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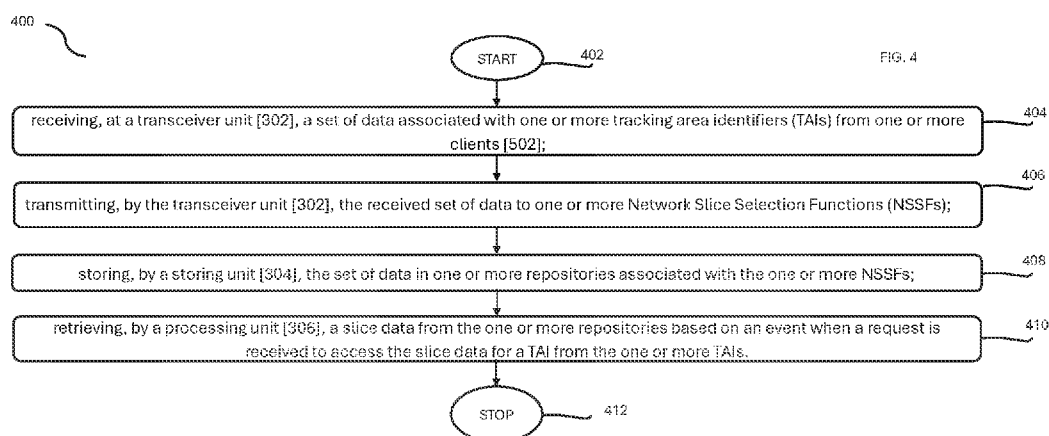
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(54) Title: METHOD AND SYSTEM FOR RETRIEVING SLICE DATA IN A COMMUNICATION NETWORK



(57) Abstract: The present disclosure relates to a method and a system for retrieving slice data in a communication network. The method includes receiving, at a transceiver unit [302], a set of data associated with one or more tracking area identifiers (TAIs) from one or more clients. Further the method includes transmitting, by the transceiver unit [302], the received set of data to one or more Network Slice Selection Functions (NSSFs) [116]. The method further encompasses storing, by a storing unit [304], the set of data in one or more repositories associated with the one or more NSSFs [116]. Furthermore, the method includes retrieving, by a processing unit [306], a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

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METHOD AND SYSTEM FOR RETRIEVING SLICE DATA IN A COMMUNICATION NETWORK

TECHNICAL FIELD

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[0001] Embodiments of the present disclosure generally relate to wireless communication systems. More particularly, embodiments of the present disclosure relate to retrieving slice data in a communication network.

10 BACKGROUND

[0002] The following description of the 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
15 be appreciated that this section is used only to enhance the understanding of the reader with respect to the present disclosure, and not as admissions of the prior art.

[0003] Wireless communication technology has rapidly evolved over the past few decades, with each generation bringing significant improvements and advancements. The first
20 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
25 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.

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[0004] In the 5G communication system, several functional modules are provided, for example an Access and Mobility Management Function (AMF), a Network Slice Selection Function (NSSF), and/or a Network Repository Function (NRF), etc., one or more of which interacts with each other to implement multiple operations of the 5G communication system.
35 NSSF is one of the key components of 5G communication system. One such operation relates

to assigning of slice to the UE in the 5G wireless communication. Notably, the NSSF is an important network function in the 5G wireless communication system. The NSSF is provided to select different slices (for different service types), as per the requirement of different UEs. The 5G communication system can deploy multiple Network Slice Instances delivering exactly the same features for different groups of UEs. The NSSF offers services to the AMF and NSSF in a different PLMN via the NSSF service-based interface. Following are the key Network Slice Selection Function (NSSF) functionalities:

- Authorize the set of network slice instances for AMF Availability (Registration).
- Determining the Allowed NSSAI for selection of Slice.
- Determining the AMF Set /Candidate list to be used to serve the UE based on the AMF Availability (registration).

[0005] Existing solutions in network slice management, particularly in Public Land Mobile Networks (PLMN), often face significant challenges in managing the enormous volume of slice data associated with different Tracking Area Identifiers (TAIs). The prior art involves querying large datasets, which can contain data for thousands of TAIs and hundreds of slices. The existing techniques are not only inefficient but also time-consuming, leading to delays that adversely affect the network's response times to slice data requests. Furthermore, the lack of an effective synchronization mechanism in the prior art means that any updates to the slice data require repeated queries across all Network Slice Selection Function (NSSF) instances, further complicating the process and introducing latency. The existing systems are typically reliant on traditional database models, which are not optimized for the dynamic and extensive data requirements of modern 5G networks, thereby struggling with scalability and real-time data retrieval challenges. This results in a bottleneck effect, especially when the system attempts to handle simultaneous queries from multiple clients, thus impacting overall network performance and reliability.

[0006] Thus, there exists an imperative need in the art to provide an efficient system and method for retrieving slice data in a communication network.

SUMMARY

[0007] 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.

[0008] An aspect of the present disclosure may relate to a method for retrieving slice data in a communication network. The method includes receiving, at a transceiver unit, a set of data associated with one or more tracking area identifiers (TAIs) from one or more clients. The method further includes transmitting, by the transceiver unit, the received set of data to one or more Network Slice Selection Functions (NSSFs). Furthermore, the method includes storing, by a storing unit, the set of data in one or more repositories associated with the one or more NSSFs. Further, the method encompasses retrieving, by a processing unit, a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

[0009] In an exemplary aspect of the present disclosure, the slice data is stored in one or more repositories associated with the one or more NSSFs in a synchronous manner.

[0010] In an exemplary aspect of the present disclosure, the request to propagate the slice data across the one or more NSSFs [116] is performed via a web-socket connection [512].

[0011] In an exemplary aspect of the present disclosure, the set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs.

[0012] In an exemplary aspect of the present disclosure, slice data comprises of details associated with available network resources, and network slice capabilities.

[0013] In an exemplary aspect of the present disclosure, the one or more NSSFs are part of a cluster, configured to synchronise the set of data in a uniform manner by broadcasting, by the transceiver unit, the received set of data to the one or more NSSFs.

[0014] In an exemplary aspect of the present disclosure, the broadcasting is triggered by an update to the slice data in the one or more repositories.

[0015] In an exemplary aspect of the present disclosure, the set of data associated with the one or more tracking area identifiers (TAIs) is received in a slice database from the one or more clients.

