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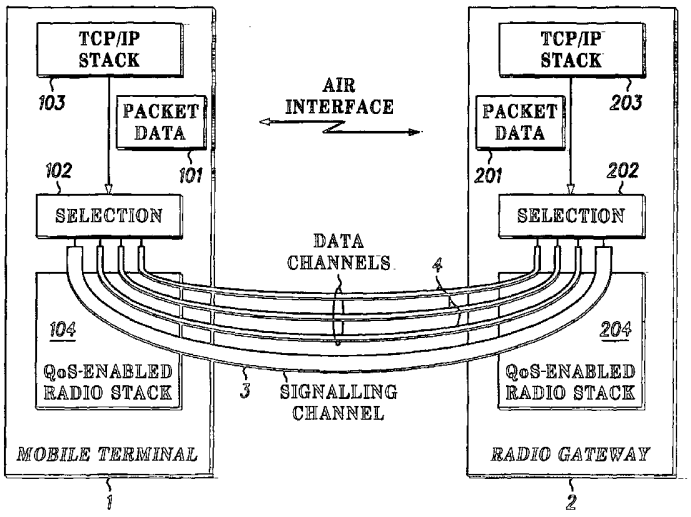
[Continued on next page]

(54) Title: APPLICATION PERSISTENCE IN A WIRELESS COMMUNICATION NETWORK



(57) Abstract: A wireless communication system (100) comprising a first application (software program) (110), in communication with at least a second application (140) over a wireless network link (115), the wireless network link connecting to a network comprising at least one mediator (defined herein) (125), acting as a gateway or proxy server, the mediator (125) characterized by facilitating the storage of information sufficient to restore the operating state of the first application by routing said information to a storage means (130) and retrieving said information as required. This enables the persistence of the state of the first application in the event of device/battery failure, a lost network connection, or upon access to the state information by a separate device equipped with a similar application.

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Application persistence in a wireless communication network

Technical Field

This invention relates to the remote storage of data. The invention is applicable to, but not limited to, the remote storage of application operation data for wireless communication devices to ensure persistence of the application.

Background

New and future wireless handheld communication devices are expected to support an ever increasing number of more advanced user-oriented applications (e.g. on-line games, shared agendas, etc).

Most of these applications will utilise the communication capabilities of the device to interact with applications on other devices. Most of these applications will also need a persistence mechanism, viz., a means to periodically store their state in order to ensure:

i) Personalisation of the application;
ii) Fault tolerance;
iii) Recovery from (soft or hard) system halt;
iv) Recovery from network connection loss.

The state of an application can be defined as a set of objects (for object-oriented applications), or more generally a set of variables that are sufficient to entirely describe the execution context (i.e. operation) of the application.

Normally, an application may be expected to store its states on the devices local memory. However, for wireless

handheld communication devices, this solution is undesirable, as:

i) Storage capacity on mobile devices is very limited;
ii) Storage capacity on mobile devices is expensive when compared to typical computer storage;
iii) Storage capacity may vary between devices, making it difficult to anticipate availability;
iv) The typical user changes their device roughly every 18 months, but there is currently no means to transfer application states between devices.

Thus there is a need to provide some alternative to the solution of local storage on the wireless handheld communication device. Preferably such a solution should solve the issues of application recovery and data transfer in as transparent and efficient a manner as possible.

Patent specification US6295611 B1 (Method and System for Software Recovery, Sun Microsystems Inc.) describes a mechanism to enable recovery of the state of an object-oriented software environment after a system halt. The mechanism stores objects (modular code blocks), but relies on the facility to reconstruct the state of the system once these blocks have been recovered. The mechanism assumes an object-oriented environment.

This requires considerable modification of the application to facilitate reconstruction and explicitly does not store the current (pre-failure) state of every block.

