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(54) **USER APPLICATION DELIVERY OVER AD-HOC WIRELESS COMMUNICATION NETWORKS**

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(52) **U.S. Cl.**

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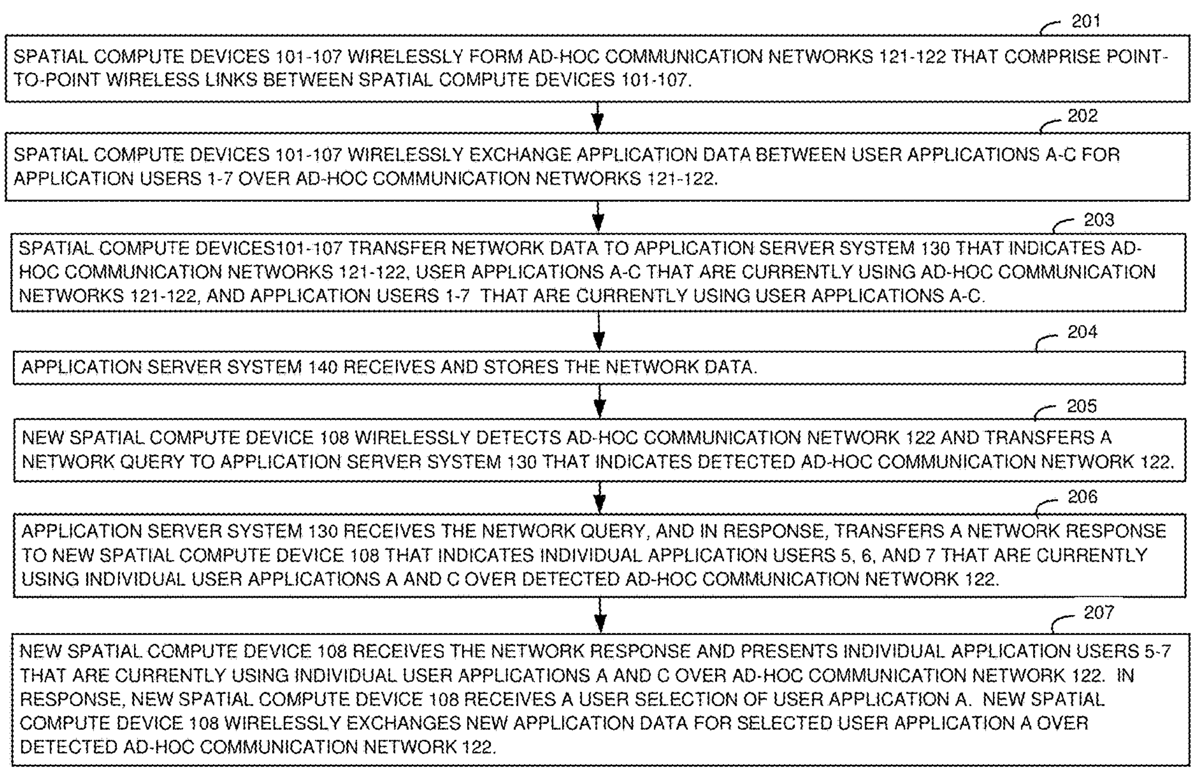
(57) **ABSTRACT**

A communication system receives a network identifier for a communication network from a user apparatus. The communication system receives an application identifier for a user application that uses the communication network from the user apparatus. The communication system receives an application username that identifies a user of the user application from the user apparatus. The communication system receives a request that indicates the network identifier from another user apparatus, and in response, transfers the application identifier and the application username to the other user apparatus.



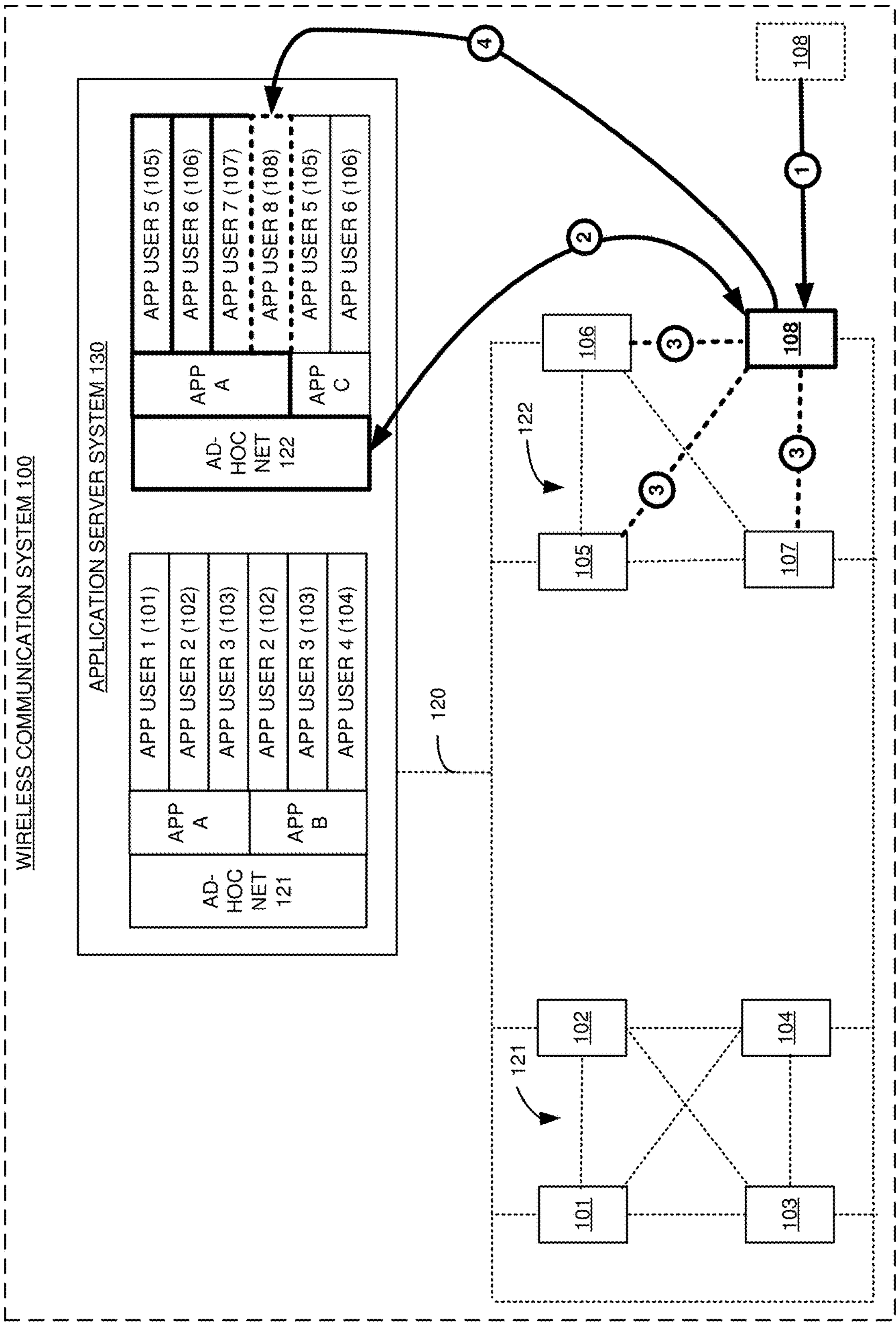

WIRELESS COMMUNICATION SYSTEM 100
APPLICATION SERVER SYSTEM 130
AD-HOC NET 121
APP A
APP B
APP USER 1 (101)
APP USER 2 (102)
APP USER 3 (103)
APP USER 2 (102)
APP USER 3 (103)
APP USER 4 (104)
AD-HOC NET 122
APP A
APP C
APP USER 5 (105)
APP USER 6 (106)
APP USER 7 (107)
APP USER 8 (108)
APP USER 5 (105)
APP USER 6 (106)
120
121
122
101
102
103
104
105
106
107
108
108
1
2
3
3
3
4

