclosed herein satisfies are listed herein below.

[0009] It is an object of the present disclosure to provide a system and a method for handling initial context setup (ICS) request failure message.

[0010] It is another object of the present disclosure to provide a system and a method for handling initial context setup (ICS) request failure that is able to avoid loads on the servers due to increase in the rate of initial registrations being initiated by the user devices.

5 [0011] It is yet another object of the present disclosure to provide a solution that avoids to cleaning up network resources such as Policy control function (PCF) terminate, Session management function (SMF) release, short message service function (SMSF) de-activate and moves to idle state after completion of Mobility Registration/Periodic Registration/Service Request Procedure at AMF.

10 [0012] It is yet another object of the present disclosure to provide signalling optimization and Mobility/Periodic/Service Request handling without rejection.

15 [0013] It is yet another object of the present disclosure to avoid frequent re-registration of UE even during frequent switching between one network (such as 4G) and another network (such as 5G network).

SUMMARY OF THE DISCLOSURE

20 [0014] This section is provided to introduce certain aspects of the present disclosure in a simplified form that are further described below in the detailed description. This summary is not intended to identify the key features or the scope of the claimed subject matter.

25 [0015] According to an aspect of the present disclosure, a method for handling initial context setup (ICS) failure message is disclosed. The method includes receiving, by an access and mobility management function (AMF) module from a user equipment (UE), an initial context setup (ICS) request. Next, the method includes sending, by the AMF module to a processing unit at a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message, wherein the connected network is a wireless communication
30 network with which the UE is connected. Next, the method includes receiving, by the AMF module from the processing unit at the connected network, one of a connection success indication and a connection failure indication. Thereafter, the method includes performing, by the AMF module, one of: a success procedure in an event the AMF module receives the connection success indication, and a failure procedure in an event the AMF module receives the connection failure
35 indication.

[0016] In an exemplary aspect of the present disclosure, the success procedure comprises registering a state of the UE at the AMF module, as a connected state.

5 [0017] In an exemplary aspect of the present disclosure, the failure procedure comprises performing, reiteratively, following steps, in an event the AMF module receives the connection failure indication: stopping, an initiation of a network cleanup process at the AMF module; registering, the state of the UE at the AMF module, as an idle state; sending, by the AMF module to the processing unit at the connected network, the ICS request with the one of the registration accept NAS message and the service accept NAS message; and receiving, by the AMF module
10 from the processing unit at the connected network, one of the connection success indication and the connection failure indication.

[0018] In an exemplary aspect of the present disclosure, the initial context setup (ICS) request is
15 one of a periodic request, a service request, and a mobility request.

[0019] In an exemplary aspect of the present disclosure, the connection failure indication is received with cause UE Connectivity dropped.

20 [0020] In an exemplary aspect of the present disclosure, the connection failure indication is received, by the AMF module from the processing unit, in an event the UE performs handover from one generation of network to another generation of network.

[0021] According to another aspect of the present disclosure, a system for handling initial context
25 setup (ICS) failure message is disclosed. The system comprising an access and mobility management function (AMF) module configured to: receive, from a user equipment (UE), an initial context setup (ICS) request; send, to a processing unit at a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message, wherein the connected network is a wireless communication network with which
30 the UE is connected; receive, from the processing unit at the connected network, one of a connection success indication and a connection failure indication; and perform one of: a success procedure in an event the AMF module receives the connection success indication, and a failure procedure in an event the AMF module receives a connection failure indication.

[0022] Yet another aspect of the present disclosure may relate to a non-transitory computer readable storage medium storing instructions for managing connection between two or more peer network entities, the instructions include executable code which, when executed by one or more units of a system, causes: an access and mobility management function (AMF) module [106] to:
5 receive, from a user equipment (UE), an initial context setup (ICS) request; send, to a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message, wherein the connected network is a wireless communication network with which the UE is connected; receive, at the connected network, one of a connection success indication and a connection failure indication; and perform one of: a success procedure in
10 an event the AMF module receives the connection success indication, and a failure procedure in an event the AMF module receives a connection failure indication

BRIEF DESCRIPTION OF DRAWINGS

[0023] The accompanying drawings, which are incorporated herein, and constitute a part of this disclosure, illustrate exemplary embodiments of the disclosed methods and systems in which like reference numerals refer to the same parts throughout the different drawings. Components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present disclosure. Some drawings may indicate the components using block diagrams and may not represent the internal circuitry of each component. It will be appreciated by
15 those skilled in the art that disclosure of such drawings includes disclosure of electrical components, electronic components or circuitry commonly used to implement such components.

[0024] FIG. 1 illustrates an exemplary block diagram representation of 5th generation core (5GC) network architecture.
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[0025] FIG. 2 is an exemplary block diagram illustrating a system for handling initial context setup (ICS) request failure, in accordance with exemplary embodiments of the present disclosure.

[0026] FIG. 3 illustrates an exemplary sequence flow diagram of system indicating the process for handling initial context setup (ICS) request failure, in accordance with exemplary embodiments of the present disclosure.
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[0027] FIG. 4 illustrates an exemplary method flow diagram indicating the process for handling initial context setup (ICS) request failure, in accordance with exemplary embodiments of the present disclosure.

5 [0028] FIG. 5 illustrates an exemplary block diagram of a computing device upon which an embodiment of the present disclosure may be implemented.

[0029] The foregoing shall be more apparent from the following more detailed description of the disclosure.

10 DESCRIPTION

[0030] In the following description, for the purposes of explanation, various specific details are set forth in order to provide a thorough understanding of embodiments of the present disclosure. It will be apparent, however, that embodiments of the present disclosure may be practiced without these specific details. Several features described hereafter can each be used independently of one another or with any combination of other features. An individual feature may not address any of the problems discussed above or might address only some of the problems discussed above. Some of the problems discussed above might not be fully addressed by any of the features described herein. Example embodiments of the present disclosure are described below, as illustrated in various drawings in which like reference numerals refer to the same parts throughout the different drawings.

20 [0031] The ensuing description provides exemplary embodiments only, and is not intended to limit the scope, applicability, or configuration of the disclosure. Rather, the ensuing description of the exemplary embodiments will provide those skilled in the art with an enabling description for implementing an exemplary embodiment. It should be understood that various changes may be made in the function and arrangement of elements without departing from the spirit and scope of the disclosure as set forth.

30 [0032] It should be noted that the terms "mobile device", "user equipment", "user device", "communication device", "device" and similar terms are used interchangeably for the purpose of describing the invention. These terms are not intended to limit the scope of the invention or imply any specific functionality or limitations on the described embodiments. The use of these terms is solely for convenience and clarity of description. The invention is not limited to any particular

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type of device or equipment, and it should be understood that other equivalent terms or variations thereof may be used interchangeably without departing from the scope of the invention as defined herein.