Patent specification WO0160022 A1 (Wireless Information Device Running Multiple Interactive Applications, Symbian Ltd.) describes a mechanism consisting of two or more applications running on the same device or on different wireless devices, communicating through an unreliable

means. The mechanism relies on the use of a software server on the device or devices to store state information locally on the device. This fails to address the problem of memory limitations within a mobile device, making restoration of states for multiple applications difficult.

Patent specification US 5 890 963 discloses a system including servers and game-playing clients in communication with the servers through a computer network. The system may also include a franchiser memory that clones the server game data and the knowledge base to produce identical copies of the game and the game state. The system of patent specification US 5 890 963 has a client-server architecture and is not applicable to peer-to-peer interactions or advanced applications where some processing is delegated to the client.

Summary of the Invention

The present invention provides a wireless communication system, and a method of wireless communication, as described in the accompanying claims.

Brief description of the drawings

Fig. 1 shows a wireless communication system in accordance with an embodiment of the present invention, given by way of example, comprising at least two wireless devices, wirelessly connected via a mediator.

Fig. 2 shows a flowchart describing the operation of an application or application monitor and the mediator in the system of Figure 1.

Fig. 3 shows a flowchart describing further operations of the mediator in the system of Figure 1.

Detailed description of the preferred embodiment

As shown in Figure 1, a preferred embodiment of the invention utilises a component of a network that is acting as a gateway or proxy (referred to herein as a mediator) 125 that is adapted to manage the persistent storage of the operating states of a first software program (hereinafter referred to as an application) 110 running on a wireless handheld communication device 105. The mediator is adapted to interpret communications from a second application 140 that affect the operation of the first application (hereinafter termed a 'remote event'), and to receive information via the device 105 concerning interaction or communications local to the first application that affect the operation of the first application (hereinafter termed a 'local event'). Local events may include user interactions, communications from the host device 105 or from another application running on the same device 105. All the communications between the first and second applications are arranged to pass through the mediator. Using these events (both remote and local) the mediator can infer the operating state of the application, and this can be stored in a storage means 130, accessible by a key stored both on the device 105 and the mediator 125 and/or storage means 130. By storing the operating state of the application, it is made robust to system failures and enables simple transference of the information to different copies of the application.

This embodiment of the present invention thus

i) enables the persistence of numerous and complex applications by overcoming the storage limitations of handheld devices;

ii) provides a degree of independence between the storage of the application state and the device, allowing the same application state to be recalled on different devices;

iii) requires little of the user, who at most may have to enter a key when wishing to transfer states between devices;

iv) is efficient, requiring the additional transmission only of events local to the application;

v) can be immediately integrated within existing network architectures.

In a preferred embodiment of the present invention, it is assumed that the first application has established a peer-to-peer communication with at least a second application (for example 140 or 180) through a network connection (for example 115 and 145, or 115 and 190). This assumption considers that most added value applications (e.g. games, shared agenda) need to exchange information, and that the peer-to-peer communication model is gaining more and more acceptance due to its suitability with networking issues (e.g. distributed object programming). It is further assumed that the second application may be connected to the network by any suitable means.

To facilitate the aforesaid peer-to-peer communication requires a mediator for at least one the following reasons:

i) there is no server (e.g. serversocket) service on the wireless device;

ii) there is a firewall on the wireless operator network, which prevents incoming access to the wireless device;

iii) the wireless connection to the device may intermittent, and the mediator helps to maintain the connection between both devices.

The present invention utilises the existence of communication via the mediator to store the state of the application not on the device, but on storage means (e.g. a database) located either with the mediator or somewhere else in the network, where storage constraints are less critical.

This solution is particularly suited to devices using always-connected protocols (e.g. GPRS) where the communication costs become negligible in comparison to the storage-media costs on small devices, but it should be clear to a person skilled in the art that the present invention could also operate on other wireless protocols.

To obtain knowledge of the state of the first application, one can infer the behaviour of the first application from a given state (e.g. the initial state), together with information regarding those external events that affect the first application and cannot be inferred themselves (e.g. remote events such as communications from the second application, or local events such as user interactions or communications from the device or other applications on the device).