FIGURE 1

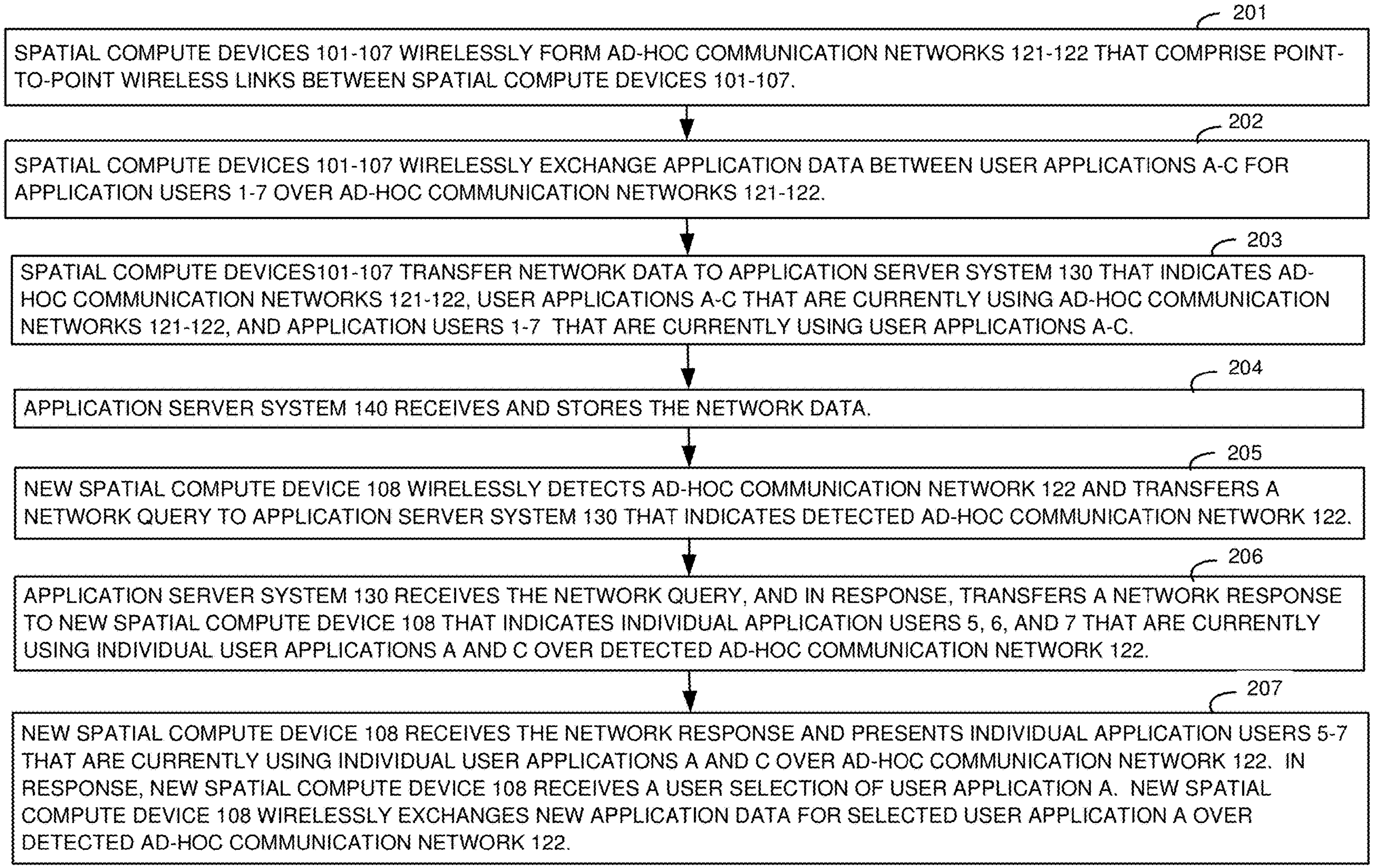

201
SPATIAL COMPUTE DEVICES 101-107 WIRELESSLY FORM AD-HOC COMMUNICATION NETWORKS 121-122 THAT COMPRISE POINT-TO-POINT WIRELESS LINKS BETWEEN SPATIAL COMPUTE DEVICES 101-107.
202
SPATIAL COMPUTE DEVICES 101-107 WIRELESSLY EXCHANGE APPLICATION DATA BETWEEN USER APPLICATIONS A-C FOR APPLICATION USERS 1-7 OVER AD-HOC COMMUNICATION NETWORKS 121-122.
203
SPATIAL COMPUTE DEVICES101-107 TRANSFER NETWORK DATA TO APPLICATION SERVER SYSTEM 130 THAT INDICATES AD-HOC COMMUNICATION NETWORKS 121-122, USER APPLICATIONS A-C THAT ARE CURRENTLY USING AD-HOC COMMUNICATION NETWORKS 121-122, AND APPLICATION USERS 1-7 THAT ARE CURRENTLY USING USER APPLICATIONS A-C.
204
APPLICATION SERVER SYSTEM 140 RECEIVES AND STORES THE NETWORK DATA.
205
NEW SPATIAL COMPUTE DEVICE 108 WIRELESSLY DETECTS AD-HOC COMMUNICATION NETWORK 122 AND TRANSFERS A NETWORK QUERY TO APPLICATION SERVER SYSTEM 130 THAT INDICATES DETECTED AD-HOC COMMUNICATION NETWORK 122.
206
APPLICATION SERVER SYSTEM 130 RECEIVES THE NETWORK QUERY, AND IN RESPONSE, TRANSFERS A NETWORK RESPONSE TO NEW SPATIAL COMPUTE DEVICE 108 THAT INDICATES INDIVIDUAL APPLICATION USERS 5, 6, AND 7 THAT ARE CURRENTLY USING INDIVIDUAL USER APPLICATIONS A AND C OVER DETECTED AD-HOC COMMUNICATION NETWORK 122.
207
NEW SPATIAL COMPUTE DEVICE 108 RECEIVES THE NETWORK RESPONSE AND PRESENTS INDIVIDUAL APPLICATION USERS 5-7 THAT ARE CURRENTLY USING INDIVIDUAL USER APPLICATIONS A AND C OVER AD-HOC COMMUNICATION NETWORK 122. IN RESPONSE, NEW SPATIAL COMPUTE DEVICE 108 RECEIVES A USER SELECTION OF USER APPLICATION A. NEW SPATIAL COMPUTE DEVICE 108 WIRELESSLY EXCHANGES NEW APPLICATION DATA FOR SELECTED USER APPLICATION A OVER DETECTED AD-HOC COMMUNICATION NETWORK 122.

FIGURE 2

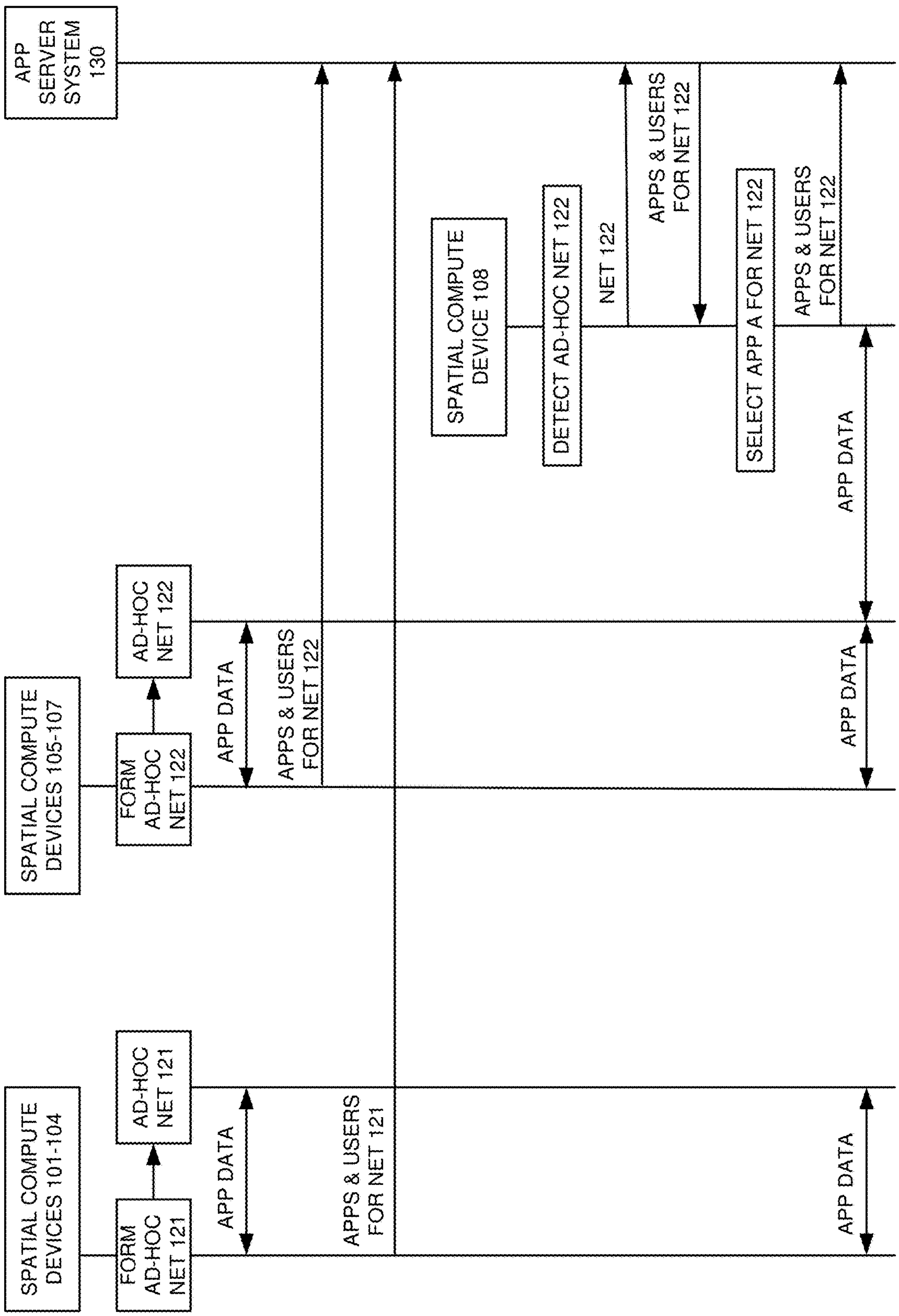

SPATIAL COMPUTE DEVICES 101-104
SPATIAL COMPUTE DEVICES 105-107
APP SERVER SYSTEM 130
FORM AD-HOC NET 121
AD-HOC NET 121
APP DATA
APPS & USERS FOR NET 121
APP DATA
FORM AD-HOC NET 122
AD-HOC NET 122
APP DATA
APPS & USERS FOR NET 122
APP DATA
SPATIAL COMPUTE DEVICE 108
DETECT AD-HOC NET 122
NET 122
APPS & USERS FOR NET 122
SELECT APP A FOR NET 122
APPS & USERS FOR NET 122
APP DATA

FIGURE 3

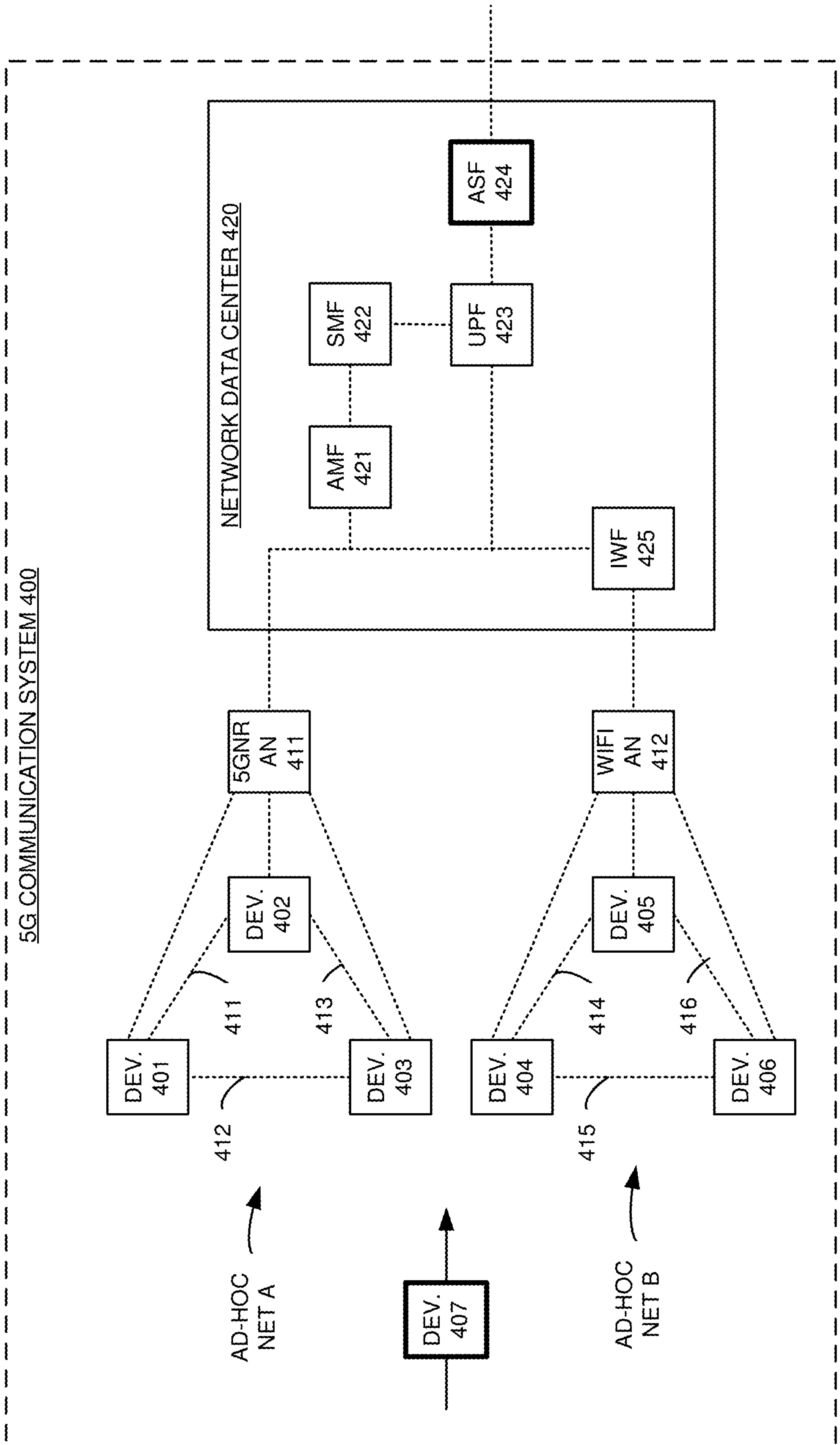
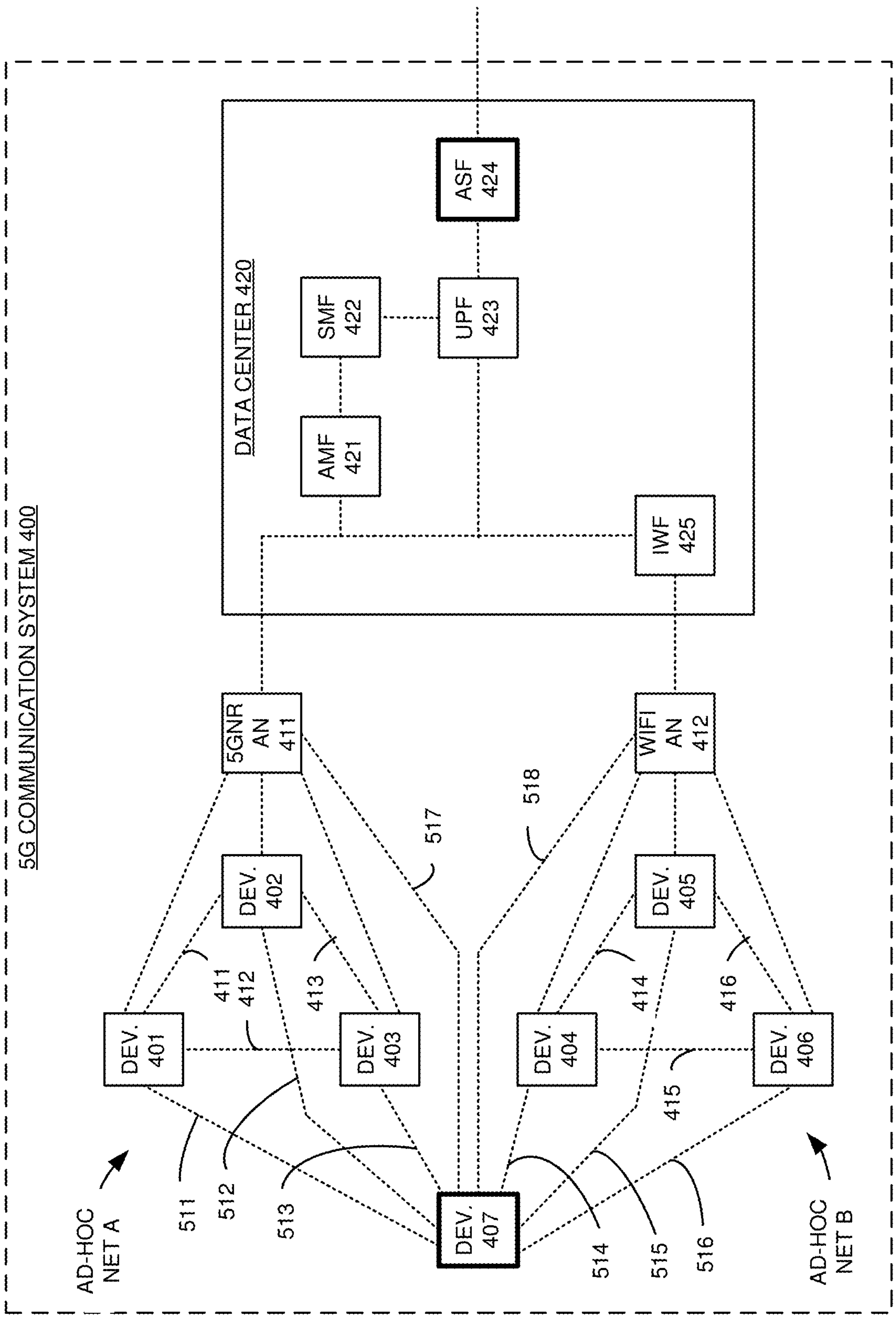

