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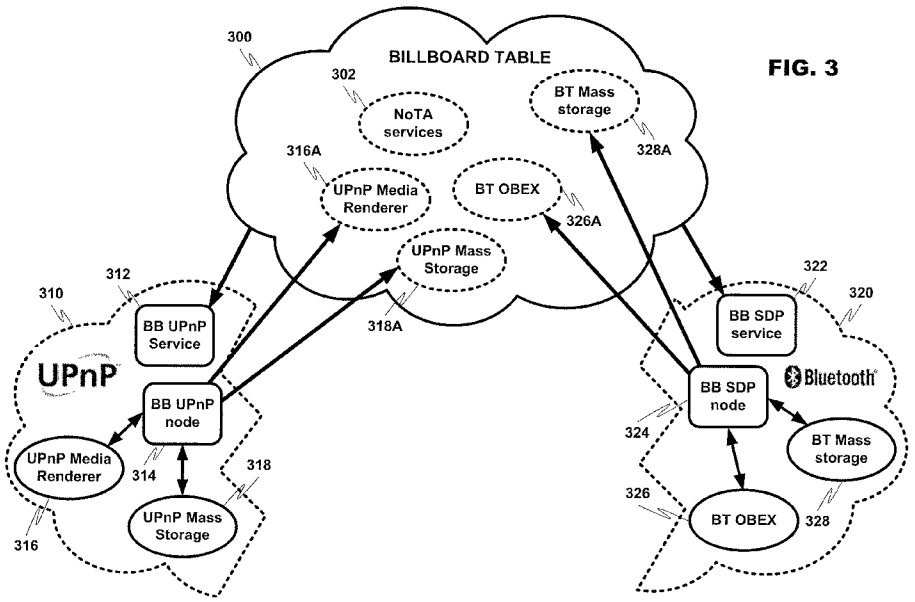

FIG. 3

(57) **Abstract:** A system including a billboard that may comprise a common memory space allocated amongst at least two devices. Service nodes created on the billboard may represent services offered by the at least two devices. Service nodes may interact with each other on the billboard in order to perform inquiries for required services. For example, an application residing in the at least two devices may access the billboard in order to locate service nodes pertaining to a desired service. Information available from service nodes may include service property and usable transport information. A direction connection may then be made between the application and the service after a service node is selected.

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CONNECTIVITY ARCHITECTURE FOR SERVICE DISCOVERY

BACKGROUND OF INVENTION

1. Field of Invention:

[0001] The present invention relates to strategies for wirelessly conveying information between devices, and more specifically, to a system for making services that may exist on one or more devices available to any device via a shared information space.

2. Background:

[0002] In general, a software program may include a set of instructions, executable by a processor, that are organized to receive input (e.g., data) for a calculation or determination that may then result in an output. Over the years, software technology has evolved to transform these individual instruction sets into modules that may in turn be integrated together to form the more complex programs we know today. Today's more-sophisticated software programs may receive various forms of input such as raw data, for example as stored in magnetic or optical storage, user input through various known types of user interfaces, measured or monitored information converted to electronic information from electronic and/or electromechanical sensors, etc.

[0003] In some instances, programs may be configured to produce data usable by other software applications. However, a problem may be presented in conveying the information from one program to another. If the relationship is known before the programs are created, then a specific strategy may be devised to convert one program's output into another program's input. Traditionally this strategy has led to functional but rigid software applications, requiring frequent and possibly substantial revisions due to changes in functionality, platform, architecture, etc.

[0004] An example of this rigid incompatibility may be seen in solutions currently utilized for coupling wireless communication devices. Some manufacturers may attempt to simplify device operation by facilitating automatic wireless recognition and connection functionality between devices. This automated behavior, similar to the original "plug and play" devices that became available with the emergence of Universal Serial Bus (USB) technology, may allow unskilled users to operate wirelessly-coupled devices without

having to first configure device communication settings. However, this functionality is often achieved through the use of services established by different manufacturers or user groups such as Bluetooth™ Service Discovery Protocol (BT SDP), Bonjour, Universal Plug and Play (UPnP), etc. Individually these protocols (e.g., groups of services) may function adequately, but they were not created with the ability to interact. In at least one problematic scenario, a wireless communication device utilizing one service discovery protocol would not be able to wirelessly connect to another device, identify another device, utilize services on another device, etc. that is utilizing a different service discovery protocol, and therefore, beneficial functionality available on a device may be lost because a wireless coupling between devices cannot be automatically established.

SUMMARY OF INVENTION

[0005] The present invention includes at least a method, computer program, device and system for managing the operation of one or more devices interacting with a shared memory area, or billboard. Nodes also resident on the one or more devices may interact with the billboard in order to transmit/receive data. For example, nodes may be associated with various services offered by the one or more devices, providing a means for interaction by which incompatibilities between different services may be overcome.

[0006] In at least one embodiment of the present invention, the billboard may be comprised of a shared memory space allocated amongst a plurality of devices. In this configuration, each device may contain within its memory a "section" of the billboard. After the one or more devices are wirelessly coupled, information related to services available on the devices may be obtained, and this information may in turn be utilized to create one or more service nodes corresponding to the offered services. Service nodes resident in the billboard may then be queried by applications also resident on the one or more devices that require the use of a particular service. Locating a service node related to the desired service may then facilitate a direct link between the application and service.

[0007] The present invention may, in at least one embodiment, initiate wireless communication with another device over a commonly supported wireless communication medium. This wireless link may support various protocols that enable the formation of the shared memory space, service nodes, etc. on the devices. Network on Terminal

Architecture (NoTA) is an example of an architecture that may be implemented in various embodiments of the present invention and that may be utilized to link billboard sections in each device. In creating service nodes, information related to properties and transport mediums usable by each service may be obtained. Property information may be made available to applications by accessing the service node. Transport medium information (e.g., typically OSI layer 1-4) may relate each service to one or more corresponding wired or wireless communication mediums, and may further be employed in formulating a connectivity map. The connectivity map ties each service to its corresponding transport mediums, and may be utilized by an application when deciding which service to select.

DESCRIPTION OF DRAWINGS

[0008] The invention will be further understood from the following description of various exemplary embodiments, taken in conjunction with appended drawings, in which:

[0009] FIG. 1 discloses the exemplary levels of a wireless communication architecture in accordance with at least one embodiment of the present invention.

[0010] FIG. 2 discloses an exemplary link between two wireless communication devices in accordance with at least one embodiment of the present invention.

[0011] FIG. 3 discloses an example of services being utilized to create service nodes on a billboard in accordance with at least one embodiment of the present invention.

[0012] FIG. 4A discloses an exemplary Network on Terminal Architecture in accordance with at least one embodiment of the present invention.

[0013] FIG. 4B discloses an exemplary transport table in accordance with at least one embodiment of the present invention.

[0014] FIG. 5 discloses an example of communication to a billboard utilizing a connection map in accordance with at least one embodiment of the present invention.

[0015] FIG. 6A-6E discloses an example of an application querying and selecting a service in accordance with at least one embodiment of the present invention.

[0016] FIG. 6F discloses an example of the provision of services between devices using a billboard in accordance with at least one embodiment of the present invention.

[0017] FIG. 7 discloses an exemplary flowchart for a process for service node creation in accordance with at least one embodiment of the present invention.

[0018] FIG. 8 discloses an exemplary flowchart for a process for accessing a service node in accordance with at least one embodiment of the present invention.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0019] While the invention has been described below in terms of a multitude of exemplary embodiments, various changes can be made therein without departing from the spirit and scope of the invention, as described in the appended claims.

I. System Architecture

[0020] An exemplary wireless communication architecture in accordance with at least one embodiment of the present invention is disclosed in FIG. 1. While the present invention focuses mainly on Billboard 120 and Connectivity Map 140, Whiteboard 100 is also disclosed for contextual purposes. Whiteboard 100 may comprise the highest level of operation in this architecture. At this level, operational groups 102 may be formed including whiteboards 104 and various application nodes. Application nodes may correspond to application existing on a plurality of wireless communication devices, and may be utilized to exchange information between these applications, for example, by placing data into, and removing data from, whiteboard 104. For example, the various nodes may consist of proactive nodes (PN) 106 that may be utilized to place information into whiteboard 104, reactive nodes (RN) 110 may be utilized to take information from whiteboard 104. Information semantics interpreter (ISI) 108 may be utilized to link different whiteboards together. Utilizing these constructs, Whiteboard 104 may provide a standardized means for application interaction that overcomes many incompatibilities.

[0021] Billboard level 120 may facilitates interaction between services available on the one or more devices. Services 130 and clients 120 that may utilize these services may be organized in service domains 122. In at least one scenario, service domains 122 may correspond to a particular protocol, such as UPnP, BT SDP, Bonjour, etc. In each service domain 122, services 130 may be represented by service nodes (SN) 126, and likewise, application nodes (AN) 128 may be established to correspond to applications. Further, service domains 122 may interact utilizing service ontology interpreters (SOI)

124. SOI 124 may allow service domains 122 to interact with other service domains 122 in the service level, even if the service domains 122 reside on different wirelessly-linked devices (e.g., to provide access information to other service domains 122).

[0022] Connectivity map 140 may define available connectivity methods/possibilities and topology for different devices participating in sharing resources in order to support whiteboard 100 and billboard 120. In at least one embodiment of the present invention, devices 144 may be linked in directly connected groups 142. Examples of directly connected groups of devices (Dev) 142 may include devices connected via Bluetooth™ piconet, a WLAN network, a wUSB link, etc. Each directly connected group of devices 142 may further be linked by gateways (GW).

[0023] While FIG. 1 discloses an overall communication architecture usable with various embodiments of the present invention, for the sake of explanation in the present disclosure, a much more rudimentary scenario will be utilized to illustrate service node related functionality. FIG. 2 discloses device A 200 and device B 210. Examples of devices usable in instance may include various wireless communication devices ranging from very basic wireless devices like wirelessly-enabled sensors or cellular handsets to more complex wirelessly-enabled computing devices like laptop or palmtop computers, wireless communicators, personal digital assistants, or any similar devices with wired connectivity interfaces. The devices disclosed in FIG. 2 may be linked via wireless communication 220 (e.g., WLAN), for example, in order to form an ad-hoc network between the devices. Device B 210 may further include a variety of services and service search mechanism such as Bluetooth™-related BT SDP and UPnP. Under existing architecture schemes, device A 200 would not be aware of these services over wireless link 220, and further, even if device A 200 was aware, most or all of these services would probably be inaccessible due to various incompatibility issues existing between services. As a result, wireless coupling 220 between Device A 200 and Device B 210 may only be beneficial for conveying information, since no access to remote services is available.

II. Service node implementation

[0024] A service may be defined as the functionality offered or derived from a particular software program. Services may pertain to all aspects of device functionality. Services may be provided, for example, by an operating system loaded on a wireless communication device, or may be added to the device by accessory applications related to

communication, security, productivity, device resource management, entertainment, etc. In accordance with at least one embodiment of the present invention, one or more service nodes may be established to correspond to services available on the one or more devices.

