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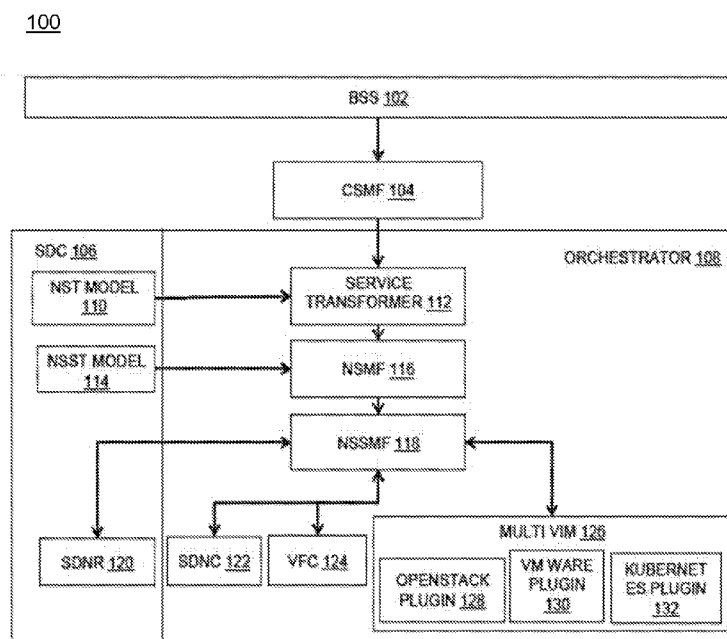


FIG. 1

(57) **Abstract:** The present disclosure provides an edge cloud architecture (100). The edge cloud architecture (100) includes BSS (102), CSMF (104), SDC (106), orchestrator (108), NST model (110), service transformer (112), NSST model (114), NSMF (116), and NSSMF (118). In addition, the edge cloud architecture (100) includes SDNR (120), SDNC (122), VFC (124), multi-VIM (126), open-stack plugin (128), VM Ware plugin (130), and Kubernetes plugin (132). The present disclosure further provides a method for creating end to end network slicing by dynamically creating and combining a plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network. The created E2E network slice is assigned to the service.



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SYSTEM AND METHOD FOR DYNAMICALLY CREATING END TO END NETWORK SLICES

TECHNICAL FIELD

[0001] The present invention seeks priority from patent application number 202011009932 filed on 7th March 2020. The present disclosure relates to the field
5 of wireless communication technology and, in particular, relates to a system and method for dynamically creating end to end network slices.

BACKGROUND

[0002] In the present scenario, wireless communications technology has a
10 significant role in making network of modern network infrastructure. The wireless communications technology allows exchange of information over significant distances and refers to all types of voice, data and video transmission. With an increasing demand in the usage of the wireless communications technology, fifth generation (5G) wireless communication technology has become a hot spot in
15 modern network industry. In addition, the 5G wireless communication technology supports a plurality of application needs. Further, the plurality of application needs includes support for higher speed, high bandwidth access, lower latency, and highly reliable information interaction. Furthermore, the 5G wireless communication technology supports a variety of vertical industry applications for vehicle
20 networking, emergency communications, Internet of Things (IoT), remotely controlled robots, heterogeneous sensors connections, and industrial Internet. Moreover, frequency spectrum of the 5G wireless communication technology is characterized into millimeter waves, mid-band, and low-band. However, the 5G wireless communication technology requires network slicing to efficiently embrace
25 the variety of vertical industry applications. Conventional network slicing systems and methods are inefficient to create end-to-end network slices. In addition, the conventional network slicing systems and methods are ineffective to support the variety of vertical industry applications. Further, the conventional network slicing systems and methods are cost-ineffective to design and monitor the end-to-end

network slices. Furthermore, the conventional network slicing systems and methods are inadequate to satisfy end-customer requirements. Moreover, the conventional network slicing systems and methods are imprecise in managing the variety of vertical industry applications.

- 5 [0003] The patent reference US10644955B2 provides a method for network slicing using appropriate slicing formats with varying degrees, based on customer requirements, however the reference could not address the problem of updating the network resource partitions in core network, RAN network and transport network, based on run time requirements by a service at user end. In light of the above stated
10 discussion, there is a need for a system and method that overcomes the above stated drawbacks.

OBJECT OF THE DISCLOSURE

- [0004] A primary object of the present disclosure is to provide an edge cloud
15 architecture that allocates appropriate amount of network resources to specific slice.

[0005] Another object of the present disclosure is to provide the edge cloud architecture that produces low latency.

- [0006] Another object of the present disclosure is to provide the edge cloud architecture that utilizes virtual network functions and software-defined networking
20 to divide physical network into multiple virtual networks based on customer requirements.

[0007] Another object of the present disclosure is to provide the edge cloud architecture that reduces expenses and capital expenditure.

SUMMARY

- [0008] In an aspect of the present disclosure, the present disclosure provides an edge cloud architecture. The edge cloud architecture includes BSS, CSMF, SDC, orchestrator, NST model, service transformer, NSST model, NSMF, and NSSMF. In addition, the edge cloud architecture includes SDNR, SDNC, VFC, multi-VIM,
30 openstack plugin, VM Ware plugin, and Kubernetes plugin. The BSS (business

support system) facilitates end users to place a customer service request. In addition, the BSS transfers the customer service request to the CSMF (customer service management function). Further, the customer service request is placed with facilitation of TMF-641. The CSMF provides service ACK (acknowledgment) to the BSS after reception of the customer service request. In addition, the CSMF converts the customer service request into RFS (resource facing service) requirements through TMF-641. Further, the CSMF provides RFS requirements to ST (slicing template). Furthermore, the ST provides ack (acknowledgment) to the CSMF after reception of RFS requirements. Moreover, the ST provides NST (network slice template), service profile and NSD ID to the NSMF. The NSMF provides NSST (network slice subnet template), splice profile, and NSSD ID to the NSSMF. The NSSMF (network slice subnet management function) provides instantiate slice for each NSSD to the VFC (virtual function component). In addition, the NSSMF provides service ID and ack (acknowledgment) to the ST. Further, the VFC interfaces with the multi-VIM. Furthermore, the multi-VIM provides VM UUIDs along with state.

[0009] In an embodiment of the present disclosure, the BSS is associated with the CSMF (customer service management function).

[0010] In an embodiment of the present disclosure, the CSMF translates customer service requirements to network slice requirements.

[0011] In an embodiment of the present disclosure, the CSMF notifies end users about failures related to customer service requirements through the BSS. In addition, the CSMF notifies about changes occurred in service level objective, SLA (service level agreement), and the like to keep track of issues.

[0012] In an embodiment of the present disclosure, the CSMF collects customer service requirements along with service specification from end users.

[0013] In an embodiment of the present disclosure, the CSMF is associated with the service transformer. In addition, the CSMF in association with the service transformer converts customer service requirements to RFS (Radio frequency system) requirements. Further, the CSM converts RFS requirements to end to end network slice requirements.

[0014] In an embodiment of the present disclosure, the SDC corresponds to service design and creation.

[0015] In an embodiment of the present disclosure, the CSMF accepts TMF aligned API calls from the BSS.

5 [0016] In an embodiment of the present disclosure, the NSMF is responsible for management and orchestration of the NSI.

[0017] In an embodiment of the present disclosure, the NSMF derives network slice subnet related requirements from network slice related requirements.

10 [0018] In an embodiment of the present disclosure, the NSMF communicates with the NSSMF and the CSMF.

[0019] Accordingly, herein discloses a method for providing an end to end (E2E) network slice for a service in a wireless communication network. The wireless communication network is a physical network infrastructure comprising at least one core network, a radio access network (RAN), and a transport network. The method
15 includes dynamically creating a plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network, wherein the plurality of dedicated logical partitions corresponds to the service. Further, the method includes combining the plurality of dedicated logical partitions to form the E2E network slice, wherein the E2E network slice corresponds to the
20 service. Furthermore, the method includes assigning the E2E network slice to the service.

[0020] The method for dynamically creating the plurality of logical partitions of network resources further comprises: dynamically creating a sub slice for the service in each of the core network, the radio access network and the transport
25 network, each of the sub-slice in the core network, the radio access network and the transport network corresponds to network resource requirement by the service, in the core network, the radio access network and the transport network.

[0021] The method further comprises monitoring consumption of network resources associated to the E2E network slice during run time.

[0022] The method further comprises dynamically adjusting network resource allocation to the E2E network slice by changing the resource allocation in the E2E network slice, based on run-time requirements of the service.

5 [0023] The method further comprises comparing the network resources associated with the E2E slice with at least one dynamically defined run time network resource requirement for the service.

[0024] The method further comprises dynamically defining at least one run time network resource requirement for the service.

10 [0025] Accordingly, herein discloses an orchestrator for creating an end to end (E2E) network slice for a service in a wireless communication system. The wireless communication network is a physical network infrastructure comprising at least one of a core network, a radio access network (RAN), and a transport network, the orchestrator managing a plurality of network resources corresponding to the physical network infrastructure in the wireless communication network, the
15 orchestrator receiving a request for E2E network slice from a user for the service, the orchestrator communicating with at least one radio access network controller. The orchestrator comprising a resource partitioning unit configured to dynamically create a plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network, wherein the plurality
20 of dedicated logical partitions corresponds to the service. Further, the orchestrator comprising a slice creation unit configured to combine the plurality of dedicated logical partitions to form the E2E network slice, wherein the E2E network slice corresponds to the service. Furthermore, the orchestrator comprising a slice assigning unit configured to assign the E2E network slice to the service.