5 **[0033]** Specific details are given in the following description to provide a thorough understanding of the embodiments. However, it will be understood by one of ordinary skill in the art that the embodiments may be practiced without these specific details. For example, circuits, systems, networks, processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail. In other instances, 10 well-known circuits, processes, algorithms, structures, and techniques may be shown without unnecessary detail in order to avoid obscuring the embodiments.

15 **[0034]** Also, it is noted that individual embodiments may be described as a process which is depicted as a flowchart, a flow diagram, a data flow diagram, a structure diagram, or a block diagram. Although a flowchart may describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently. In addition, the order of the operations may be re-arranged. A process is terminated when its operations are completed but could have additional steps not included in a figure.

20 **[0035]** The word “exemplary” and/or “demonstrative” is used herein to mean serving as an example, instance, or illustration. For the avoidance of doubt, the subject matter disclosed herein is not limited by such examples. In addition, any aspect or design described herein as “exemplary” and/or “demonstrative” is not necessarily to be construed as preferred or advantageous over other aspects or designs, nor is it meant to preclude equivalent exemplary structures and techniques 25 known to those of ordinary skill in the art. Furthermore, to the extent that the terms “includes,” “has,” “contains,” and other similar words are used in either the detailed description or the claims, such terms are intended to be inclusive—in a manner similar to the term “comprising” as an open transition word—without precluding any additional or other elements.

30 **[0036]** As used herein, an “electronic device”, or “portable electronic device”, or “user device” or “communication device” or “user equipment” or “device” refers to any electrical, electronic, electromechanical and computing device. The user device is capable of receiving and/or transmitting one or parameters, performing function/s, communicating with other user devices and transmitting data to the other user devices. The user equipment may have a processor, a display, a 35 memory, a battery and an input-means such as a hard keypad and/or a soft keypad. The user

equipment may be capable of operating on any radio access technology including but not limited to IP-enabled communication, Zig Bee, Bluetooth, Bluetooth Low Energy, Near Field Communication, Z-Wave, Wi-Fi, Wi-Fi direct, etc. For instance, the user equipment may include, but not limited to, a mobile phone, smartphone, virtual reality (VR) devices, augmented reality (AR) devices, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, mainframe computer, or any other device as may be obvious to a person skilled in the art for implementation of the features of the present disclosure.

[0037] Further, the user device may also comprise a “processor” or “processing unit” includes processing unit, wherein processor refers to any logic circuitry for processing instructions. The processor may be a general-purpose processor, a special purpose processor, a conventional processor, a digital signal processor, a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits, Field Programmable Gate Array circuits, any other type of integrated circuits, etc. The processor may perform signal coding data processing, input/output processing, and/or any other functionality that enables the working of the system according to the present disclosure. More specifically, the processor is a hardware processor.

[0038] As portable electronic devices and wireless technologies continue to improve and grow in popularity, the advancing wireless technologies for data transfer are also expected to evolve and replace the older generations of technologies. In the field of wireless data communications, the dynamic advancement of various generations of cellular technology are also seen. The development, in this respect, has been incremental in the order of second generation (2G), third generation (3G), fourth generation (4G), and now fifth generation (5G), and more such generations are expected to continue in the forthcoming time.

[0039] Radio Access Technology (RAT) refers to the technology used by mobile devices/ user equipment (UE) to connect to a cellular network. It refers to the specific protocol and standards that govern the way devices communicate with base stations, which are responsible for providing the wireless connection. Further, each RAT has its own set of protocols and standards for communication, which define the frequency bands, modulation techniques, and other parameters used for transmitting and receiving data. Examples of RATs include GSM (Global System for Mobile Communications), CDMA (Code Division Multiple Access), UMTS (Universal Mobile Telecommunications System), LTE (Long-Term Evolution), and 5G. The choice of RAT depends on a variety of factors, including the network infrastructure, the available spectrum, and the mobile

device's/device's capabilities. Mobile devices often support multiple RATs, allowing them to connect to different types of networks and provide optimal performance based on the available network resources.

5 **[0040]** As used herein, non-access stratum (NAS) messages are used for signalling between the user equipment (UE) and the core network (CN), such as 5G network. NAS messages handle signalling between the UE and the CN for functions such as registration, authentication, security control, session management and the like. The UE may send registration request NAS message or service request NAS message to the network for registration or for requesting a service such as,
10 data service or voice service. In response to this, the CN may send registration accept NAS message or service accept NAS message to the UE. For example, the AMF may send a service accept NAS message with at least PDU session information, temporary identifier to the UE.

15 **[0041]** As used herein, success procedure refers to the process wherein, upon receiving a connection success indication from the processing unit at the connected network, the access and mobility management function (AMF) module registers the state of the user equipment (UE) as a connected state. The success procedure involves updating the network's records to reflect that the UE is actively connected and capable of participating in communication sessions.

20 **[0042]** As used herein, failure procedure refers to the process initiated by the access and mobility management function (AMF) module upon receiving a connection failure indication from the processing unit at the connected network. Instead of initiating a network cleanup, the AMF module stops this process and registers the state of the user equipment (UE) as idle. The AMF module then reiteratively sends the initial context setup (ICS) request along with the appropriate non-access
25 stratum (NAS) message back to the processing unit.

30 **[0043]** As used herein, reiteratively refers to the process of performing a series of actions repeatedly until a desired outcome is achieved. The AMF module continuously executing the steps of stopping the initiation of a network cleanup process, registering the state of the user equipment (UE) as an idle state, resending the initial context setup (ICS) request with a registration accept or service accept non-access stratum (NAS) message to the processing unit at the connected network, and awaiting either a connection success indication or a connection failure indication. This iterative approach ensures that the network handles connectivity issues efficiently, particularly in
35 scenarios where the UE frequently transitions between different network generations, thereby optimizing the UE's connection stability and reducing unnecessary re-registration attempts.

5 [0044] As used herein, network clean-up procedure refers to the process initiated by the AMF module to systematically disengage and deregister network resources associated with a user equipment (UE) when it is deemed unreachable or disconnected. The network clean-up procedure involves notifying relevant network nodes such as the Policy Control Function (PCF), Short Message Service Function (SMSF), and Session Management Function (SMF) to terminate any active sessions, release allocated resources, and update their records to reflect the UE's inactive status. Additionally, a purge timer may be activated to ensure that the network resources are efficiently reallocated and any residual state information is cleared.

10 [0045] As used herein, an initial context setup (ICS) failure message refers to a notification sent from the processing unit at the connected network to the AMF module indicating that the attempt to establish an initial context for the user equipment (UE) has failed. The initial context setup (ICS) failure message is triggered when the UE experiences connectivity issues, such as transitioning from a 5G network with poor signal coverage to a more robust 4G network. The initial context
15 setup (ICS) failure message facilitates in informing the AMF module of the unsuccessful setup, prompting it to execute predefined procedures to handle the failure, such as adjusting the UE's state to idle and preventing unnecessary network cleanup processes.