[0016] Another aspect of the present disclosure may relate to a system for retrieving slice data in a communication network. The system includes a transceiver unit, configured to receive a set of data for one or more tracking area identifiers (TAIs) from one or more clients. The transceiver unit is further configured to transmit the received set of data to one or more

Network Slice Selection Functions (NSSFs). Furthermore, the system includes a storing unit configured to store the set of data in one or more repositories associated with the one or more NSSFs. The system further includes a processing unit configured to retrieve a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

[0017] Yet another aspect of the present disclosure may relate to a non-transitory computer readable storage medium storing instructions for retrieving slice data in a communication network, the instructions include executable code which, when executed by one or more units of a system, causes a transceiver unit of the system to receive a set of data for one or more tracking area identifiers (TAIs) from one or more clients and transmit the received set of data to one or more Network Slice Selection Functions (NSSFs). Further, the instructions include executable code which, when executed by one or more units of a system, causes a storing unit of the system to store the set of data in one or more repositories associated with the one or more NSSFs. Further, the instructions include executable code which, when executed by one or more units of a system, causes a processing unit of the system to retrieve a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

OBJECTS OF THE INVENTION

[0018] Some of the objects of the present disclosure, which at least one embodiment disclosed herein satisfies are listed herein below.

[0019] It is an object of the present disclosure to provide a system and a method for retrieval of slice data and availability document data in NSSF.

[0020] It is another object of the present disclosure to provide a system and a method for a synchronization mechanism to facilitate the seamless dissemination of slice data across all NSSF instances, eliminating the need for frequent database queries.

[0021] It is another object of the present disclosure to provide a system and a method for restructuring of conventional or standard slice document that is being stored in slice database storage of NSSF application and it is broadcasted across all NSSF application instances to sync slice document uniformly which are part of same cluster.

DESCRIPTION OF THE DRAWINGS

[0022] 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. Also, the embodiments shown in the figures are not to be construed as limiting the disclosure, but the possible variants of the method and system according to the disclosure are illustrated herein to highlight the advantages of the disclosure. It will be appreciated by those skilled in the art that disclosure of such drawings includes disclosure of electrical components or circuitry commonly used to implement such components.

[0023] FIG. 1 illustrates an exemplary network architecture diagram of communication between the NSSF and the system, in accordance with exemplary implementation of the present disclosure.

[0024] FIG. 2 illustrates an exemplary block diagram of a computing device upon which the features of the present disclosure may be implemented in accordance with exemplary implementation of the present disclosure.

[0025] FIG. 3 illustrates an exemplary block diagram of a system for retrieving slice data in a communication network, in accordance with exemplary implementations of the present disclosure.

[0026] FIG. 4 illustrates a method flow diagram for retrieving slice data in a communication network in accordance with exemplary implementations of the present disclosure.

[0027] FIG. 5 illustrates an exemplary method flow for retrieving slice data in NSSF, in accordance with exemplary embodiments of the present disclosure.

[0028] The foregoing shall be more apparent from the following more detailed description of the disclosure.

DETAILED DESCRIPTION

[0029] 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 may 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.

[0030] 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.

[0031] 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, processes, and other components may be shown as components in block diagram form in order not to obscure the embodiments in unnecessary detail.

[0032] 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 may 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.

[0033] 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 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.

[0034] As used herein, a “processing unit” or “processor” or “operating processor” includes one or more processors, wherein processor refers to any logic circuitry for processing instructions. A 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 (Digital Signal Processing) 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 or processing unit is a hardware processor.

[0035] As used herein, “a user equipment”, “a user device”, “a smart-user-device”, “a smart-device”, “an electronic device”, “a mobile device”, “a handheld device”, “a wireless communication device”, “a mobile communication device”, “a communication device” may be any electrical, electronic and/or computing device or equipment, capable of implementing the features of the present disclosure. The user equipment/device may include, but is not limited to, a mobile phone, smart phone, laptop, a general-purpose computer, desktop, personal digital assistant, tablet computer, wearable device or any other computing device which is capable of implementing the features of the present disclosure. Also, the user device may contain at least one input means configured to receive an input from at least one of a transceiver unit, a processing unit, a storage unit, a detection unit and any other such unit(s) which are required to implement the features of the present disclosure.

[0036] As used herein, “storage unit” or “memory unit” refers to a machine or computer-readable medium including any mechanism for storing information in a form readable by a computer or similar machine. For example, a computer-readable medium includes read-only memory (“ROM”), random access memory (“RAM”), magnetic disk storage media, optical storage media, flash memory devices or other types of machine-accessible storage media. The

storage unit stores at least the data that may be required by one or more units of the system to perform their respective functions.

[0037] As used herein “interface” or “user interface refers to a shared boundary across which two or more separate components of a system exchange information or data. The interface may also be referred to a set of rules or protocols that define communication or interaction of one or more modules or one or more units with each other, which also includes the methods, functions, or procedures that may be called.

[0038] As user herein “cluster” refers to a group of Network Slice Selection Functions (NSSFs) that operate collectively within a telecommunications network to manage and synchronize network slice data effectively. Each NSSF in the cluster is responsible for handling specific tasks related to the dynamic allocation and optimization of network slices based on real-time data regarding network resources, user demands, and geographic distribution. The cluster is designed to ensure uniformity and coherence across the network by broadcasting updates and changes in slice data to all NSSF instances simultaneously.

[0039] All modules, units, components used herein, unless explicitly excluded herein, may be software modules or hardware processors, the processors being a general-purpose processor, a special purpose processor, a conventional processor, a digital signal processor (DSP), a plurality of microprocessors, one or more microprocessors in association with a DSP core, a controller, a microcontroller, Application Specific Integrated Circuits (ASIC), Field Programmable Gate Array circuits (FPGA), any other type of integrated circuits, etc.

[0040] As used herein the transceiver unit include at least one receiver and at least one transmitter configured respectively for receiving and transmitting data, signals, information, or a combination thereof between units/components within the system and/or connected with the system.

[0041] As discussed in the background section, existing solutions in network slice management, particularly in Public Land Mobile Networks (PLMN), often face significant challenges in managing the enormous volume of slice data associated with different Tracking Area Identifiers (TAIs). The prior art involves querying large datasets, which can contain data for thousands of TAIs and hundreds of slices. The existing techniques are not only inefficient but also time-consuming, leading to delays that adversely affect the network's response times

to slice data requests. Furthermore, the lack of an effective synchronization mechanism in the prior art means that an updates to the slice data require repeated queries across all Network Slice Selection Function (NSSF) instances, further complicating the process and introducing latency. The existing systems are typically reliant on traditional database models, which are not optimized for the dynamic and extensive data requirements of modern 5G networks, thereby struggling with scalability and real-time data retrieval challenges. This results in a bottleneck effect, especially when the system attempts to handle simultaneous queries from multiple clients, thus impacting overall network performance and reliability.