25 [0026] The dynamic creation of the plurality of logical partitions of network resources, by the resource partitioning unit, further comprising: dynamically creating a sub slice for the service in each of the core network, the radio access network and the transport network, each of the sub-slice in the core network, the radio access network and the transport network corresponds to network resource
30 requirement by the service, in the core network, the radio access network and the transport network.

[0027] The orchestrator further comprising a monitoring unit configured to monitor consumption of network resources associated to the E2E network slice during run time.

5 [0028] The orchestrator further comprising a dynamic allocation unit configured to dynamically adjust network resource allocation to the E2E network slice by changing the resource allocation in the E2E network slice, based on run-time requirements of the service.

10 [0029] The orchestrator further comprises a resource management unit configured to compare the network resources associated with the E2E slice with at least one dynamically defined run time network resource requirement for the service. The resource management unit is further configured to dynamically define at least one run time network resource requirement for the service.

[0030] The orchestrator further comprises a virtual infrastructure management unit configured to allow flexibility in allocation of resources to the E2E slice.

15 [0031] The orchestrator is at least one of: a service orchestrator, an edge orchestrator, a global service orchestrator, and a master orchestrator.

BRIEF DESCRIPTION OF FIGURES

20 [0032] Having thus described the disclosure in general terms, reference will now be made to the accompanying figures, wherein:

[0033] **FIG. 1** illustrates an edge cloud architecture in 5G network technology for creating end to end network slices to provide network services.

[0034] **FIG. 2** illustrates a flow chart for creating end to end network slicing to provide network services using the edge cloud architecture.

25 [0035] **FIG. 3** illustrates a hardware framework of the edge cloud architecture.

[0036] **FIG. 4** illustrates various hardware elements of an orchestrator.

[0037] **FIG. 5** is a flowchart illustrating a method for providing the end-to-end network slice for the service in a wireless communication network.

30 [0038] It should be noted that the accompanying figures are intended to present illustrations of exemplary embodiments of the present disclosure. These figures are

not intended to limit the scope of the present disclosure. It should also be noted that accompanying figures are not necessarily drawn to scale.

DETAILED DESCRIPTION

[0039] In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present technology. It will be apparent, however, to one skilled in the art that the present
5 technology can be practiced without these specific details. In other instances, structures and devices are shown in block diagram form only in order to avoid obscuring the present technology.

[0040] Reference in this specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection
10 with the embodiment is included in at least one embodiment of the present technology. The appearance of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some
15 embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but no other embodiments.

[0041] Moreover, although the following description contains many specifics for the purposes of illustration, anyone skilled in the art will appreciate that many variations and/or alterations to said details are within the scope of the present
20 technology. Similarly, although many of the features of the present technology are described in terms of each other, or in conjunction with each other, one skilled in the art will appreciate that many of these features can be provided independently of other features. Accordingly, this description of the present technology is set forth without any loss of generality to, and without imposing limitations upon, the present
25 technology.

[0042] **FIG. 1** illustrates an edge cloud architecture **100** in 5G network technology to create end to end network slices for providing network services. Network services may be any service provided by service provider to user using the network infrastructure and resources. Example of network services may be communication
30 services, calling service, video conferencing service, messaging service, virtual reality service, augmented reality service, machine to machine communication

service, vehicle to vehicle or vehicle to everything (V2X) services, and similar other services which may be provided by a service provider. In general, 5G network slicing facilitates service providers to create virtual end to end networks sliced to application requirements. In an example, 5G network slicing has reliable low latency. In addition, 5G networks are optimized using dynamic network slicing. Further, dynamic network slicing allows dynamic end to end network partitioning. Network slicing may be a specific form of virtualization that allows multiple logical networks to run on top of a shared physical network infrastructure. The key benefit of the network slicing concept is that it provides an end-to-end virtual network encompassing not just networking but compute and storage functions as well. With network slicing, the available network resources may be utilized efficiently to facilitate multiple services for a user.

[0043] The edge cloud architecture **100** includes BSS **102**, CSMF **104**, SDC **106**, orchestrator **108**, NST model **110**, service transformer **112**, NSST model **114**, NSMF **116**, and NSSMF **118**. In addition, the edge cloud architecture **100** includes SDNR **120**, SDNC **122**, VFC **124**, multi-VIM **126**, openstack plugin **128**, VM Ware plugin **130**, and Kubernetes plugin **132**.

[0044] The edge cloud architecture **100** includes the BSS **102**. The BSS **102** corresponds to business support system. In general, business support system (BSS) sets up relationship between network service providers and end users. In addition, business support system (BSS) performs a plurality of operations. Further, the plurality of operations includes receiving orders from end users (customers). Furthermore, the plurality of operations includes ensuring completion of order. Moreover, the plurality of operations includes processing bill for end users. Also, the plurality of operations includes collecting payment from end users. In an example, the BSS **102** is utilized by telecom industry to run business operations towards customers. In another example, the BSS **102** manages one or more processes. In addition, the one or more processes include but may not be limited to product management, customer management, order management, and revenue management. In an embodiment of the present disclosure, the BSS **102** is associated with the CSMF (customer service management function) **104**.

[0045] The edge cloud architecture 100 includes the CSMF 104. The CSMF 104 corresponds to customer service management function. In an embodiment of the present disclosure, the CSMF 104 translates customer service requirements to network slice requirements. In an example, the CSMF 104 is an entity that utilizes one or more networking parameters to deploy a network slice in association with customer service requirements. In an embodiment of the present disclosure, the CSMF 104 notifies end users about failures related to customer service requirements through the BSS 102. In addition, the CSMF 104 notifies about changes occurred in service level objective, SLA (service level agreement), and the like to keep track of issues. In an embodiment of the present disclosure, the CSMF 104 collects customer service requirements along with service specification from end users. In an embodiment of the present disclosure, the CSMF 104 is associated with the service transformer 112. In addition, the CSMF 104 in association with the service transformer 112 converts customer service requirements to RFS (resource facing service) requirements. The RFS may be technical services corresponding to customer Service requirements at the orchestrator end. The customer service requirements may be converted to RFS requirements, in order to provide virtual network functions and physical network functions for the customer service requirements. Further, the CSMF 104 converts RFS requirements to end to end network slice requirements. In addition, the RFS facilitates one or more software services for the fifth generation (5G) communication infrastructure. Further, the one or more software services include but may not be limited to drafting, designing, modeling, simulation, analyzing infrastructure, testing, error detection, and 5g-installation solutions. Furthermore, the fifth generation (5G) communication infrastructure includes a plurality of elements. Moreover, the plurality of elements includes but may not be limited to one or more small cells, one or more RAN cell towers, one or more antennas, and one or more lightweight duplexers. The 5G communication infrastructure may include atleast an orchestrator (managed by a user or telco) connected with one or more RAN intelligent controllers, which are further connected to RAN network, providing services to a plurality of user equipments. In an embodiment of the present disclosure, the CSMF 104 accepts

TMF aligned API calls from the BSS 102. The TMF aligned API calls may be open APIs provided by TM Forum (<https://www.tmforum.org/about-tm-forum/>) which may support an architecture based on modularity and reuse using industry agreed Open APIs. In general, TMF APIs supports business agility by providing industry
5 agreed open APIs. In addition, TMF APIs provides business solutions through configuration and reconfiguration of systems.

[0046] The edge cloud architecture **100** includes the SDC **106**. In an embodiment of the present disclosure, the SDC **106** corresponds to Service Design and Creation (SDC) platform. In general, Service Design and Creation (SDC) supports complete
10 lifecycle management of fifth generation (5G) communication infrastructure. In addition, the Service Design and Creation (SDC) is used for design and on-boarding of the various models and artifacts for physical and virtual network functions. Further, the Service Design and Creation (SDC) creates descriptors and policies for initial deployment of the fifth generation (5G) communication infrastructure.
15 Furthermore, the Service Design and Creation (SDC) includes descriptors and policies associated with transport connectivity. Moreover, the transport connectivity includes but may not be limited to front-haul connectivity, mid-haul connectivity, and back-haul connectivity. The front-haul connectivity or network may be the connection between the base band to a remote radio unit. The backhaul
20 network may be the transport network that connects the core network and the RAN (Radio Access Network) of the mobile network. The mid-haul connectivity may be link between the controller and the remote radio head that feeds a next link. Also, the Service Design and Creation (SDC) supports data collection and analysis of policies to identify actionable conditions. Also, the service Design and Creation
25 (SDC) support for deployment of the fifth generation (5G) communication infrastructure, optimization and slicing management. In an example, the SDC **106** manages one or more assets. In addition, the one or more assets include but may not be limited to resource and service. Further, resource refers to fundamental capability that is implemented over software or software that interacts with
30 hardware device. Furthermore, each resource is combination of a plurality of virtual function components (VFCs) along with information used to perform a set of

functions. The virtual function components may be components of virtual network functions, which provides handling of specific network functions such as load balancing, network resource monitoring, taking a control action, etc. Moreover, the set of functions includes instantiate, update, delete, and manage resources. Also, the one or more assets include service. Also, service is a kind of object that includes one or more resources. Also, services are created from resources by service designers. Also, services include information that facilitates to instantiate, update, delete, and manage service.

[0047] The edge cloud architecture **100** includes the orchestrator **108**. In general, orchestrator automates, customizes, and enhances service performance to satisfy customer expectations. In addition, the orchestrator automates creation and delivery of services. Further, the orchestrator facilitates edge cloud architecture to provide customized services to customers in short time. The orchestrator **108** includes one or more components. In an embodiment of the present disclosure, the one or more components include but may not be limited to service resolver, service orchestration, policy framework, VES collection framework, DCAE platform, and non-real-time app layer.