20 [0046] As used herein, generation of networks refers to the different iterations or versions of mobile communication technology, each representing a significant advancement in terms of performance, speed, and capabilities. The generation of networks includes 1G (first generation) which introduced analog voice communication, 2G (second generation) which brought digital voice and basic data services, 3G (third generation) which enhanced mobile internet access and video calling, 4G (fourth generation) which significantly increased data transfer speeds and
25 supported high-definition video streaming and mobile broadband, and 5G (fifth generation) which offers ultra-fast data speeds, low latency, massive connectivity for IoT devices, and enhanced mobile broadband.

30 [0047] As used herein, handover refers to the process of transferring an ongoing call or data session from one cell or network node to another, ensuring continuity of service as the user equipment (UE) moves. The handover transition can occur within the same generation of network technology or between different generations, such as from 4G to 5G or vice versa.

35 [0048] As discussed in the background section, Existing technologies in the mobile communication networks, especially those transitioning between different network generations such as 4G and 5G, often face significant challenges with user equipment (UE) re-registration

procedures. One of the primary issues in the prior art is the inefficient handling of the initial context setup (ICS) failures, which frequently occur due to fluctuating network signal strengths and the subsequent movement of UE between networks with varying coverage qualities. When a UE attempts to connect to the network through mobility, periodic, or service requests and transitions between 4G and 5G coverage due to differential signal strengths, ICS failures can be prompted. These failures traditionally lead to the network (specifically, the Access and Mobility Management Function, or AMF) initiating a cleanup process across multiple network functions, such as the Policy Control Function (PCF), the Short Message Service Function (SMSF), and the Session Management Function (SMF). This cleanup process is not only resource-intensive but also results in the UE being considered unreachable for mobile terminated (MT) data during the purge timer's duration. Consequently, when the UE reinitiates a service request, the AMF might respond with a rejection, compelling the UE to undergo a re-registration process. This repeated re-registration is not only a significant overhead in terms of signalling but also deteriorates the user experience by potentially causing service delays and interruptions. Furthermore, this approach does not optimally utilize network resources, as it involves unnecessary reiterations of registration processes that could otherwise be avoided. The existing approach thus lacks efficiency in handling transitions between network generations, especially in scenarios of signal variation, which is a common occurrence given the nature of mobile networks and their coverage areas. The emphasis on network cleanup and re-registration under such circumstances highlights a need for a more adaptable and resource-efficient method of managing ICS failures and UE state transitions, one that can maintain service continuity and optimize signalling in the face of network variability.

[0049] To overcome these and other inherent problems in the art, the present disclosure proposes a solution of handling Initial context setup (ICS) failure messages in a novel way that optimizes network signalling and minimizes the need for frequent re-registration of User Equipment (UE) when moving between different generations of network coverage. Instead of initiating a network cleanup procedure which typically leads to resource-intensive processes across multiple network functions and results in the UE being unreachable, the AMF module is designed to simply move the UE's state to 'idle'. This significant alteration in protocol effectively allows the UE to maintain its registration state, obviating the need for re-registration and reducing the signalling load on the network. By deactivating the PDU session IDs received in the User Data Status (UDS) and transitioning the UE state to idle rather than initiating purge, the AMF module avoids triggering network cleanup processes such as the termination of sessions with the Policy Control Function (PCF), the release of sessions with the Session Management Function (SMF), and deactivation with the Short Message Service Function (SMSF). As a result, the UE remains reachable for

mobile terminated data without the network exerting itself in unnecessary cleanups and re-registrations. When the UE issues a subsequent Mobility/Periodic/Service Request post the initial ICS failure, the AMF module responds by attempting to reestablish the ICS without rejecting the request, thus maintaining a continuous service experience for the user. This method optimizes the signalling required for UE to move seamlessly between 4G and 5G networks, enhances the user experience by preventing service delays and interruptions, and ensures a more efficient use of network resources.

[0050] It would be appreciated by the person skilled in the art that the present disclosure presents a solution that is adaptive and resource-efficient, handling ICS failures and UE state transitions in a way that ensures service continuity and optimizes network signalling amidst the variability inherent in mobile network coverage.

[0051] Hereinafter, exemplary embodiments of the present disclosure will be described with reference to the accompanying drawings.

[0052] FIG. 1 illustrates an exemplary block diagram representation of 5th generation core (5GC) network architecture, in accordance with exemplary embodiment of the present disclosure. As shown in FIG. 1, the 5GC network architecture [100] includes a user equipment (UE) [102], a radio access network (RAN) [104], an access and mobility management function (AMF) [106] (alternatively referred to as AMF [106] herein), a Session Management Function (SMF) [108], a Service Communication Proxy (SCP) [110], an Authentication Server Function (AUSF) [112], a Network Slice Specific Authentication and Authorization Function (NSSAAF) [114], a Network Slice Selection Function (NSSF) [116], a Network Exposure Function (NEF) [118], a Network Repository Function (NRF) [120], a Policy Control Function (PCF) [122], a Unified Data Management (UDM) [124], an application function (AF) [126], a User Plane Function (UPF) [128], a data network (DN) [130], wherein all the components are assumed to be connected to each other in a manner as obvious to the person skilled in the art for implementing features of the present disclosure.

[0053] The User Equipment (UE) [102] interfaces with the network via the Radio Access Network (RAN) [104]; the Access and Mobility Management Function (AMF) [106] manages connectivity and mobility, while the Session Management Function (SMF) [108] administers session control; the service communication proxy (SCP) [110] routes and manages communication between network services, enhancing efficiency and security, and the Authentication Server

Function (AUSF) [112] handles user authentication; the NSSAAF [114] for integrating the 5G core network with existing 4G LTE networks i.e., to enable Non-Standalone (NSA) 5G deployments, the Network Slice Selection Function (NSSF) [116], Network Exposure Function (NEF) [118], and Network Repository Function (NRF) [120] enable network customization, secure interfacing with external applications, and maintain network function registries respectively; the Policy Control Function (PCF) [122] develops operational policies, and the Unified Data Management (UDM) [124] manages subscriber data; the application function (AF) [126] enables application interaction, the User Plane Function (UPF) [128] processes and forwards user data, and the Data Network (DN) [130] connects to external internet resources; collectively, these components are designed to enhance mobile broadband, ensure low-latency communication, and support massive machine-type communication, solidifying the 5GC as the infrastructure for next-generation mobile networks.

[0054] Radio Access Network (RAN) [104] is the part of a mobile telecommunications system that connects user equipment (UE) [102] to the core network (CN) and provides access to different types of networks (e.g., 5G network). It consists of radio base stations and the radio access technologies that enable wireless communication.

[0055] Access and Mobility Management Function (AMF) [106] (alternatively referred to as AMF module [106] herein) is a 5G core network function responsible for managing access and mobility aspects, such as UE registration, connection, and reachability. It also handles mobility management procedures like handovers and paging.

