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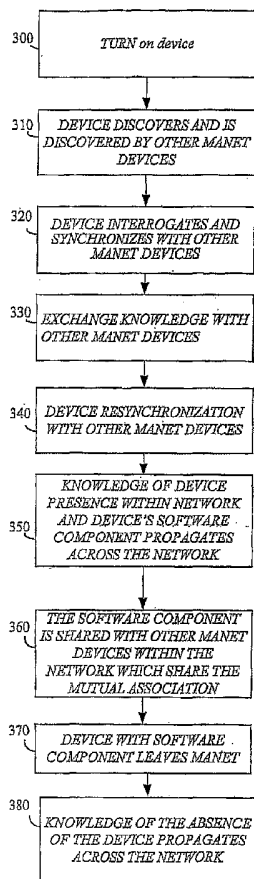
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[Continued on next page]

(54) Title: METHOD AND APPARATUS TO SHARE SOFTWARE COMPONENT



(57) Abstract: Briefly, a device and method of sharing a software component within a wireless ad hoc network based upon a priori knowledge of a mutual association shared by devices within the wireless ad hoc network.

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METHOD AND APPARATUS TO SHARE A SOFTWARE COMPONENT AMONG TERMINALS
IN A WIRELESS AD-HOC NETWORK

BACKGROUND OF THE INVENTION

[0001] A mobile ad hoc network (MANET) may be an autonomous system of mobile devices, for example, routers and/or associated hosts connected by wireless links, the union of which forms an arbitrary graph. The mobile devices are free to move randomly and organize themselves arbitrarily. Thus, the wireless topology of the MANET may change rapidly and unpredictably.

[0002] MANET may operate in a standalone fashion, or may be connected to the Internet. Furthermore, a device within the MANET may communicate with every other device within the MANET. The MANET protocol may define all devices as routers, and may maintain real time knowledge about the existence of all other routers within the network.

[0003] Devices within MANET (MANET nodes) may be equipped with wireless transmitters and receivers using antennas, which may be omni-directional (Broadcast), highly-directional (point-to-point), steerable, dipole antennas, and the like. At a given point in time, depending on the nodes positions and their transmitter and receiver coverage patterns, transmission power levels and co-channel interference levels, a wireless connectivity in the form of a random, multihop graph of the "ad hoc" network exists between the nodes. This ad hoc topology may change with time as the nodes move or adjust their transmission and reception parameters.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. The invention, however, both as to organization and method of operation, together with objects, features and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanied drawings in which:

[0005] FIG. 1 is an illustration of a mobile ad hoc network according to exemplary embodiments of the present invention;

[0006] FIG. 2 is a block diagram of a wireless device according to an exemplary embodiment of the present invention; and

[0007] FIG. 3 is a flowchart of a method of sharing a software component according to an exemplary embodiment of the invention.

[0008] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF THE INVENTION

[0009] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However it will be understood by those of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components and circuits have not been described in detail so as not to obscure the present invention.

[0010] Some portions of the detailed description, which follow, are presented in terms of algorithms and symbolic representations of operations on data bits or binary digital signals within a computer memory. These algorithmic descriptions and representations may be the techniques used by those skilled in the data processing arts to convey the substance of their work to others skilled in the art.

[0011] Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as “processing,” “computing,” “calculating,” “determining,” or the like, refer to the action and/or processes of a computer or computing system, or similar electronic computing device, that manipulate and/or transform data represented as physical, such as electronic, quantities within the computing system’s registers and/or memories into other data similarly represented as physical quantities within the computing system’s memories, registers or other such information storage, transmission or display devices. In addition, the term “plurality” may be used throughout the specification to describe two or more components, devices, elements, parameters and the like. For example, “plurality of mobile units” describes two or more mobile units.

[0012] It should be understood that the present invention may be used in a variety of applications. Although the present invention is not limited in this respect, the block diagrams, methods and techniques disclosed herein may be used in many apparatuses such as units of a wireless communication system, such as for example, a cellular communication system, a hybrid wireless network, a WLAN communication system, MANET, and the like. Units of WLAN communication system intended to be included within the scope of the present invention include, by way of example only, mobile units (MU), access points (AP), public APs, a cellular device with Bluetooth

capabilities, and the like. Although the scope of the present invention is not limited in this respect, the cellular device with Bluetooth capabilities may form MANET with WLAN devices such as, for example, hand held device, personal digital assistance (PDA), and the like.