5G COMMUNICATION SYSTEM 400
NETWORK DATA CENTER 420
AMF 421
SMF 422
UPF 423
ASF 424
IWF 425
5GNR AN 411
WIFI AN 412
DEV. 401
DEV. 402
DEV. 403
DEV. 404
DEV. 405
DEV. 406
DEV. 407
411
412
413
414
415
416
AD-HOC NET A
AD-HOC NET B

FIGURE 4



5G COMMUNICATION SYSTEM 400
DATA CENTER 420
AMF 421
SMF 422
UPF 423
ASF 424
IWF 425
5GNR AN 411
WIFI AN 412
DEV. 401
DEV. 402
DEV. 403
DEV. 404
DEV. 405
DEV. 406
DEV. 407
AD-HOC NET A
AD-HOC NET B
411
412
413
414
415
416
511
512
513
514
515
516
517
518

FIGURE 5

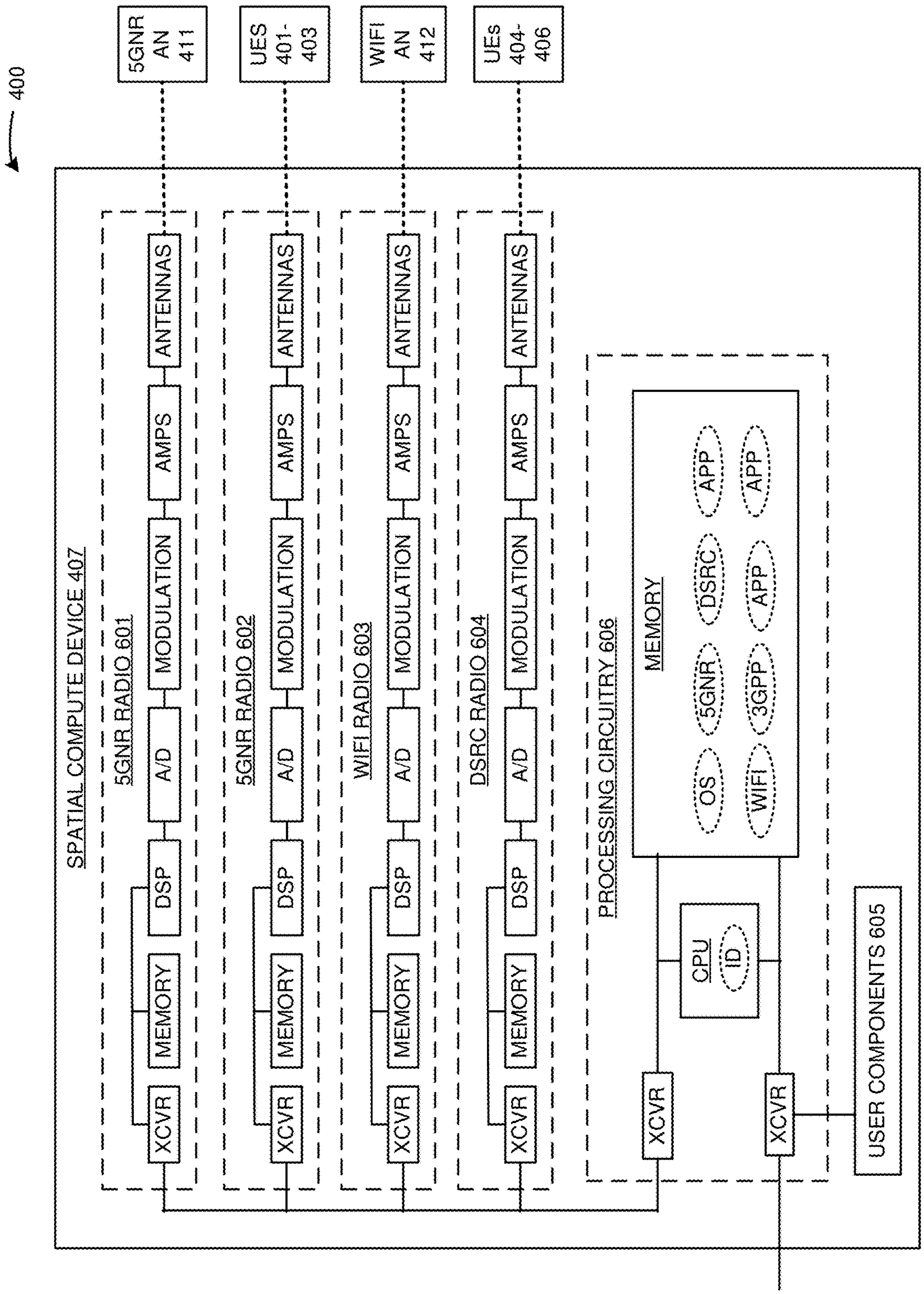

400
SPATIAL COMPUTE DEVICE 407
5GNR RADIO 601
5GNR RADIO 602
WIFI RADIO 603
DSRC RADIO 604
XCVR
MEMORY
DSP
A/D
MODULATION
AMPS
ANTENNAS
5GNR AN 411
UES 401-403
WIFI AN 412
UEs 404-406
PROCESSING CIRCUITRY 606
MEMORY
OS
5GNR
DSRC
APP
WIFI
3GPP
APP
APP
CPU
ID
XCVR
XCVR
USER COMPONENTS 605