[0048] In an embodiment of the present disclosure, service resolver includes definition and decomposition of end to end network slices along with integration to service layer. In addition, service layer integrated with end to end network slices. In an embodiment of the present disclosure, service orchestration handles multi-layer complex hierarchical orchestration. In an embodiment of the present disclosure, policy framework includes template and rules driven policy framework. In an embodiment of the present disclosure, VES collection framework corresponds to virtual event streaming collector. In general, virtual event streaming collection framework supports individual events posted to collector end-point(s) and post to interface/bus for other applications to subscribe. In addition, virtual event streaming collection framework verifies source and validates events against VES schema before distributing. In an embodiment of the present disclosure, VES collection framework mediates data collected through pipelines before transmission of data to bus.

[0049] In an embodiment of the present disclosure, DCAE platform corresponds to Data collection, analytics and events. In addition, DCAE includes a plurality of major components. Further, the plurality of major components includes analytics framework, collection framework, data distribution bus, and persistence storage framework. In general, analytics framework facilitates data development and processing platform using micro-services, policy enabled elementary analytic functions that support structured and unstructured data processing. In general, collection framework includes a set of streaming and batch collectors that support virtualized network devices and infrastructure data. In general, data distribution bus facilitates different components within DCAE (Data collection, analytics and events) and ECOMP (Enhanced Control, Orchestration, Management & Policy) to publish and subscribe to data and transmits data from edge of network downstream for processing. The DCAE platform may support functions to deploy, host and perform **DCAE** service components in a distributed environment. In general, persistence storage framework is data storage platform for short term and long term consumption. In an embodiment of the present disclosure, DCAE is integration framework for analytics and intelligence plugin. In an embodiment of the present disclosure, non-real-time app layer provides power to the edge cloud architecture **100** through AI/ML (artificial intelligence and machine learning) driven applications.

[0050] The edge cloud architecture **100** includes the NST model **110**. The NST model **110** corresponds to network slice template. In general, Network slice instances are created based on network slice templates. In addition, the network slice template (NST) information includes network function description, resource requirement description, network function organization structure, network function configuration, network function, and the like. Further, the network slice template (NST) is governed based on telecom industry requirements and operator's design requirements. Furthermore, the network slice template is used to create instances of Information Object Class (IOC) of network slice. In an example, network slice template T1 is used to create a new network slice instance to satisfy requirements such as enhanced mobile broadband (eMBB), massive machine type

communications mMTC, and ultra-reliable low latency communications (URLLC). The eMBB may be an extension of services first enabled by 4G LTE networks that allows for a high data rate across a wide coverage area. The eMBB may provide the greater capacity necessary to support peak data rates both for large crowds and for end users who are on the move. The mMTC may provide connections to large numbers of devices that intermittently transmit small amounts of traffic. The URLLC may be the new service category in **5G** communication infrastructure to accommodate emerging services and applications having stringent latency and reliability requirements. In another example, network slice template T2 is used to create network slice instances to satisfy specific industry requirements such as vehicle to everything (V2X), smart grid, and Remote Healthcare. In an embodiment of the present disclosure, the NST model **110** is associated with the service transformer **112**.

[0051] The edge cloud architecture **100** includes the service transformer **112**. The service transformer 112 is connected with the NST model 110 of SDC 106 in the orchestrator 108. In general, service transformer facilitates to transform mobile network into software defined network-based mobile transport and computing platform. In addition, the software defined network-based mobile transport and the computing platform transports network slicing into mobile networks. The mobile networks may be the wireless network comprises of RAN network. In an embodiment of the present disclosure, the service transformer 112 receives service request from CSMF 104 and further communicates with the NSMF 116.

[0052] The edge cloud architecture **100** includes the NSST model **114**. The NSST model **114** corresponds to network slice subnet template. In general, Network slice subnet instances are created based on network slice subnet templates. In addition, the network slice subnet template (NSST) includes resource model information, management model information, capability model information, and the like. Further, the resource model information defines static parameters and functional components of network slice subnet. Furthermore, the resource model information includes NSST ID, network slice subnet type, system features, priorities, Quality of Service (QoS) attributes, and the like. Moreover, the network slice subnet type

includes enhanced mobile broadband (eMBB), radio access network (RAN), and the like. Also, the system features include multicast and edge computing. Also, the Quality of Service (QoS) attributes include bandwidth, latency, number of subscribers and the like. Also, the management model information corresponds to

5 information model that is used for network slice subnet lifecycle management. Also, the management model information includes configuration profiles such as application configuration parameters. Also, the capability model information corresponds to supported communication service characteristic information the quality of service (QoS) attributes and capacity such as maximum number of user

10 equipment. Also, the supported communication service characteristic information includes service type, user equipment mobility level, density of subscribers, traffic density, and the like. In an embodiment of the present disclosure, the network slice subnet template (NSST) is characterized in a plurality of ways. In addition, the plurality of ways includes but may not be limited to Global System of Mobile

15 communication (GSM) System, Code Division Multiple Access (CDMA) system, Wideband Code Division Multiple Access (WCDMA) system, Long Term Evolution (LTE) system, and fifth generation (5G) mobile communication system. In an example, network slice subnet template (NSST) T1 is classified as GSM subnet templates. In another example, network slice subnet template (NSST) T2 is

20 classified as CDMA subnet templates. In yet another example, network slice subnet template (NSST) T3 is classified as WCDMA subnet templates. In yet another example, network slice subnet template (NSST) T4 is classified as LTE subnet templates. In yet another example, network slice subnet template (NSST) T5 is classified as 5G subnet templates.

25 **[0053]** In an embodiment of the present disclosure, the NSST model **114** is associated with the NSMF **116**. In addition, the NSMF **116** corresponds to network slice management function. In an embodiment of the present disclosure, the NSMF **116** is responsible for management and orchestration of the NSI. In general, network slice management function consists of service instance layer, network slice

30 instance layer, and resource layer. NSI is the network slice instance which may be consist of a set of network functions, and resources to run the network functions,

forming a complete instantiated logical network in order to meet certain network characteristics required by the service. In addition, service instance layer is managed by orchestrator associated with BSS (business support system). Further, network slice instance layer is business to business management function.

5 In an example, the NSMF **116** (network slice management function) creates end to end slice with facilitation of different technology domains. In addition, the NSMF **116** controls performance of end to end slice. In an embodiment of the present disclosure, the NSMF **116** resides over the NSSMF **118** (network slice subnet management function). In an embodiment of the present disclosure, the NSMF **116**
 10 derives network slice subnet related requirements from network slice related requirements. In an embodiment of the present disclosure, the NSMF **116** communicates with the NSSMF **118** and the CSMF **104**.

[0054] The edge cloud architecture **100** includes the NSSMF **118**. The NSSMF **118** corresponds to network slice subnet management function. In an embodiment
 15 of the present disclosure, the NSSMF **118** is responsible for management and orchestration of the NSST model **114** via NSMF **116**. In an embodiment of the present disclosure, the NSSMF **118** communicates with the SDNR **120**, the SDNC **122**, and the VFC **124** to fulfill creation of the NSSI on network. In an embodiment of the present disclosure, the NSSMF **118** communicates with NSMF **116**. In
 20 general, network slice subnet management function manages network slice subnet. In addition, network slice subnet is composed of network function. In general, NSSMF is responsible and management of NSSI (network slice subnet instances). In addition, NSSI contains required network function (NF). Furthermore, NSSMF receives required resources to create NSSI from network functions. Moreover,
 25 NSSMF manages and controls transmission of user NSSI to form the NSI. Also, NSSMF removes or replaces deactivated resources or reallocate to another NSSI.

[0055] The edge cloud architecture **100** includes the SDNR **120**. The SDNR **120** corresponds to software defined network-radio. In general, SDNR implements open APIs to control and manage physical and virtual network functions. The
 30 virtual network functions may be software implementation of network devices which are virtualized and run on a virtual machine which are movable and scalable.

In addition, SDNR is used for radio technologies, such as radio access network (RAN), distributed antenna systems, wireless transport, and the like. Also, the SDNR 120 may provide APIs for physical and virtual network functions in order to facilitate creation of end to end network slice. The SDNR 120 may coordinate with
5 NSSMF 118 for managing and controlling the physical and virtual network functions, in order to create the end to end network slices dynamically.

[0056] The edge cloud architecture **100** includes the SDNC **122**. The SDNC **122** corresponds to software-defined networking controller. Software defined networking (SDN) may be an approach to network management that enables
10 dynamic, programmatically efficient network configuration in order to improve network performance and monitoring. SDN may be an architecture that abstracts different, distinguishable layers of a network in order to make networks agile and flexible. In general, software-defined networking (SDN) controller is an application in a software-defined networking (SDN) architecture that manages flow control for
15 improved network management and application performance. In addition, the SDN controller runs on a server and uses protocols to enable packets to transfer using switches where to send packets. Further, the SDN controller directs traffic according to forwarding policies that a network operator puts in place. Furthermore, the SDN controller facilitates automated network management and
20 allows easy integration and administration of business applications. Moreover, the SDN controller serves as an operating system (OS) for the network.