In the preferred embodiment, the mediator already has access to all remote events, as it acts to pass them between the second and first applications. Consequently all that is required to infer knowledge of the state of the application is that the mediator receives information describing the local events.

To provide the mediator with information describing the local events, the application may be adapted to enable transmission of local event information to the mediator.

In an alternative embodiment, the mediator may receive information from an application monitor provided to enable transmission of local event information pertaining to the first application, the first application possibly being one of a plurality of applications on the device being monitored in this fashion by the application monitor.

In the preferred embodiment when the first application is started for the first time, contact is made with the mediator. The mediator knows in advance the form of the data and states required by the application for storage, though to a person skilled in the art that it will be apparent that there is scope for specific storage requirements to be requested by the application or application monitor at this point.

The mediator or storage means then issues a unique key. An application with this key will have its state information stored in a storage space uniquely corresponding to that key. The key is stored both by the device and by the mediator and/or storage means.

On subsequent runs of the application (either instigated by the user or automatically restarted after a system halt or lost network connection), the key is transmitted from the device to the mediator, which then facilitates recall of the state of the application, transmitting the state information back to the device.

In the preferred embodiment, the key is a simple alphanumeric sequence. This enables the user to enter the sequence on another device that contains a copy of the application, and effectively transfer the state of the first application to a subsequent copy operating on a separate device.

It is within the contemplation of the invention that other methods of transfer may be implemented, instead of or as well as that above. Examples include:

i) Storing keys on the SIM of the device, to be transferred between devices;

ii) Storing keys with the network provider, to be accessed by any device registered with the same user.

In each instance the transfer of a plurality of keys is simplified. Note also that transferring keys may also provide means by which to automatically transfer subscriptions to services etc., received by applications on each device, simplifying administration for the network provider.

With reference to figure 2, a flowchart of the operation of an application or application monitor and the mediator in the preferred embodiment is now described.

The flowchart commences with the launch of the application, as shown in step 210. The application or application monitor determines if a key has been stored in step 220. If a key has been stored, the key is transmitted to the mediator in step 222 and the state information is returned by the mediator in step 224. If a key has not been stored, contact is made to a mediator in step 230, which issues a new key for first use of the application in step 235. This key is stored in step 240.

The application or application monitor then awaits the occurrence of a local event, in step 250. A decision is made at step 260 whether the local event resulted in a change of state. If so, data pertaining to the local event is transmitted to the mediator in step 270. Step 280 then

loops back to step 250 until the application terminates at step 290.

With reference to figure 3, a flowchart of the additional operations of the mediator in the preferred embodiment is now described.

In addition to those operations described in the flowchart of figure 2, the mediator also operates as follows:

The flowchart commences with the connection of the application or application monitor, as shown in step 310. The mediator interprets communications from the second application to identify any remote events in step 320. The mediator infers any change in state due to the remote event in step 330. If a change is determined to have occurred, the inferred change of state is stored in the storage means in step 340. Step 350 then loops back to step 320 until the application disconnects at step 360.

Claims

1. A wireless communication system (100) comprising device (105), a first application (as defined herein) (110) for operating on said device (105) and for interacting with at least a second application (140) through communications passing over a wireless network link (115), the wireless network link connecting to a network comprising at least one mediator (as defined herein) (125), characterised in that:

the communications between said first and second applications are arranged to pass through said mediator, and

said mediator comprises routing means for routing to a storage means (130) information for use in restoring an operating state of the first application and retrieving said information as required.

2. A wireless communication system (100) according to claim 1 wherein said routing means is arranged to route to said storage means information sufficient to restore said operating state of the first application.

3. A wireless communication system (100) according to claim 1 or 2 wherein said mediator is arranged to transmit to said device, as required, information stored in said storage means for use in restoring said operating state of the first application.