FIGURE 6

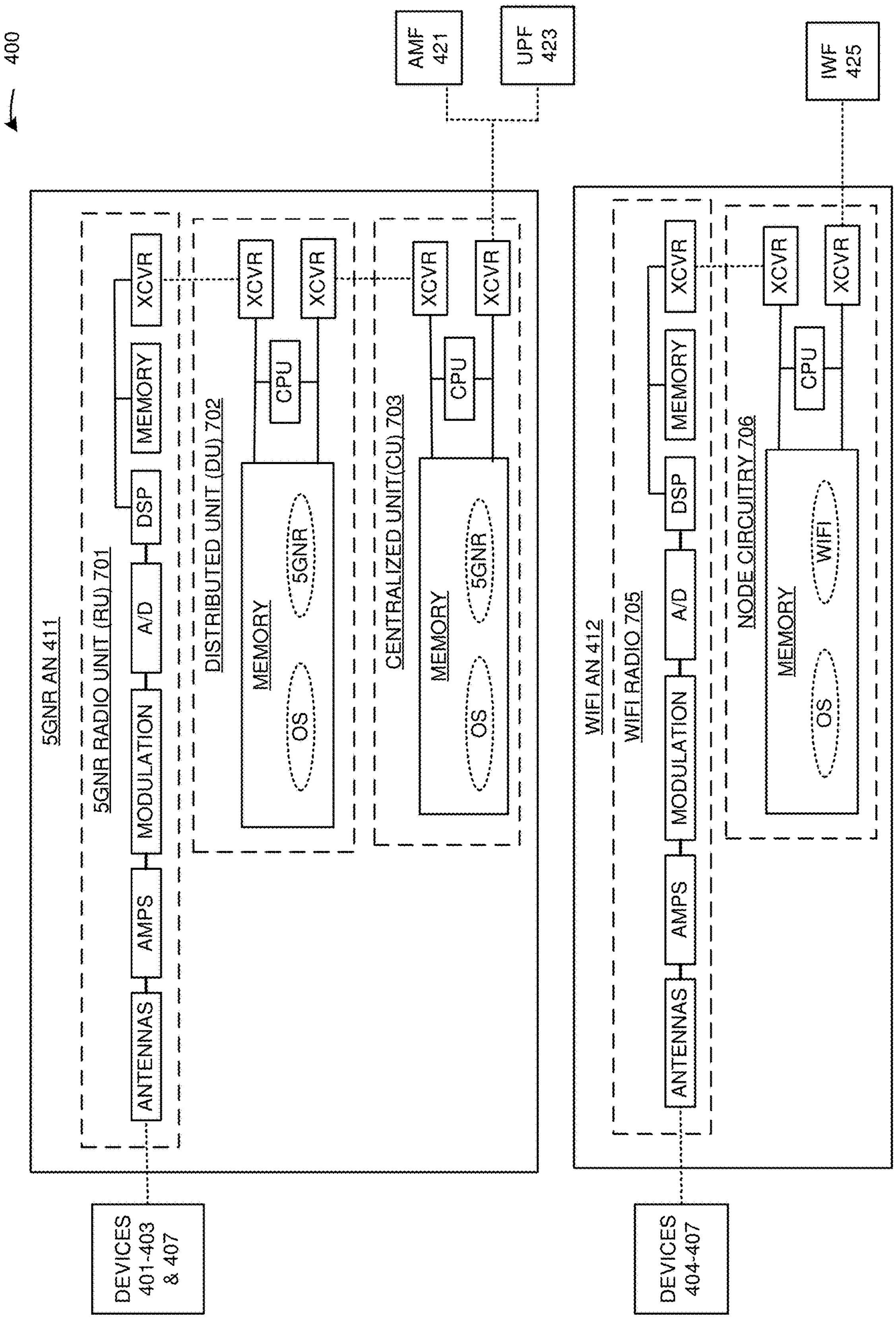

400
AMF 421
UPF 423
IWF 425
5GNR AN 411
5GNR RADIO UNIT (RU) 701
ANTENNAS
AMPS
MODULATION
A/D
DSP
MEMORY
XCVR
DISTRIBUTED UNIT (DU) 702
XCVR
XCVR
CPU
MEMORY
OS
5GNR
CENTRALIZED UNIT(CU) 703
XCVR
XCVR
CPU
MEMORY
OS
5GNR
WIFI AN 412
WIFI RADIO 705
ANTENNAS
AMPS
MODULATION
A/D
DSP
MEMORY
XCVR
NODE CIRCUITRY 706
XCVR
XCVR
CPU
MEMORY
OS
WIFI
DEVICES 401-403 & 407
DEVICES 404-407

FIGURE 7

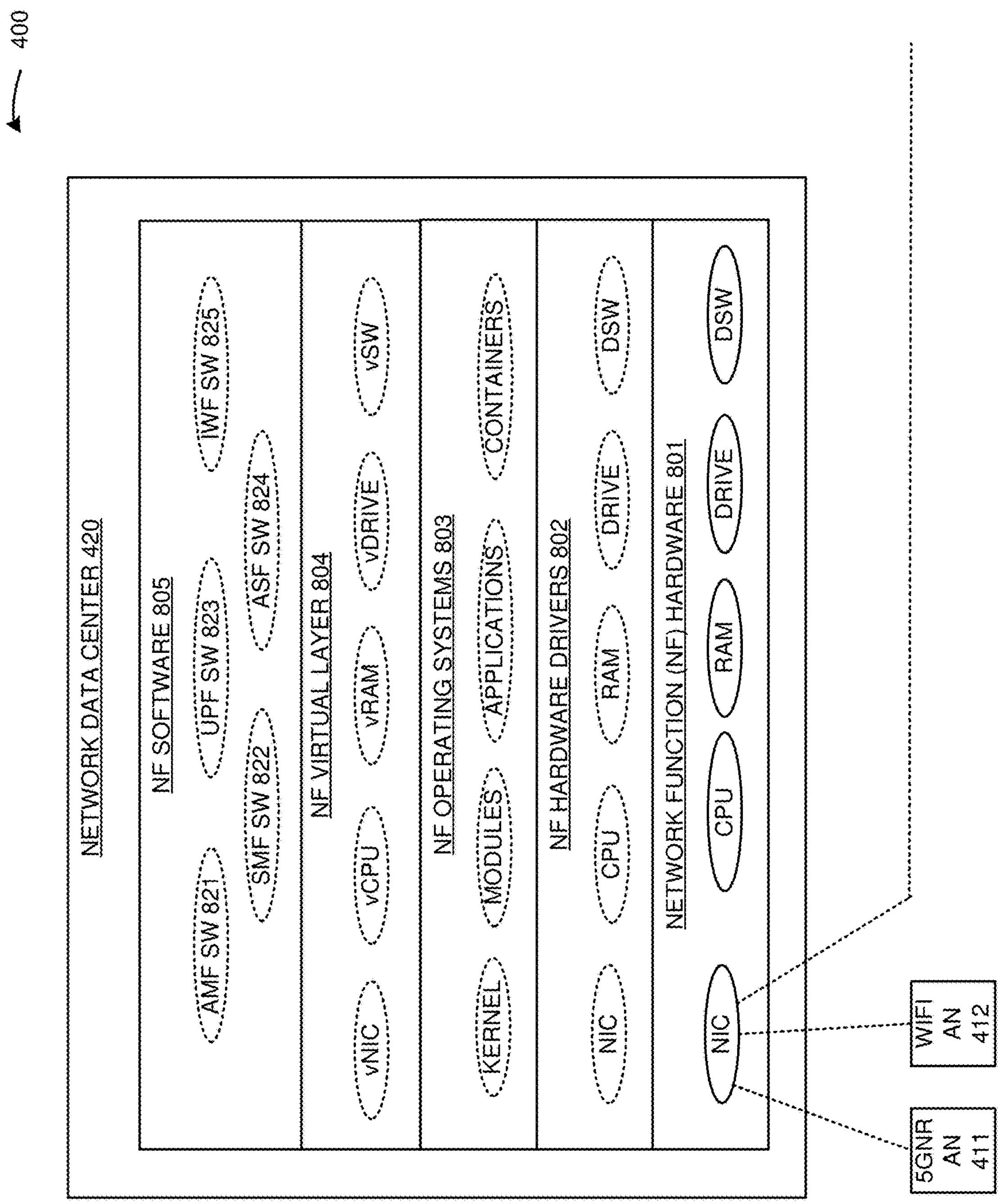

400
NETWORK DATA CENTER 420
NF SOFTWARE 805
AMF SW 821
SMF SW 822
UPF SW 823
ASF SW 824
IWF SW 825
NF VIRTUAL LAYER 804
vNIC
vCPU
vRAM
vDRIVE
vSW
NF OPERATING SYSTEMS 803
KERNEL
MODULES
APPLICATIONS
CONTAINERS
NF HARDWARE DRIVERS 802
NIC
CPU
RAM
DRIVE
DSW
NETWORK FUNCTION (NF) HARDWARE 801
NIC
CPU
RAM
DRIVE
DSW
WIFI AN 412
5GNR AN 411

FIGURE 8

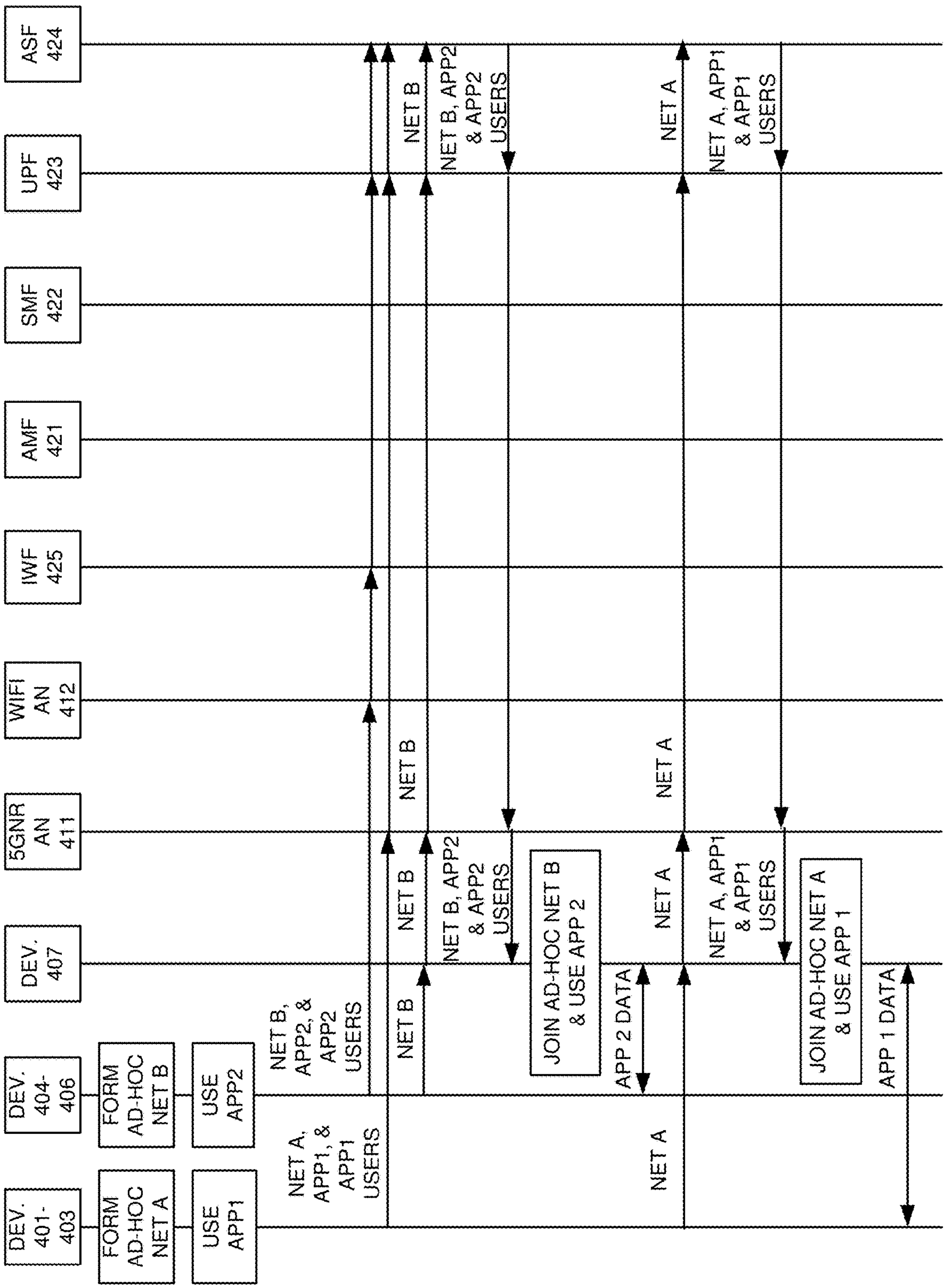

DEV. 401-403
DEV. 404-406
DEV. 407
5GNR AN 411
WIFI AN 412
IWF 425
AMF 421
SMF 422
UPF 423
ASF 424
FORM AD-HOC NET A
FORM AD-HOC NET B
USE APP1
USE APP2
NET A, APP1, & APP1 USERS
NET B, APP2, & APP2 USERS
NET B
NET B
NET B
NET B
NET B, APP2 & APP2 USERS
NET B, APP2 & APP2 USERS
JOIN AD-HOC NET B & USE APP 2
APP 2 DATA
NET A
NET A
NET A
NET A
NET A, APP1 & APP1 USERS
NET A, APP1 & APP1 USERS
JOIN AD-HOC NET A & USE APP 1
APP 1 DATA