[0056] Session Management Function (SMF) [108] is a 5G core network function responsible for managing session-related aspects, such as establishing, modifying, and releasing sessions. It coordinates with the User Plane Function (UPF) for data forwarding and handles IP address allocation and QoS enforcement.

[0057] As used herein, service communication proxy (SCP) [110] refers to a network function within the 5G core network architecture configured to manage and optimize communication between network functions (NFs). The SCP facilitates the routing, load balancing, and failover mechanisms for service-based interfaces (SBI), ensuring efficient and reliable communication among NFs.

[0058] Authentication Server Function (AUSF) [112] is a network function in the 5G core responsible for authenticating UEs during registration and providing security services. It generates and verifies authentication vectors and tokens.

5 **[0059]** Network Slice Specific Authentication and Authorization Function (NSSAAF) [114] is a network function that provides authentication and authorization services specific to network slices. It ensures that UEs can access only the slices for which they are authorized.

10 **[0060]** Network Slice Selection Function (NSSF) [116] is a network function responsible for selecting the appropriate network slice for a UE based on factors such as subscription, requested services, and network policies.

15 **[0061]** Network Exposure Function (NEF) [118] is a network function that exposes capabilities and services of the 5G network to external applications, enabling integration with third-party services and applications.

20 **[0062]** Network Repository Function (NRF) [120] is a network function that acts as a central repository for information about available network functions and services. It facilitates the discovery and dynamic registration of network functions.

[0063] Policy Control Function (PCF) [122] is a network function responsible for policy control decisions, such as QoS, charging, and access control, based on subscriber information and network policies.

25 **[0064]** Unified Data Management (UDM) [124] is a network function that centralizes the management of subscriber data, including authentication, authorization, and subscription information.

30 **[0065]** Application function (AF) [126] is a network function that represents external applications interfacing with the 5G core network to access network capabilities and services.

[0066] User Plane Function (UPF) [128] is a network function responsible for handling user data traffic, including packet routing, forwarding, and QoS enforcement.

[0067] Data Network (DN) [130] refers to a network that provides data services to user equipment (UE) [102] in a telecommunications system. The data services may include but are not limited to Internet services, private data network related services.

5 [0068] Referring to FIG. 2, an exemplary block diagram [200] illustrating a system [200A] handling initial context setup (ICS) request failure is shown, in accordance with the exemplary embodiments of the present invention. The block diagram [200] comprises a system [200A] and at least one user equipment (UE) [102]. The system [200A] comprises at least one processing unit [202], at least one AMF Module [106], at least one storage unit [204]. Also, all of the components/
10 units of the system [200A] are assumed to be connected to each other unless otherwise indicated below. Also, in FIG. 2 only a few units are shown, however, the system [200A] may comprise multiple such units or the system [200A] may comprise any such numbers of said units, as required to implement the features of the present disclosure.

15 [0069] The system [200A] is configured for handling initial context setup (ICS) request failure, with the help of the interconnection between the components/units of the system [200A].

[0070] In order to handle initial context setup (ICS) request failure, the system [200A] comprises the processing unit [202] of the system [200A] and AMF module [106], which communicate for
20 receiving and handling one of the periodic request, service request, or mobility request from the user equipment (UE) [102]. The AMF module [106] is configured to receive an initial context setup (ICS) request from the UE [102]. The ICS request may comprise initial UE context including such as but not limited only to protocol data unit (PDU) session context, security key, mobility restriction list, UE network radio capability and the like. In an exemplary aspect, the initial context
25 setup (ICS) request is at least one of a periodic request, a service request, and a mobility request. In response to this, the AMF module [106] sends the ICS request with one of a registration accept non-access stratum (NAS) message, and a service accept NAS message to a processing unit [202] at a connected network. The connected network herein is a wireless communication network, such as, but not limited to, 5G network, higher than 5G network, and like other network, with which
30 the user device is connected.

[0071] Further, the AMF module [106] is configured to receive one of a connection success indication and a connection failure indication from the processing unit [202] at the connected network. The connection success indication signifies that the initial context setup (ICS) has been
35 successfully completed, and the UE [102] is now connected to the network. In this case, the AMF

module [106] proceeds with the connection success procedure, which includes registering the state of the UE [102] at the AMF module [106] as a connected state. The registration ensures that the UE [102] is recognized as being connected to the network and can receive services accordingly.

5 **[0072]** On the other hand, if the AMF module [106] receives a connection failure indication, it indicates that the initial context setup (ICS) has failed, and the UE [102] is not connected to the network. The failure indication can be accompanied by a cause, such as "UE Connectivity dropped," which provides further information about the reason for the failure. In this case, the AMF module [106] initiates the failure procedure.

10 **[0073]** To perform the failure procedure, the AMF module [106] is configured to carry out a series of steps in a repetitive manner whenever it receives a connection failure indication. Firstly, the AMF module [106] stops any initiation of a network cleanup process. Secondly, the AMF module [106] registers the state of the User Equipment (UE) [102] to an idle state. This signifies
15 that the UE [102] is not actively engaged in communication with the network but is still recognized by the network for future interactions. Thirdly, the AMF module [106] sends the (ICS) request again to the processing unit [202] at the connected network. This request is accompanied by either a Registration Accept Non-Access Stratum (NAS) message or a Service Accept NAS message, depending on the specific circumstances. Finally, the AMF module [106] awaits a new response
20 from the processing unit [202]. This response can either indicate a successful connection or another failure. By repeating these steps, the AMF module [106] aims to resolve the initial context setup (ICS) failure and establish a successful connection for the UE [102] without triggering a complete network cleanup process, thereby optimizing the use of network resources and improving the efficiency of the network's response to connection failures.

25 **[0074]** After receiving in an event of connection failure indication, the AMF module [106] is also configured to perform one of a failure procedure. In an exemplary aspect, the connection failure indication is received with cause 'UE connectivity dropped'. The cause 'UE connectivity dropped' may happen, due to low coverage signal in 5G network and better coverage signal in 4G
30 network, the UE [102] moves to 4G network from the 5G network, then processing unit [202] sends failure indication to the AMF module [106].

35 **[0075]** In an exemplary aspect, to perform the failure procedure, the AMF module [106] is configured to perform, reiteratively, following steps, in an event the AMF module [106] receives a connection failure indication: stop, an initiation of a network cleanup process at the AMF module

[106]; register, the state of the UE [102] at the AMF module [106], as an idle state; send, by the AMF module [106] to the processing unit [202] at the connected network, the ICS request with the one of the registration accept NAS message and the service accept NAS message; and receive, by the AMF module [106] from the processing unit [202] at the connected network, one of the connection success indication and the connection failure indication.

[0076] In an exemplary aspect, reiteratively may represent, the UE [102] may perform frequent re-registration, due to frequent switching between 4G and 5G due to poor network signalling. In response to this, the AMF module [106] may stop initiation of a network cleanup process and register the UE [102] in idle state for the signalling optimization and avoiding frequent re-registration of the UE [102].