[0013] Types of WLAN communication systems intended to be within the scope of the present invention include, although are not limited to, "IEEE-Std 802.11, 1999 Edition (ISO/IEC 8802-11: 1999)" standard, and more particularly in "IEEE-Std 802.11b-1999, IEEE-Std 802.11a, IEEE-Std 802.11g, IEEE-Std 802.11j, or the like.

[0014] Turning to FIG. 1, a portion of a mobile ad hoc network (MANET) 1000 in accordance with exemplary embodiment of the invention is shown. Although the scope of the present invention is not limited to this example, MANET 1000 may include an association of associated devices 102, 104, 106, 108, 110, and 115. MANET 1000 may also include a plurality of sharing devices 120, 130, 140, 150, and 160 that may be wireless devices, if desired. In this embodiment of the present invention sharing devices 120, 130 and 140 may share, among other things, a software component (SC) 170, sharing device 150 may share, among other things, a processing unit (PU) 155 and sharing device 160 may share, among other things, a memory unit (MU) 165.

[0015] Although the scope of the present invention is not limited in this respect, associated devices 102, 104, 106, 108, 110 and 115 may include wireless devices and may share a mutual association as indicated by dotted line 180. Furthermore, in this embodiment of the invention associated devices 110 and 115 may share another mutual association, indicated by thick line 190.

[0016] Although the scope of the present invention is not limited in this respect, in the association of devices 102, 104, 106, 108, 110 and 115, the associated devices 102, 104, 106, 108, 110 and 115 may have and/or share similar attributes and/or applications as part of the association and may together form a sub-network, for example, MANET 1000. For example, the association may be a network game, security privileges, buddies list that may be used by chat application, and the like. In addition, authentication operations may need to be performed to verify or confirm the mutual association. For example, the association may include members that perform climate data gathering for climate analysis and predictions, if desired.

Although the scope of the present invention is not limited in this respect, the mutual association may create a subset of the total devices that may be active, and which form the complete MANET 1000. The devices that share the mutual association may share this knowledge a priori. Thus, the devices may perform a discovery and authentication process and may update the routing tables of online devices that shared the mutual association.

[0017] Although the scope of the present invention is not limited in this respect, a new device that has similar mutual association with the other devices may be authenticated to MANET 1000. The new device may exchange its knowledge of storage capability with the nearby devices (e.g., within range) that have the mutual association. Knowledge of the storage capability of the new device may be propagated across the network, via iterative and frequent exchanges of the knowledge of the devices that share the mutual association to get to non-nearby devices, e.g., devices not within communication range. Other information may also be exchanged among the devices. For example, the devices within MANET 1000 may exchange knowledge of other devices within their respective routing tables that share the mutual association, including information about those devices' storage capabilities.

[0018] Although the scope of the present invention is not limited in this respect, an example of sharing SC 170 by sharing device 120, which may have wireless communication capabilities, will now be described. Although the scope of the present invention is not limited in this respect, examples of SC 170 may include a printer driver, a computational algorithm, a security component, an operating system component, an operating system and the like. For example, computational algorithms may be downloaded on an as needed basis to perform dedicated computational tasks.

[0019] Furthermore, the operating system components may be downloaded on an as needed basis to perform specific input/output (I/O) functions. For example, a device driver for a gateway onto another network, wherein the driver may be general and un-optimized, may be dynamically optimized for the microcontroller's instruction set to improve throughput, if desired.

[0020] In addition, complete operating systems may be downloaded on an as needed basis to perform specific system level functions. In some embodiments, the operating system may download and utilize a stripped-down operating system that optimizes the

gaming capabilities of the hardware device by removing much of the OS layer and running in a bare-bones environment, if desired. The operating system may be optimized, for example, for a specific local area party game, and may be further optimized for the specific hardware of a device so that a heterogeneous network of gaming devices may be formed, wherein all devices may simultaneously play the specific game.