FIGURE 9

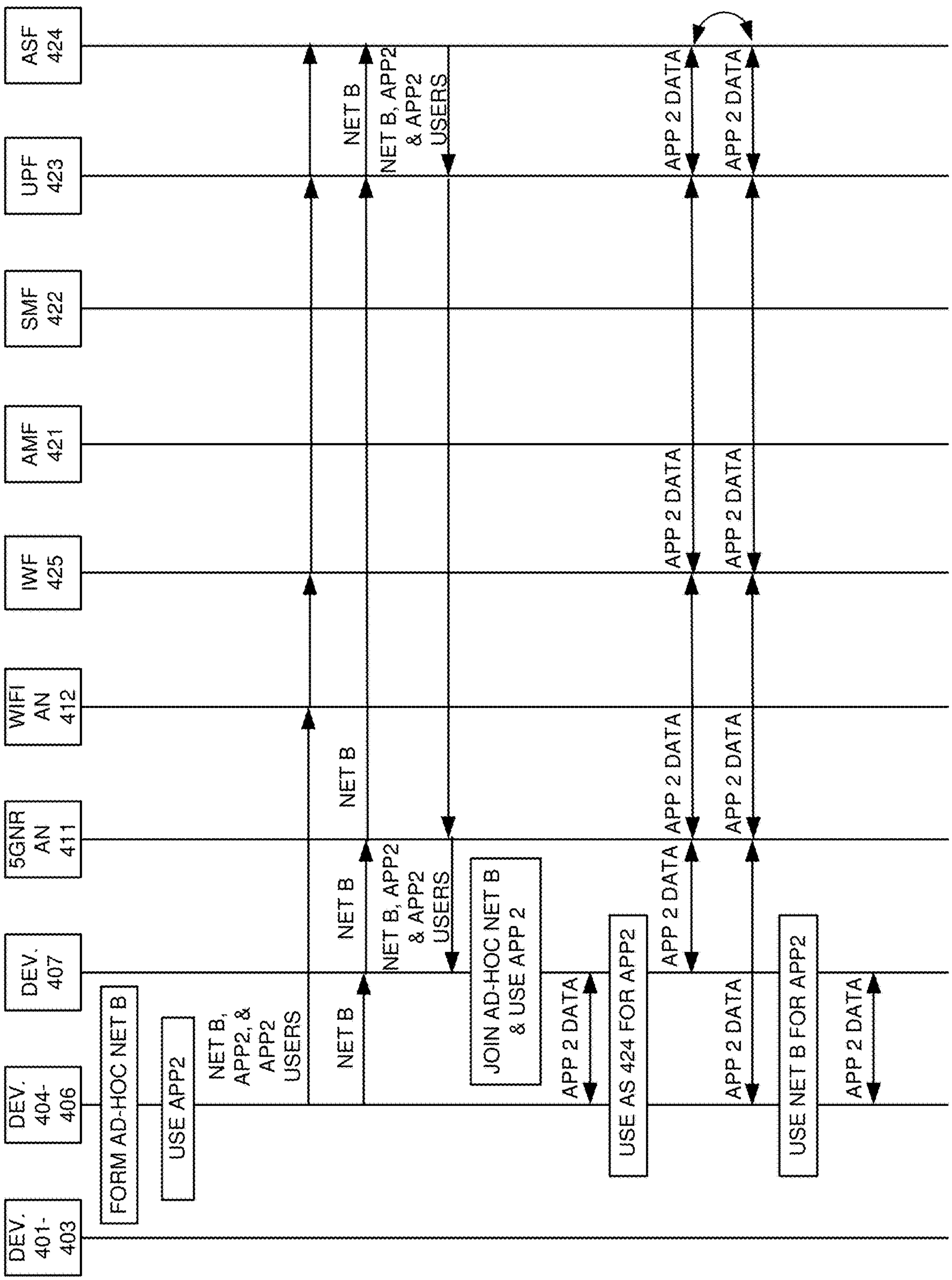

DEV. 401-403
DEV. 404-406
DEV. 407
5GNR AN 411
WIFI AN 412
IWF 425
AMF 421
SMF 422
UPF 423
ASF 424
FORM AD-HOC NET B
USE APP2
NET B, APP2, & APP2 USERS
NET B
NET B
NET B, APP2 & APP2 USERS
NET B
NET B
NET B, APP2 & APP2 USERS
JOIN AD-HOC NET B & USE APP 2
APP 2 DATA
USE AS 424 FOR APP2
APP 2 DATA
APP 2 DATA
APP 2 DATA
APP 2 DATA
APP 2 DATA
APP 2 DATA
APP 2 DATA
APP 2 DATA
USE NET B FOR APP2
APP 2 DATA

FIGURE 10

USER APPLICATION DELIVERY OVER AD-HOC WIRELESS COMMUNICATION NETWORKS

RELATED CASES

[0001] This United States Patent Application is a continuation of U.S. patent application Ser. No. 17/875,200 that was filed on Jul. 27, 2022 and is entitled "USER APPLICATION DELIVERY OVER AD-HOC WIRELESS COMMUNICATION NETWORKS." U.S. patent application Ser. No. 17/875,200 is hereby incorporated by reference into this United States Patent Application.

TECHNICAL BACKGROUND

[0002] Wireless communication networks provide wireless data services to wireless user devices. Exemplary wireless data services include user data messaging, machine-control, internet-access, media-streaming, and social-networking. Exemplary wireless user devices comprise phones, computers, vehicles, robots, and sensors. The wireless user devices execute user applications that use the wireless data services. For example, a smartphone may execute a social-networking application that communicates with a content server over a wireless communication network.

[0003] The wireless communication networks have wireless access nodes which exchange wireless signals with the wireless user devices over radio frequency bands. The wireless signals use wireless network protocols like Fifth Generation New Radio (5GNR), Long Term Evolution (LTE), Institute of Electrical and Electronic Engineers (IEEE) 802.11 (WIFI), and Low-Power Wide Area Network (LP-WAN). The wireless access nodes exchange network signaling and user data with network elements that are often clustered together into wireless network cores. The wireless network elements comprise Access and Mobility Management Functions (AMFs), Session Management Functions (SMFs), User Plane Functions (UPFs), and the like.

[0004] The wireless user devices may directly communicate over point-to-point wireless links. The wireless user devices may form ad-hoc wireless networks that are comprised of these point-to-point wireless links. The ad-hoc wireless networks use wireless protocols like Direct Short Range Radio Communication (DSRC), 5GNR, WIFI, Bluetooth Low Energy (BLE), Near Field Communications (NFC), and the like. The ad-hoc wireless networks spontaneously form based on geographic proximity that triggers the automatic creation of point-to-point links and associated networking capabilities. For example, a pair of proximate smartphones may discover one another and establish WIFI links to form an ad-hoc wireless network. A newly arriving smartphone may discover the existing pair and establish new WIFI links with each smartphone to grow the ad-hoc wireless network. Additional smartphones may join the ad-hoc wireless network in a like manner.

[0005] The wireless user devices may host user applications that use the ad-hoc wireless networks. For example, vehicle-transceivers may host anti-collision Vehicle-to-Vehicle (V2V) applications that use ad-hoc wireless networks among proximate vehicles to avoid crashes. In another example, a gamer's smart-goggles may host a user application that uses an ad-hoc wireless network to interact with other nearby smart-goggles to present interactive gameplay to multiple gamers.

[0006] The wireless user devices interact with wireless network cores to obtain network services like internet access and data messaging. The wireless user devices also interact with one another to obtain wireless ad-hoc services like interactive gaming. The wireless network cores help the ad-hoc wireless networks by authorizing the wireless user devices and scheduling resources for the wireless user devices. Unfortunately, the wireless network cores do not effectively interact with the wireless user devices to support the user applications that use the ad-hoc wireless networks. Moreover, the wireless user devices do not efficiently interact with the application users to control their use of their user applications over the ad-hoc wireless networks.

TECHNICAL OVER VIEW

[0007] In some examples, a communication system comprises one or more wireless access nodes and an application server. The one or more wireless access nodes wirelessly receive a network identifier for a communication network and transfer the network identifier to the application server. The one or more wireless access nodes wirelessly receive an application identifier for a user application that uses the communication network and transfer the application identifier to the application server. The application server associates the application identifier with the network identifier. The one or more wireless access nodes wirelessly receive an application username that identifies a user of the user application and transfer the application username to the application server. The application server associates the application username with the application identifier. The one or more wireless access nodes to wirelessly receive a request that indicates the network identifier and transfer the request to the application server. The application server transfers the application username associated with the application identifier and the application identifier associated with the network identifier to the one or more wireless access nodes in response to the request. The one or more wireless access nodes wirelessly transfer the application username associated with the application identifier and the application identifier associated with the network identifier in response to the request.

[0008] In some examples, a method comprises the following operations. Authenticate a user apparatus that has a user application that uses a communication network. Receive a network identifier for the communication network and an application identifier for the user application from the user apparatus. Receive an application username for a user of the user application from the user apparatus. Authenticate another user apparatus that has the user application. Receive a request that indicates the network identifier from the other user apparatus, and in response, transfer the application identifier and the application username to the other user apparatus.

[0009] In some examples, a method comprises the following operations. Receive a network identifier for a communication network from a user apparatus. Receive an application identifier for a user application that uses the communication network from the user apparatus. Receive an application username that identifies a user of the user application from the user apparatus. Receive a request that indicates the network identifier from another user apparatus, and in response, transfer the application identifier and the application username to the other user apparatus.

DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** illustrates an exemplary wireless communication system to deliver user applications to spatial compute devices over ad-hoc communication networks.

[0011] FIG. **2** illustrates an exemplary operation of the wireless communication system to deliver the user applications to the spatial compute devices the over the ad-hoc communication networks.

[0012] FIG. **3** illustrates an exemplary operation of the wireless communication system to deliver the user applications to the spatial compute devices over the ad-hoc communication networks.

[0013] FIG. **4** illustrates an exemplary Fifth Generation (5G) communication network to deliver user applications to spatial compute devices over ad-hoc communication networks.

[0014] FIG. **5** illustrates the exemplary 5G communication network to deliver the user applications to the spatial compute devices over the ad-hoc communication networks.

[0015] FIG. **6** illustrates an exemplary spatial compute device in the 5G communication network.

[0016] FIG. **7** illustrates exemplary access nodes in the 5G communication network.

[0017] FIG. **8** illustrates an exemplary data center in the 5G communication network.

[0018] FIG. **9** illustrates an exemplary operation of the 5G communication network to deliver the user applications to the spatial compute devices over the ad-hoc communication networks.

[0019] FIG. **10** illustrates an exemplary operation of the 5G communication network to deliver the user applications to the spatial compute devices over the ad-hoc communication networks.

DETAILED DESCRIPTION

[0020] FIG. **1** illustrates exemplary wireless communication system **100** to deliver user applications to spatial compute devices **101-108** over ad-hoc communication networks **121-122**. Wireless communication system **100** comprises spatial compute devices **101-108**, access networks **120**, ad-hoc communication networks **121-122**, and application server system **130**. Spatial compute devices **101-108** comprise phones, computers, goggles, controllers, and/or some other user apparatus with communication circuitry that is configured to operate as described below. The user applications are designated alphabetically and may comprise gaming applications, Augmented Reality (AR) applications, Virtual Reality (VR) applications, and/or some other type of user software.

[0021] Access networks **120** comprise wireless networks, wireline networks, satellite systems, and/or some other type of data communication equipment. Ad-hoc networks **121-122** comprise point-to-point wireless links between pairs of spatial compute devices **101-108** that are rapidly formed based on public standards and geographic proximity. Ad-hoc networks **121-122** may use Fifth Generation New Radio (5GNR), Direct Short Range Radio Communication (DSRC), Institute of Electrical and Electronic Engineers (IEEE) 802.11 (WIFI), Bluetooth Low Energy (BLE), Near Field Communications (NFC), and/or some other ad-hoc networking protocol. Application server system **130** comprises one or more networked computers with communication and database software that are configured to operate as described below. Application server system **130** maintains a data structure that associates individual application users with their individual user applications. The data structure also associates the individual user applications with their individual ad-hoc communication networks.