[0077] In an exemplary aspect, the connection failure indication is received by the AMF module [106] from the processing unit [202], in an event the UE [102] performs handover from one generation of network, such as 5G network, to another generation of network, such as, 4G network.

[0078] The storage unit [204] is configured to store data and/or information to facilitate for handling initial context setup (ICS) request failure.

[0079] Referring to FIG. 3, illustrates an exemplary sequence flow diagram of system [300] indicating the process for handling initial context setup (ICS) request failure, in accordance with exemplary embodiments of the present disclosure. As shown in FIG. 3, sequence flow diagram of system [300] comprises UE [102], gNB/5G [304], and AMF module [106].

[0080] At step S1, the User Equipment (UE) [102] initiates one of the three possible requests a periodic request (PR), a service request (SR), or a mobility request (MR)—which is received by the Access and Mobility Management Function (AMF) module [106]. The AMF module [106] then processes this request.

[0081] At step S2, the AMF module [106] prepares the Initial context setup (ICS) request accompanied by either a registration accept, or service accept Non-Access Stratum (NAS) message. The ICS request facilitates in establishing or modifying the context of the UE [102] at the gNB [304].

[0082] At step S3, in response to the UE's [102] movement to 4G, due to poor coverage in the 5G network, the gNB [304] sends an Initial context setup (ICS) failure message back to the AMF module [106]. The reason for this failure is indicated as "UE Connectivity dropped." The AMF module [106] may perform network clean-up procedure.

5

[0083] At step S4, as a part of the standard flow [208a], the AMF module [106] would typically reject the Mobility/Periodic/Service Request from the UE [102] after receiving the initial context setup (ICS) failure.

10

[0084] At step S5, following the rejection at step S5, the standard procedure would be to have the UE [102] undergo a registration process again, which adds to the signalling load and may impact network performance.

15

[0085] At step S6, as part of the standard registration process, the UE [102] would initiate the registration afresh following the previous rejection.

20

[0086] At step S7, the optimized flow [208b] diverges from the standard procedure. Here, when the gNB [304] sends the initial context setup (ICS) failure message with the cause being "UE Connectivity dropped" or "Radio connection with UE lost," the AMF [106] does not initiate the network cleanup process. Instead, it changes the user state to idle.

25

[0087] At step S8, the AMF module [106], instead of rejecting the request due to the failure, continues with the procedure. When the UE [102] initiates another Mobility/Periodic/Service Request, the AMF module [106] responds by processing the request and preparing to send another ICS request to the gNB [304].

30

[0088] At step S9, the AMF module [106] sends out the Initial context setup (ICS) Request with a registration accept or service accept NAS message to the gNB [304] to be communicated to the UE [102], thus aiming to maintain the service continuity despite the initial failure. This optimized process seeks to prevent service interruption and reduce the need for re-registration by the UE [102].

[0089] Referring to FIG. 4 an exemplary method flow diagram [400] for handling initial context setup (ICS) request failure, in accordance with exemplary embodiments of the present invention

is shown. In an implementation the method [400] is performed by the at least one of system [200A] and AMF module [106]. As shown in FIG. 4, the method [400] starts at step [402].

5 [0090] At step [404], the method [400] as disclosed by the present disclosure comprises receiving, by an access and mobility management function (AMF) module [106] from a user equipment (UE) [102], an initial context setup (ICS) request. The method [400] implemented by the system [200A] comprises the AMF module [106], which is configured to receive the ICS from the UE [102] may be at least one of a periodic request (PR), a mobility request (MR), and a service request (SR).

10 [0091] Next, at step [406], the method [400] as disclosed by the present disclosure comprises sending, by the AMF module [106] to a processing unit [202] at a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message, wherein the connected network is a wireless communication network with which the UE [102] is connected. The method [400] implemented by the system [200A] comprises the AMF module [106], which is configured to send to the processing unit [202] at a connected network, such as a wireless communication network with which the UE [102] is connected, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message. In an exemplary aspect, wireless communication network may be one of 5G network, higher than 5G network and the like.

20 [0092] Next, at step [408], the method [400] as disclosed by the present disclosure comprises receiving, by the AMF module [106] from the processing unit [202] at the connected network, one of a connection success indication and a connection failure indication. The method [400] implemented by the system [200A] comprises the AMF module [106], which is configured to receive from the processing unit [202] at the connected network, one of a connection success indication and a connection failure indication. In an exemplary aspect, the connection failure indication is received with cause 'UE Connectivity dropped'. The cause 'UE connectivity dropped' may happen, due to low coverage signal in 5G network and better coverage signal in 4G network, the UE [102] moves to 4G network from the 5G network, then processing unit [202] sends failure indication to the AMF module [106].

30 [0093] Next, at step [410], the method [400] as disclosed by the present disclosure comprises performing, by the AMF module [106], one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure in an event the AMF

35

module [106] receives the connection failure indication. The connection failure is received by the AMF module [106] from the processing unit [202] in an event the user device performs handover from one generation of network such as, but not limited to, 5G network to another generation of network, such as, but not limited to 4G network. The success procedure comprises registering a state of the user device at the AMF module [106] as a connected state.

[0094] Further, the failure procedure comprises performing, reiteratively, following steps, in an event the AMF module [106] receives the connection failure indication: stopping, an initiation of a network cleanup process at the AMF module [106]; registering, the state of the user device at the AMF module [106], as an idle state; sending, by the AMF module [106] to the processing unit [202] at the connected network, the ICS request with the one of the registration accept NAS message and the service accept NAS message; and receiving, by the AMF module [106] from the processing unit [202] at the connected network, one of the connection success indication and the connection failure indication.

[0095] In an exemplary aspect, reiteratively may represent, the UE [102] may perform frequent re-registration, due to frequent switching between 4G and 5G due to poor network signalling. In response to this, the AMF module [106] may stop initiation of a network cleanup process and register the UE [102] in idle state for the signalling optimization and avoiding frequent re-registration of the UE [102].

[0096] Thereafter, the method [400] terminates at step [412].

[0097] It is made clear to a person skilled in the art that the handover of the UE may happen between any higher and lower technology RAN and not necessarily between 4G and 5G only, and that the handover of user device or user equipment as mentioned above between 4G and 5G is exemplary for understanding purposes only.

[0098] Referring to FIG. 5, which illustrates an exemplary block diagram of a computing device [500] (also referred to herein as a computer system [500]) upon which an embodiment of the present disclosure may be implemented. In an implementation, the computing device [500] implements the method for handling initial context setup (ICS) failure message using the system [200A]. In another implementation, the computing device [500] itself implements the method for handling initial context setup (ICS) failure message using one or more units configured within the

computing device [500], wherein said one or more units are capable of implementing the features as disclosed in the present disclosure.