[0042] To overcome these and other inherent problems in the art, the present disclosure proposes a solution of streamlining the management of network slice data within Public Land Mobile Networks (PLMNs) through an optimized in-memory data store, which addresses the inefficiencies of querying large datasets containing thousands of Tracking Area Identifiers (TAIs) and multiple network slices. The proposed method significantly enhances the process of retrieving and synchronizing slice data across various Network Slice Selection Function (NSSF) instances, which traditionally suffered from slow response times due to the extensive size of the datasets. The proposed solution comprises receiving a set of data associated with one or more TAIs from clients at a transceiver unit. The data is then transmitted to one or more NSSFs, where it is stored in a repository that is designed to handle and synchronize the slice data more effectively. The introduction of an event-driven retrieval process, where slice data is fetched based on specific requests for a TAI, ensures that data is accessed only when needed, thereby reducing unnecessary database queries. For example, when a client device moves into a new tracking area and requires information on available network slices, it can send a request that triggers the retrieval of specific slice data from the NSSF. The proposed solution avoids the need for the client or the server to scan through an entire traditional database, which would typically involve significant delays. Instead, the data associated with the specific TAI is quickly accessible, allowing for prompt service provision without lag. Furthermore, the proposed solution provides the data is not only stored but also synchronized across all NSSF instances in a uniform manner. This is achieved through broadcasting updates to the slice data whenever there are changes, ensuring all instances have the latest data without the need for each instance to individually query for updates. This broadcasting mechanism, triggered by updates in the slice data, exemplifies an effective synchronization process that mitigates the issues found in previous systems where frequent, separate queries to each database instance created bottlenecks.

[0043] It would be appreciated by the person skilled in the art that the proposed solution provides a robust framework for handling large volumes of slice data associated with various TAIs in a PLMN. By optimizing the data storage and retrieval processes and introducing synchronized updates across all instances of the NSSF, the solution effectively addresses the scalability and latency issues previously encountered in modern 5G networks, ensuring quicker response times and enhanced reliability in network performance.

[0044] Hereinafter, exemplary embodiments of the present disclosure will be described with reference to the accompanying drawings.

[0045] **FIG. 1** illustrates an exemplary network architecture diagram of communication between a Network Slice Selection Function (NSSF) [116] and a system [300].

[0046] The 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.

[0047] The present disclosure is implemented by the system [300] (as shown in FIG. 3). Referring to FIG. 1, an exemplary network architecture diagram of the implementation of system [100] is shown. The system [100] is in connection with the at least one NSSF [116]. The system [300] as shown in FIG. 3 includes at least one transceiver unit [302], at least one storing unit [304], and at least one processing unit [306].

[0048] The transceiver unit [302] of the system [300] may send a set of data to the NSSF [116]. The set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs. The slice data is stored in one or more repositories associated with the one or more NSSFs [116] in a synchronous manner. Synchronous storage facilitates in ensuring that whenever the slice data is updated or modified in one repository, these changes are simultaneously reflected across all linked repositories associated with the NSSFs [116].

[0049] Further, the components and working of the system [300] will be explained further with reference to FIG. 3.

[0050] **FIG. 2** illustrates an exemplary block diagram of a computing device [200] upon which the features of the present disclosure may be implemented in accordance with

exemplary implementation of the present disclosure. In an implementation, the computing device [200] may also implement a method for mapping a target person identity to a user identity utilising the system. In another implementation, the computing device [200] itself implements the method mapping a target person identity to a user identity, using one or more units configured within the computing device [200], wherein said one or more units are capable of implementing the features as disclosed in the present disclosure.

[0051] The computing device [200] may include a bus [202] or other communication mechanism for communicating information, and a hardware processor [204] coupled with bus [202] for processing information. The hardware processor [204] may be, for example, a general-purpose microprocessor. The computing device [200] may also include a main memory [206], such as a random-access memory (RAM), or other dynamic storage device, coupled to the bus [202] for storing information and instructions to be executed by the processor [204]. The main memory [206] also may be used for storing temporary variables or other intermediate information during execution of the instructions to be executed by the processor [204]. Such instructions, when stored in non-transitory storage media accessible to the processor [204], render the computing device [200] into a special-purpose machine that is customized to perform the operations specified in the instructions. The computing device [200] further includes a read only memory (ROM) [208] or other static storage device coupled to the bus [202] for storing static information and instructions for the processor [204].

[0052] A storage device [210], such as a magnetic disk, optical disk, or solid-state drive is provided and coupled to the bus [202] for storing information and instructions. The computing device [200] may be coupled via the bus [202] to a display [212], such as a cathode ray tube (CRT), Liquid crystal Display (LCD), Light Emitting Diode (LED) display, Organic LED (OLED) display, etc. for displaying information to a computer user. An input device [214], including alphanumeric and other keys, touch screen input means, etc. may be coupled to the bus [202] for communicating information and command selections to the processor [204]. Another type of user input device may be a cursor controller [216], such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor [204], and for controlling cursor movement on the display [212]. The 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.

[0053] The computing device [200] 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 [200] causes or programs the computing device [200] to be a special-purpose machine. According to one implementation, the techniques herein are performed by the computing device [200] in response to the processor [204] executing one or more sequences of one or more instructions contained in the main memory [206]. Such instructions may be read into the main memory [206] from another storage medium, such as the storage device [210]. Execution of the sequences of instructions contained in the main memory [206] causes the processor [204] to perform the process steps described herein. In alternative implementations of the present disclosure, hard-wired circuitry may be used in place of or in combination with software instructions.

[0054] The computing device [200] also may include a communication interface [218] coupled to the bus [202]. The communication interface [218] provides a two-way data communication coupling to a network link [220] that is connected to a local network [222]. For example, the communication interface [218] 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 [218] 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 [218] sends and receives electrical, electromagnetic or optical signals that carry digital data streams representing various types of information.

[0055] The computing device [200] can send messages and receive data, including program code, through the network(s), the network link [220] and the communication interface [218]. In the Internet example, a server [230] might transmit a requested code for an application program through the Internet [228], the ISP [226], the local network [222], the host [224], and the communication interface [218]. The received code may be executed by the processor [204] as it is received, and/or stored in the storage device [210], or other non-volatile storage for later execution.