4. A wireless communication system (100) according to any preceding claim wherein said mediator comprises said storage means.

5. A wireless communication system (100) according to any preceding claim wherein the first application (110) is arranged to send information to the mediator (125)

regarding events acting upon the first application (110) instigated by the user, by the device (105) upon which the first application (110) is operating, or by another application (111) upon the same device (105).

6. A wireless communication system (100) according to any preceding claim and comprising a monitoring application (111) operating on the same device (105) as the first application (110) for sending information to the mediator (125) regarding events acting upon the first application (110) instigated by the user, by the device (105) upon which the first application is operating, or by another application (111) upon the same device (105).

7. A wireless communication system (100) according to any preceding claim, wherein the mediator (125) is responsive to information regarding events acting upon the first application instigated by the user, by the device (105) upon which the first application is operating, or by another application (111) upon the same device (105).

8. A wireless communication system (100) according to any preceding claim, wherein the mediator (125) is further adapted to extract information regarding events acting upon the first application (110) instigated by the second application (140) via the network.

9. A wireless communication system (100) according to any preceding claim, wherein the mediator (125) is arranged to infer from successive events the operating state of the first application (110).

10. A wireless communication system (100) according to any preceding claim, wherein said storage space allocated for the state information of the first application (110) is uniquely identified by a key, the key being issued by the

mediator (125) or by said storage means (130) upon the first use of the first application (110).

11. A wireless communication system (100) according to claim 10, wherein the key is stored both on the device (105) and by the mediator (125) and/or storage means (130), the key then being used to identify stored state information within the storage means (130), for the purposes of access to said information and modification of said information on behalf of the first application or any similar application equipped with the key.

12. A wireless communication system (100) according to claims 10 or 11, wherein the key is a simple alphanumeric sequence.

13. A device for use in a system as claimed in any preceding claim, said device being arranged to send the communications to said second application through said mediator.

14. A device as claimed in claim 13 and comprising said first application (110) and another application (111), said first application (110) being arranged to send information to the mediator (125) regarding events acting upon the first application (110) instigated by the user, by the device (105) upon which the first application (110) is operating, or by said other application (111) upon the same device (105).

15. A method of storing information pertaining to a first application (defined herein) 110, in communication with at least a second application 140 over a wireless network link 115, the wireless network link connecting to a network

comprising at least one mediator (as defined herein) 125, characterised in that:

the communications between said first and second applications pass through said mediator, and