[0022] Various examples of network operation and configuration are described herein. In some examples, spatial compute devices **101-107** wirelessly form ad-hoc communication networks **121-122** while spatial compute device **108** (represented by dotted lines) is still located away from ad-hoc communication networks **121-122**. Spatial compute devices **101-107** wirelessly exchange application data between user applications A-C for application users **1-7** over ad-hoc communication networks **121-122**. Spatial compute devices **101-107** individually transfer network data to application server system **130** over access networks **120** that indicates: 1) the individual ad-hoc communication networks **121-122** that they currently use, 2) the user applications A-C that they currently use over ad-hoc communication networks **121-122**, and 3) the individual application users **1-7** that currently use individual user applications A-C over the individual ad-hoc networks **121-122**. Individual application users are typically identified by self-selected usernames, although other user indicators could be used. Application server system **130** receives and stores the network data.

[0023] As indicated by arrow #**1**, spatial compute device **108** (now represented by solid bold lines) moves toward and wirelessly detects ad-hoc communication network **122**. As indicated by arrow #**2**, spatial compute device **108** responsively transfers a network query to application server system **130** over access networks **120** that indicates detected ad-hoc communication network **122**. Application server system **130** receives the network query and responsively translates an identifier for ad-hoc communication network **123** into information for a network response that indicates user application A and its current application users **5-7** along with user application C and its current application users **5-6**. As indicated by arrow #**2**, application server system **130** transfers the network response to spatial compute device **108**. Spatial compute device **108** receives the network response and responsively presents that application users **5**, **6**, and **7** are using user application A over ad-hoc communication network **122**, and that application users **5** and **6** are using user application C over ad-hoc communication network **122**. In response, spatial compute device **108** receives a user selection of user application A. As indicated by lines #**3**, spatial compute device **108** establishes point-to-point links with spatial compute devices **105-107** to join ad-hoc communication network **122**. Application user **8** in spatial compute device **108** wirelessly exchanges application data for selected user application A with application users **5**, **6**, and **7** over ad-hoc communication network **122**. As indicated by arrow #**4**, spatial compute device **108** transfers network data to application server system **130** that indicates that application user **8** is currently using user application A over ad-hoc network **122**. Application server system **130** receives, stores, and subsequently serves the new network data for ad-hoc communication network **122**.

[0024] Advantageously, wireless communication system **100** effectively interacts with spatial compute devices **101-108** to support user applications A-C that use ad-hoc communication networks **121-122**. Moreover, spatial compute devices **101-108** efficiently interact with application users **1-8** to control their use of ad-hoc communication networks **121-122** and user applications A, B, and C.

[0025] In some examples, spatial compute device **108** presents a network option to use application server system **130** for user applications A or C instead of ad-hoc communication network **122**. Spatial compute device **108** may receive a user selection of the network option with users **5-7** and establish connectivity to application users **5-7** in spatial compute devices **105-107** through application server system **130**. Application user **8** in spatial compute device **108** then exchanges application data for user application A with the same users over application server system **130** instead of ad-hoc communication network **122**. Spatial compute device **108** may also receive a user selection of another network option to establish connectivity to different application users of the user application through application server system **130**.

[0026] Spatial compute devices **101-108** comprise radios that wirelessly communicate using wireless protocols like 5GNR, DSRC, WIFI, BLE, NFC, Low-Power Wide Area Network (LP-WAN), Code Division Multiple Access (CDMA), Frequency Division Multiple Access (FDMA), and Time Division Multiple Access (TDMA). Spatial compute devices **101-108** and application server system **130** comprise microprocessors, software, memories, transceivers, bus circuitry, and the like. The microprocessors comprise Digital Signal Processors (DSP), Central Processing Units (CPU), Graphical Processing Units (GPU), Application-Specific Integrated Circuits (ASIC), and/or the like. The memories comprise Random Access Memory (RAM), flash circuitry, disk drives, and/or the like. The memories store software like operating systems, user applications, radio applications, and network applications. The microprocessors retrieve the software from the memories and execute the software to drive the operation of wireless communication system **100** as described herein.

[0027] FIG. **2** illustrates an exemplary operation of wireless communication system **100** to deliver user applications to spatial compute devices **101-108** over ad-hoc communication networks **121-122**. The operation may vary in other examples. Spatial compute devices **101-107** wirelessly form ad-hoc communication networks **121-122** that comprise point-to-point connections between spatial compute devices **101-107** (**201**). Spatial compute devices **101-107** wirelessly exchange application data between the user applications for the application users A-C over ad-hoc communication networks **121-122** (**202**). Spatial compute devices **101-107** transfer network data to application server system **130** over access networks **120** that indicates: the individual ad-hoc communication networks **121-122** that they currently use, the individual user applications A-C that they currently use over which individual ad-hoc communication networks **121-122**, and the individual application users **1-7** that are currently using which user applications A-C (**203**). Application server system **130** receives and stores the network data (**204**). New spatial compute device **108** wirelessly detects ad-hoc communication network **122** and transfers a network query to application server system **130** over access networks **120** that indicates detected ad-hoc communication network **122** (**205**). Application server system **120** receives the network query and responsively transfers a network response that indicates the current user applications and their current application users for ad-hoc communication network **122** (**206**). Application server system **130** transfers the network response to new spatial compute device **108** (**206**). New spatial compute device **108** receives the network response and graphically presents the individual application users that are the individual user applications over ad-hoc communication network **122** (**206**). New spatial compute device **108** receives a user selection of user application A over ad-hoc communication network **122** and establishes point-to-point wireless links with spatial compute devices **105-107** in ad-hoc communication network **122**. New spatial compute device **108** wirelessly exchanges application data for the selected user application A with spatial compute devices **105-107** over ad-hoc communication network **122** (**207**).

[0028] FIG. **3** illustrates an exemplary operation of the wireless communication system **100** to deliver the user applications to spatial compute devices **101-108** the over ad-hoc communication networks **121-122**. The operation may vary in other examples. Spatial compute devices **101-104** wirelessly form ad-hoc communication network **121**. Spatial compute devices **101-104** wirelessly exchange application data over ad-hoc communication network **121**. Spatial compute devices **105-107** wirelessly form ad-hoc communication network **122**. Spatial compute devices **105-107** wirelessly exchange application data over ad-hoc communication network **122**. Spatial compute devices **101-107** transfer network data to application server system **130** that indicates their individual apps A-C and their individual application users **1-7** for ad-hoc networks **121-122**. The indication of application users **1-7** comprises self-selected usernames by the users of spatial compute devices **101-107** or some other user identifiers.

[0029] Spatial compute device **108** wirelessly detects ad-hoc communication network **122** and transfers a network query to application server system **130** for ad-hoc communication network **122**. Application server system **130** transfers a response to spatial compute device **108** that indicates the individual application users and the individual user applications for ad-hoc communication network **122**. Spatial compute device **108** receives the network response and selects user application A in ad-hoc communication network **122**-typically after a graphic interaction with the user. Spatial compute device **108** establishes point-to-point wireless links with spatial compute devices **105-107** to join ad-hoc communication network **122**. Spatial compute device **108** transfers network data to application server system **130** that indicates that application user **8** is currently using user application A over ad-hoc network **122**. The indication of application user **8** comprises a self-selected username by the user of spatial compute device **108** or some other user identifier. Application users **1-4** in spatial compute devices **101-104** wirelessly exchange application data for their user applications over ad-hoc communication network **121**. Application users **5-8** of spatial compute devices **105-108** wirelessly exchange application data for their user applications over ad-hoc communication network **122**.

[0030] FIG. **4** illustrates exemplary Fifth Generation (5G) communication network **400** to deliver user applications to spatial compute devices (DEV.) **401-407** over ad-hoc communication networks A and B. 5G communication system **400** comprises an example of wireless communication system **100**, although system **100** may differ. 5G communication system **400** comprises: spatial compute devices **401-407**, Access Nodes (ANs) **411-412**, and network data center

420. Network data center 420 comprises Access and Mobility Management Function (AMF) 421, Session Management Function (SMF) 422, User Plane Function (UPF) 423, Application Server Function (ASF) 424, and Interworking Function (IWF) 425. Network data center 420 typically includes additional network functions like Network Repository Function (NRF) and Unified Data Management (UDM) that are omitted for clarity.

[0031] Spatial compute device 401 wirelessly attaches to 5GNR AN 411. Spatial compute device 401 registers with AMF 421 over 5GNR AN 411. AMF 421 authenticates and authorizes spatial compute device 401 for data services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 401 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 401 to 5GNR AN 411, and 5GNR AN 411 transfers the spatial compute device context to spatial compute device 401. To initiate a Virtual Reality (VR) application with other spatial compute devices, spatial compute device 401 broadcasts a beacon for ad-hoc network A. Over 5GNR AN 411 and UPF 423, spatial compute device 401 notifies ASF 424 of the VR application that is available over ad-hoc communication network A along with the VR application username for spatial compute device 401. The user of spatial compute device 401 selects a network name for ad-hoc communication network A and the VR application username.

[0032] Spatial compute device 402 wirelessly attaches to 5GNR AN 411. Spatial compute device 402 registers with AMF 421 over 5GNR AN 411. AMF 421 authenticates and authorizes spatial compute device 402 for services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 402 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 402 to 5GNR AN 411, and 5GNR AN 411 transfers the spatial compute device context to spatial compute device 402. Spatial compute device 401 detects ad-hoc communication network A and queries ASF 424 for corresponding information over 5GNR AN 411 and UPF 423. ASF 424 translates ad-hoc communication network A into the VR application and VR application username for spatial compute device 401. ASF 424 indicates the VR application on ad-hoc communication network A and the VR application username for spatial compute device 401 to spatial compute device 402. Spatial compute device 402 displays a prompt to use the VR application with the VR application username for spatial compute device 401 over ad-hoc communication network A. In response, spatial compute device 402 receives a user instructions to join ad-hoc communication network A and use the VR application with a select VR application username. Spatial compute devices 401-402 establish point-to-point 5GNR link 411. Spatial compute devices 401-402 exchange VR application data over 5GNR link 411 in ad-hoc communication network A. Spatial compute device 402 notifies ASF 424 of its VR application username and its use of the VR application over ad-hoc communication network A.

[0033] Spatial compute device 403 wirelessly attaches to 5GNR AN 411. Spatial compute device 403 registers with AMF 421 over 5GNR AN 411. AMF 421 authenticates and authorizes spatial compute device 403 for services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 403 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 403 to 5GNR AN 411, and AN 411 transfers the spatial compute device context to spatial compute device 403. Spatial compute device 403 detects ad-hoc communication network A and queries ASF 424 over 5GNR AN 411 and UPF 423. ASF 424 translates ad-hoc communication network A into the VR application and the VR application usernames for spatial compute devices 401-402. ASF 424 indicates the VR application on ad-hoc communication network A and the VR application usernames for spatial compute devices 401-402 to spatial compute device 403. Spatial compute device 403 displays a prompt to use the VR application with the VR application usernames for spatial compute devices 401-402 over ad-hoc communication network A. In response, spatial compute device 403 receives user instructions to join ad-hoc communication network A and use the VR application. Spatial compute device 403 establishes point-to-point 5GNR links 412-413 with respective spatial compute devices 401-402. Spatial compute devices 401-403 exchange VR application data over 5GNR links 411-413 in ad-hoc communication network A. Spatial compute device 403 notifies ASF 424 of its VR application username and its use of the VR application over ad-hoc communication network A. Spatial compute devices 401-403 may use additional applications over ad-hoc communication network A in a like manner.