[0056] The present disclosure is implemented by a system [300] (as shown in FIG. 3). In an implementation, the system [300] may include the or reside in the computing device [200] (as shown in FIG. 2). It is further noted that the computing device [200] may perform the steps of a method [400] (as shown in FIG. 4).

[0057] Referring to **FIG. 3**, an exemplary block diagram of a system [300] for retrieving slice data in a communication network is shown, in accordance with the exemplary implementations of the present disclosure. The system [300] comprises at least one transceiver unit [302], at least one storing unit [304], and at least one processing unit [306]. Also, all the components/ units of the system [300] are assumed to be connected to each other unless otherwise indicated below. As shown in the figures all units shown within the system should also be assumed to be connected to each other. Also, in FIG. 3 only a few units are shown, however, the system [300] may comprise multiple such units or the system [300] may comprise any such numbers of said units, as required to implement the features of the present disclosure. Further, in an implementation, the system [300] may be present in a user device to implement the features of the present disclosure. The system [300] may be a part of the user device / or may be independent of but in communication with the user device (may also referred herein as a UE). In another implementation, the system [300] may reside in a server or a network entity. In yet another implementation, the system [300] may reside partly in the server/ network entity and partly in the user device.

[0058] The system [300] is configured for retrieving slice data in a communication network, with the help of the interconnection between the components/units of the system [300].

[0059] The system [300] includes a transceiver unit [302], configured to receive a set of data for one or more tracking area identifiers (TAIs) from one or more provisioning clients [502]. The one or more provisioning clients may be an Operations Support System (OSS), a business support system (BSS), and the like. The set of data associated with the one or more tracking area identifiers (TAIs) is received in a slice database from the one or more provisioning clients [502]. Tracking Area Identifiers (TAIs) are a set of identifiers which are used to track and control the location of a user equipment. For example, in a telecommunication network where various mobile devices operate within distinct geographic regions known as tracking areas, each area is assigned a unique TAI. When a client, such as a mobile phone or a network-connected device, moves into a new tracking area or initiates communication from within a tracking area, it sends data related to its location and other network requirements to the transceiver unit [302]. The set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs. A slice data refers to division of a network into different segments. The slice data comprises of

details associated with available network resources, and network slice capabilities. In an exemplary embodiment of the present disclosure, in the 5G Core network, an area 'X' of the city is divided into multiple TAIs. In the area X- Client A has TAI X_001, Client B has TAI X_002, Client C has TAI X_003. The transceiver unit [302] receives information of the TAIs like available network resources data, network slice capacity data, and the like.

[0060] The transceiver unit [302] is further configured to transmit the received set of data to one or more Network Slice Selection Functions (NSSFs) [116]. Once the transceiver unit [302] receives data associated with the tracking area identifiers (TAIs) from the one or more provisioning clients [502], the transceiver unit [302] then transmits the set of data to the Network Slice Selection Functions (NSSFs) [116] for optimal resource allocation and management. The one or more clients include but are not limited only to mobile device, computing device, user device, and IoT sensor. The set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs. The one or more NSSFs [116] are part of a cluster, configured to synchronise the set of data in a uniform manner by broadcasting, by the transceiver unit, the received set of data to the one or more NSSFs [116]. For example, a telecommunications network that spans across various geographical regions, each served by different NSSFs within the cluster. When the transceiver unit receives updated data, such as changes in network load or service demands from a specific region (such TAIs), the data needs to be updated across all relevant NSSFs to maintain uniformity in network slice management. The NSSF is configured to transmit the set of data in a synchronous manner, i.e., broadcasting updates to all instances in the cluster simultaneously, which ensures that each instance has the same, most current version of the data. Each slice can be configured such that to meet specific service requirements, such as high bandwidth, low latency, or mass connectivity. By sending the TAI-associated data to the one or more NSSFs [116], the transceiver unit [302] enables the network to dynamically adjust and optimize the allocation of resources across different slices, ensuring that each client receives the necessary level of service with minimal delay.

[0061] The broadcasting is triggered by any modification to the slice data in the one or more repositories. When slice data, such as resource availability, or network capabilities, is modified in one repository, the changes need to be propagated quickly across all NSSFs in a uniform manner to prevent discrepancies that could affect service delivery. For instance, if adjustments are made to the bandwidth allocation in a particular network slice due to

increased demand in a specific area, this updated information is immediately broadcast to all NSSFs in the cluster.

[0062] The slice data comprises of details associated with available network resources, and network slice capabilities. The available network resources include information on the type and amount of network resources currently available or allocated within a specific network slice. The network slice capabilities refer to specific capabilities of a network slice, such as support for ultra-reliable low-latency communications (URLLC), enhanced Mobile Broadband (eMBB), or massive machine type communications (MTC). Each capability is suited to different types of applications, eMBB for high-speed internet services, URLLC for critical missions requiring rapid data transmission like remote surgery or autonomous driving, and mMTC for handling communications across a large number of IoT devices.

[0063] In an implementation of the present disclosure, the data received by the transceiver unit [102] of the clients is transmitted to the NSSFs, where the NSSFs are deployed as part of a cluster to handle network slice management. Each NSSF microservice instance in the cluster is responsible for managing network slices for specific geographical regions or service domains within the metropolitan area. NSSF_X is deployed to manage the network slices in the geographical area X of the city in a synchronous manner to ensure that the network slices contain the most recent version of the data. For example, in a large-scale event, like a sports game, where thousands of spectators are simultaneously using their devices. Each device communicates its TAI along with any specific network service requirements. UE in different locations report their TAC and request for slice to be used in a tracking area. The NSSF facilitates providing the slice data. They consider factors such as network load, the type of service requested by the clients, and the geographic distribution of the clients within the tracking areas.

[0064] The system further includes a storing unit [304], communicatively coupled to the transceiver unit [302]. The storing unit [304] is configured to store the set of data in one or more repositories associated with the one or more Network Slice Selection Functions (NSSFs) [116]. For example, a telecommunications operator that manages data traffic for millions of users across multiple regions. As the transceiver unit receives tracking area identifiers (TAIs) and related network usage data from users' devices, this data must be stored efficiently to facilitate quick access and processing. The storing unit organizes the set of data into repositories that are specifically linked to the NSSFs. Each repository under the storing unit's

control is optimized for rapid data retrieval and high throughput. The set of data stored can include but not limited only to user device locations, and the types of services being accessed. In an implementation of the present disclosure, for the geographical area 'X' of the city, the storing unit associated with the NSSF_X is X-store, which stores the information of TAIs from clients A, B and C.