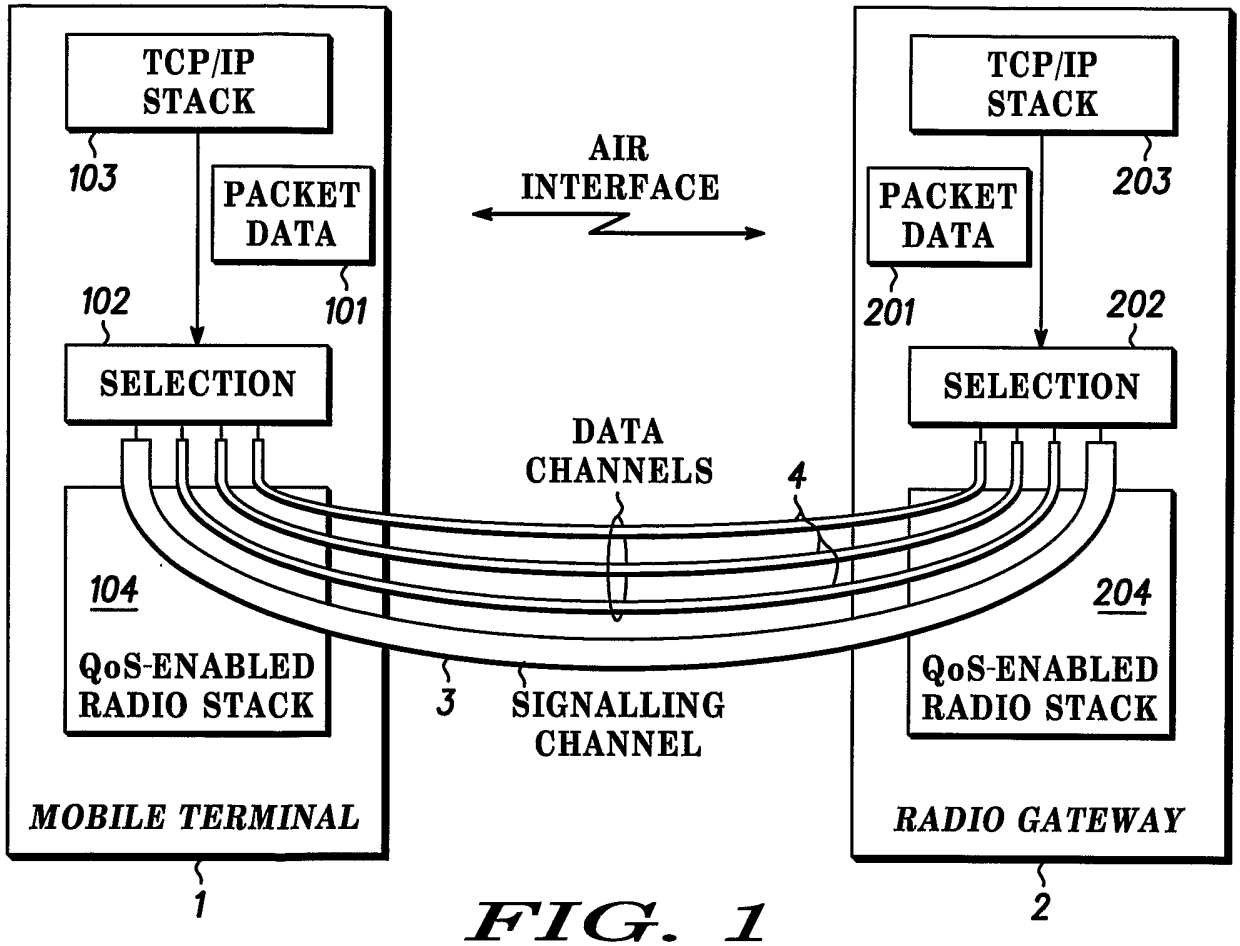
the mediator 125 stores information used in restoring the operating state of the first application 110 by routing said information to a storage means 130 and retrieving said information as required.

16. A method of storing information pertaining to a first application according to claim 15, wherein said mediator stores in said storage means (130) sufficient information to restore the operating state of the first application (110).

17. A method of storing information pertaining to a first application according to claim 15 wherein:

i) the mediator 125 extracts information regarding events acting upon the first application 110 instigated by the second application 140 through the network, and