[0025] FIG. 3 discloses an example of billboard functionality in accordance with at least one embodiment of the present invention. Billboard 300 may comprise a shared memory space established amongst one or more wired or wireless devices. The scenario disclosed in FIG. 3 may further include a protocol such as UPnP 310 installed on a device (e.g., device A 200), and Bluetooth™ SDP 320 installed, for example, on device B 210. Billboard 300 may interact with these protocols using one or more services installed on devices A 200 and B 210, such as exemplary billboard services BB UPnP service 312 and BB SDP service 322. BB services 312 and 322 may typically be components of UPnP and BT architecture but they may be components of an NoTA architecture, an exemplary configuration of which is described in detail below with respect to FIG. 4.

[0026] UPnP 310 may offer various services locally on device A 200. These services may include UPnP media renderer service 316 and UPnP mass storage service 318. Similarly, Bluetooth™ SDP 320 may provide BT OBEX service 316 and BT mass storage service 328 on device B 210. It is important to note that these specific services have been used only for the sake of example in the present disclosure, and are not intended to limit the scope of services usable with various embodiments of the present invention. While these exemplary services would normally only be accessible to applications residing on the same service domain, the present invention, in accordance with at least one embodiment, may provide for the interaction of various services and/or applications, regardless of the domain on which a service resides.

[0027] At least one embodiment of the present invention may operate to create service nodes corresponding to the services offered on each device in billboard table 300. In the scenario disclosed in FIG. 3, BB UPnP node 314 and BB SDP node 324 may create service nodes UPnP media renderer service 316A and UPnP mass storage service 318A, as well as BT OBEX service 316A and BT mass storage service 328A, respectively. These nodes exist in a common billboard table 300, despite the protocols and services actually residing on separate devices. Further, the nodes may provide information about services to other services and/or applications, such as the name of the service, service properties, pairing & authentication information utilized in accessing a particular service

and/or transport mediums usable with each service. This service information may be obtained, for example by utilizing BB SDP service 324 if billboard table 300 wants to be used from the BT domain, or BB UPnP 314 service if billboard table 300 is wants to be utilized from the UPnP domain. It may also be possible that some architectures, such as NoTA, support billboard service directly. NoTA services 302 may be utilized, in accordance with at least one embodiment of the present invention, to establish the initial communication between devices A 200 and B 210 via a wireless communication medium in order to establish a shared memory space that will be utilized as Billboard table 300.

III. Underlying architecture

[0028] FIG. 4A discloses an example of an underlying logical architecture that may be utilized in implementing NoTA. NoTA may be configured as multiple subsystems (e.g., 400 and 420) coupled by interconnect 450. NoTA interconnect 450 may comprise two layers: High Interconnect (H_IN) layer 452 and Low Interconnect (L_IN) layer 454 coupled by switch 456. Low interconnect layer 454 may include ISO/OSI layers L1 – L4 and may provide transport socket type interface upwards. High Interconnect layer 452 may act as the middleware between L_IN 454 and the higher level Application nodes (AN) 402 and Service nodes (SN) 422 residing in subsystems like 400 and 420. Key H_IN 452 functionality is to provide client nodes (AN 402 or SN 422) on top a direct access to services (without having to disclose the location of the latter). All communication may be connection-oriented, meaning that before any service or data communication takes place, connection setup procedures need to be carried out. Security features have been added to countermeasure the identified threats. NoTA is an architecture that may be used to provide intra-device service access, making it possible to build independent subsystems providing both services and applications. In an exemplary implementation there may be several individual NoTA devices involved in direct inter sub-system communication.

[0029] FIG. 4B discloses another underlying construct that may be implemented in various embodiments of the present invention. Connectivity map 480 may be utilized to map the various services offered on the one or more devices participating in billboard table 300 to various transport mediums that may be utilized with each service. In the present example, transport mediums may comprise wireless communication mediums such as Bluetooth™, WLAN, Wibree™, wUSB, etc. In addition, the present invention,

in accordance with at least one embodiment, may also be that radio technologies can be used with several protocols (e.g., Bluetooth protocols may be implemented over WLAN). However, the present invention is not specifically limited to using these particular wireless communication mediums, and may be implemented with other wireless communication mediums that are usable by services offered by various devices. In this example, Services offered by the devices may be listed under services 482, and the corresponding available transport mediums are listed under transports 484. Arrows between services 482 and transport mediums 484 indicate the one or more transport mediums usable by each service. Connectivity map 480 may be utilized by applications in determining an appropriate transport medium to utilize with a particular service. Where two or more transport mediums are available, a particular transport medium may be selected based on various characteristics such as speed, traffic, priority of executing the service, other active wireless communication mediums, etc.

[0030] Now referring to FIG. 5, an example depicting a wireless transaction between device A 200 and device B 210 is disclosed in accordance with at least one embodiment of the present invention. In this instance, BB service search 500 on device A 200 may require the use of a particular service. Further, billboard table 300 may reside on device B 210. Regardless of the actual location of the service required by BB service search 500, a query may be made of billboard table 300 to gain access to a corresponding service node. This is because all available service information on the one or more devices participating in billboard table 300 is centrally located, reducing the steps required to access each service, and therefore, increasing the speed of access for available services. In addition, various embodiments of the present invention may include more than one billboard table 300 established between the linked devices. These billboard tables 300 may interact with each other to create a shared information pool that services may access.

[0031] BB service search 500 may, for example, using NoTA service 502 residing on device A 200 in order to access billboard table 300. In this example, connectivity map 504 may map to at least Bluetooth™ 506 as a transport medium usable by NoTA service 502. Other wireless communication mediums may also be usable as transport mediums, however in this example Bluetooth™ 506 is selected (e.g., by a user, by BB service search 500, by an application calling BB service search 500, etc.) A Bluetooth™ wireless link 508 may then be utilized to communicate between device A 200 and device B 210.

[0032] The wireless inquiry sent by device A 200 may then be received by device B 210. Bluetooth™ resources 520 in device B may correspond to (e.g., may be usable by) NoTA service 524 as determined by a mapping in connectivity map 522. NoTA service 524 may provide access to search billboard table 528, which may contain various service nodes 528 corresponding to various services available in the linked wireless communication devices. Again, while two devices are shown in the example of FIG. 5, more than two devices may participate in billboard table 300, including service nodes 528 corresponding to services that are offered by each device. BB service search 500 may then perform an inquiry of the service nodes 528 available in billboard table 300 in order to determine if any service will be suitable for the parameters specified in the search. An exemplary inquiry of billboard table 300 is now described with respect to FIG. 6A-6E.

IV. Exemplary Application/Service Node Interaction

[0033] FIG. 6A-6E disclose an exemplary usage scenario in accordance with at least one embodiment of the present invention. In FIG. 6A, an exemplary situation is shown wherein application 600 running on one of the devices participating in billboard table 300 may have a requirement for storage as indicated at 602. As a result, access to a service providing storage activities may be desired in order to support application 600. This inquiry may be performed, at least in part, by a billboard query 604.

[0034] An inquiry process in accordance with at least one embodiment of the present invention is shown in FIG. 6B. Storage inquiry 602 may be referred billboard query 604, which queries all of the service nodes in billboard table 300 in order to determine the services that may potentially fulfill the needs of Application 600. In FIG. 6B two service nodes have been highlighted as potentially corresponding to services appropriate for storage requirement 602. The potentially applicable service nodes are UPnP mass storage 318A and BT mass storage 328A. Billboard query 604 may further obtain information related to the services from their respective nodes. For example, property information may be supplied by service nodes 318A and 328A to application 600 through billboard query 604. Information regarding transport mediums usable by each service may also be obtained through the use of connectivity map 480. All of the aforementioned information may be used in determining which service to select for supporting application 600. For example, the properties of a particular service may be more useful for, or accessible to, application 600. A particular service may also be

selected because a usable transport medium is better able to support the activity to be performed because other transport mediums already have too much traffic, are experiencing interference, conflict with other transport mediums, etc.

[0035] In FIG. 6C, BT mass storage service node 328A has been selected to support application 600. This selection may be made automatically by control elements in the one or more devices supporting billboard table 300, by application 600, by user selection of a preferred service and/or transport medium, etc. Billboard query 604 may then obtain all of the information necessary to access BT Mass storage service 328 from BT mass storage service node 328A. This information may include, for example, property information and transport medium information that may be further conveyed to application 600 in order to facilitate a direct link between application 600 with BT Mass storage service 328. An exemplary direct linkage is shown in FIG. 6D, and a communication transaction resulting between application 600 and BT Mass storage service 328 is further shown in FIG. 6E.

[0036] Now referring to FIG. 6F, an example of devices providing services to other devices via billboard table 300 in accordance with at least one embodiment of the present invention is disclosed. In this example, devices 610 and 620 may be wirelessly coupled to device 630. A UPnP protocol in device 610 may couple to device 630 via WLAN, as shown at 612, in order to create a UPnP mass storage service node in billboard table 300. Similarly, a BT mass storage service in device 620 may utilize the BT SDP protocol to create a service node in billboard table 300 via Bluetooth™ communication 622. After these devices have established billboard table 630, device 640 may enter.

[0037] Device 640 includes an application that requires a storage service. Device 640 may then access billboard table 300 on device 630 as shown at 642. This connection may be made, for example, utilizing a NoTA service communicating over WLAN. Device 640 may access billboard table 300 in order to query the available services. If more than one applicable service is located, a selection may be made as to the service most appropriate for the application. In this example it is determined that the BT mass storage service will be most appropriate to assist the application in device 640. Device 640 may then obtain information from the BT mass storage node, such as property and transport medium information, that will be needed in order to access the BT mass storage

service. Device 640 may then access the BT mass storage service on device 620 in order to establish a direct connection between the application and the service a shown at 644.

V. Exemplary process flow

[0038] A process for establishing service nodes in accordance with at least one embodiment of the present invention is disclosed in FIG. 7. In step 700, a device may wirelessly link to another device. For example, an initial connection may be established over a wireless communication medium supported by at least two devices. After the initial connection is established, a determination may be made in step 702 as to whether billboard 300 is available on the linked devices. If billboard 704 is not available, then in step 704 the availability of resources related to supporting a needed service is verified. If these services are available, the process may proceed to node interoperation 718 where various nodes may interact. Otherwise, the process may return to step 700 until at least two Billboard-enabled devices are linked. Alternatively, if billboard 300 is available the process may move to step 706.

[0039] In step 706 a shared memory space may be established amongst the at least two participating devices in order to support billboard table 300. A query may then occur in step 708 in order to obtain information on all services offered by the devices involved in billboard table 300. An inquiry may be made, for example, by billboard query 604. As part of this inquiry, the names, property information, transport medium information, etc. for each offered service may be collected. This service information may be used, for example, to create a connectivity map 480 linking services to all corresponding usable transport mediums and protocols in step 710. Further, one or more service nodes associated with a service may be created in step 712. A service node may be created in shared memory space for each service offered by the at least two linked devices.

[0040] In step 714, a determination may be made as to whether any additional devices have been wirelessly linked to the existing at least two devices for participation in billboard 300. If new devices have been added, then in step 716 services available on the newly added device(s) may be incorporated into billboard 300 by repeating steps 710 and 712 in order to create additional transport mapping and service node creation to account for the additional or changed services. If in step 714 no further devices have been added to billboard 300, then node interoperation may begin in step 718. Node interoperation may include exemplary interaction between service nodes, at least one aspect of which is

described in more detail with respect to the flowchart of FIG. 8. Node interoperation may continue in step 720 until the connection is terminated. The process may then return to initial step 700 to wait for a new wireless connection to occur between devices.