[0065] The slice data is stored in one or more repositories associated with the one or more NSSFs [116] in a synchronous manner. Synchronous storage facilitates in ensuring that whenever slice data is updated or modified in one repository, these changes are simultaneously reflected across all linked repositories. The synchronization facilitates in maintaining data integrity and consistency across the network. For example, a network that serves a large metropolitan area with multiple NSSFs managing different segments of the network. If a change is made to the slice configuration for a particular TAI to accommodate a surge in data traffic during a large event, it's essential that this change is propagated instantly to all NSSFs that might also serve or interact with that TAI. The propagation of the slice data across the one or more NSSFs may ensure that any changes made at any part of the network regarding resource allocation are based on the most current and accurate Slice data available.

[0066] The system further includes the processing unit [306], communicatively coupled to the storing unit [304]. The processing unit [306] is configured to retrieve slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs. The request to propagate the slice data across the one or more NSSFs [116] may be received via a web-socket connection [512]. The web socket connection is two-way simultaneous communication channel which means that the connection between client and server will keep alive until it is terminated by either party.

[0067] In an implementation of the present disclosure, the processing unit [306] retrieves the data of the particular slice data from the X-store for a mentioned TAI from the stored multiple TAIs of multiple clients in the X-store via a web-socket connection [512] efficiently. For example, a significant event, such as a major public celebration, leads to a sudden influx of mobile users in a specific tracking area. As the users begin to access various network services, the demand for data related to that particular TAI spikes. Devices in the area might start requesting high bandwidth applications such as video streaming or large-scale data uploads, which necessitates specific types of network slices to handle the load effectively.

[0068] Referring to FIG. 4, an exemplary method flow diagram [400] for retrieving slice data in a communication network, in accordance with exemplary implementations of the present disclosure is shown. In an implementation the method [400] is performed by the system [300]. Further, in an implementation, the system [300] may be present in a server device to implement the features of the present disclosure. Also, as shown in FIG. 4, the method [400] starts at step [402].

[0069] At step [404], the method comprises receiving, at a transceiver unit [302], a set of data associated with one or more tracking area identifiers (TAIs) from one or more provisioning clients [502]. The one or more provisioning clients may be an Operations Support System (OSS), a business support system (BSS), and the like. The set of data associated with the one or more tracking area identifiers (TAIs) is received in a slice database from the one or more provisioning clients [502]. Tracking Area Identifiers (TAIs) are a set of identifiers which are used to track and control the location of a user equipment. For example, in a telecommunication network where various mobile devices operate within distinct geographic regions known as tracking areas, each area is assigned a unique TAI. When a client, such as a mobile phone or a network-connected device, moves into a new tracking area or initiates communication from within a tracking area, it sends data related to its location and other network requirements to the transceiver unit [302]. The set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs. A slice data refers to division of a network into different segments. The slice data comprises of details associated with available network resources, and network slice capabilities. In an implementation of the present disclosure, in the 5G Core network, an area 'X' of the city is divided into multiple TAIs. In the area X- Client A has TAI X_001, Client B has TAI X_002, Client C has TAI X_003. The transceiver unit [302] receives information of the TAIs like available network resources data, network slice capacity data, and the like.

[0070] Next at step [406], the method further comprises transmitting, by the transceiver unit [302], the received set of data to one or more Network Slice Selection Functions (NSSFs). Once the transceiver unit [302] receives data associated with the tracking area identifiers (TAIs) from the one or more provisioning clients [502], the transceiver unit [302] then transmits the set of data to the Network Slice Selection Functions (NSSFs) [116] for optimal resource allocation and management. The one or more clients include but not limited only to mobile device, computing device, user device, and IoT sensor. The set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more

TAIs. The one or more NSSFs [116] are part of a cluster, configured to synchronise the set of data in a uniform manner by broadcasting, by the transceiver unit, the received set of data to the one or more Network NSSFs. For example, a telecommunications network that spans across various geographical regions, each served by different NSSFs instances within the cluster. When the transceiver unit receives updated data, such as changes in network load or service demands from a specific region (such TAIs), the data needs to be updated across all relevant NSSFs instance to maintain uniformity in network slice management. The NSSF is configured to transmit the set of data in a synchronous manner, i.e., broadcasting updates to all instances in the cluster simultaneously, which ensures that each instance has the same, most current version of the data. Each slice can be configured such that to meet specific service requirements, such as high bandwidth, low latency, or mass connectivity. By sending the TAI-associated data to the one or more NSSFs [116], the transceiver unit [302] enables the network to dynamically adjust and optimize the allocation of resources across different slices, ensuring that each client receives the necessary level of service with minimal delay.

[0071] In an implementation of the present disclosure, the data received by the transceiver unit [102] of the clients is transmitted to the NSSFs, where the NSSFs are deployed as part of a cluster to handle network slice management. Each NSSF in the cluster is responsible for managing network slices for specific geographical regions or service domains within the metropolitan area. NSSF_X is deployed to manage the network slices in the geographical area X of the city in a synchronous manner to ensure that the network slices contain the most recent version of the data. For example, in a large-scale event, like a sports game, where thousands of spectators are simultaneously using their devices. Each device communicates its TAI along with any specific network service requirements. The transceiver unit gathers the multitude of data points and transmits them to the NSSFs.

[0072] Next at step [408], the method further comprises storing, by a storing unit [304], the set of data in one or more repositories associated with the one or more NSSFs. The slice data is stored in one or more repositories associated with the one or more NSSFs [116] in a synchronous manner. For example, a telecommunications operator that manages data traffic for millions of users across multiple regions. As the transceiver unit receives tracking area identifiers (TAIs) and related network usage data from users' devices, this data must be stored efficiently to facilitate quick access and processing. The storing unit organizes the set of Slice data into repositories that are specifically linked to the NSSFs. Each repository under the storing unit's control is optimized for rapid data retrieval. In an implementation of the present

disclosure, for the geographical area 'X' of the city, the storing unit associated with the NSSF_X is X-store, which stores the information of TAIs from clients A, B and C.

[0073] Next at step [410], the method further encompasses retrieving, by a processing unit [306], a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs. The request to propagate the slice data across the one or more NSSFs [116] may be received via a web-socket connection [512]. In an implementation of the present disclosure, retrieving of set of data of the particular slice data from the X-store for a mentioned TAI from the stored multiple TAIs of multiple clients in the X-store via a web-socket connection [512] is performed efficiently by the processing unit [306]. The web socket connection is two-way simultaneous communication channel which means that the connection between client and server will keep alive until it is terminated by either party.