[0057] The edge cloud architecture **100** includes the multi-VIM **126**. The multi-VIM **126** corresponds to virtualized infrastructure manager. In general, Virtualized Infrastructure Manager is entity responsible for management of the underlying NFV
25 Infrastructure (NFVI) of the fifth generation (5G) Mobile communication system. NFVI stands for network functions virtualization infrastructure, which may encompass all of the networking hardware and software needed to support and connect virtual network functions in carrier networks. In an embodiment of the present disclosure, the multi-VIM **126** are the entities that act as intermediary
30 between orchestrator and physical resources located at a plurality of levels. The physical resources located at the plurality of levels may be physical network

resources, such as storage device, computing device, processing component. In addition, the plurality of levels includes Core VIM for data center level, Edge VIM for network edge level, extended edge for devices level, and the like. The core VIM may be the virtual infrastructure manager for controlling, managing, and monitoring the NFVI compute, storage, and network hardware, the software for the virtualization layer, and the virtualized resources at the data center level. Similarly, the network edge uses the Edge VIM and end user devices use extended edge, for implementing the VIM functionality. Further, the multi-VIM includes a plurality of plugins. The plurality of plugins includes but may not be limited to openstack plugin **128**, VMware plugin **130**, Kubernetes plugin **132**. The plurality of plugins such as openstack plugins 128, VMware plugin 130, Kubernetes plugin 132 may control pools of compute, storage, and networking resources that can be managed through their respective APIs. Furthermore, each of the multi-VIM **126** includes a plurality of virtual machine universal unique identifiers (UUIDs). In an embodiment of the present disclosure, the multi-VIM **126** provides adapter layer for communication between orchestration platform and various downstream infrastructure platforms, such as openstack plugin **128**, VMware plugin **130**, and Kubernetes plugin **132**.

[0058] FIG 2 illustrates a flow chart **200** to create end to end network slicing for providing network services using the edge cloud architecture **100**.

[0059] The BSS **102** facilitates end users to place a customer service request. In an embodiment of the present disclosure, the BSS **102** transfers the customer service request to the CSMF **104**. In addition, the customer service request is placed with facilitation of TMF-641, which is an open API provided by the TM Forum. In general, TMF-641 is service order API. In addition, TMF-641 is REST-API for service order management. The REST-API may be an architectural style for an application program interface (API) that uses HTTP requests to access and use data. Further, TMF-641 provides mechanism to place service order with order parameters. Furthermore, TMF-641 allows users to create, update, and retrieve service orders. Moreover, TMI-641 allows users to manage notification related to service order.

[0060] In an embodiment of the present disclosure, the CSMF **104** provides service ACK (acknowledgment) to the BSS **102** after reception of the customer service request. In an embodiment of the present disclosure, the CSMF **104** converts the customer service request into RFS requirements through TMF-641. In addition, the CSMF **104** provides RFS requirements to ST (slicing template) **202**. In an embodiment of the present disclosure, the ST **202** provides ack (acknowledgment) to the CSMF **104** after reception of RFS requirements. In an embodiment of the present disclosure, the ST **202** corresponds to slicing template. In addition, the ST **202** provides NST, service profile and NSD ID to the NSMF **116**. The service profile may be the network resource requirement profile corresponding to the network resources required to facilitate the service, for the user. Also, NSD may signify the network service descriptor, which may include a globally unique identifier (ID) for identifying each descriptor instance. In general, NSD corresponds to network service descriptor. In addition, NSD consists of configuration documents. Further, NSD determines network service in terms of virtualized network functions. Furthermore, NSD facilitates onboarding of network service into system. In an embodiment of the present disclosure, the NSMF **116** provides NSSD, splice profile, and NSSD ID to the NSSMF **118**. In general, NSSD corresponds to network security service daemon. In addition, NSSD provides network security services. Further, NSSD provides network security services for one or more security disciplines. Furthermore, one or more security services include but may not be limited to IPsec. Moreover, NSSD provides certificate service, remote management service, and the like.

[0061] In an embodiment of the present disclosure, the NSSMF **118** provides instantiate slice for each NSSD to the VFC **124**. In addition, the NSSMF **118** provides service ID and ack (acknowledgment) to the ST **202**. In an embodiment of the present disclosure, the VFC **124** interfaces with the multi-VIM **126**. In an embodiment of the present disclosure, the multi-VIM **126** provides VM UUIDs along with state. In general, VM UUID corresponds to virtual machine universal unique identifier. In an example, the multi-VIM **126** provides UUIDs to each virtual machine for identification.

[0062] FIG. 3 illustrates a hardware framework 300 of the edge cloud architecture 100. The edge cloud architecture 100 is a non-transitory computer-readable storage medium. The edge cloud architecture 100 includes a bus 302 that directly or indirectly couples the following devices: memory 304, one or more processors 306, one or more presentation components 308, one or more input/output (I/O) ports 310, one or more input/output components 312, and an illustrative power supply 314. The bus 302 represents what may be one or more busses (such as an address bus, data bus, or combination thereof). Although the various blocks of FIG. 3 are shown with lines for the sake of clarity, in reality, delineating various components is not so clear, and metaphorically, the lines would more accurately be grey and fuzzy. For example, one may consider a presentation component such as a display device to be an I/O component. Also, processors have memory. The inventors recognize that such is the nature of the art and reiterate that the diagram of FIG. 3 is merely illustrative of an exemplary device that can be used in connection with one or more embodiments of the present invention. Distinction is not made between such categories as “workstation,” “server,” “laptop,” “hand-held device,” etc., as all are contemplated within the scope of FIG. 3 and reference to “computing device.”

[0063] The edge cloud architecture 100 typically includes a variety of computer-readable media. The computer-readable media can be any available media that can be accessed by the edge cloud architecture 100 and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, the computer-readable media may comprise computer storage media and communication media. The computer storage media includes volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. The computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the edge cloud architecture 100. The communication

media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term “modulated data signal” means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer-readable media.

5 [0064] Memory 304 includes computer-storage media in the form of volatile and/or nonvolatile memory. The memory 304 may be removable, non-removable, or a combination thereof. Exemplary hardware devices include solid-state memory, hard drives, optical-disc drives, etc. The edge cloud architecture 100 includes the one or more processors 306 that read data from various entities such as memory 10
15 304 or I/O components 312. The one or more presentation components 308 present data indications to a user or other device. Exemplary presentation components include a display device, speaker, printing component, vibrating component, etc. The one or more I/O ports 310 allow the edge cloud architecture 100 to be logically coupled to other devices including the one or more I/O components 312, some of
20 which may be built in. Illustrative components include a microphone, joystick, game pad, satellite dish, scanner, printer, wireless device, etc.

[0065] The present invention has various advantages over the prior art. The present invention relates to the edge cloud architecture that allocates appropriate amount of network resources to specific slice. In addition, the edge cloud architecture
25 produces low latency. Further, the edge cloud architecture utilizes virtual network functions and software-defined networking to divide physical network into multiple virtual networks based on customer requirements. Furthermore, the edge cloud architecture reduces expenses and capital expenditure by dynamically creating dedicated end to end network slices for specific services and reusing the network
30 resources once the service requirement is fulfilled. The reuse of network resources and less requirement of physical network resources (due to efficient network

utilization) makes it a capex (capital expenditure) and opex (operational expenditure) friendly method.

CUSTOMER SERVICE AND SLICE ORCHESTRATION

[0066] CSMF

- 5 • Responsible for translating communication service related requirements to network slice related requirements.
- Communicate with Network Slice Management Function (NSMF).

[0067] NSMF

- Responsible for management and orchestration of NSI.
- 10 • Derive network slice subnet related requirements from network slice related requirements.
- Communicate with the Network Slice Subnet Management Function (NSSMF) and Communication Service Management Function.

[0068] NSSMF

- 15 • Responsible for management and orchestration of NSSI.
- Communicate with Network Slice Management Function (NSMF).

[0069] Slice Manager - Architecture

- ☐ Aligned with Other party's Slice manager and E2E Orchestrator
- ☐ Slice manager maintains the global view of the network via monitoring and has rules framework to implement the SLA compliance
- 20 ☐ End to End Slice Monitoring can be looked at monitoring various service composing a slice
- ☐ Policy Infrastructure supported through ONAP for SLA enforcement - monitoring, analytics and action trigger

25 SERVICE DESIGN COMPONENT

[0070] SDC, is a subsystem of the design-time framework, accessible through the ONAP portal. SDC provides the tools for designing services as well as creating the necessary artifacts for service orchestration. With its graphical interface and visual tools, users can drag and drop different components onto the SDC canvas to model
5 their service

[0071] As the design time component, SDC handles all design time activities

[0072] SDC is the ONAP visual modeling and design tool. It creates internal metadata that describes assets used by all ONAP components, both at design time and run time.

10 [0073] The definitions of assets include Information Artifacts and Deployment Artifacts.

[0074] The SDC manages the content of a catalog, and logical assemblies of selected catalog items (as needed) to completely define how and when VNFs are realized in a target environment.

15 [0075] A complete virtual assembly of specific catalog items, together with selected workflows and instance configuration data, completely defines how the deployment, activation, and life-cycle management of VNFs are accomplished.

[0076] SDC manages two levels of assets:

20 [0077] Resource: a fundamental capability, implemented either entirely in software, or as software that interacts with a hardware device. Each Resource is a combination of one or more Virtual Function Components (VFCs), along with all the information necessary to instantiate, update, delete, and manage the Resource. A Resource also includes license-related information. There are three kinds of Resource:

- 25
- Infrastructure (the Cloud resources, e.g., Compute, Storage)
 - Network (network connectivity functions & elements); example: a Virtual Network Function (VNF)
 - Application (features and capabilities of a software application); example: a load-balancing function

- Service: a well formed object comprising one or more Resources. Service Designers create Services from Resources, and include all of the information about the Service needed to instantiate, update, delete, and manage the Service

5 **[0078] SDC Component Description:**

- SDC Provides Service Provider a seamless design time user experience
- Allow SP to configure for its design environment including user roles and design workflows
- Import generic ONAP management functions (MS, Flows, Policies) from ONAP developed software and SP's adaptations (1) (2)
- Onboard & Design resource level network functions (VNF, PNF) (3)
- Compose Service models with resources (4)
- Design Service Provider specific Management Flows and Policies for the Resource or Service Model (5)
- SDC Provides a common Catalog for designed objects.
- Provide linkage & management of SP's Test/validation process & artifacts for certification of the designed models (6)
- Distributes models to runtime for execution (7)

[0079] Workflow

- Resource onboarding: From portal, designer Add models and other artifacts required to create, configure, instantiate, and manage a VF/PNF and, optionally, a VFC.
- VF/PNF Creation and Testing: Using VSPs, create one or more VFs/PNFs as the building blocks for a service. Validate and certify the Vfs/PNFs.