ii) the mediator 125 receives information regarding events acting upon the first application 110 instigated by the user, by the device 105 upon which the first application is operating, or by another application 111 upon the same device 105.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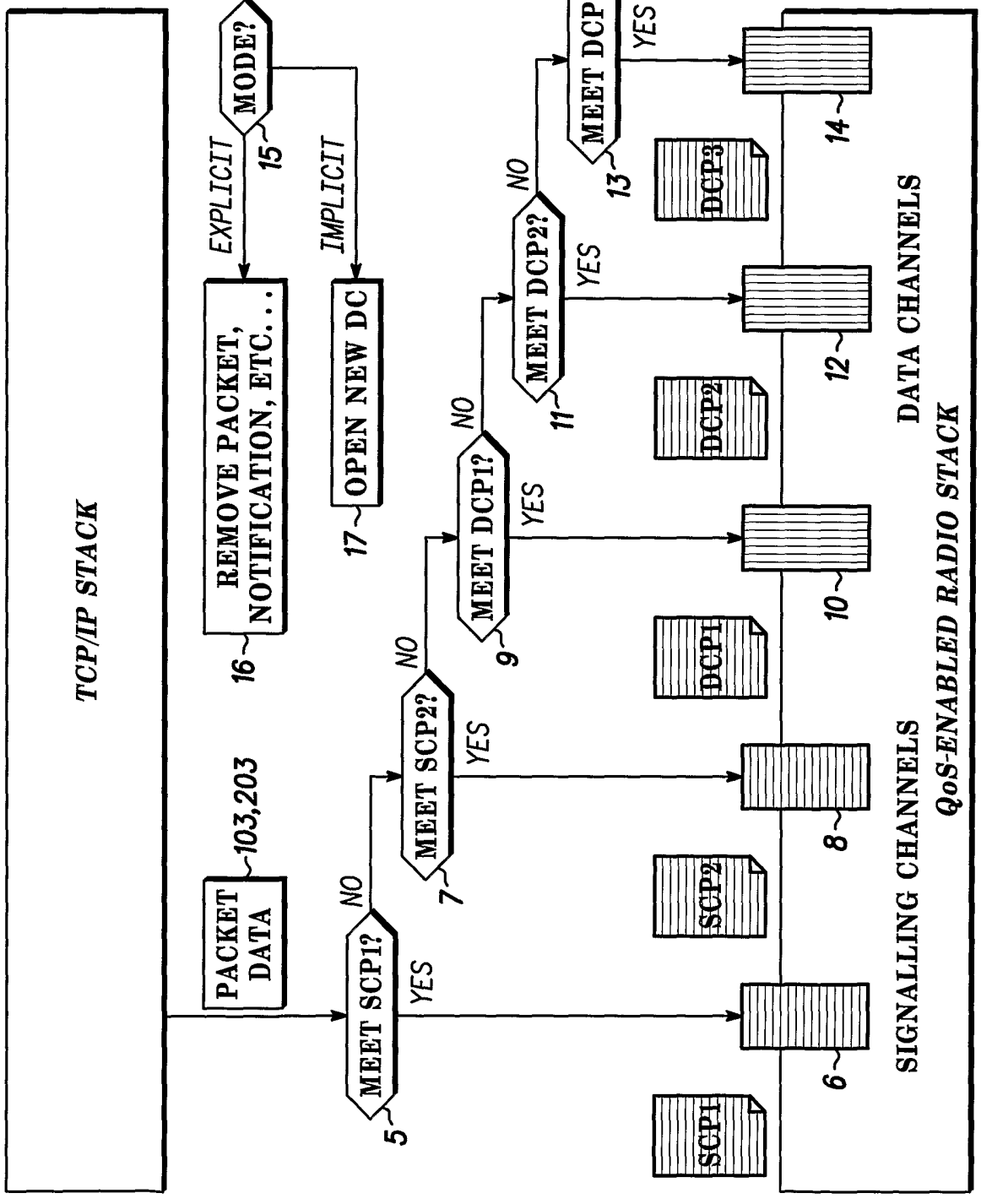
101
102
SELECTION
AIR INTERFACE
DATA CHANNELS
4
104
QoS-ENABLED RADIO STACK
3
SIGNALLING CHANNEL
MOBILE TERMINAL
1
TCP/IP STACK
203
PACKET DATA
201
202
SELECTION
204
QoS-ENABLED RADIO STACK
RADIO GATEWAY
2