[0021] In embodiments of the invention, sharing device 120 may include printing capabilities which may be shared with associated devices 102, 104, 106, 108, 110, 115 within the authenticated MANET 1000, if desired. Associated devices 102, 104, 106, 108, 110, 115 may be simultaneously able to communicate with the sharing device 120. SC 170 for example, a printer driver of sharing device 120, may be shared with other authenticated members of MANET 1000, e. g., devices 102, 104, 106, 108, 110, and/or 115, to create a functioning printer driver. Sharing device 120 may be authenticated on the network, and may advertise its services via methods of discovery, authentication, routing, and transmission known to one skilled in the art, although the scope of the present invention is not limited in this respect. For example, associated devices 110, 102, and 104 may be able to communicate with sharing device 120 directly. However, associated devices 115, 106 and 108 may communicate with sharing device 120 via intermediate devices, such as, for example, device 102 and/or device 104 and/or other intermediate devices, if desired.

[0022] Although the scope of the present invention is not limited in this respect, associated device 115 may print a document on sharing device 120. Associated device 115 may request a software component, e.g., the printer driver, from the sharing device 120. Communications from associated device 115 to sharing device 120 may be routed through one or more of associated devices 102, 104, 106, 108, 110. A request to share SC 170 and its reply (containing SC 170) may be communicated across the MANET 1000 using the principles known to one skilled in the art via the methods of discovery, authentication, routing, and transmission. Associated device 115 may receive SC 170 and may use a Just-In-Time compiler to create a native version of the printer driver. In addition, associated device 115 may generate a printable bit-stream for communication back to the printer that may be connected to sharing device 120, if desired.

[0023] Although the scope of the present invention is not limited in this respect, an example of sharing multiple distributed SC 170, and sharing processing capabilities of at least one sharing device and, more specifically, an example of performing a financial audit by associated devices 102, 104, 106, 108, 110, 115, which share a mutual association, will now be described.

[0024] Although the scope of the present invention is not limited in this respect, in order to perform the financial audit, associated devices 102, 104, 106, 108, 110, 115 may share SC 170 of sharing device 120, for example, a printer driver, and SC 170 of sharing device 140, for example a financial management driver. In addition, associated devices 102, 104, 106, 108, 110, 115 may share the corporate financial data that may store on MU 165 of sharing device 160 and PU 155 of sharing device 150 to perform computing intensive calculations, if desired.

[0025] Although the scope of the present invention is not limited in this respect, associated devices 102, 104, 106, 108, 110, 115 may perform their financial assessments using software management applications, units, and tools provided, for example, by sharing device 140. In addition, associated devices 102, 104, 106, 108, 110, 115 may use the data obtained from corporate database stored, for example, at sharing device 160, and may use processing capabilities of sharing device 150. Associated devices 102, 104, 106, 108, 110, 115 may print documents via sharing device 120, for example, a wireless printer.

[0026] Turning now to an example of sharing, across MANET 1000, multiple distributed software components with multiple associative links. In this example, the financial data stored in MU 165 may be encrypted and the financial management software components of device 140 may require additional security authentication to decrypt the financial data. Consequently, there may be a second network overlain (shown with thick line 190) on the first network (shown with dotted line 180) specifically to share the security authentication. For example, devices 106, 110, 115, 130, 140, 150 and 160 may share an association of special security privileges that may be known a priori. However, device 106 may be unable to join the second association's network because there is no contiguous link between device 106 and one of the devices 110 and/or 115. Thus, the device properties associated with this second mutual association for device 106 may not be shared with devices 104 and 108, which

do not contain the association, and consequently knowledge of these second association properties may not propagate across the network. However, the knowledge of the first mutual association properties for device 106 may propagate across the network via devices 104 and 108.

[0027] Turning to FIG. 2, a block diagram of a wireless device 200 according to an exemplary embodiment of the invention is shown. Although the scope of the present invention is not limited in this respect, wireless device 200 may include an antenna 210, for example a dipole antenna, omni directional antenna or the like, a transceiver 220, for example a WLAN transceiver, a processor 230, for example a baseband processor, a communication processor or the like, and a memory 240, for example a Flash memory, random access memory (RAM), or the like.

[0028] More specifically, processor 230 may include an acquiring module 232 to acquire a software component stored in another device within a wireless network based on a priori knowledge of a mutual association shared by one or more other devices within the wireless network, for example MANET 1000. Processor 230 may further include a determining module 234 to determine the route based on proximity of the one or more devices within the wireless network, for example MANET 1000. Furthermore, determining module 234 may be able to determine the route based on a proximity to one other device having the software component, for example, sharing device 120.