[0074] Referring to FIG. 5 illustrates an exemplary functional diagram of the system [300] for retrieving slice data in the NSSF [116], in accordance with exemplary embodiments of the present disclosure. In an implementation, the system [300] performs a method [500]. Further, in an implementation, the system [300] may be present in a server device to implement the features of the present disclosure.

[0075] The system [300] comprises at least one client [502], a provisioning application [504a], a processing unit [504b], a server [504], NSSF 1 [506a], NSSF 2 [506b], decision unit 1 [508a], decision unit 2 [508b], slice data storage unit 1 [510a], slice data storage unit 2 [510b], database [514], web-socket connection 1 [512a], and web-socket connection 2 [512b].

[0076] The provisioning application [504a] acts as an intermediary that facilitates the flow of data between the client [502] and the network infrastructure. The provisioning application [504a] receives the set of data from client [502]. The provisioning application [504a] transmits the received set of data to the NSSF [506a] through a web socket connection. The web socket connection helps in providing efficient two-way communication between the client [502], NSSF 1 [506a] and the NSSF 2 [506b], and Server [504]. The client [502] includes network-connected device (such as user device, mobile device) that sends slice data pertaining to Public Land Mobile Networks (PLMNs) and Tracking Area Identifiers (TAIs) to the provisioning application [504a]. The slice data contains essential information about network resources, and the capabilities required to support various network services and applications.

[0077] The NSSF 1 [506a] comprises a decision unit 1 [508a] and a slice data storage unit 1 [510a]. The NSSF 2 [506b] comprises a decision unit 2 [508b] and a slice data storage unit 2 [510b]. The decision unit 1 [508a] analyses the received data and makes determinations about which network slice instances to activate or modify based on the current network demands as indicated by the TAI range. Thereafter, the slice data storage unit 1 [510a] or the slice data storage unit 2 [510b] stores the appropriate slice data of the network. The database [514] serves as a central repository for all the slice data, ensuring it is securely stored and readily accessible for ongoing network operations. The provisioning application [504a] and a processing unit [504b], connected through server [504], can access the database [514] to retrieve or update data as needed.

[0078] It would be apparent to the person skilled in the art that the present disclosure describes the present disclosure using only one NSSF unit. However, the system may comprise multiple such units or the system may comprise any such numbers of said units, as required to implement the features of the present disclosure.

[0079] Exemplarily, the slice data information in the slice data storage unit may be stored as per the format shown in following table:

PLMN + Slice	List TAIs	List TAI Ranges
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Table 1

[0080] Exemplarily, list of TAIs contains list of distinct TAIs (TAI1, TAI2)

[0081] Exemplarily, list of TAI Ranges contains list of TAI ranges (TAI1..., TAI100, TAI12, ..., 200)

PLMN Slice	AMF Instance (AMF Set)	List TAIs	List TAI Ranges
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Table 2

[0082] It would be appreciated by the person skilled in the art that there is no need for whole document to be scanned, for any query needs to be done with respect to slice and TAIs. Therefore, a bigger document can be stored in an efficient way thereby reducing query response time.

[0083] The present disclosure further discloses a non-transitory computer readable storage medium storing instructions for retrieving slice data in a communication network, the instructions include executable code which, when executed by one or more units of a system, causes a transceiver unit of the system to receive a set of data for one or more tracking area identifiers (TAIs) from one or more clients and transmit the received set of data to one or more Network Slice Selection Functions (NSSFs). Further, the instructions include executable code which, when executed by one or more units of a system, causes a storing unit of the system to store the set of data in one or more repositories associated with the one or more NSSFs. Further, the instructions include executable code which, when executed by one or more units of a system, causes a processing unit of the system to retrieve a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

[0084] Further, in accordance with the present disclosure, it is to be acknowledged that the functionality described for the various the 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 encompassed within the scope of the present disclosure.

[0085] As is evident from the above, the present disclosure provides a technically advanced solution for retrieving slice data in a communication network. The present solution provides a method and system for a synchronization mechanism to facilitate the seamless dissemination of slice data across all NSSF instances, eliminating the need for frequent database queries by implementing an optimized in-memory data store which significantly improves the process of retrieving necessary information from the slice data store. This results in reduced retrieval time and minimizing network latency and addresses the challenge of synchronizing slice data across multiple NSSF instances. The present disclosure restructures the standard slice document that is stored in slice data-store of NSSF application and broadcasts it across all NSSF application instances to synchronize slice document uniformly.

[0086] While considerable emphasis has been placed herein on the disclosed implementations, it will be appreciated that many implementations can be made and that many changes can be made to the implementations without departing from the principles of the present disclosure. These and other changes in the implementations 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.

5

We Claim:

1. A method to retrieve slice data in a communication network, the method comprising:
5 receiving, at a transceiver unit [302], a set of data associated with one or more tracking area identifiers (TAIs) from one or more provisioning clients [502];
transmitting, by the transceiver unit [302], the received set of data to one or more Network Slice Selection Functions (NSSFs) [116];
storing, by a storing unit [304], the set of data in one or more repositories associated
10 with the one or more NSSFs [116]; and
retrieving, by a processing unit [306], a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.
- 15 2. The method as claimed in claim 1, wherein the slice data is stored in one or more repositories associated with the one or more NSSFs [116] in a synchronous manner.
3. The method as claimed in claim 1, wherein the request to propagate the slice data across the one or more NSSFs [116] is received via a web-socket connection [512].
20
4. The method as claimed in claim 1, wherein the set of data comprises a set of slice data associated with one or more PLMNs and a list of corresponding one or more TAIs.
5. The method as claimed in claim 1, wherein the slice data comprises of details associated
25 with available network resources, and network slice capabilities.
6. The method as claimed in claim 1, wherein the one or more NSSFs [116] are part of a cluster, configured to synchronise the set of data in a uniform manner by broadcasting, by the transceiver unit, the received set of data to the one or more NSSFs [116].
30
7. The method as claimed in claim 6, wherein the broadcasting is triggered by an update to the slice data in the one or more repositories.

8. The method as claimed in claim 1, wherein the set of data associated with the one or more tracking area identifiers (TAIs) is received in a slice database from the one or more provisioning clients [502].