[0041] A process describing an exemplary interaction between an application and billboard 300 in accordance with at least one embodiment of the present invention is now described with respect to FIG. 8. In step 800 an application may request utilization of a service. This request may be routed, for example, via billboard query 604. Billboard query 604 may then interact with one or more services, for example services that are linking components of a NoTA, in order to determine if any of the services offered by the at least two devices, and represented by service nodes in billboard 300, may be applicable to meeting the needs of the requesting application. If in step 802 no suitable service nodes are located, then in step 804 corrective action may occur. Corrective action may include activating the required service on the at least two devices, or may involve notification to a requesting application and/or a user that the service required by the application is currently not available. The process may then return to step 800 to await a new or modified service inquiry. If at least one service node is located that may be applicable to fulfilling the requirements of the requesting application, then the process may proceed to step 806.

[0042] In step 806 the services applicable to the requirements of the requesting application node may be reviewed. This review may include reviewing the properties of each service, which may be available to the requesting application from the service node, and further, reviewing the corresponding transport mediums usable by each service. The transport mediums may be determined, for example, by reviewing a connectivity map 480 that links services and corresponding transport mediums. A service may be selected based on a variety of characteristics related to one or more of the requesting application, the particular service, the device a service resides upon, the transport medium usable by a service, etc. If no service is selected in step 808, then the process may return to step 802 until an acceptable service is located or no potential services are located (e.g., step 804). Once a service is selected, then in step 810 the application may be directly connected to the service, allowing the application to directly access the service, and the process may then return to step 800 to await the next application that may request access to a service.

[0043] Accordingly, it will be apparent to persons skilled in the relevant art that various changes in forma and detail can be made therein without departing from the spirit and scope of the invention. The breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

WHAT IS CLAIMED:

1. A method, comprising:

linking at least two devices via a communication medium to form an ad-hoc network;

creating a shared memory space for the ad-hoc network;

obtaining service information related to services offered within the ad-hoc network, the service information including transport medium information;

creating a connectivity table, wherein the connectivity table is associated with the service information and maps the transport medium information to the service information; and

creating at least one service node corresponding to the service information in the shared memory space.

2. The method of claim 1, wherein the communication medium is a wireless communication medium.

3. The method of claim 1, wherein creating a shared memory space is facilitated by a service, the service being part of a network on terminal architecture.

4. The method of claim 1, wherein the service information further includes property information for each service.

5. The method of claim 1, wherein the transport medium information includes any communication mediums over which each service can communicate.

6. The method of claim 5, wherein the connectivity table maps each service to the communication mediums over which each service can communicate.

7. The method of claim 1, further comprising searching the shared memory space in order to select at one least service node and at least one transport medium, the at least one transport medium being determined utilizing the connectivity table.

8. The method of claim 7, wherein the at least one service node is specified by an application resident on a device in the ad-hoc network.

9. The method of claim 8, wherein the at least one service node provides service property information and transport medium information to the application.

10. The method of claim 8, wherein the application is directly coupled to the service after the at least one service node and at least one transport medium are selected.

11. A computer program product comprising a computer usable medium having computer readable program code embodied in said medium, comprising:

a computer readable program code configured to link at least two devices via a communication medium to form an ad-hoc network;

a computer readable program code configured to create a shared memory space for the ad-hoc network;

a computer readable program code configured to obtain service information related to services offered within the ad-hoc network, the service information including transport medium information;

a computer readable program code configured to create a connectivity table, wherein the connectivity table is associated with the service information and maps the transport medium information to the service information; and

a computer readable program code configured to create at least one service node corresponding to the service information in the shared memory space.

12. The computer program product of claim 11, wherein the communication medium is a wireless communication medium.

13. The computer program product of claim 11, wherein creating a shared memory space is facilitated by a service, the service being part of a network on terminal architecture.

14. The computer program product of claim 11, wherein the service information further includes property information for each service.

15. The computer program product of claim 11, wherein the transport medium information includes any communication mediums over which each service can communicate.

16. The computer program product of claim 15, wherein the connectivity table maps each service to the communication mediums over which each service can communicate.

17. The computer program product of claim 11, further comprising searching the shared memory space in order to select at one least service node and at least one transport medium, the at least one transport medium being determined utilizing the connectivity table.

18. The computer program product of claim 17, wherein the at least one service node is specified by an application resident on a device in the ad-hoc network.

19. The computer program product of claim 18, wherein the at least one service node provides service property information and transport medium information to the application.

20. The computer program product of claim 18, wherein the application is directly coupled to the service after the at least one service node and at least one transport medium are selected.

21. A device, comprising:

at least one communication module; and

a processor coupled to the at least one communication module, the processor being configured to:

connect the device to an ad-hoc network via a communication medium;

create a shared memory space for the ad-hoc network;

obtain service information related to services offered within the ad-hoc network, the service information including transport medium information;

create a connectivity table, wherein the connectivity table is associated with the service information and maps the transport medium information to the service information; and

create at least one service node corresponding to the service information in the shared memory space.

22. The device of claim 21, wherein the communication medium is a wireless communication medium.

23. The device of claim 21, wherein creating a shared memory space is facilitated by a service, the service being part of a network on terminal architecture.

24. The device of claim 21, wherein the service information further includes property information for each service.

25. The device of claim 21, wherein the transport medium information includes any communication mediums over which each service can communicate.

26. The device of claim 25, wherein the connectivity table maps each service to the communication mediums over which each service can communicate.

27. A device, comprising:

means for connecting the device to an ad-hoc network via a communication medium;

means for creating a shared memory space for the ad-hoc network;

means for obtaining service information related to services offered within the ad-hoc network, the service information including transport medium information;

means for creating a connectivity table, wherein the connectivity table is associated with the service information and maps the transport medium information to the service information; and

means for creating at least one service node corresponding to the service information in the shared memory space.

28. The device of claim 27, wherein the communication medium is a wireless communication medium.

29. The device of claim 27, wherein creating a shared memory space is facilitated by a service, the service being part of a network on terminal architecture.

30. The device of claim 27, wherein the service information further includes property information for each service.

31. The device of claim 27, wherein the transport medium information includes any communication mediums over which each service can communicate.

32. The device of claim 31, wherein the connectivity table maps each service to the wireless communication mediums over which each service can communicate.

33. A system, comprising:

at least two devices, the at least two devices including at least one communication module coupled to a processor;

the at least two devices linking via a communication medium to form an ad-hoc network;

at least one of the at least two devices creating a shared memory space for the ad-hoc network and obtaining service information related to services offered within the ad-hoc network, the service information including transport medium information;

at least one of the at least two devices further creating a connectivity table, wherein the connectivity table is associated with the service information and maps the transport medium information to the service information; and

at least one of the at least two devices creating at least one service node corresponding to the service information in the shared memory space.

34. A method, comprising:

querying a shared memory space established amongst two or more devices connected in an ad-hoc network, the shared memory space including service nodes related to services offered within the ad-hoc network, the service nodes being configured to provide information including property information;

querying a connectivity table, wherein the connectivity table is associated with the services and maps the service nodes to transport medium information; and

selecting at least one service node in the shared memory space.

35. The method of claim 34, wherein an application on one of the at least two devices is directly connected to the service associated with the selected service node.

36. A computer program product comprising a computer usable medium having computer readable program code embodied in said medium, comprising:

a computer readable program code configured to query a shared memory space established amongst two or more devices connected in an ad-hoc network, the shared memory space including service nodes related to services offered within the ad-hoc network, the service nodes being configured to provide information including property information;

a computer readable program code configured to query a connectivity table, wherein the connectivity table is associated with the services and maps service nodes to transport medium information; and

a computer readable program code configured to select at least one service node in the shared memory space.

37. The computer program product of claim 36, wherein an application on one of the at least two devices is directly connected to the service associated with the selected service node.

38. A device, comprising:

at least one communication module; and

a processor coupled to the at least one communication module, the processor being configured to:

query a shared memory space established amongst two or more devices connected in an ad-hoc network, the shared memory space including service nodes related to services offered within the ad-hoc network, the service nodes being configured to provide information including property information;

query a connectivity table, wherein the connectivity table is associated with the services and maps service nodes to transport medium information; and

select at least one service node in the shared memory space.

FIG. 1

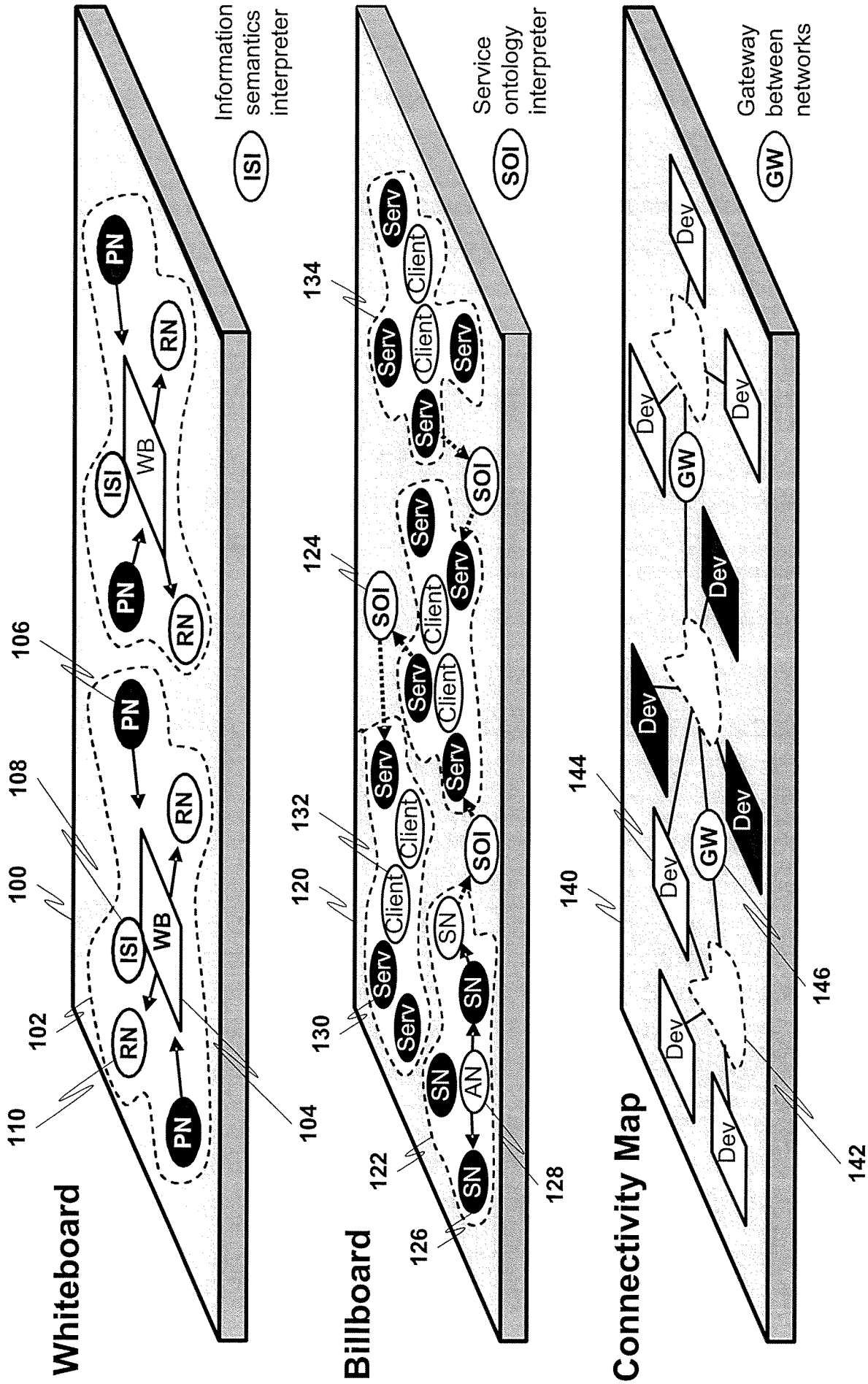

Whiteboard
Billboard
Connectivity Map
Information semantics interpreter
Service ontology interpreter
Gateway between networks
ISI
SOI
GW
PN
RN
WB
SN
AN
Serv
Client
Dev
100
102
104
106
108
110
120
122
124
126
128
130
132
134
140
142
144
146