5 [0099] The computing device [500] encompasses a wide range of electronic devices capable of processing data and performing computations. Examples of computing device [500] include, but are not limited only to, personal computers, laptops, tablets, smartphones, servers, and embedded systems. The devices may operate independently or as part of a network and can perform a variety of tasks such as data storage, retrieval, and analysis. Additionally, computing device [500] may include peripheral devices, such as monitors, keyboards, and printers, as well as integrated components within larger electronic systems, showcasing their versatility in various technological applications.

10 [0100] The computing device [500] may include a bus [502] or other communication mechanism for communicating information, and a processor [504] coupled with bus [502] for processing information. The processor [504] may be, for example, a general purpose microprocessor. The computing device [500] may also include a main memory [506], such as a random access memory (RAM), or other dynamic storage device, coupled to the bus [502] for storing information and instructions to be executed by the processor [504]. The main memory [506] also may be used for storing temporary variables or other intermediate information during execution of the instructions to be executed by the processor [504]. Such instructions, when stored in non-transitory storage media accessible to the processor [504], render the computing device [500] into a special-purpose machine that is customized to perform the operations specified in the instructions. The computing device [500] further includes a read only memory (ROM) [508] or other static storage device coupled to the bus [502] for storing static information and instructions for the processor [504].

25 [0101] A storage device [510], such as a magnetic disk, optical disk, or solid-state drive is provided and coupled to the bus [502] for storing information and instructions. The computing device [500] may be coupled via the bus [502] to a display [512], such as a cathode ray tube (CRT), for displaying information to a computer user. An input device [514], including alphanumeric and other keys, may be coupled to the bus [502] for communicating information and command selections to the processor [504]. Another type of user input device may be a cursor controller [516], such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor [504], and for controlling cursor movement on the display [512]. This input device typically has two degrees of freedom in two axes, a first axis (e.g., x) and a second axis (e.g., y), that allow the device to specify positions in a plane.

[0102] The computing device [500] may implement the techniques described herein using customized hard-wired logic, one or more ASICs or FPGAs, firmware and/or program logic which in combination with the computing device [500] causes or programs the computing device [500] to be a special-purpose machine. According to one embodiment, the techniques herein are performed by the computing device [500] in response to the processor [504] executing one or more sequences of one or more instructions contained in the main memory [506]. Such instructions may be read into the main memory [506] from another storage medium, such as the storage device [510]. Execution of the sequences of instructions contained in the main memory [506] causes the processor [504] to perform the process steps described herein. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions.

[0103] The computing device [500] also may include a communication interface [518] coupled to the bus [502]. The communication interface [518] provides a two-way data communication coupling to a network link [520] that is connected to a local network [522]. For example, the communication interface [518] may be an integrated services digital network (ISDN) card, cable modem, satellite modem, or a modem to provide a data communication connection to a corresponding type of telephone line. As another example, the communication interface [518] may be a local area network (LAN) card to provide a data communication connection to a compatible LAN. Wireless links may also be implemented. In any such implementation, the communication interface [518] sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

[0104] The computing device [500] can send messages and receive data, including program code, through the network(s), the network link [520] and the communication interface [518]. In the Internet example, a server [530] might transmit a requested code for an application program through the Internet [528], the ISP [526], the Host [524], the local network [522] and the communication interface [518]. The received code may be executed by the processor [504] as it is received, and/or stored in the storage device [510], or other non-volatile storage for later execution.

[0105] The present disclosure further discloses a non-transitory computer-readable storage medium storing instructions for managing connection between two or more peer network entities, the instructions include executable code which, when executed by one or more units of a system, causes: receive, from a user equipment (UE) [102], an initial context setup (ICS) request; send, to a connected network, the ICS request with one of a registration accept non-access stratum (NAS)

message and a service accept NAS message, wherein the connected network is a wireless communication network with which the UE [102] is connected; receive, at the connected network, one of a connection success indication and a connection failure indication; and perform one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure in an event the AMF module [106] receives a connection failure indication.

[0106] As is evident from the above, the present disclosure provides a technically advanced solution for handling initial context setup (ICS) failure message that is able to avoid loads on the servers due to increase in the rate of initial registrations being initiated by the user devices. Also, implementing the features of the present invention, a person is able to obtain a solution that avoids user purge state that cleans up the network resources at AMF. The present disclosure provides a solution that avoids to cleaning up network resources such as Policy control function (PCF) terminate, Session management function (SMF) release, short message service function (SMSF) de-activate and moves to idle state after completion of Mobility Registration/Periodic Registration/Service Request Procedure at AMF module [106].

[0107] Further, in accordance with the present disclosure, it is to be acknowledged that the functionality described for the various components/units can be implemented interchangeably. While specific embodiments may disclose a particular functionality of these units for clarity, it is recognized that various configurations and combinations thereof are within the scope of the disclosure. The functionality of specific units, as disclosed in the disclosure, should not be construed as limiting the scope of the present disclosure. Consequently, alternative arrangements and substitutions of units, provided they achieve the intended functionality described herein, are considered to be encompassed within the scope of the present disclosure.

[0108] While considerable emphasis has been placed herein on the disclosed embodiments, it will be appreciated that many embodiments can be made and that many changes can be made to the embodiments without departing from the principles of the present disclosure. These and other changes in the embodiments of the present disclosure will be apparent to those skilled in the art, whereby it is to be understood that the foregoing descriptive matter to be implemented is illustrative and non-limiting.

We Claim:

1. A method for handling initial context setup (ICS) failure message, the method comprising:
 - receiving, by an access and mobility management function (AMF) module [106] from a user equipment (UE) [102], an initial context setup (ICS) request;
 - 5 - sending, by the AMF module [106] to a processing unit [202] at a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message,
wherein the connected network is a wireless communication network with which the UE [102] is connected;
 - 10 - receiving, by the AMF module [106] from the processing unit [202] at the connected network, one of a connection success indication and a connection failure indication; and
 - performing, by the AMF module [106], one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure
 - 15 in an event the AMF module [106] receives the connection failure indication.
2. The method as claimed in claim 1, wherein the success procedure comprises registering a state of the UE [102] at the AMF module [106], as a connected state.
- 20 3. The method as claimed in claim 2, wherein the failure procedure comprises performing, reiteratively, following steps, in an event the AMF module [106] receives the connection failure indication:
 - o stopping, an initiation of a network cleanup process at the AMF module [106];
 - o registering, the state of the UE at the AMF module [106], as an idle state;
 - 25 o sending, by the AMF module [106] to the processing unit [202] at the connected network, the ICS request with the one of the registration accept NAS message and the service accept NAS message; and
 - o receiving, by the AMF module [106] from the processing unit [202] at the connected network, one of the connection success indication and the connection
 - 30 failure indication.
4. The method as claimed in claim 1, wherein the initial context setup (ICS) request is one of a periodic request, a service request, and a mobility request.