- 5 9. A system to retrieve slice data in a communication network, the system comprising:
a transceiver unit [302], configured to:
receive a set of data for one or more tracking area identifiers (TAIs) from one or
more provisioning clients [502]; and
transmit the received set of data to one or more Network Slice Selection
10 Functions (NSSFs) [116];
a storing unit [304] configured to store the set of data in one or more repositories
associated with the one or more NSSFs [116]; and
a processing unit [306] configured to retrieve a slice data from the one or more
repositories based on an event when a request is received to access the slice data for a TAI
15 from the one or more TAIs.
10. The system as claimed in claim 9, wherein the slice data is stored in one or more repositories
associated with the one or more NSSFs [116] in a synchronous manner.
- 20 11. The system as claimed in claim 9, wherein the request to propagate the slice data across the
one or more NSSFs [116] is received via a web-socket connection [512].
12. The system as claimed in claim 9, wherein the set of data comprises a set of slice data
associated with one or more PLMNs and a list of corresponding one or more TAIs.
- 25 13. The system as claimed in claim 9, wherein the slice data comprises of details associated with
available network resources, and network slice capabilities.
14. The system as claimed in claim 9, wherein the one or more NSSFs [116] are part of a cluster,
30 configured to synchronise the set of data in a uniform manner by broadcasting, by the
transceiver unit, the received set of data to the one or more NSSFs [116].
15. The system as claimed in claim 14, wherein the broadcasting is triggered by an update to the
slice data in the one or more repositories.
- 35

16. The system as claimed in claim 9, wherein the set of data associated with the one or more tracking area identifiers (TAIs) is received in a slice database from the one or more provisioning clients [502].
- 5 17. A non-transitory computer-readable storage medium storing instructions for retrieving slice data in a communication network, the instructions comprising executable code which, when executed by one or more units of a system, causes:
- 10 a transceiver unit [3021] to:
- receive a set of data for one or more tracking area identifiers (TAIs) from one or more provisioning clients [502]; and
- transmit the received set of data to one or more Network Slice Selection Functions (NSSFs) [116];
- a storing unit [304] configured to store the set of data in one or more repositories associated with the one or more NSSFs [116]; and
- 15 a processing unit [306] configured to retrieve a slice data from the one or more repositories based on an event when a request is received to access the slice data for a TAI from the one or more TAIs.