25 **[0080] DATA FRAMEWORK AND ORCHESTRATION**

- **DCAE Overview**

- The Data Collection, Analytics and Events is a subsystem in ONAP architecture.
- Responsible for gathering performance, usage, configuration data from downstream system like VNFs etc.
- 5 • Performing analytics on those data.
- The analyzed data are passed to other ONAP components by generating some alerts (e.g., policy, ticketing, MSO etc) for further operation.

[0081] Data Collection

- Data collection process, first data is passed to the ves agent to convert it into VES data and then xNF pushes the VES data to the DCAE collectors i.e Ves collector, similarly SNMP collector collects data in the SNMP trap and send it to the mapper to convert it into the VES data, Now VES data is ready to pass into the analytical framework VIA Dmaap.
- 10

[0082] Analytics As a Service

- 15 Stage 1: Estimator; data is collected from different network functions and gets stored in the storage, then batch processing starts for training those data using ML algorithms, once data is trained it is stored in the model stack, now different models are ready for Kinds different data.

- Stage 2. Transformer; streaming data can go to the model / inferencing apps to generate some insights and gives output to the other component.
- 20

[0083] Data gets collected from various VNFs, and then distributed to storage lake and inferencing apps, for training data , data is extracted by performing batch processing from storage lake, once data is trained , model is stored in Models Database.

- 25 **[0084]** For inferencing apps , data can directly get distributed to inferencing apps where some logical rules are designed for deducing new information from the data and then correlation analysis is being performed to find the relationship between the data and then data is ready to pass to External components such as Kubernetes, SDNC.

[0085] POLICY FRAMEWORK**Policy Framework Capabilities/Requirements**

- ☐ The framework must be capable of being triggered by an event or invoked, and making decisions at run time.
- 5 ☐ Must be deployment agnostic; capable of managing policies for various Policy Decision Points (PDPs) or Policy engines or Policy-enabled other external Components (ex DCAE).
- ☐ Must be Metadata (Model) driven, allowing policies to be deployed, modified, upgraded, and removed as the system executes.
- 10 ☐ Must provide a flexible model driven policy design approach for policy type programming and specification of policies.
- ☐ Must be extensible, allowing straightforward integration of new PDPs, policy formats, and policy development environments.

[0086] MULTI VIM & ESR15 **[0087] Introduction Multi-Vim/Cloud**

[0088] The scope of Multi-VIM/Cloud project is a pluggable and extensible framework that provides a Multi-VIM/Cloud Mediation Layer which includes the following functional modules.

- 20 ☐ Provider Registry to register infrastructure site/location/region and their attributes and capabilities in A&AI.
- ☐ Infra Resource to manage resource request (compute, storage and memory) from SO, DCAE, or other ONAP components, so as to get VM created and VNF instantiated at the right infrastructure.
- 25 ☐ SDN Overlay to configure overlay network via local SDN controllers for the corresponding cloud infrastructure.
- ☐ VNF Resource LCM to perform VM lifecycle management as requested by VNFM (APP-C or VNF-C)

- FCAPS to report infrastructure resource metrics (utilization, availability, health, performance) to DCAE Collectors for Close Loop Remediation.
- ❑ Provides a common northbound interface (NBI) / Multi-Cloud APIs of the functional modules to be consumed by SO, SDN-C, APP-C, VF-C, DCAE etc.
- ❑ Provides a common abstraction model
- ❑ Provides the ability to
 - handle differences in models
 - generate or extend NBI based on the functional model of underlying infrastructure
 - implement adapters for different providers.

[0089] Multi-Vim Components

[0090] **Broker:** A single broker deployed as micro-service exposes following functionalities:

- Expose metadata list of supported plugins to ESR
- Route and forward API requests to appropriate plugin by looking up AAI cloud region with ID of the cloud region
- Dispatch capacity checking API to all related plugins

[0091] **Plugin(s):** Plugin adapts API requests to corresponding VIM/Cloud.

- There are multiple plugins deployed as micro-services available:
- Plugin for Wind River: Adapt to Wind River Titanium Cloud R3, R4 or R5
- Plugin for Ocata/Pike: Adapt to Vanilla OpenStack Releases: Ocata, Pike
- Plugin for VIO: Adapt to VMware VIO

- Plugin for Azure: Adapt to Microsoft Azure Cloud.
- Plugin for kubernetes: Adapt to Kubernetes clusters

[0092] Multi-VIM Definition – Components

- Focus: Life Cycle Management
- 5 • Telemetry Data
 - Events: Fault, Metrics, Syslogs, Heartbeat
 - Event Definitions Yaml (Including Actions: Vendor Recommendations, Configurations)
- Inventory : Topology, Resources
- 10 • Focus:
 - Resource Allocation
 - Resource Utilization

[0093] Dependencies (ESR - AAI & MSB)

- MultiCloud micro-services exposed services via MSB
- 15 • MultiCloud relies on MSB for API forwarding between broker and plugin micro-services
- MultiCloud micro-services rely on AAI for any persistent data storage.
e.g. AAI Cloud Region Object

[0094] Workflow Elaboration - AAI Operation

- 20 1. OOM Deploys ONAP MultiCloud services
2. ESR creates AAI cloud region object
3. ONAP users on-boards underlying VIM or Cloud instances via ONAP ESR GUI
4. Requests MultiCloud to update the cloud region with discovered
- 25 infrastructure's resources and capabilities

[0095] Multi-VIM Workflow elaboration

- **Registry**

- User inputs backend Cloud information into ESR portal
- ESR stores the backend Cloud information as auth model into AAI, key is cloudowner_cloudregion
- 5 • User triggers VIM register service exposed by Multi VIM which will trigger registry implements in different VIM plugins to fill in VIM Model information into AAI
- Each plugin handles AAI query about the backend Cloud information for backend Cloud operations

- 10 ▪ **Service Access**

- Controller which relies on Openstack APIs creates service client and get keystone token by Multi VIM/Cloud service URL.
- Multi VIM/Cloud service returns tokens and the catalog of endpoint list which are SBI defined by different plugins
- 15 • Controller will use the composition of returned endpoints and service API for the following OpenStack API access
- Multi VIM/Cloud translates the composted service API into the required OpenStack API then return the response to the caller.

[0096] The wireless communication network may be an end-to-end communication
 20 network over a physical network infrastructure. The physical network infrastructure may include a plurality of physical network resources which provides compute, storage and processing capacity to the network. In another aspect, the wireless communication system may be a fraction of the end-to-end communication network (for example, the edge cloud architecture **100**). The end-to-end communication
 25 network may include a plurality of sub-networks, such as a core network, a radio access network and a transport layer network. The Transport layer network may provide transparent transmission of client data traffic between connected client devices by establishing and maintaining point-to-point or point-to-multipoint

connections between such devices. It may include wired or wireless connectivity between the devices. For example, a vehicle to vehicle communication or an autonomous car network may be implemented using atleast the transport layer network. The core network may be a central element of the wireless communication system which provides services to an end consumer, the end consumer being directed connected to the radio access network. The radio access network may include at least one radio controller and at least one base station (such as nodeB, enodeB, gNodeB). The radio access network may be connected to the core network. The transport network may be a backhaul network which transports digital messages from point to another. The transport network may an optical backhaul network which connects with a plurality of networks for fulfilling traffic needs and transportation of messages.

[0097] Referring back to FIG. 1, the orchestrator **108** may be an entity that create, manage, deploy and control allocation of resources, for facilitating different types of services in the wireless communication network. The orchestrator **108** may be connected to the business support system (BSS) **102**, placed at a consumer end. The orchestrator **108** may receive at least one request from the BSS, for creating an end-to-end network slice for the service. The orchestrator may receive the service request and transform the request into service specific requirement. The orchestrator **108** may be further placed at an edge node. In an embodiment, the orchestrator **108** comprises a resource partitioning unit **402**, a slice creation unit **404**, a slice assigning unit **406**, a monitoring unit **408**, a dynamic allocation unit **410**, a resource management unit **412** and a virtual infrastructure management unit **414**, as shown in **FIG. 4**. The virtual infrastructure management unit 414 may provide the multiple VIM comprising a plurality of plugins (such as openstack plugins, VMware plugins, Kubernetes plugins) for managing and controlling the virtual infrastructure. The various hardware elements of the orchestrator **108** (listed above) may merge with each other logically, i.e., the components within the orchestrator **108** are not physically separated and may work together as a consolidated entity. Further, the various hardware elements of the orchestrator (108) (listed above) may work independently without merging with each other.

Further, the various hardware elements of the orchestrator (108) (listed above) may be capable to communicate with each other. Further, one or more hardware elements from the various hardware elements of the orchestrator (108) (listed above) may logically merge with one or more hardware elements from the previously defined hardware elements of Fig. 1 (such as SDC **106**, orchestrator **108**, NST model **110**, service transformer **112**, NSST model **114**, NSMF **116**, and NSSMF **118**, SDNR **120**, SDNC **122**, VFC **124**, multi-VIM **126**, openstack plugin **128**, VM Ware plugin **130**, and Kubernetes plugin **132**) of the orchestrator. Further, in an example, the service transformer **112** can be configured to perform the features of the resource partitioning unit **402**. Similarly, the multi-VIM **126** can be configured to perform the features of the dynamic allocation unit **410**, resource management unit **412**, more particularly for the allocation of the resources. Also, by using the multi-VIM platform, the problem with conventional network slicing method for supporting the variety of vertical industry applications can be resolved, as the multi-VIM platform may provide a plurality of plugins for network resource management.