5. The method as claimed in claim 1, wherein the connection failure indication is received with cause UE Connectivity dropped.
6. The method as claimed in claim 1, wherein the connection failure indication is received, by the AMF module [106] from the processing unit [202], in an event the UE [102] performs handover from one generation of network to another generation of network.
7. A system for handling initial context setup (ICS) failure message, the system comprising:
- an access and mobility management function (AMF) module [106] configured to:
 - receive, from a user equipment (UE) [102], an initial context setup (ICS) request;
 - send, to a processing unit [202] at a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message,
- wherein the connected network is a wireless communication network with which the UE [102] is connected;
- receive, from the processing unit [202] at the connected network, one of a connection success indication and a connection failure indication; and
 - perform one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure in an event the AMF module [106] receives a connection failure indication.
8. The system as claimed in claim 7, wherein the success procedure comprises registering a state of the UE [102] at the AMF module [106], as a connected state.
9. The system as claimed in claim 8, wherein to perform the failure procedure, the AMF module [106] is configured to perform, reiteratively, following steps, in an event the AMF module [106] receives a connection failure indication:
- stop, an initiation of a network cleanup process at the AMF module [106];
 - register, the state of the UE [102] at the AMF module [106], as an idle state;
 - send, by the AMF module [106] to the processing unit [202] at the connected network, the ICS request with the one of the registration accept NAS message and the service accept NAS message; and
 - receive, by the AMF module [106] from the processing unit [202] at the connected network, one of the connection success indication and the connection failure indication.

10. The system as claimed in claim 7, wherein the initial context setup (ICS) request is one of a periodic request, a service request, and a mobility request.
11. The system as claimed in claim 7, wherein the connection failure indication is received with cause UE Connectivity dropped.
12. The system as claimed in claim 7, wherein the connection failure indication is received, by the AMF module [106] from the processing unit [202], in an event the UE [102] performs handover from one generation of network to another generation of network.
13. A non-transitory computer-readable storage medium storing instructions for managing connection between two or more peer network entities, the instructions include executable code which, when executed by one or more units of a system, causes:
- an access and mobility management function (AMF) module [106] to:
 - o receive, from a user equipment (UE) [102], an initial context setup (ICS) request;
 - o send, to a connected network, the ICS request with one of a registration accept non-access stratum (NAS) message and a service accept NAS message, wherein the connected network is a wireless communication network with which the UE [102] is connected;
 - o receive, at the connected network, one of a connection success indication and a connection failure indication; and
 - o perform one of: a success procedure in an event the AMF module [106] receives the connection success indication, and a failure procedure in an event the AMF module [106] receives a connection failure indication.

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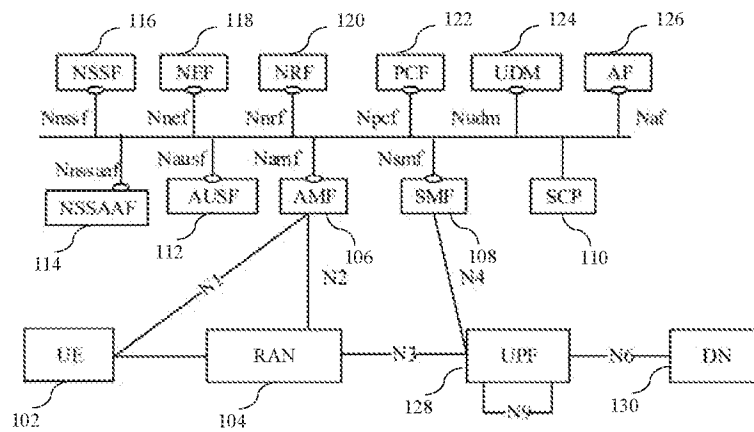