FIG. 2

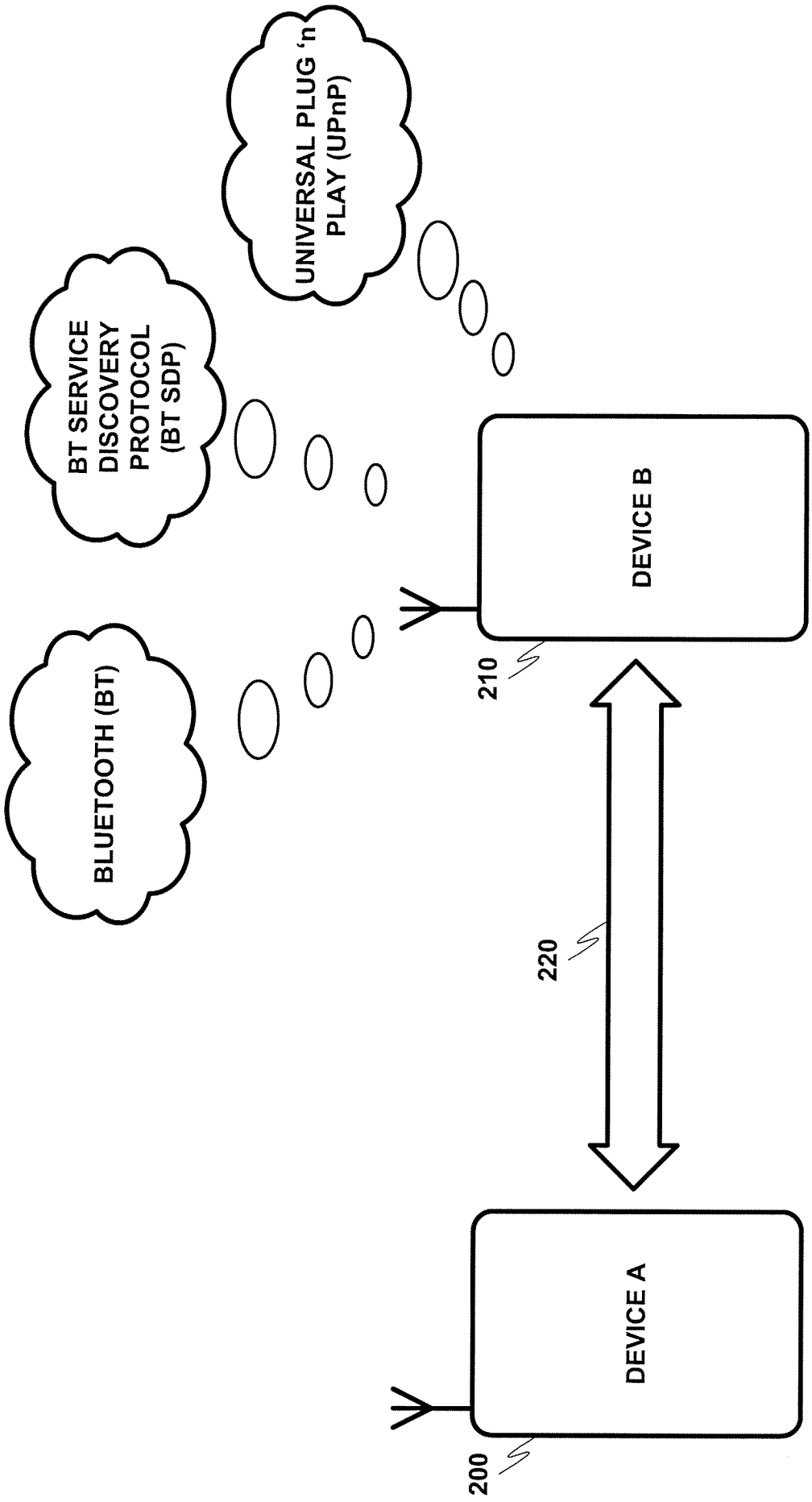

UNIVERSAL PLUG 'n PLAY (UPnP)
BT SERVICE DISCOVERY PROTOCOL (BT SDP)
BLUETOOTH (BT)
DEVICE B
210
220
DEVICE A
200

FIG. 3

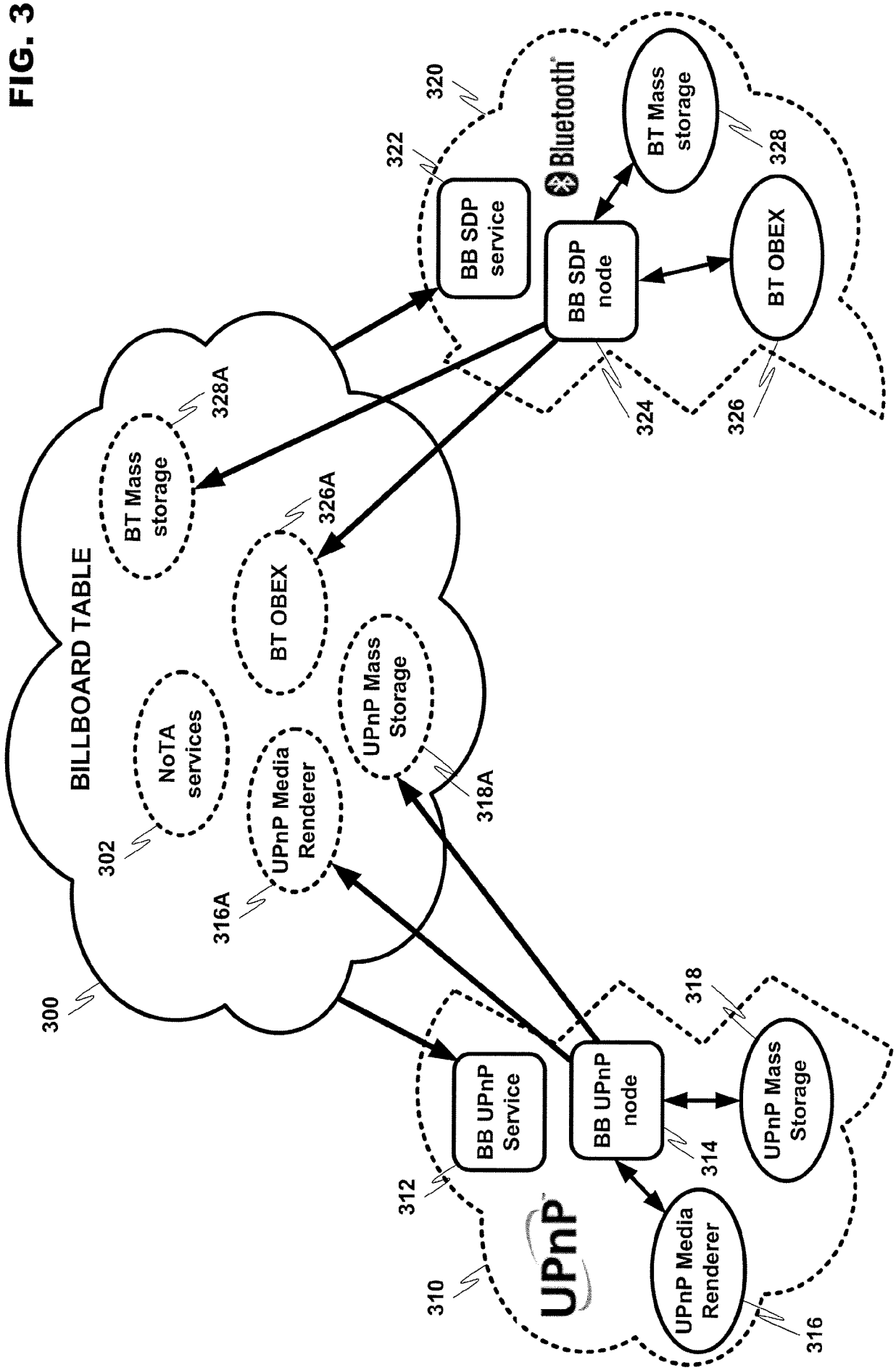

BILLBOARD TABLE
300
BT Mass storage
328A
BT OBEX
326A
NoTA services
302
UPnP Media Renderer
316A
UPnP Mass Storage
318A
BB SDP service
322
BB SDP node
324
BT Mass storage
328
BT OBEX
326
320
Bluetooth
BB UPnP Service
312
BB UPnP node
314
UPnP Mass Storage
318
UPnP Media Renderer
316
310
UPnP