[0029] Although the scope of the present invention is not limited in this respect, processor 230 may further include a discovering module 236 to discover one or more routes to one or more online devices within the wireless network that share the mutual association, for example, security privileges. Processor 230 may further include a routing module 238 to route one or more communications between one or more online devices, for example, associated device 110 and 115 who share the mutual association of security privileges, if desired.

[0030] In alternative embodiments of the present invention, processor 230 may include acquiring module 232 and routing module 238. In those embodiments, routing module 238 may include the determining module 234 and the discovering module 236, if desired.

[0031] Although the scope of the present invention is not limited in this respect, MANET 1000 may be a portion of a wireless network such as, for example, a WLAN network. Transceiver 220 may be a WLAN transceiver able to transmit and to receive communications of the devices of MANET 1000 that share the mutual association. Memory 240 may include a routing table 242 and processor 230 may dynamically modify routing information of one or more devices which share the mutual association based on information stored in routing table 242. Processor 230 may share the modified routing information with other devices within MANET 1000 that share the mutual association.

[0032] Although the scope of the present invention is not limited in this respect, wireless device 200 may be one of associate devices 102, 104, 106, 108 110 and 115 or one of the sharing devices 130 and/or 140. If wireless devices 200 is one of the sharing devices, memory 240 may include a software component (SC) 244 and processor 230 may include an advertising module 250 to advertise its services by sending messages via transceiver 220 to devices that share the mutual association. Furthermore, processor 230 may include a sharing module 260 to share SC 244 with the other devices within MANET 1000 that share the mutual association.

[0033] Turning to FIG. 3, a flowchart of a method of sharing software component according to an exemplary embodiment of the invention is shown. Although the scope of the present invention is not limited in this respect, a sharing device, for example, sharing device 130 may be turned on (block 300). Sharing device 130 may discover and be discovered by devices in proximity, for example, device 110 (block 310). Device 130 may interrogate device 110 to determine a mutually acceptable synchronization period with a corresponding frequency-hopping pattern, direct sequence spreading code, or other form of communication protocol, if desired (block 320).

[0034] Coincidentally and/or subsequently, device 130 may exchange knowledge with device 110 (block 330). For example, devices 130 and 110 may share and authenticate the identifying association. Devices 130 and 110 may set up security protocols, may exchange knowledge about SC 170 capabilities, may exchange knowledge of other devices within their respective routing tables that share the mutual association, including knowledge about such other devices' SC 170 capabilities.

Sharing devices 130 and 110 may update their respective routing tables with changes such as, for example, additions, subtractions or routing hop-distance changes, or routing changes based upon a cost-based algorithm, if desired.

[0035] Although the scope of the present invention is not limited in this respect, sharing devices 130 and 110 may subsequently, at the required interval, resynchronize to reset their mutual clocks, and determine if there is information or network updates to be passed between the two devices (block 340). Device 110 may propagate knowledge of device 130 joining the network across MANET 1000, via iterative and frequent exchange of the knowledge of online devices that share the mutual association (block 350).

[0036] Although the scope of the present invention is not limited in this respect, device 110 may share the software component with devices of MANET 1000 that share the mutual association (block 360), for example associated devices 102, 104, 106, 108, 115, if desired. For example, during the period when sharing device 130 is to be joined to the network, its presence may be maintained in the routing tables of the contiguous mesh of devices sharing the mutual association, and device 130 may route information to other devices which share this association within the network via these intermediate devices, based upon the routing table information.

[0037] Furthermore, during the period when device 130 may be joined to MANET 1000, other devices that share this mutual association within the network may route information via this specific device, based upon the routing table information. Device 130 may be available for servicing the requirements of the online devices that share the mutual association.

[0038] Although the scope of the present invention is not limited in this respect, when device 130 may join MANET 1000, all information/status transfers are scheduled and delivered based upon the mutual determination of the two devices that form a device pair. For example, the information may include the latency or speed of delivery, buffering capabilities, error correction methods, and the like. The connection between devices, whether connection-oriented or connection-less service, may be determined by the device pairs at their initial interrogation, and may be subsequently revised based on changing device or network status. In addition, when device 130 leaves MANET 1000 (block 370), the frequent updates of its neighbors determine that it has

left the network, and this knowledge may be propagated across the network in the respective iterative updates (block 380).