[0098] The resource partitioning unit **402** is configured to dynamically create a plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network. Example of network resources may be compute resources, storage resources and processing resources in the core network, RAN network and transport network. The plurality of dedicated logical partitions corresponds to the service. The dynamic creation of plurality of dedicated logical partitions of network resources may signify creation of dedicated logical partitions, based on requirements by the service (such as augmented reality service, virtual reality service, vehicle to vehicle communication, etc.), in a dynamic manner. Each of the logical partitions which are created may be dedicated to the service, requested by a user i.e., the logical partition of network resources may be created specifically for individual services and also, different for different types of service. The dedicated nature of logical partitioning of network resources ensures that there may be no sharing of logical partitioning allowed among different services. The dedicated nature of logical partitioning of network resources may

signify exclusivity of the network slice for the service, with a defined service requirement. The dedicated nature of logical partitioning of network resources may be dynamic in nature, such that the dedicated logical partitions are created for specific requirement. The network resources in the dedicated logical partitioning
5 may be released upon fulfillment of the specific requirement. The released network resources may be available for creation of another dedicated logical partition to cater another requirement. This means, with change in service requirement, the logical partitioning may be changed dynamically and then cater to the new service requirement. The dynamic creation of logical partitions of network resources for
10 the service may signify creation of new logical partitions or adjusted logical partitions when a request for different service may be received, i.e., the logical partitions may be created once a request for logical partitions (or end to end network slice) is received.

[0099] The resource partitioning unit **402** may be further configured to dynamically
15 create a sub slice for the service in each of the core network, the radio access network and the transport network. Each of the sub-slice in the core network, the radio access network and the transport network correspond to network resource requirement by the service, in the core network, the radio access network and the transport network. The network resource requirement may be the requirement by
20 one of the network portion (from the core network, RAN network and the transport network) for compute capability, storage capability, processing capability, virtual function capability, software defined controlling capability or any other physical resource capability to create network partitions or sub slice for providing service to the user. The network resource requirement for a service may change in run time,
25 depending on the change in surrounding, data traffic, bandwidth, user requirements, location of the user, etc. For example, the dynamic creation of plurality of logical partitions of network resources may be the creation of at least one sub-slice corresponding to each of the core network, the RAN and the transport network. Each of the sub-slice corresponding to each of the network may signify an
30 independent combination of network resources which may cater to the service requirements within each network. For example, a sub-slice created for the RAN

network may cater all the requirement of the service, specific to the RAN network. Further, at least one sub-slice created for the service, from each of the core network, the RAN and the transport network may be combined to create the end-to-end network slice for the service.

- 5 [00100] Further, the slice creation unit **404** is configured to combine the plurality of dedicated logical partitions to form the E2E network slice, wherein the E2E network slice corresponds to the service. The creation of end-to-end network slice may be required in order to fulfill network resource requirement by multiple services in the 5G network. Further, the end to end network slice corresponding to
- 10 the service may provide a dedicated network slice which runs across all the networks such as the core network, the radio access network and the transport network in a dedicated manner, for the specific service. These end-to-end network slices may be created dynamically by the orchestrator **108** based on run time requirements for services by a user. For example, if the user wants to experience an
- 15 in-stadium virtual reality service, then a dedicated end to end network slice may be created by the orchestrator **108** for this service, in order to provide a seamless experience to the user. However, if there may be any change in the run-time requirements, then the network resources in the end-to-end network slice may be adjusted in order to cater the run time service requirements. For example, if the user
- 20 may stop the requirement of in-stadium virtual reality service and may want to avail the virtual reality service out of the stadium, then the service requirements may get changed, which may further change the network resource requirements by this new service. As a result, the previously created end to end network slice for in-stadium virtual reality service may be adjusted with the network resource in order to cater
- 25 the new service (out of the stadium virtual reality experience). Hence, the problem of inefficient creation of end to end network slices with conventional methods may be resolved using the above mentioned method, which may create dedicated network slice for specific services efficiently in real time manner. Also, the above mentioned method may satisfy end-customer requirements flexibly as it uses the
- 30 dynamic method of resource partitioning based on run time requirements of the user.

[00101] Further, the slice assigning unit **406** is configured to assign the E2E network slice to the service. The created logical partitions may combine to form the end to end (E2E) network slice, which is specific to the service. The E2E slice may be different for different services. The E2E slice may be exclusive to each of the service. The E2E slice may be adjusted with the network resources it includes, to create an adjusted E2E network slice which shows its dynamic nature. The E2E network slice may be created by logically stitching a plurality of logical partitions from each of the core network, the RAN and the transport network. The E2E network slice corresponding to the service may be assigned to fulfill the service.

10 The E2E network slice may be created and assigned according to the run time requirements by the service.

[00102] Further, the monitoring unit **408** is configured to monitor consumption of network resources associated to the E2E network slice during run time. The consumption of network resources associated to the E2E network slice may be monitored in each of the core network, the RAN and the transport network. For example, the network resources corresponding to the core network, which may create the logical partition or sub-slice for the core network may be monitored to check the resource consumption in the core network. Further, the network resources may be monitored to check if there is an under allocation or over allocation of resources in each of the logical partition in each of the network, with respect to the service requirements in each of the network (the network including the core network, the RAN and the transport network).

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[00103] Further, the dynamic allocation unit **410** is configured to dynamically adjust network resource allocation to the E2E network slice by changing the resource allocation in the E2E network slice, based on run-time requirements of the service. The dynamic adjustment of network resource allocation to create the E2E network slice include changing of resource allocation based on run-time requirements of the service. In this case, a user consuming the end-to-end network slice for a vehicle-to-vehicle communication service may require different quality of service and hence different network resources while moving from a highway to local street road. In order to cater the new requirements by the user, the network

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resources in the E2E network resources are dynamically allocated by adjusting the network resources within the E2E slice. Here, the network resources may be adjusted in the same E2E slice, without any need for creating a new E2E slice for the new service requirement. Also, the run time may be the time period when the network resources are actually being consumed by the different network portions to create the sub slices for facilitating the service. The run time may further be time period when the application starts running to serve the user and is ready to consume the network resources within the end to end network slice or one of the sub slice.

[00104] Further, the resource management unit **412** is configured to compare the network resources associated with the E2E slice with at least one dynamically defined run time network resource requirement for the service and that the resource management unit **412** is configured to dynamically define at least one run time network resource requirement for the service. The run time requirement for network resources for the service may be the change in the requirement of network resources for the service during consumption of the created end to end network slice. With change in the requirement of the network resources with respect to the change in service requirements (for example, in case of user changing the road from a highway to a street road for vehicle-to-vehicle communication service), the run-time network resource requirements may be defined dynamically. The dynamic run-time network resource requirement may be defined for each of the core network, the RAN and the transport network. The dynamically defined run-time network resource requirement may include a changed network resource requirement as compared to the network resource requirement initially allocated to the created logical partitions in each of the network.

[00105] FIG. 5 is a flowchart **500** illustrating a method for providing the end-to-end network slice for the service in the wireless communication network.

[00106] At **502**, the method includes dynamically creating the plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network. The plurality of dedicated logical partitions corresponds to the service.

[00107] At **504**, the method includes combining the plurality of dedicated logical partitions to form the E2E network slice, wherein the E2E network slice corresponds to the service.

[00108] At **506**, the method includes assigning the E2E network slice to the service.

5 [00109] The various actions, acts, blocks, steps, or the like in the flow chart **500** may be performed in the order presented, in a different order or simultaneously. Further, in some embodiments, some of the actions, acts, blocks, steps, or the like may be omitted, added, modified, skipped, or the like without departing from the scope of the invention.

10 [00110] The foregoing descriptions of specific embodiments of the present technology have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the present technology to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The embodiments were chosen and described in order
15 to best explain the principles of the present technology and its practical application, to thereby enable others skilled in the art to best utilize the present technology and various embodiments with various modifications as are suited to the particular use contemplated. It is understood that various omissions and substitutions of equivalents are contemplated as circumstance may suggest or render expedient, but
20 such are intended to cover the application or implementation without departing from the spirit or scope of the claims of the present technology.

[00111] While several possible embodiments of the invention have been described above and illustrated in some cases, it should be interpreted and understood as to have been presented only by way of illustration and example, but not by limitation.

25 Thus, the breadth and scope of a preferred embodiment should not be limited by any of the above-described exemplary embodiments.

CLAIMS

We Claim:

1. A method for providing an end to end (E2E) network slice for a service in a
5 wireless communication network, the wireless communication network is a
physical network infrastructure comprising at least one of a core networks, a radio
access network (RAN), and a transport network, the method comprising:
 dynamically creating, by a resource partitioning unit (402), a plurality of
dedicated logical partitions of network resources in the core network, the radio
10 access network and the transport network, wherein the plurality of dedicated logical
partitions corresponds to the service;
 combining, by a slice creation unit (404), the plurality of dedicated logical
partitions to form the E2E network slice, wherein the E2E network slice
corresponds to the service; and
15 assigning, by a slice assigning unit (406), the E2E network slice to the
service.
2. The method as claimed in claim 1, wherein dynamically creating the plurality of
logical partitions of network resources further comprising dynamically creating a
20 sub slice for the service in each of the core network, the radio access network and
the transport network, each of the sub-slice in the core network, the radio access
network and the transport network corresponds to network resource requirement by
the service, in the core network, the radio access network and the transport network.
- 25 3. The method as claimed in claim 1, further comprising:
 monitoring, by a monitoring unit (408), consumption of network resources
associated to the E2E network slice during run time.
4. The method as claimed in claim 1, further comprising:

dynamically adjusting, by a dynamic allocation unit (410), network resource allocation to the E2E network slice by changing the resource allocation in the E2E network slice, based on run-time requirements of the service.