FIG. 4A

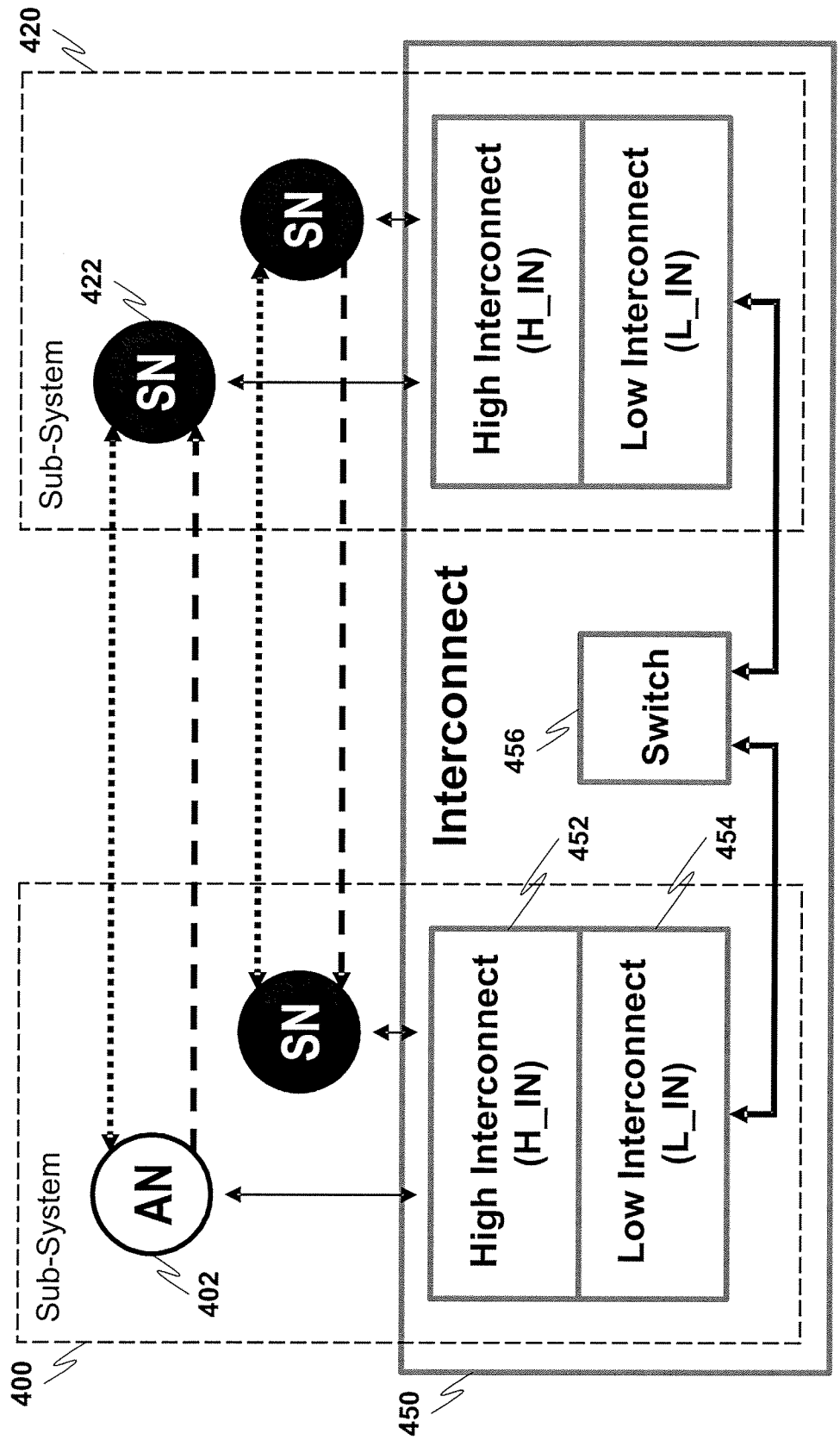

420
Sub-System
422
SN
SN
High Interconnect (H_IN)
Low Interconnect (L_IN)
Interconnect
456
Switch
452
454
SN
AN
402
Sub-System
400
High Interconnect (H_IN)
Low Interconnect (L_IN)
450

FIG. 4B

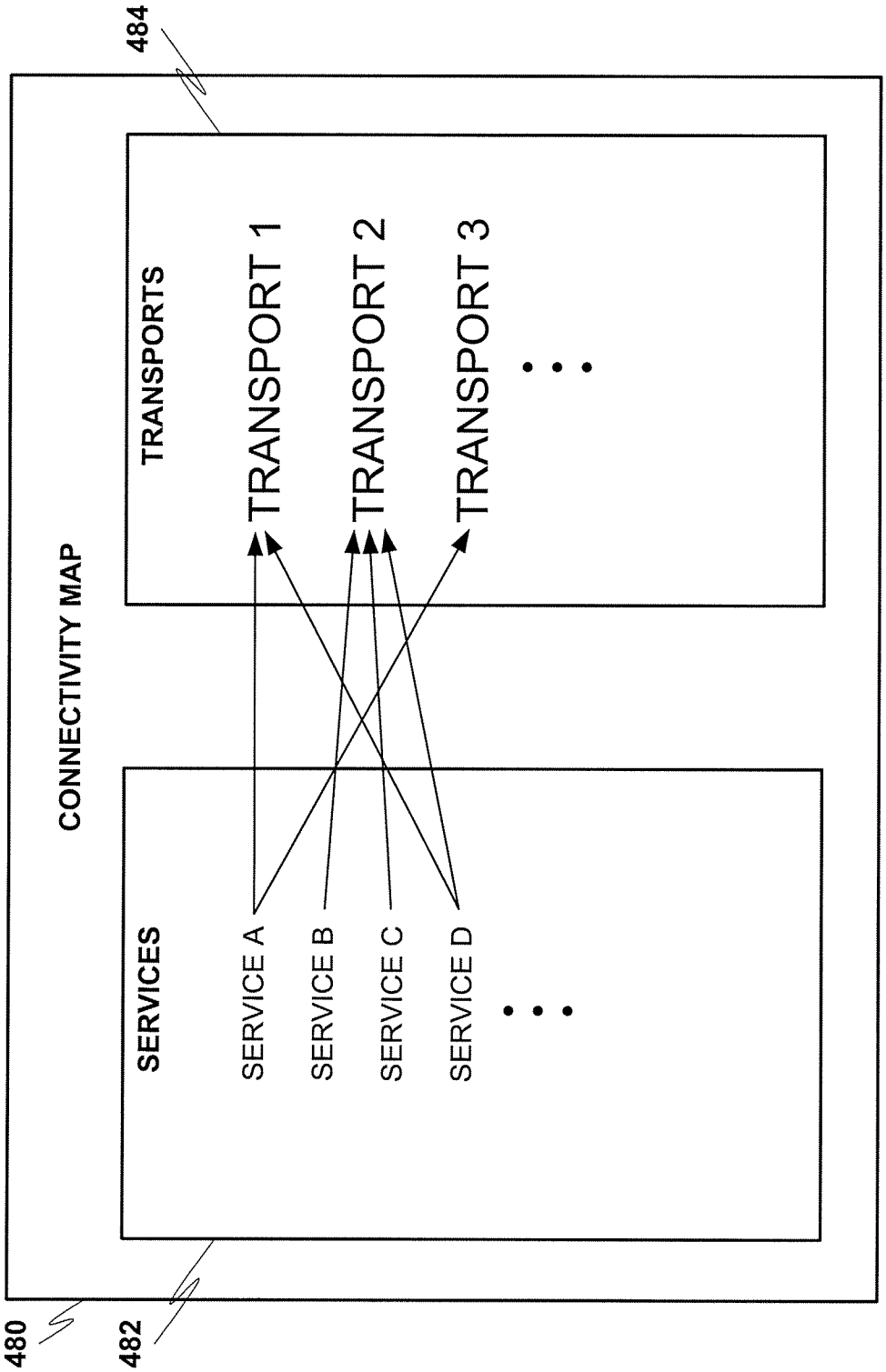

484
CONNECTIVITY MAP
TRANSPORTS
TRANSPORT 1
TRANSPORT 2
TRANSPORT 3
SERVICES
SERVICE A
SERVICE B
SERVICE C
SERVICE D
480
482

FIG. 5

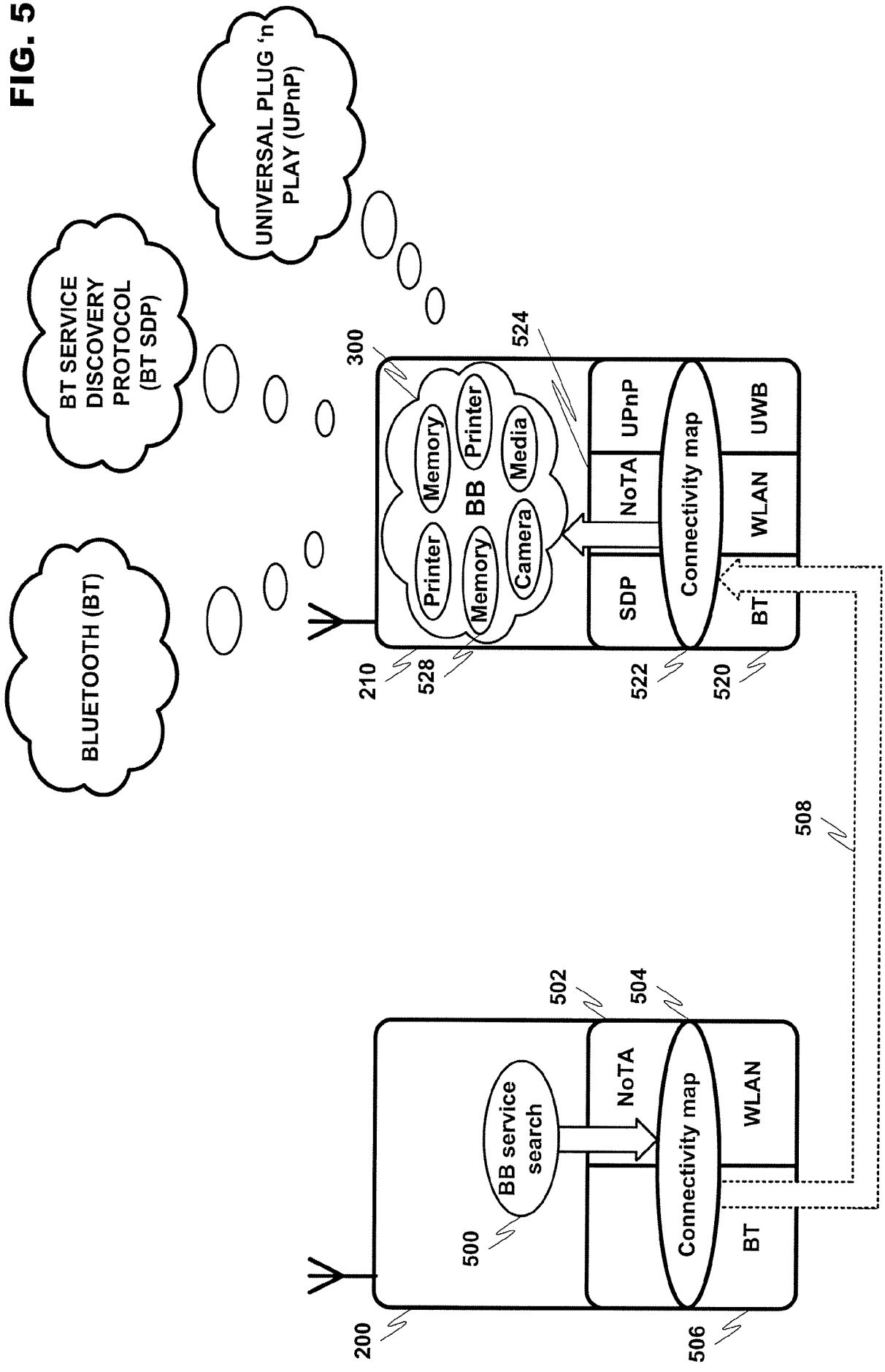

UNIVERSAL PLUG 'n PLAY (UPnP)
BT SERVICE DISCOVERY PROTOCOL (BT SDP)
BLUETOOTH (BT)
300
524
Memory
Printer
Media
BB
Printer
Memory
Camera
UPnP
NoTA
SDP
Connectivity map
UWB
WLAN
BT
210
528
522
520
508
502
504
BB service search
NoTA
Connectivity map
WLAN
BT
500
200
506