FIG. 1

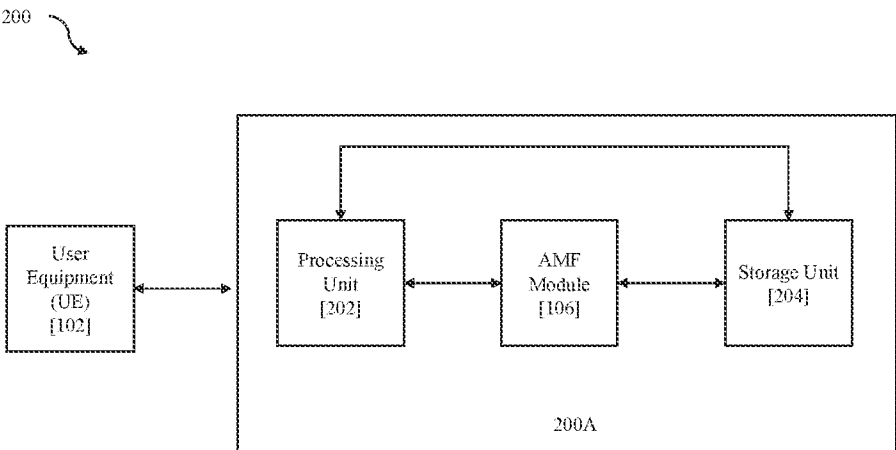


FIG. 2

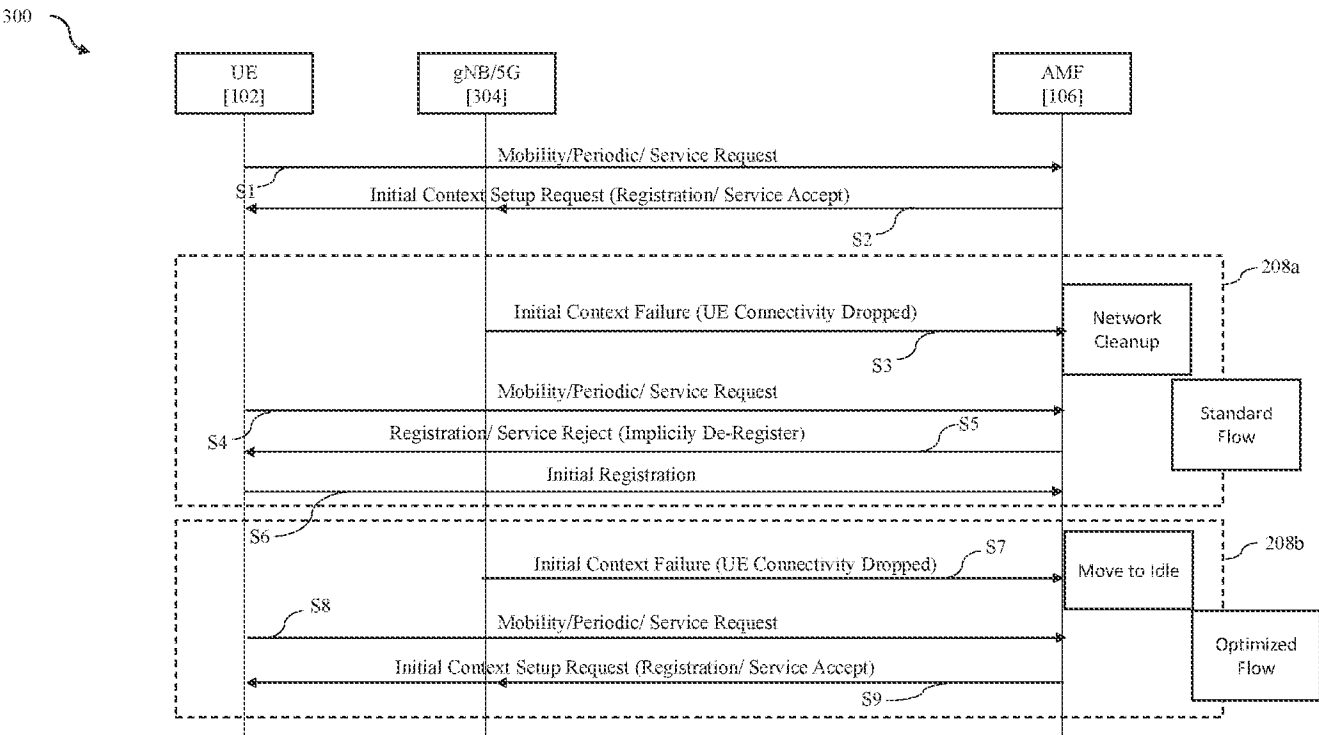


FIG. 3

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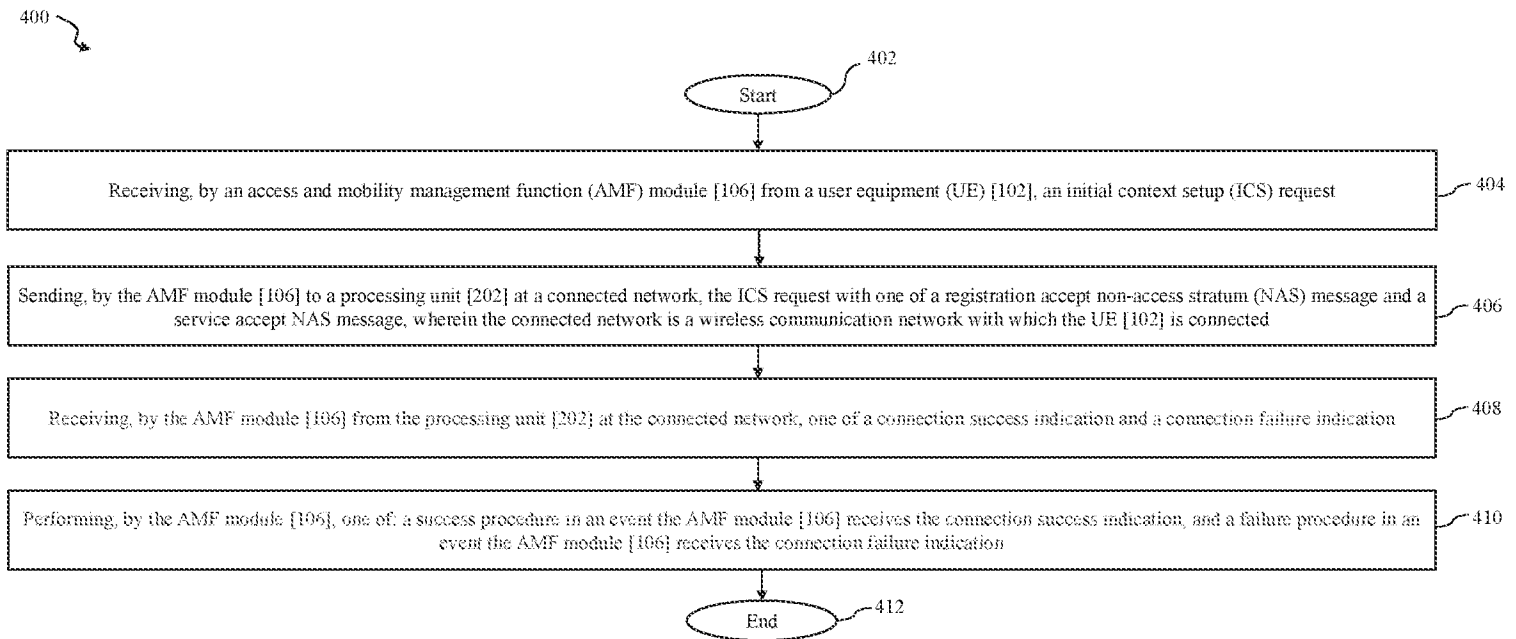


FIG. 4

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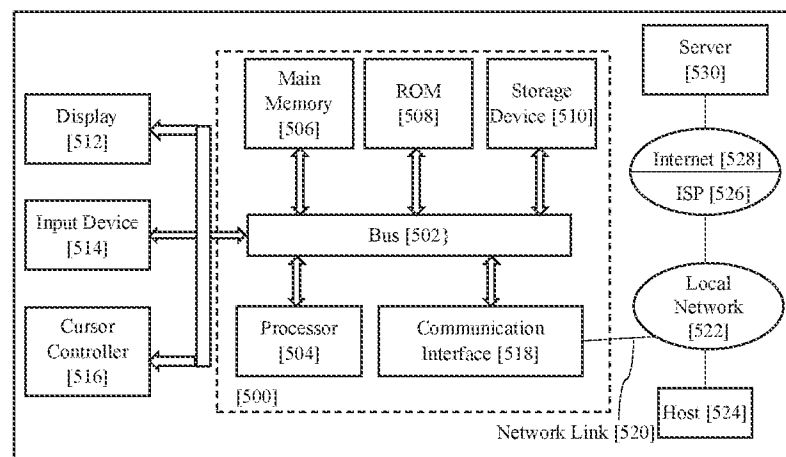


FIG. 5

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference FPA02123-PA03486-PO198		FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/IN2024/050976	International filing date (day/month/year) 27-06-2024	(Earliest) Priority Date (day/month/year) 05-07-2023	
Applicant JIO PLATFORMS LIMITED			

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 3

☐ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☒ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IN2024/050976

A. CLASSIFICATION OF SUBJECT MATTER

H04W60/04, H04W76/18, H04W60/00, H04W76/10, H04W76/25, H04W76/27, H04W4/70, H04W36/00 Version=2024.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database consulted during the international search (name of database and, where practicable, search terms used)

PatSeer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	3GPP TS 38.413 V15.9.0 (2020-09); 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NG-RAN; NG Application Protocol (NGAP); (Release 15) section 8.3.1 -----	1-13
Y	US20220361054A1 (LG ELECTRONICS INC) 10 Nov 2022 (10-11-2022) paragraphs [0065-0076]	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

05-11-2024

Date of mailing of the international search report

05-11-2024

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