[0039] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

[0040] What is claimed is:

1. A method comprising:
 - acquiring a software component stored in a first device of a wireless network based on a priori knowledge of a mutual association shared by the first device and at least a second device of the wireless network.
2. The method of claim 1, wherein acquiring comprises:
 - generating a routing table to indicate a route from an acquiring device to the software component stored in the first device.
3. The method of claim 2, wherein generating a routing table comprises:
 - determining the route based on a proximity of the second device to the acquiring device.
4. The method of claim 1, wherein generating a routing table comprises:
 - determining the route based on a proximity of the acquiring device to the first device.
5. The method of claim 1, comprising:
 - dynamically sharing information of the first and second devices and one or more other devices within the wireless network that share the mutual association.
6. The method of claim 5, comprising:
 - dynamically modifying routing information to the first and second devices and the one or more other devices that share the mutual association based on the shared information.
7. The method of claim 5 comprising:

determining one or more routes to the one or more other devices within the wireless network that share the mutual association.

8. The method of claim 7 comprising:
 - routing a communication to exchange information between one or more other online devices that share the mutual association.

9. The method of claim 5 comprising:
 - transmitting and receiving the shared information between the one or more other devices that share the mutual association.

10. A device comprising:
 - an acquiring module to acquire a software component stored in a sharing device, within a wireless network, based on a priori knowledge of a mutual association shared by one or more associated devices within the wireless network.

11. The device of claim 10 comprising:
 - a routing table to indicate a route to the software component stored in the sharing device.

12. The device of claim 11, further comprising:
 - a determining module to determine the route based on the proximity between the one or more associated devices within the wireless network.

13. The device of claim 11 wherein the determining module is able to determine the route based on the proximity of the one or more associated devices to the sharing device having the software component.

14. The device of claim 10 comprising:

a discovering module to discover one or more other associated devices within the wireless network that share the mutual association.

15. The device of claim 10 further comprising:
 - a routing module to route one or more communications between the one or more associated devices that share the mutual association.

16. The device of claim 10, comprising:
 - a processor to dynamically modify routing information of one or more associated devices that share the mutual association based on information stored in a routing table and to share the modified routing information with said one or more devices which share the mutual association.

17. The device of claim 16, wherein the processor comprises the acquiring module, a determining module, a discovering module and a routing module.

18. The device of claim 16, wherein the processor comprises the acquiring module, and a routing module which includes a determining module and a discovering module.

19. The device of claim 10, further comprising:
 - a transceiver to transmit and to receive communications of the one or more devices that share the mutual association.

20. An apparatus comprising:
a software component able to be acquired by an acquiring device in communication with one or more associated devices of an ad-hoc wireless network based upon a priori knowledge of a mutual association, wherein said one or more associated devices able to share the software component.
21. The apparatus of claim 20, further comprising:
a memory device to store the software component; and
a transceiver to transmit and to receive communications of the one or more associated devices of the ad-hoc wireless network.
22. The apparatus of claim 20, further comprising:
a routing module to route one or more communications between one or more associated devices that share the mutual association.
23. The apparatus of claim 20, comprising:
a processor to dynamically modify routing information of the one or more associated devices of the mutual association based on information stored in a routing table and to share the modified routing information with said one or more associated devices that share the mutual association.
24. A mobile ad hoc network comprising:
a plurality of wireless devices that share a mutual association;
a sharing device to provide services to at least one device of the plurality of wireless devices by sharing a software component stored in the sharing device.
25. The mobile ad hoc network of claim 24, wherein the software component is able to be acquired by an acquiring device in communication with the plurality of wireless devices of the ad-hoc wireless network based upon a priori knowledge of the mutual association, and wherein said plurality of devices are able to share the software component.