FIG. 6A

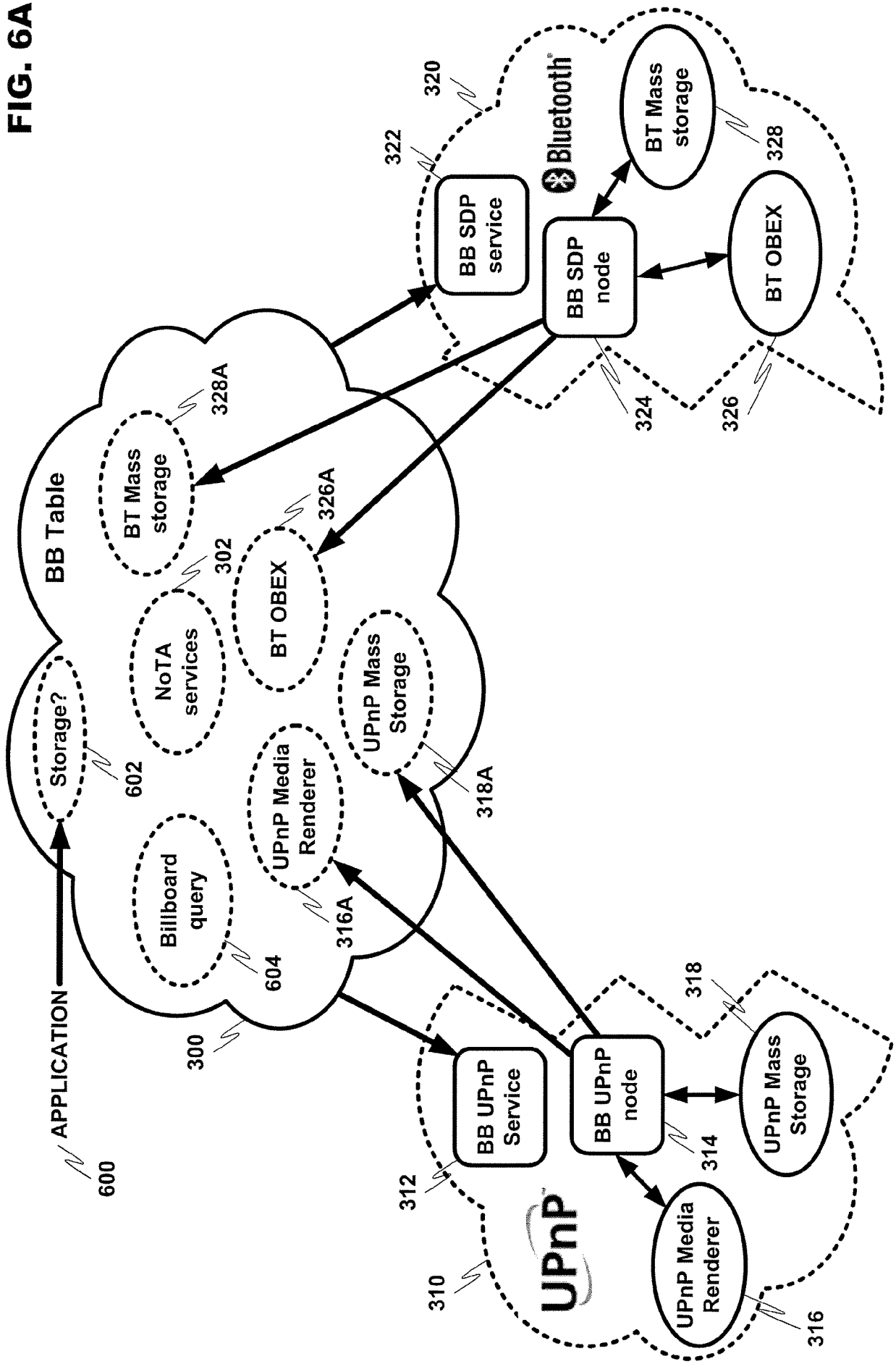

APPLICATION
600
BB Table
300
Storage?
602
Billboard query
604
NoTA services
302
BT Mass storage
328A
BT OBEX
326A
UPnP Media Renderer
316A
UPnP Mass Storage
318A
BB UPnP Service
312
BB UPnP node
314
UPnP Media Renderer
316
UPnP Mass Storage
318
UPnP
310
BB SDP service
322
BB SDP node
324
BT OBEX
326
BT Mass storage
328
320
Bluetooth

FIG. 6B

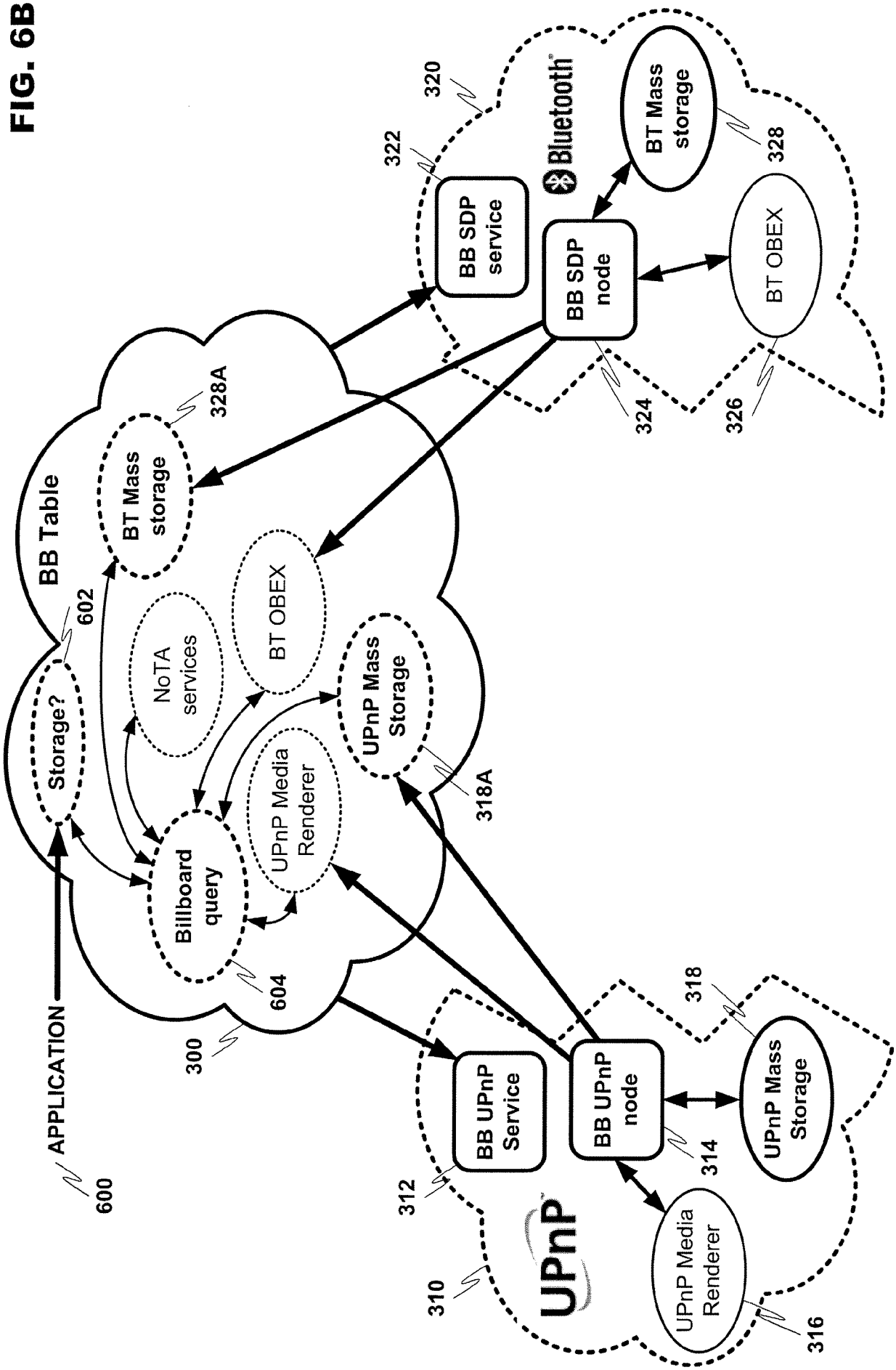

APPLICATION
600
BB Table
602
Storage?
Billboard query
604
NoTA services
BT OBEX
UPnP Media Renderer
BT Mass storage
328A
UPnP Mass Storage
318A
300
Bluetooth
320
322
BB SDP service
BB SDP node
BT Mass storage
328
BT OBEX
324
326
UPnP
310
312
BB UPnP Service
BB UPnP node
314
318
UPnP Mass Storage
UPnP Media Renderer
316