5 5. The method as claimed in claim 1, further comprising:

comparing, by a resource management unit (412), the network resources associated with the E2E slice with at least one dynamically defined run time network resource requirement for the service.

10 6. The method as claimed in claim 1, further comprising:

dynamically defining, by a resource management unit (412), at least one run time network resource requirement for the service.

7. An orchestrator (108) for creating an end to end (E2E) network slice for a service
15 in a wireless communication system, the wireless communication network is a physical network infrastructure comprising at least one of a core network, a radio access network (RAN), and a transport network, the orchestrator managing a plurality of network resources corresponding to the physical network infrastructure in the wireless communication network, the orchestrator receiving a request for E2E
20 network slice from a user for the service, the orchestrator communicating with at least one radio access network controller, the orchestrator comprising:

a resource partitioning unit (402) configured to dynamically create a plurality of dedicated logical partitions of network resources in the core network, the radio access network and the transport network, wherein the plurality of
25 dedicated logical partitions corresponds to the service;

a slice creation unit (404) configured to combine the plurality of dedicated logical partitions to form the E2E network slice, wherein the E2E network slice corresponds to the service; and

a slice assigning unit (406) configured to assign the E2E network slice to
30 the service.

8. The orchestrator as claimed in claim 7, wherein the dynamic creation of the plurality of logical partitions of network resources, by the resource partitioning unit, further comprising:

5 dynamically creating a sub slice for the service in each of the core network, the radio access network and the transport network, each of the sub-slice in the core network, the radio access network and the transport network corresponds to network resource requirement by the service, in the core network, the radio access network and the transport network.

10 9. The orchestrator as claimed in claim 7, further comprising:

 a monitoring unit (408) configured to monitor consumption of network resources associated to the E2E network slice during run time.

10. The orchestrator as claimed in claim 7, further comprising:

15 a dynamic allocation unit (410) configured to dynamically adjust network resource allocation to the E2E network slice by changing the resource allocation in the E2E network slice, based on run-time requirements of the service.

11. The orchestrator as claimed in claim 7, further comprising:

20 a resource management unit (412) configured to compare the network resources associated with the E2E slice with at least one dynamically defined run time network resource requirement for the service.

12. The orchestrator as claimed in claim 7, further comprising:

25 a resource management unit (412) configured to dynamically define at least one run time network resource requirement for the service.

13. The orchestrator as claimed in claim 7, further comprising:

30 a virtual infrastructure management unit (414) configured to allow flexibility in allocation of resources to the E2E slice.

14. The orchestrator as claimed in claim 7, wherein the orchestrator is at least one of: a service orchestrator, an edge orchestrator, a global service orchestrator, and a master orchestrator.

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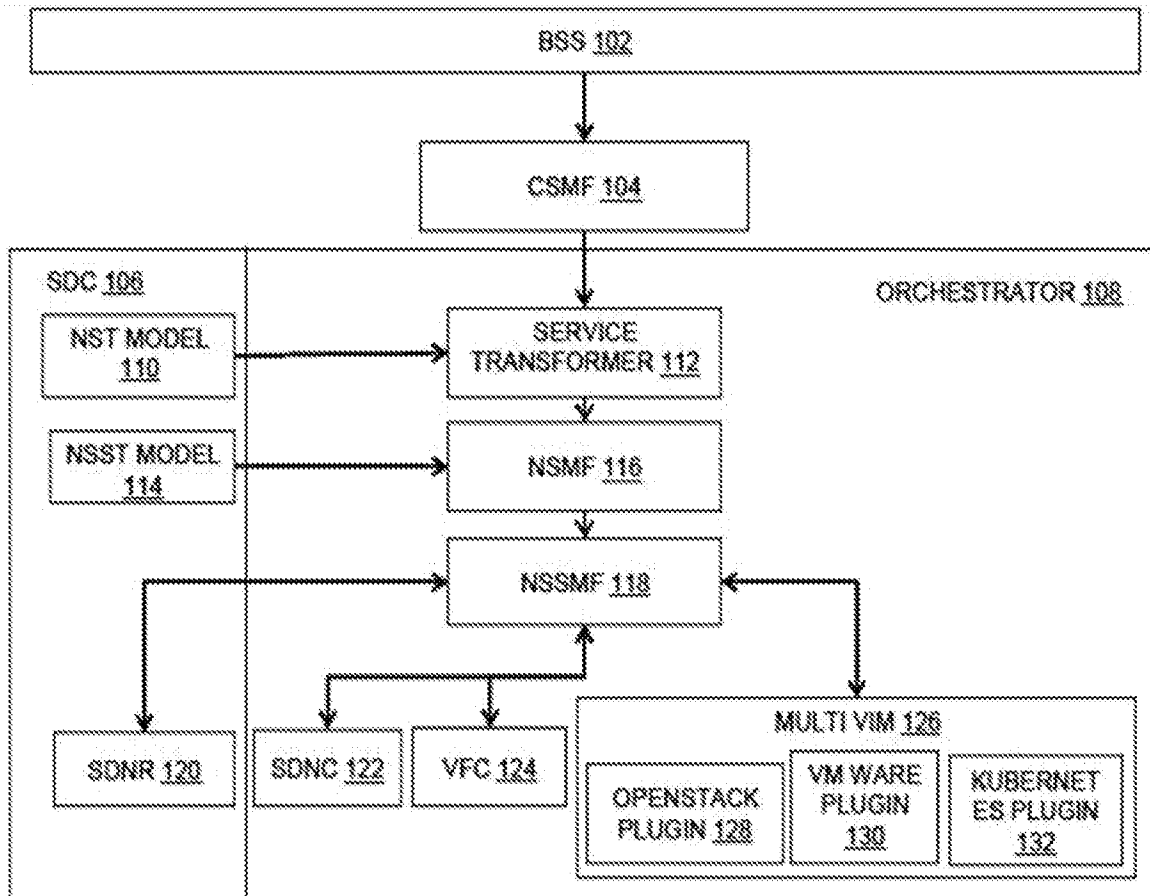
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FIG. 1

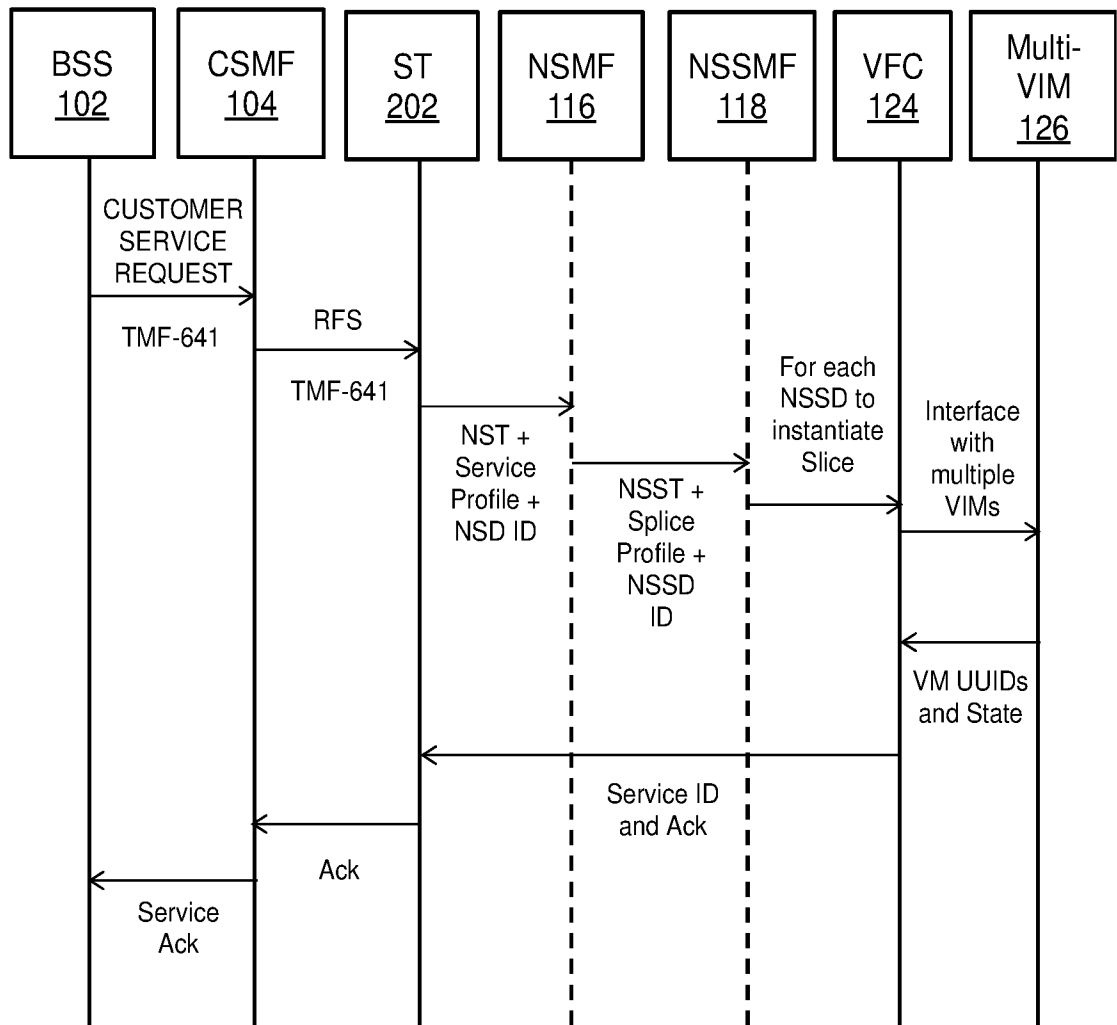
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FIG. 2