26. The mobile ad hoc network of claim 25, wherein the sharing device comprises:
a memory device to store the software component; and
a transceiver to transmit and receive communications of the plurality of wireless devices of the ad-hoc wireless network.
27. The mobile ad hoc network of claim 25, wherein the sharing device comprises:
a routing module to route one or more communication between the plurality of wireless devices who share the mutual association.
28. The mobile ad hoc network of claim 25, wherein the sharing device comprises:
a processor to dynamically modify routing information of the one or more wireless devices of the mutual association based on information stored in a routing table and to share the modified routing information with said one or more other wireless devices that share the mutual association.
29. A wireless communication device comprising:
a software component able to be acquired by an acquiring device in communication with one or more associated devices of an ad-hoc wireless network based upon a priori knowledge of a mutual association, wherein said one or more associated devices able to share the software component; and
an omni-directional antenna to transmit and receive communications of the one or more associated devices of the ad-hoc wireless network.
30. The wireless communication device of claim 29, further comprising:
a memory device to store the software component; and
a transceiver to transmit and to receive communications of the one or more associated devices of the ad-hoc wireless network.
31. The wireless communication device of claim 29, further comprising:
a routing module to route one or more communication between one or more associated devices who share the mutual association.

32. The wireless communication device of claim 29, comprising:
a processor to dynamically modify routing information of the one or more associated devices of the mutual association based on information stored in a routing table and to share the modified routing information with said one or more associated devices that share the mutual association.
33. An article comprising: a storage medium having stored thereon instructions that when executed result in:
acquiring a software component stored in a first device of a wireless network based on a priori knowledge of a mutual association shared by the first device and at least a second device of the wireless network.
34. The article of claim 33, wherein the instructions when executed further result in:
generating a routing table to indicate a route from an acquiring device to the software component stored in the first device.
35. The article of claim 33, wherein the instructions when executed further result in:
determining the route based on a proximity of the second device to the acquiring device.
36. The article of claim 33, wherein the instructions when executed further result in:
dynamically sharing information of the first and second devices and one or more other devices within the wireless network that share the mutual association.