FIG. 6C

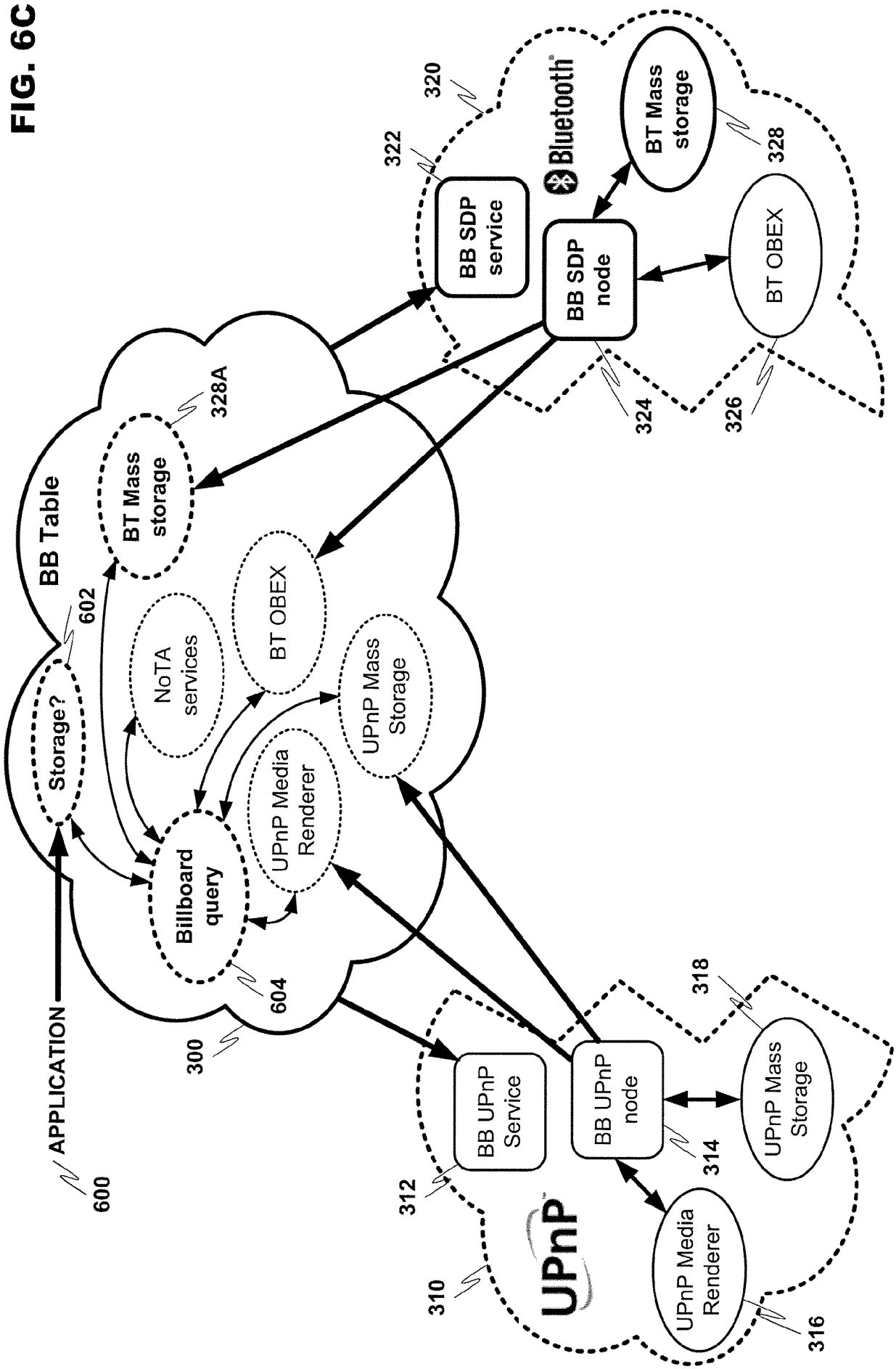

APPLICATION
600
BB Table
602
Storage?
Billboard query
604
NoTA services
BT Mass storage
328A
BT OBEX
UPnP Media Renderer
UPnP Mass Storage
300
Bluetooth
320
322
BB SDP service
BB SDP node
BT Mass storage
328
BT OBEX
324
326
UPnP
310
312
BB UPnP Service
BB UPnP node
314
318
UPnP Mass Storage
UPnP Media Renderer
316

FIG. 6D

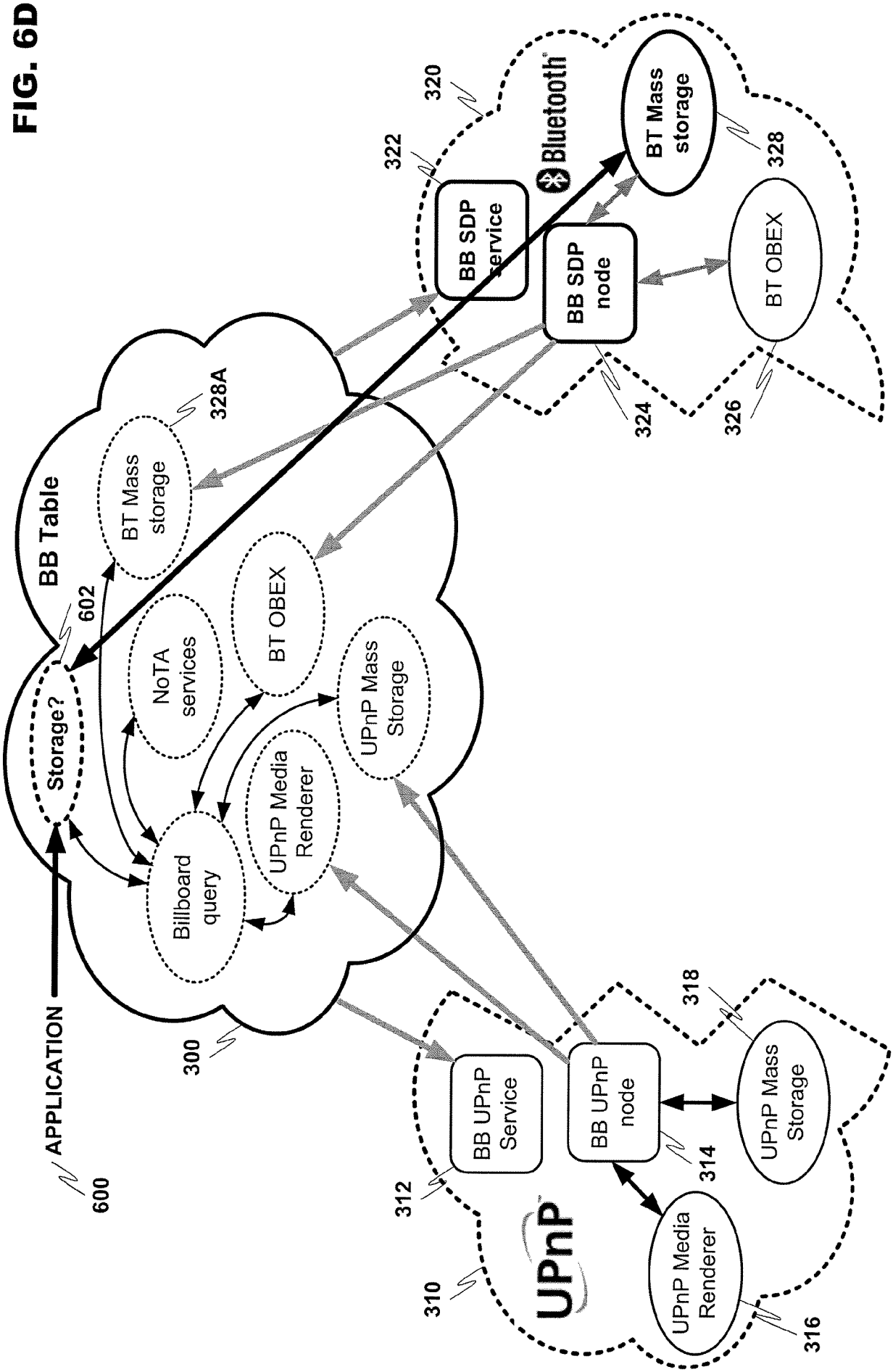

APPLICATION
600
BB Table
602
Storage?
Billboard query
NoTA services
BT OBEX
UPnP Media Renderer
UPnP Mass Storage
BT Mass storage
328A
300
Bluetooth
320
322
BB SDP service
BB SDP node
BT Mass storage
328
BT OBEX
324
326
UPnP
310
312
BB UPnP Service
BB UPnP node
314
318
UPnP Mass Storage
UPnP Media Renderer
316