[0034] Spatial compute device 404 wirelessly attaches to WIFI AN 412. Spatial compute device 404 establishes a secure tunnel with IWF 425 over WIFI AN 412. Spatial compute device 404 registers with AMF 421 over WIFI AN 412 and IWF 425. AMF 421 authenticates and authorizes spatial compute device 404 for data services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 404 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 404 to IWF 425 and to spatial compute device 404 over IWF 425 and WIFI AN 412. To initiate an interactive gaming application with other spatial compute devices, spatial compute device 404 broadcasts a beacon for ad-hoc communication network B. Over WIFI AN 412, IWF 425, and UPF 423, spatial compute device 404 notifies ASF 424 of the interactive gaming application that is available over ad-hoc communication network B along with the gaming application username for spatial compute device 404.

[0035] Spatial compute device 405 wirelessly attaches to WIFI AN 412. Spatial compute device 405 establishes a secure tunnel with IWF 425 over WIFI AN 412. Spatial compute device 405 registers with AMF 421 over WIFI AN 412 and IWF 425. AMF 421 authenticates and authorizes spatial compute device 405 for services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 405 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 405 to IWF 425 and to spatial compute device 405 over IWF 425 and WIFI AN 412. Spatial compute device

405 detects ad-hoc communication network B and queries ASF 424 for corresponding information over WIFI AN 411, IWF 425, and UPF 423. ASF 424 translates ad-hoc communication network B into the interactive gaming application and gaming application username for spatial compute device 404. ASF 424 indicates the interactive gaming application on ad-hoc communication network B and the gaming application username for spatial compute device 404 to spatial compute device 405. Spatial compute device 405 displays a prompt to use the interactive gaming application with the gaming application username for spatial compute device 404 over ad-hoc communication network B. In response, spatial compute device 405 receives a user instruction to join ad-hoc communication network B and use the interactive gaming application. Spatial compute devices 404-405 establish point-to-point Direct Short Range Radio Communication (DSRC) link 414. Spatial compute devices 404-405 exchange interactive gaming application data over DSRC link 414 in ad-hoc communication network B. Spatial compute device 405 notifies ASF 424 of its gaming application username and its use of the interactive gaming application over ad-hoc communication network B.

[0036] Spatial compute device 406 wirelessly attaches to WIFI AN 412. Spatial compute device 406 establishes a secure tunnel with IWF 425 over WIFI AN 412. Spatial compute device 406 registers with AMF 421 over WIFI AN 412 and IWF 425. AMF 421 authenticates and authorizes spatial compute device 406 for services that include connectivity to ASF 424. AMF 421 transfers spatial compute device context for the services for spatial compute device 406 to SMF 423, and SMF 423 transfers the spatial compute device context to UPF 423. AMF 421 transfers spatial compute device context for the services for spatial compute device 406 to IWF 425 and to spatial compute device 406 over IWF 425 and WIFI AN 412. Spatial compute device 406 detects ad-hoc communication network B and queries ASF 424 for corresponding information over WIFI AN 411, IWF 425, and UPF 423. ASF 424 translates ad-hoc communication network B into the interactive gaming application and gaming application usernames for spatial compute devices 404-405. ASF 424 indicates the interactive gaming application on ad-hoc communication network B and the gaming application usernames for spatial compute devices 404-405 to spatial compute device 406. Spatial compute device 406 displays a prompt to use the interactive gaming application with the gaming application usernames for spatial compute devices 404-405 over ad-hoc communication network B. In response, spatial compute device 406 receives a user instruction to join ad-hoc communication network B and use the interactive gaming application. Spatial compute device 406 and spatial compute devices 404-405 establish respective DSRC links 415-416. Spatial compute devices 404-406 exchange interactive gaming application data over DSRC links 414-416 in ad-hoc communication network B. Spatial compute device 406 notifies ASF 424 of its gaming application username and its use of the interactive gaming application over ad-hoc communication network B. Spatial compute devices 404-406 may use additional applications over ad-hoc communication network B in a like manner. The description continues below with respect to FIG. 5.

[0037] FIG. 5 illustrates exemplary 5G communication network 400 to serve spatial compute devices 401-407 over ad-hoc communication networks A and B. The description of FIG. 5 follows from the above description of FIG. 4. Spatial compute device 407 attaches 5GNR AN 411 over 5GNR link 517 and/or to WIFI AN 412 over WIFI link 518. Spatial compute device 407 registers with AMF over 5GNR AN 411 and/or WIFI AN 412 and IWF 425. Spatial compute device 407 interacts with ASF 424 over 5GNR AN 411 and UPF 423 and/or WIFI AN 412, IWF 425, and UPF 423. Spatial compute device 407 detects both ad-hoc communication networks A and B. Spatial compute device 407 queries ASF 424 for information for ad-hoc communication networks A and B. ASF 424 translates ad-hoc communication network A into the VR application, the VR application usernames for spatial compute devices 401-403, and ad-hoc communication network A. ASF 424 translates ad-hoc communication network B into the interactive gaming application, the gaming application usernames for spatial compute devices 404-406, and ad-hoc communication network B.

[0038] ASF 424 indicates the VR application on ad-hoc network A and the VR application usernames for spatial compute devices 401-403 to spatial compute device 407. ASF 424 further indicates the interactive gaming application on ad-hoc network B and the gaming application usernames for spatial compute devices 404-406 to spatial compute device 407. Spatial compute device 407 displays a prompt to use the VR application with the gaming application usernames for spatial compute devices 401-403 over ad-hoc communication network A. Spatial compute device 407 displays another prompt to use the interactive gaming application with the gaming application usernames for spatial compute devices 404-406 over ad-hoc communication network B. In response, spatial compute device 407 receives user instructions to join ad-hoc communication network A and use the VR application and to join ad-hoc communication network B and use the interactive gaming application. Spatial compute device 407 and spatial compute devices 401-403 establish respective 5GNR links 511-513. Spatial compute devices 401-403 and 407 exchange VR application data over 5GNR links 411-413 and 511-513 in ad-hoc communication network A. Spatial compute device 407 and spatial compute devices 404-406 establish respective DSRC links 514-516. Spatial compute devices 404-407 exchange interactive gaming application data over DSRC links 414-416 and 514-516 in ad-hoc communication network B. Spatial compute device 407 notifies ASF 424 of its VR application username and its use of the VR application over ad-hoc communication network A. Spatial compute device 407 also notifies ASF 424 of its gaming application username and its use of the interactive gaming application over ad-hoc communication network B. Spatial compute device 407 may use additional applications over ad-hoc communication networks A and B in a like manner. Spatial compute device 407 may interact with ASF 424 over WIFI AN 412, IWF 425, and UPF 423 instead of 5GNR AN 411.

[0039] In some examples, spatial compute device 407 interacts with spatial compute devices 401-406 over ASF 424 instead of ad-hoc networks A and B. For example, spatial compute device 407 may interact with spatial compute devices 401-403 over ASF 424 instead of ad-hoc network A—and spatial compute devices 401-403 and 407 may use either the WIFI link (WIFI AN 412-IWF 425-UPF 423) or the 5GNR link (5GNR AN 411-UPF 423) to access ASF 424. Spatial compute device 407 may interact with spatial compute devices 404-406 over ASF 424 instead of ad-hoc network B—and spatial compute devices 404-407 may use either the WIFI link or the 5GNR link to access ASF

424. The use of ad-hoc networks A-B or ANs **411-412** for the individual user applications and application usernames is controlled by the user of spatial compute device **407** and may be automatically selected by spatial compute device **407** based on data communication quality. Spatial compute devices **401-406** and other spatial compute devices could be configured and operate like spatial compute device **407**.

[0040] FIG. **6** illustrates exemplary spatial compute device **407** in 5G communication network **400**. Spatial compute device **407** comprises an example of spatial compute devices **101-108** and **401-406**, although spatial compute devices **101-108** and **401-406** may differ. Spatial compute device **407** comprises 5GNR radios **601-602**, WIFI radio **603**, DSRC radio **604**, user components **605**, and processing circuitry **606**. Radios **601-604** comprise antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSP, memory, and transceivers that are coupled over bus circuitry. User components **605** comprise displays, speakers, microphones, controllers, and/or some other user apparatus. Processing circuitry **606** comprises CPU, memory, and transceivers (XCVRs) that are coupled over bus circuitry. The memory in processing circuitry **606** stores an operating system (OS), Third Generation Partnership Project applications (3GPP), 5GNR applications (5GNR), DSRC applications (DSRC), WIFI applications (WIFI), and user applications (APP) for gaming, VR, and AR.

[0041] The antennas in 5GNR radio **601** exchange 5GNR signals with 5GNR AN **411**. The antennas in 5GNR radio **602** exchange 5GNR signals with spatial compute devices **401-403** over ad-hoc network A. The antennas in WIFI radio **603** exchange WIFI signals with WIFI AN **412**. The antennas in DSRC radio **604** exchange DSRC signals with spatial compute devices **404-406** over ad-hoc network B. User components **605** and the transceivers in radios **601-604** are coupled to transceivers in processing circuitry **606**. In processing circuitry **606**, the CPU retrieves the operating system and applications from the memory and executes the operating system and applications to operate spatial compute device **407** as described herein.

[0042] FIG. **7** illustrates exemplary 5GNR AN **411** and WIFI AN **412** in 5G communication network **400**. ANs **411-412** comprise examples of access networks **120**, although networks **120** may differ. 5GNR AN **411** comprises 5GNR Radio Unit (RU) **701**, Distributed Unit (DU) **702**, and Centralized Unit (CU) **703**. 5GNR RU **701** comprises antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSP, memory, radio applications, and transceivers that are coupled over bus circuitry. DU **702** comprises memory, CPU, user interfaces and components, and transceivers that are coupled over bus circuitry. The memory in DU **702** stores operating system and 5GNR network applications for physical layer, media access control, and radio link control. CU **703** comprises memory, CPU, and transceivers that are coupled over bus circuitry. The memory in CU **603** stores an operating system and 5GNR network applications for packet data convergence protocol, service data adaption protocol, and radio resource control.

[0043] The antennas in 5GNR RU **701** are wirelessly coupled to spatial compute devices **401-403** and **407** over 5GNR links. Transceivers in 5GNR RU **701** are coupled to transceivers in DU **702**. Transceivers in DU **702** are coupled to transceivers in CU **703**. Transceivers in CU **703** are coupled AMF **421** and UPF **423**. The DSP and CPU in RU **701**, DU **702**, and CU **703** execute the radio applications, operating systems, and network applications to exchange data and signaling with spatial compute devices **401-403**, spatial compute device **407**, AMF **421**, and UPF **423**. In particular, the 5GNR radio resource control in CU **703** may schedule 5GNR resource blocks between spatial compute devices to form point-to-point 5GNR links **411-413** and **511-513**.