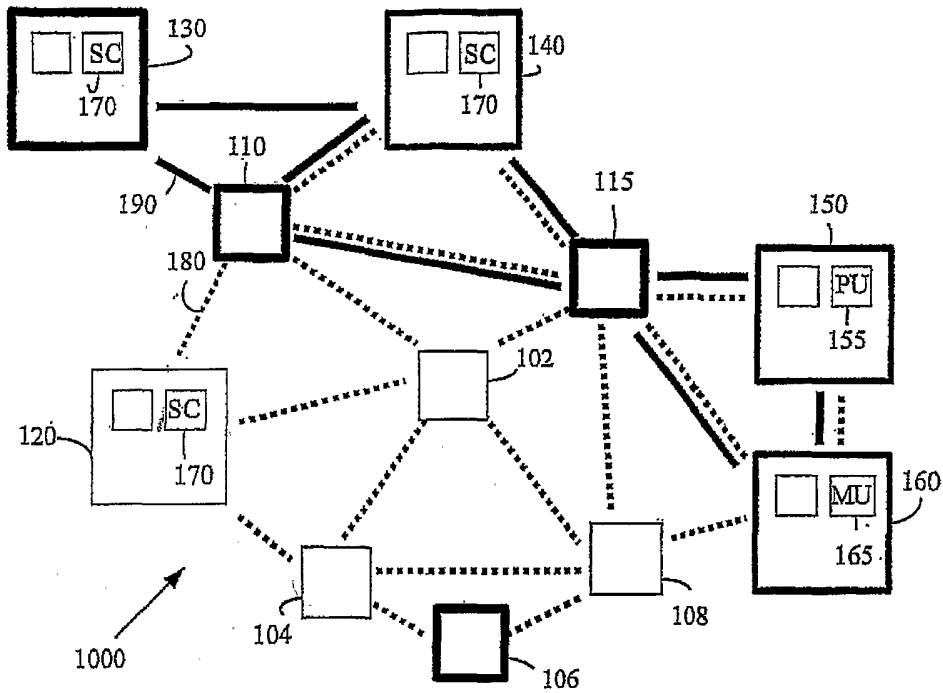


FIG. 1

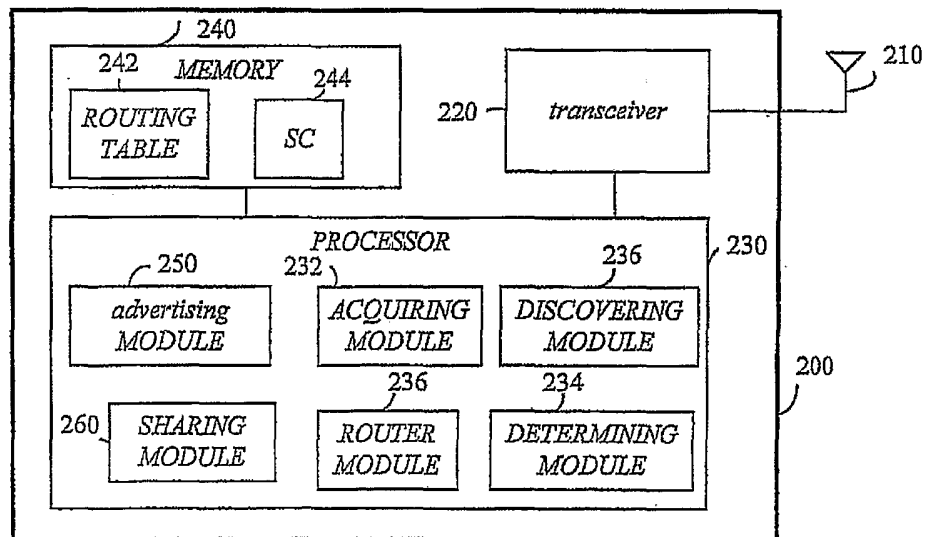
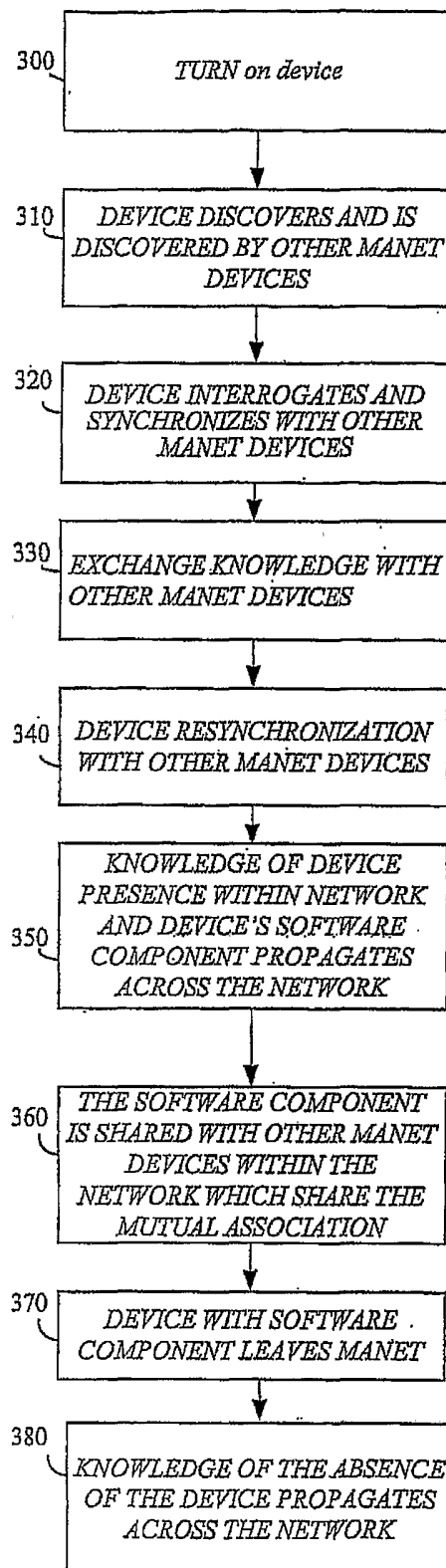


FIG. 2

**FIG. 3**

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US2004/018232

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/56 G06F9/44 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)
IPC 7 H04L G06F

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | WO 01/86419 A (SUN MICROSYSTEMS INC) 15 November 2001 (2001-11-15) abstract page 2, line 31 - line 37 page 6, line 18 - line 22 page 14, line 31 - line 38 page 16, line 26 - line 39 page 37, line 35 - page 38, line 39 page 39, line 37 - page 40, line 7 page 60, line 12 - line 14 page 60, line 38 - line 40 ----- -/-- | 1-36 |

Further documents are listed in the continuation of box C. Patent family members are listed in annex.

° Special categories of cited documents :

| | |
|---|---|
| *A* document defining the general state of the art which is not considered to be of particular relevance | *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
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| Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016 | Authorized officer Rüschmann, F |
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