FIG. 6E

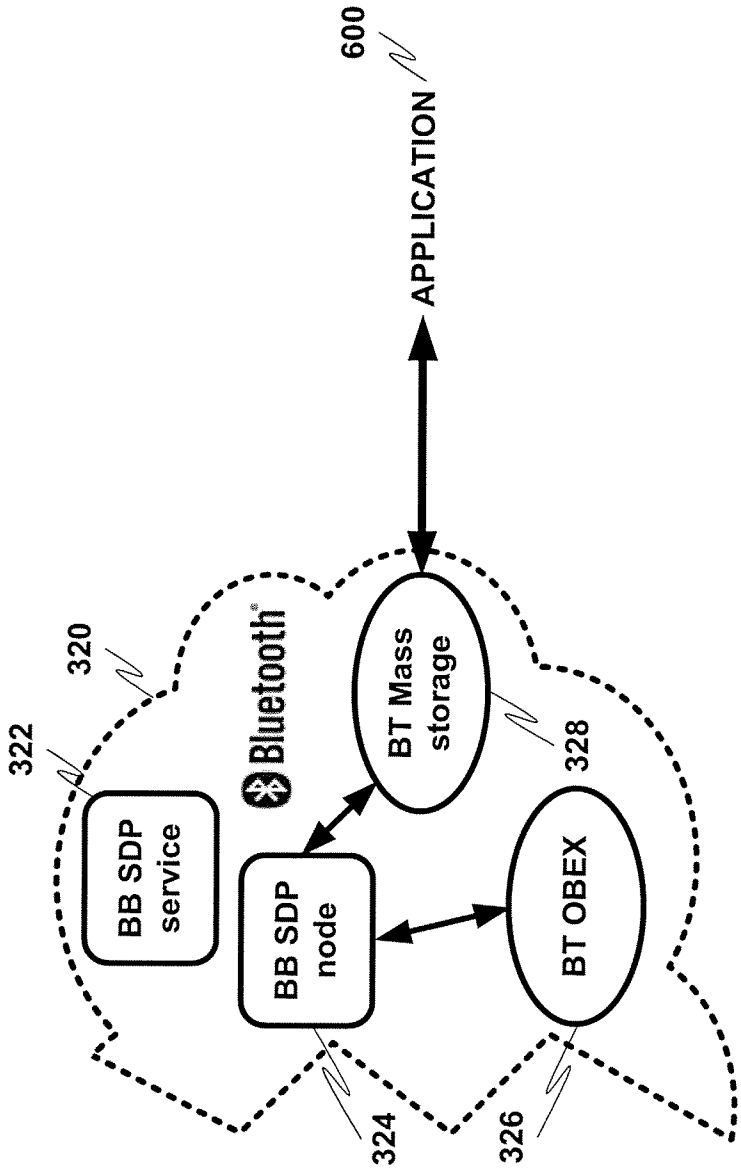

600
APPLICATION
320
322
Bluetooth
BB SDP service
BB SDP node
BT Mass storage
328
BT OBEX
324
326

FIG. 6F

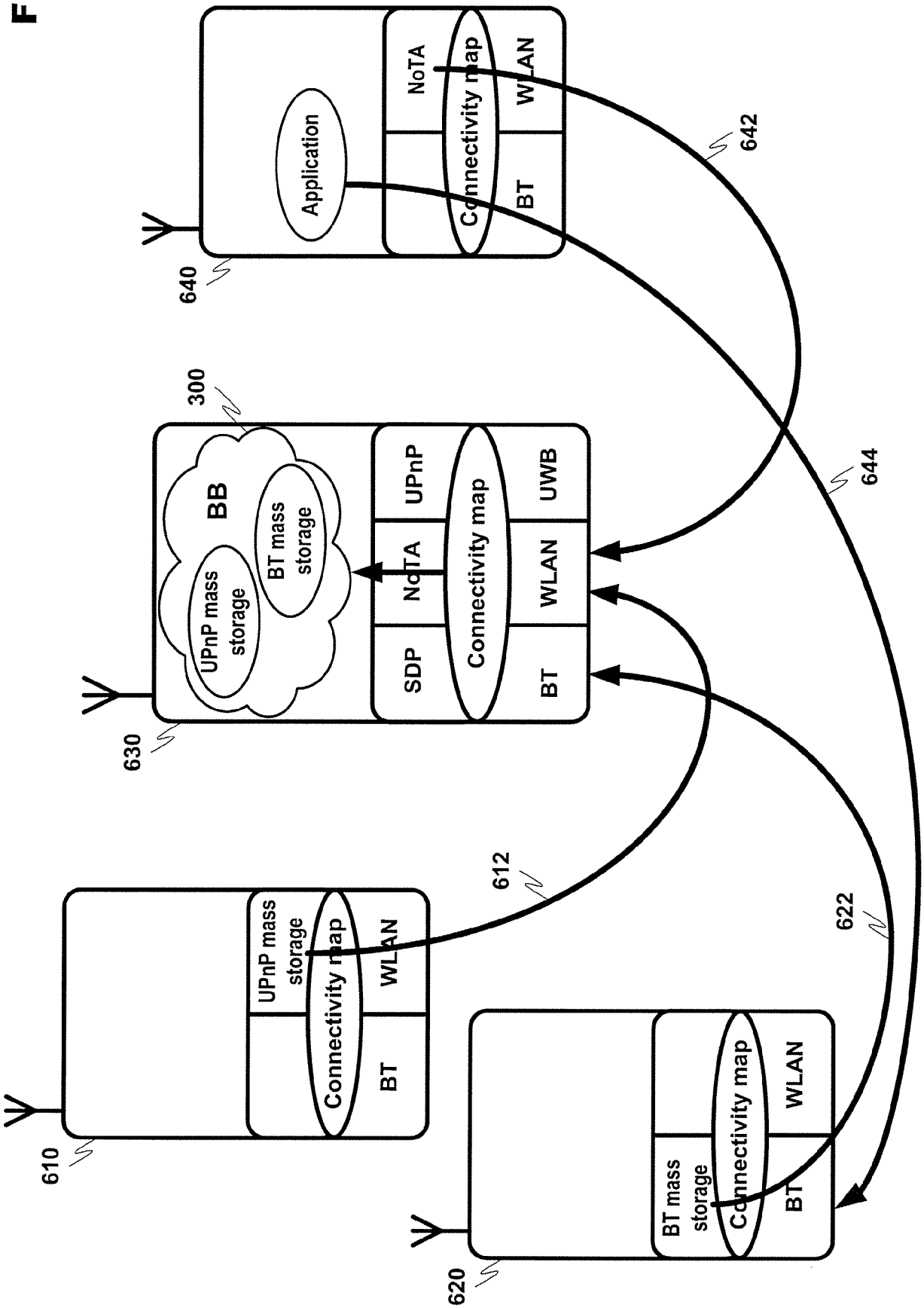

610
UPnP mass storage
Connectivity map
WLAN
BT
612
620
BT mass storage
Connectivity map
WLAN
BT
622
630
300
BB
UPnP mass storage
BT mass storage
SDP
NoTA
UPnP
Connectivity map
UWB
WLAN
BT
644
640
Application
NoTA
Connectivity map
WLAN
BT
642

FIG. 7

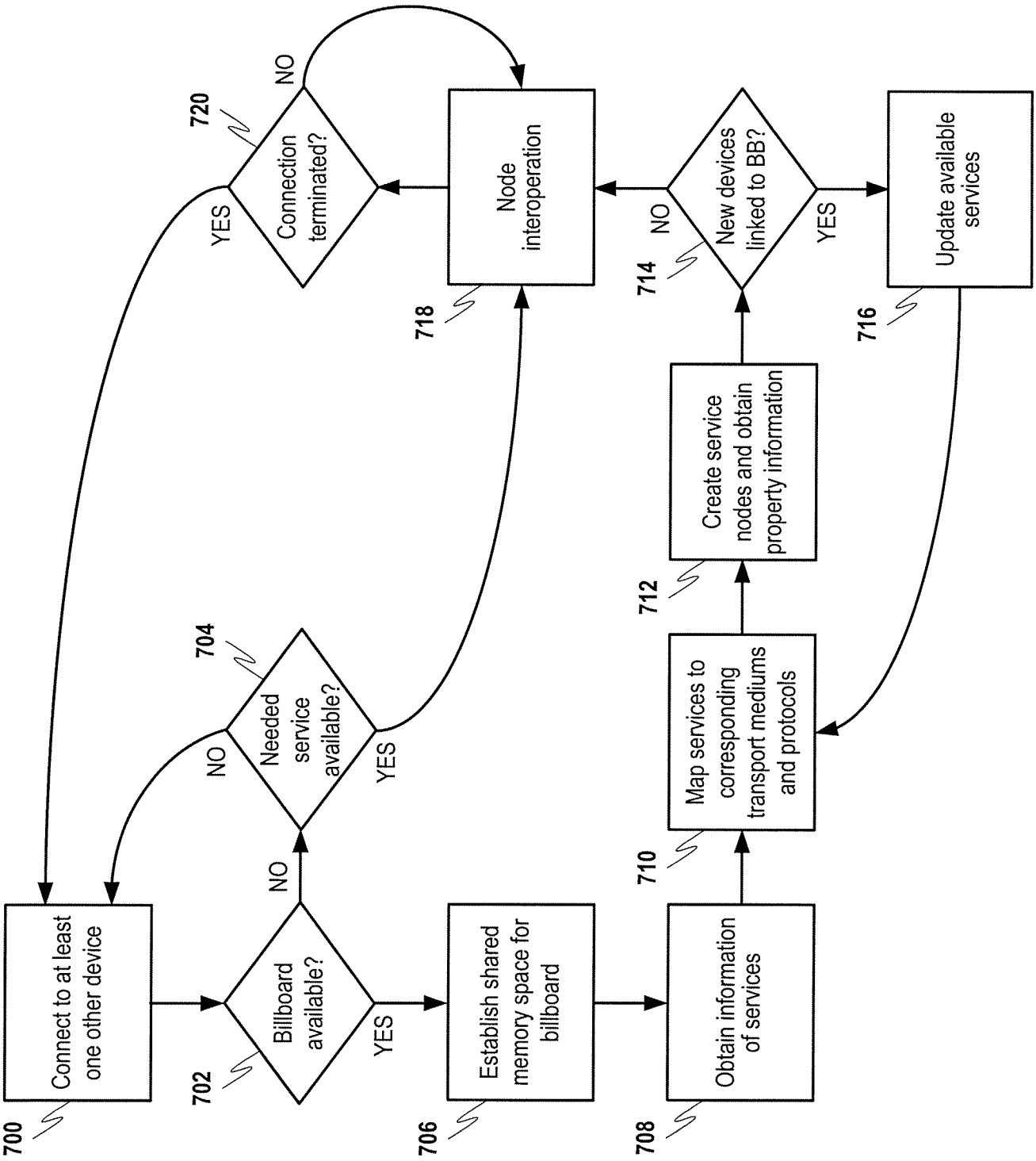
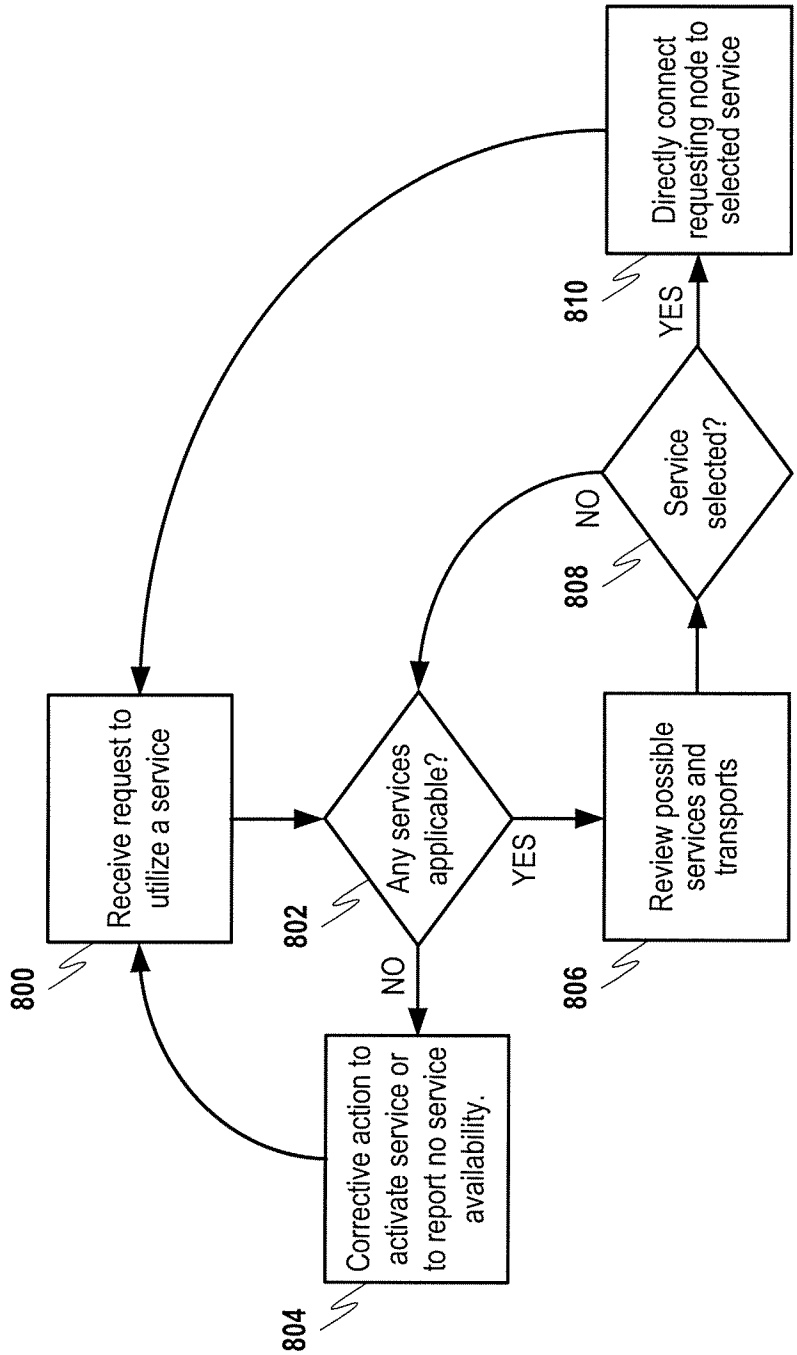

Connect to at least one other device
700
Billboard available?
702
NO
YES
Needed service available?
704
NO
YES
Establish shared memory space for billboard
706
Obtain information of services
708
Map services to corresponding transport mediums and protocols
710
Create service nodes and obtain property information
712
New devices linked to BB?
714
NO
YES
Update available services
716
Node interoperation
718
Connection terminated?
720
NO
YES

FIG. 8


Receive request to utilize a service
800
Any services applicable?
802
NO
YES
Corrective action to activate service or to report no service availability.
804
Review possible services and transports
806
Service selected?
808
NO
YES
Directly connect requesting node to selected service
810

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2007/054550

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L29/08

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 practical, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/114448 A1 (SKOMRA STEWART A [US]) 26 May 2005 (2005-05-26) figures 1,2 paragraphs [0039], [0044], [0062], [0063], [0065], [0067] - [0070]	1-38
A	EP 1 542 409 A (SONY INT EUROP GMBH [DE]) 15 June 2005 (2005-06-15) figure 1 paragraphs [0033] - [0051]	1-38
A	US 2005/097087 A1 (PUNAGANTI VENKATA MURALI K [FI] ET AL) 5 May 2005 (2005-05-05) the whole document	1-38

☐ 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

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

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

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

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

"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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 October 2008	15/10/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Tyszka, Krzysztof

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2007/054550

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005114448 A1	26-05-2005	NONE	
EP 1542409 A	15-06-2005	CN 1627760 A	15-06-2005
		US 2005128958 A1	16-06-2005
US 2005097087 A1	05-05-2005	NONE	