[0044] WIFI AN **411** comprises WIFI radio **705** and node circuitry **706**. WIFI radio **705** comprises antennas, amplifiers, filters, modulation, analog-to-digital interfaces, DSP, memory, radio applications, and transceivers that are coupled over bus circuitry. Node circuitry **706** comprises memory, CPU, and transceivers that are coupled over bus circuitry. The memory in node circuitry **706** stores operating system and WIFI applications. The antennas in WIFI radio **705** are wirelessly coupled to spatial compute devices **404-407** over WIFI links. Transceivers in WIFI radio **705** are coupled to transceivers in node circuitry **706**. Transceivers in node circuitry **706** are coupled to IWF **425**. The CPU in node circuitry **706** execute the WIFI applications and operating systems to exchange data and signaling with spatial compute devices **404-407** and IWF **425**.

[0045] FIG. **8** illustrates exemplary data center **420** in 5G communication system **400**. Network data center **420** comprises an example of access networks **120** and application server system **130**, although networks **120** and system **130** may differ. Network data center **420** comprises Network Function (NF) hardware **801**, NF hardware drivers **802**, NF operating systems **803**, NF virtual layer **804**, and NF Software (SW) **805**. NF hardware **801** comprises Network Interface Cards (NICs), CPU, RAM, Flash/Disk Drives (DRIVE), and Data Switches (DSW). NF hardware drivers **802** comprise software that is resident in the NIC, CPU, RAM, DRIVE, and DSW. NF operating systems **803** comprise kernels, modules, and applications that form containers for virtual layer and NF software execution. NF virtual layer **804** comprises vNIC, vCPU, vRAM, vDRIVE, and vSW. NF SW **805** comprises AMF SW **821**, SMF SW **822**, UPF SW **823**, ASF SW **824**, and IWF SW **825**. Other NF SW like Network Repository Function (NRF) SW is typically present but is omitted for clarity. Network data center **420** may be located at a single site or be distributed across multiple geographic locations. The NIC in NF hardware **801** are coupled to 5GNR AN **411**, WIFI AN **412**, and external systems. NF hardware **801** executes NF hardware drivers **802**, NF operating systems **803**, NF virtual layer **804**, and NF SW **805** to form and operate AMF **421**, SMF **422**, UPF **423**, ASF **424**, and IWF SW **425** as described herein. In particular, AMF **421**, SMF **422**, UPF **423**, and IWF **425** serve spatial compute device access to ASF **424**. ASF **424** serves user application information for ad-hoc networks including the individual application users. ASF **424** also serves connectivity for some user applications and hosts other user applications.

[0046] FIG. **9** illustrates an exemplary operation of 5G communication network **400** to deliver user applications to spatial compute devices (DEV.) **401-407** over the ad-hoc communication networks A and B. The operation may differ in other examples. Representative user applications **1-2** are used in this example, and user applications **1-2** could be for gaming, AR, VR, or some other user service. Spatial compute devices **401-403** form ad-hoc communication network A, execute user application **1**, and exchange application **1** data over point-to-point 5GNR links. Spatial compute devices **404-406** form ad-hoc communication network B, execute user application **2**, and exchange application **2** data over point-to-point DSRC links. Spatial compute devices **404-406** individually report their use of network application **2**, ad-hoc communication network B, and their own application **2** usernames to ASF **424** over WIFI AN **412**, IWF **425**, and UPF **423**. Spatial compute devices **401-403** individually report their use of network application **1**, ad-hoc communication network A, and their own application **1** usernames to ASF **424** over 5GNR AN **411** and UPF **423**.

[0047] Spatial compute device **407** detects ad-hoc communication network B and queries ASF **424** over 5GNR AN **411** and UPF **423**. ASF **424** translates ad-hoc network B into user application **2** and its application **2** usernames. ASF **424** responds to spatial compute device **407** with user application **2** and its application **2** usernames for ad-hoc communication network B. In response to a user prompt and selection, spatial compute device **407** joins ad-hoc communication network B and executes user application **2**. Spatial compute devices **401-403** and **407** exchange data for user application **2** over ad-hoc communication network B. For example, user application **2** could be a VR application, and the VR application usernames could share VR application data over ad-hoc communication network B.

[0048] Spatial compute device **407** detects ad-hoc communication network A and queries ASF **424** over 5GNR AN **411** and UPF **423**. ASF **424** translates ad-hoc network A into user application **1** and its application usernames. ASF **424** responds to spatial compute device **407** with user application **1** and its application usernames for ad-hoc communication network A. In response to a user prompt and selection, spatial compute device **407** joins ad-hoc communication network A and executes user application **1**. Spatial compute devices **401-403** and **407** exchange data for user application **1** over ad-hoc communication network A. For example, user application **1** could be an interactive gaming application and the gaming application usernames share gaming application data over ad-hoc communication network A.

[0049] FIG. **10** illustrates an exemplary operation of 5G communication network **400** to deliver the user applications to spatial compute devices (DEV.) **401-407** over ad-hoc communication networks A and B. The operation may differ in other examples. Spatial compute devices **404-406** form ad-hoc communication network B and execute user application **2**. Spatial compute devices **404-406** individually report their use of network application **2**, ad-hoc communication network B, and their own application usernames to ASF **424**. Spatial compute device **407** detects ad-hoc communication network B and queries ASF **424** over 5GNR AN **411** and UPF **423**. ASF **424** translates ad-hoc communication network B into user application **2** and its application **2** usernames. ASF **424** responds to spatial compute device **407** with user application **2** and its application **2** usernames for ad-hoc communication network B. Spatial compute device **407** joins ad-hoc communication network B and executes user application **2**. Spatial compute devices **401-403** and **407** exchange data for user application **2** over ad-hoc communication network B. For example, user application **2** could be an AR application and the AR application usernames share AR application data over ad-hoc communication network A.

[0050] Spatial compute device **407** receives a user instruction to use ASF **424** to interact with spatial compute devices **404-406** for user application **2**. In response, spatial compute device **407** interacts with spatial compute devices **404-406** for user application **2** over 5GNR AN **411**, UPF **423**, ASF **424**, UPF **423**, IWF **425**, and WIFI AN **412**. Spatial compute devices **404-406** may opt to use ASF **424** in a similar manner. ASF **424** could host user application **2** for spatial compute devices **404-407** in a client server mode. Spatial compute device **407** then receives a user instruction to use ad-hoc communication network B to interact with spatial compute device **404-406** for user application **2**. In response, spatial compute device **407** rejoins ad-hoc communication network B and directly interacts with spatial compute devices **404-406** for user application **2**.

[0051] The wireless data network circuitry described above comprises computer hardware and software that form special-purpose wireless network circuitry to serve spatial compute devices over ad-hoc communication networks. The computer hardware comprises processing circuitry like CPUs, DSPs, GPUs, transceivers, bus circuitry, and memory. To form these computer hardware structures, semiconductors like silicon or germanium are positively and negatively doped to form transistors. The doping comprises ions like boron or phosphorus that are embedded within the semiconductor material. The transistors and other electronic structures like capacitors and resistors are arranged and metallically connected within the semiconductor to form devices like logic circuitry and storage registers. The logic circuitry and storage registers are arranged to form larger structures like control units, logic units, and Random-Access Memory (RAM). In turn, the control units, logic units, and RAM are metallically connected to form CPUs, DSPs, GPUs, transceivers, bus circuitry, and memory.

[0052] In the computer hardware, the control units drive data between the RAM and the logic units, and the logic units operate on the data. The control units also drive interactions with external memory like flash drives, disk drives, and the like. The computer hardware executes machine-level software to control and move data by driving machine-level inputs like voltages and currents to the control units, logic units, and RAM. The machine-level software is typically compiled from higher-level software programs. The higher-level software programs comprise operating systems, utilities, user applications, and the like. Both the higher-level software programs and their compiled machine-level software are stored in memory and retrieved for compilation and execution. On power-up, the computer hardware automatically executes physically-embedded machine-level software that drives the compilation and execution of the other computer software components which then assert control. Due to this automated execution, the presence of the higher-level software in memory physically changes the structure of the computer hardware machines into special-purpose wireless network circuitry to serve spatial compute devices over ad-hoc communication networks.

[0053] The above description and associated figures teach the best mode of the invention. The following claims specify the scope of the invention. Note that some aspects of the best mode may not fall within the scope of the invention as specified by the claims. Those skilled in the art will appreciate that the features described above can be combined in various ways to form multiple variations of the invention. Thus, the invention is not limited to the specific embodiments described above, but only by the following claims and their equivalents.

What is claimed is:

1. A method comprising:

receiving a network identifier for a communication network from a user apparatus;

receiving an application identifier for a user application that uses the communication network from the user apparatus;

receiving an application username that identifies a user of the user application from the user apparatus; and

receiving a request that indicates the network identifier from another user apparatus, and in response, transferring the application identifier and the application username to the other user apparatus.

2. The method of claim **1** further comprising:

authenticating the user apparatus; and

authenticating the other user apparatus.

3. The method of claim **1** further comprising scheduling wireless communication resources to exchange application data over the communication network between the user apparatus and the other user apparatus.

4. The method of claim **1** further comprising hosting the user application.

5. The method of claim **1** wherein the user application comprises an interactive gaming application.

6. The method of claim **1** wherein the user application comprises an Augmented Reality (AR) application.

7. The method of claim **1** wherein the user application comprises a Virtual Reality (VR) application.

8. The method of claim **1** wherein the user application comprises a Vehicle-to-Vehicle (V2V) application.

9. The method of claim **1** wherein the communication network uses Direct Short Range Radio Communication (DSRC) links.

10. The method of claim **1** wherein the communication network uses Fifth Generation New Radio (5GNR) communication links.

11. The method of claim **1** wherein the communication network uses Wireless Fidelity (WIFI) communication links.

12. The method of claim **1** wherein the communication network uses Bluetooth Low Energy (BLE) communication links.

13. The method of claim **1** wherein the communication network uses Near Field Communication (NFC) links.

14. A method comprising:

authenticating a user apparatus that has a user application that uses a communication network;

receiving a network identifier for the communication network and an application identifier for the user application from the user apparatus;

receiving an application username for a user of the user application from the user apparatus;

authenticating another user apparatus that has the user application; and

receiving a request that indicates the network identifier from the other user apparatus, and in response, transferring the application identifier and the application username to the other user apparatus.

15. A communication system comprising:

one or more wireless access nodes to wirelessly receive a network identifier for a communication network and transfer the network identifier to an application server;

the one or more wireless access nodes to wirelessly receive an application identifier for a user application that uses the communication network and transfer the application identifier to the application server;

the application server to associate the application identifier with the network identifier;

the one or more wireless access nodes to wirelessly receive an application username that identifies a user of the user application and transfer the application username to the application server;

the application server to associate the application username with the application identifier;

the one or more wireless access nodes to wirelessly receive a request that indicates the network identifier and transfer the request to the application server;

the application server to transfer the application username associated with the application identifier and the application identifier associated with the network identifier to the one or more wireless access nodes in response to the request; and

the one or more wireless access nodes to wirelessly transfer the application username associated with the application identifier and the application identifier associated with the network identifier in response to the request.

16. The communication system of claim **15** further comprising one or more network functions to authenticate a wireless user device that executes the user application for the user.

17. The communication system of claim **15** further comprising the one or more wireless access nodes to schedule wireless communication resources to exchange application data for the user application over the communication network.

18. The communication system of claim **15** wherein the user application comprises an interactive gaming application.

19. The communication system of claim **15** wherein the user application comprises an Augmented Reality (AR) application.

20. The communication system of claim **15** wherein the user application comprises a Virtual Reality (VR) application.

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