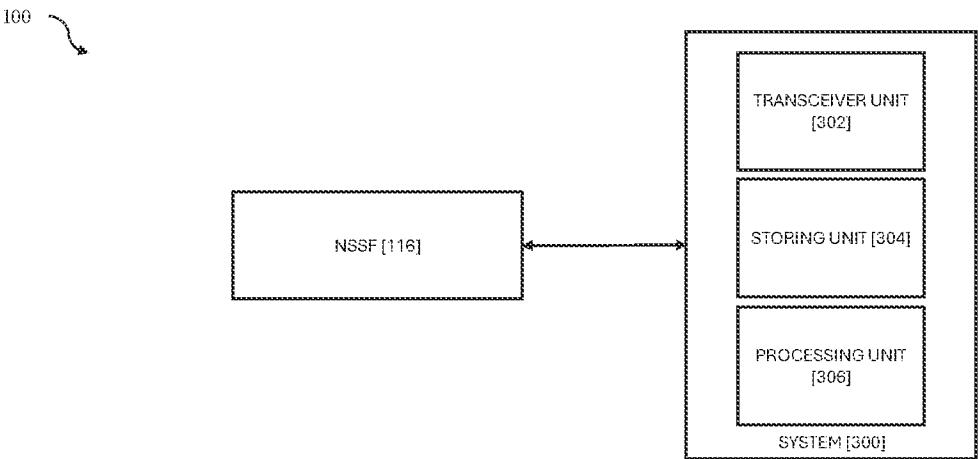


FIG. 1

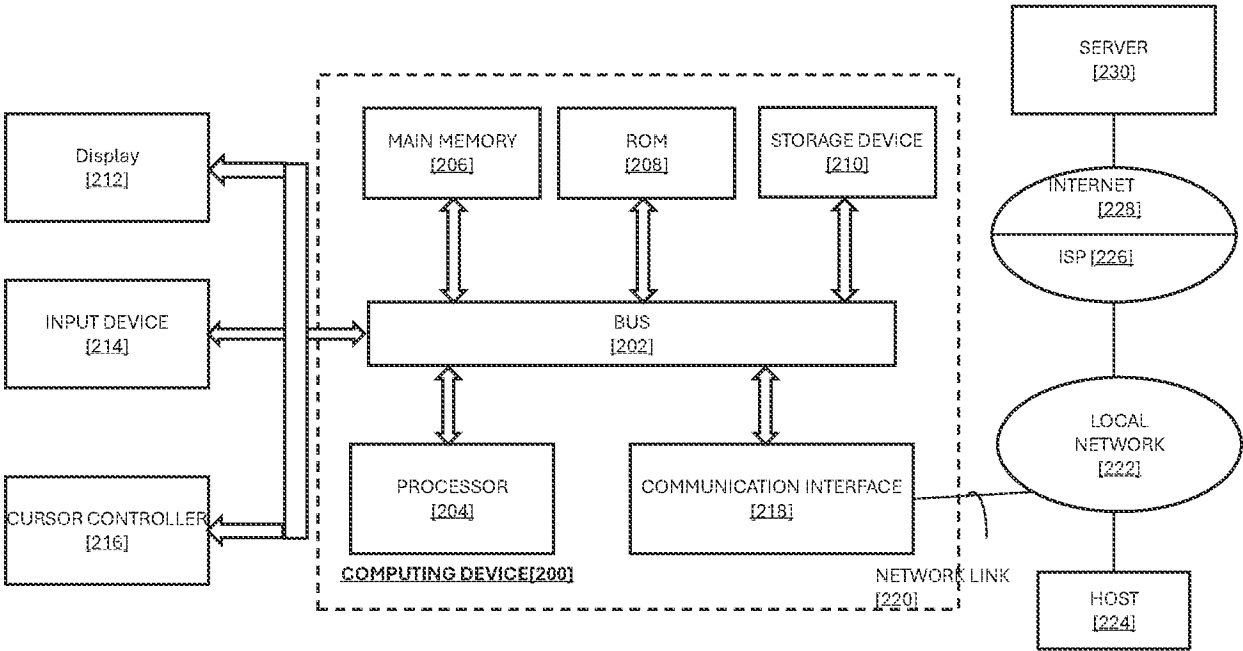


FIG. 2

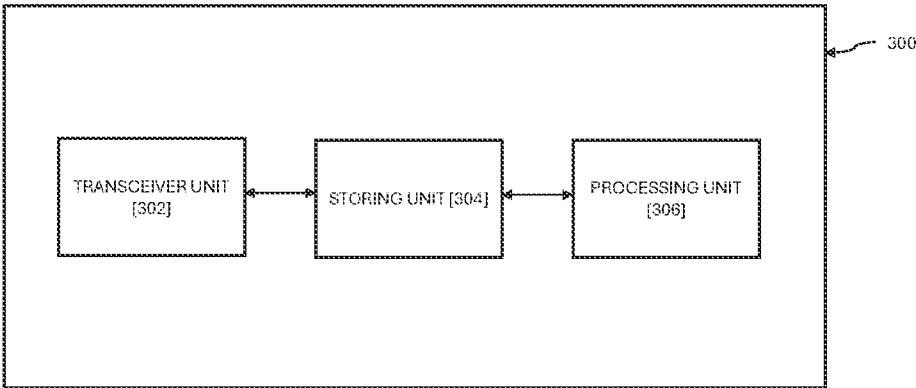


FIG. 3

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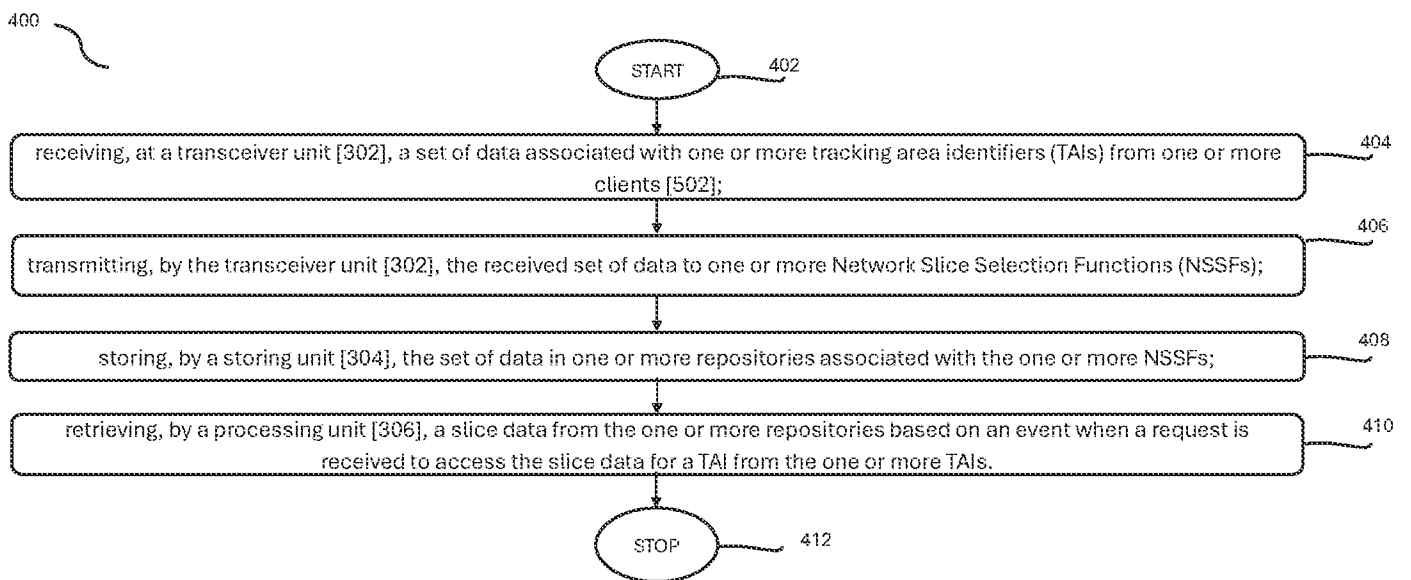


FIG. 4

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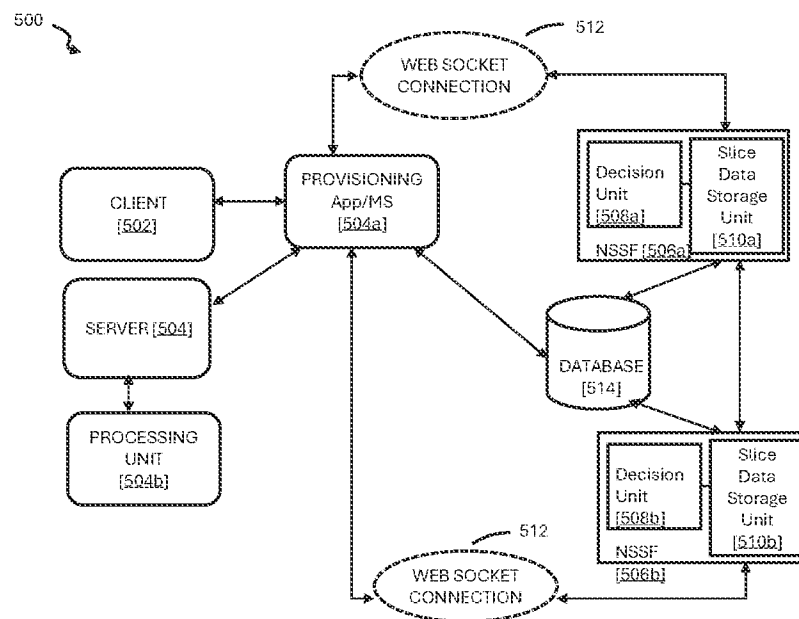


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2024/050938

A. CLASSIFICATION OF SUBJECT MATTER

H04W48/18, H04W48/16, H04W60/04, H04W24/02 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)

DATABASES: IPO INTERNAL DATABASE, PATSEER

KEYWORDS: TRACKING IDENTIFIERS, NSSF

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN116170859A (Guangzhou Aipu Road Network Technology Co Ltd) (26/05/2023) 26 May 2023 whole document	1-16
Y	----- Network Slice Selection Function (NSSF) Cloud Native User's Guide; Release 1.2; F21274-02 (Oracle® Communications) (31/03/2020) 31 March 2020 whole document	1-16



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

14-10-2024

Date of mailing of the international search report

14-10-2024

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/IN2024/050938

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 17
because they relate to subject matter not required to be searched by this Authority, namely:
The subject matter of claim 17 relates to computer programs, which does not require an international search by the International Searching Authority in accordance with PCT Article 17(2)(a)(i) and [Rule 39.1(vi)].
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.