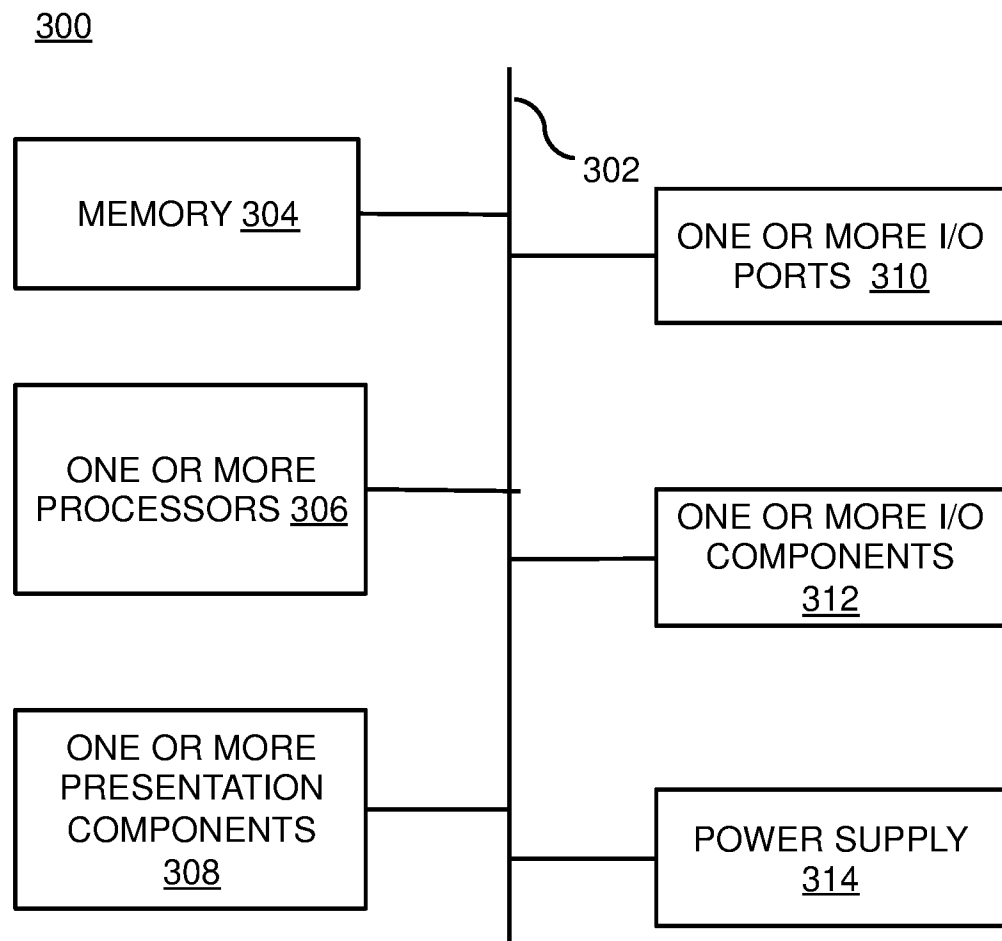


FIG. 3

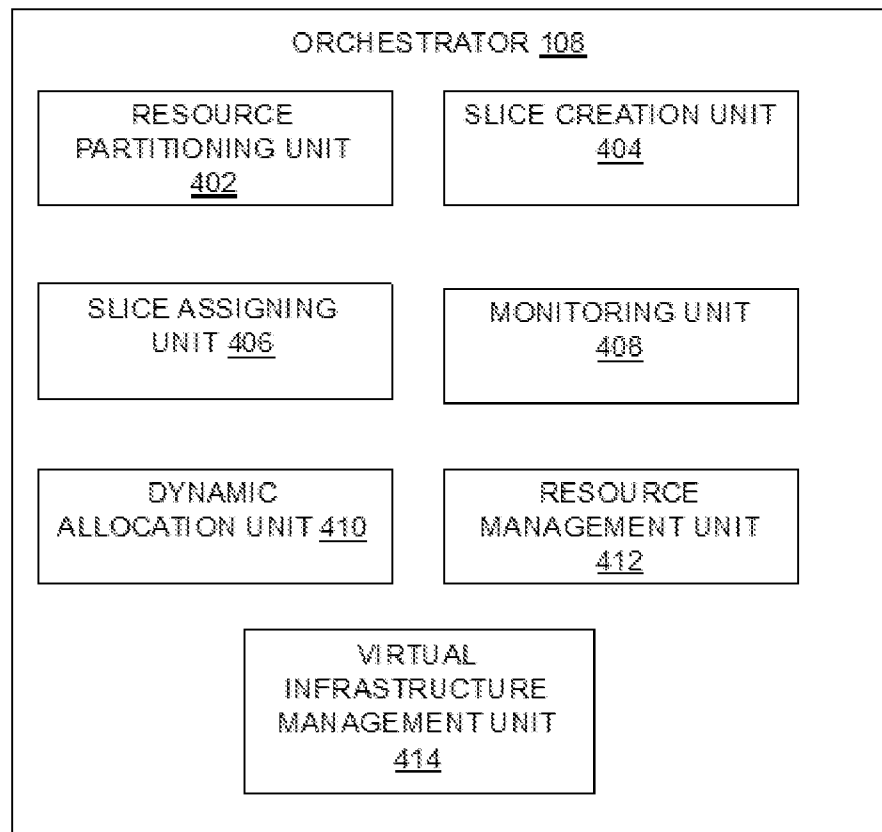


FIG. 4

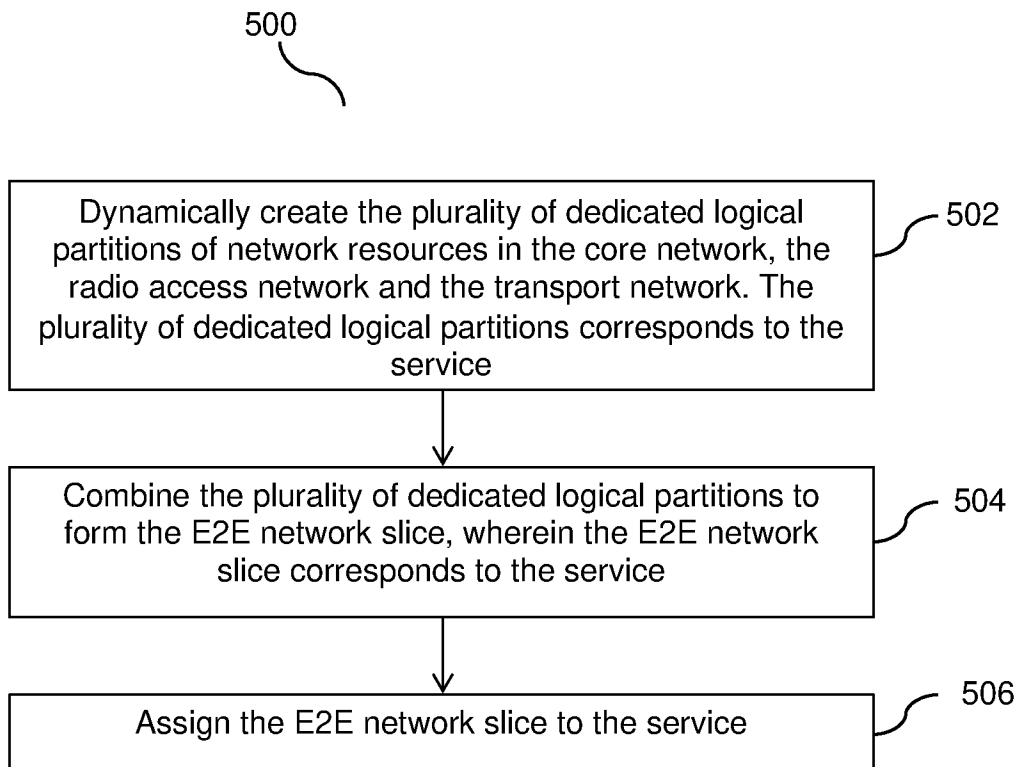


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IN2021/050220

A. CLASSIFICATION OF SUBJECT MATTER
H04L12/24, H04L12/801, H04L12/803 Version=2021.01

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)

H04L

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

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

Databases- Total Patent One, IPO Internal Database.
Searched Terms- end to end, network slice, orchestrator

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20170054595 A1 (HUAWEI TECHNOLOGIES CO., LTD.), 23 February 2017 (23/02/2017) Whole Document	1-14
Y	US 20190021010 A1 (HUAWEI TECHNOLOGIES CO., LTD.), 17 January 2019 (17/01/2019) Whole Document	1-14

☐ 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	"T" 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
"D" document cited by the applicant in the international application	"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
"E" earlier application or patent but published on or after the international filing date	"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
"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)	"&" document member of the same patent family
"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	

Date of the actual completion of the international search

25-06-2021

Date of mailing of the international search report

25-06-2021

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IN2021/050220

Citation	Pub.Date	Family	Pub.Date
US 20170054595 A1	23-02-2017	WO 2017032280 A1	02-03-2017
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