FIG. 1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MEET SCP2?
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9
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YES
MEET DCP2?
11
NO
YES
MEET DCP3?
13
NO
YES
MODE?
15
EXPLICIT
IMPLICIT
REMOVE PACKET, NOTIFICATION, ETC. . .
16
OPEN NEW DC
17
SCP1
SCP2
DCP1
DCP2
DCP3
6
8
10
12
14
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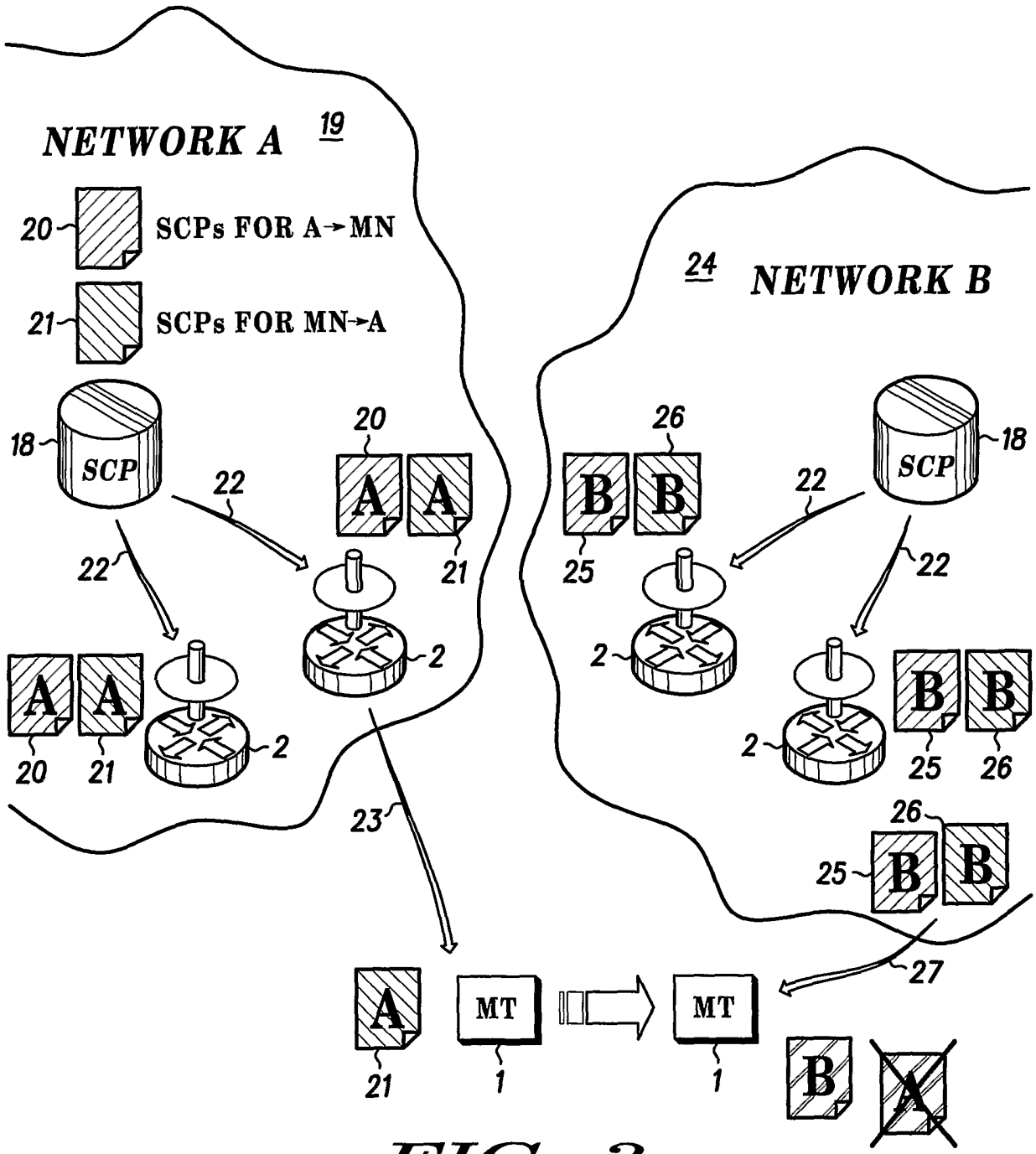
DATA CHANNELS
QoS-ENABLED RADIO STACK

FIG. 2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SCPs FOR MN→A
18
SCP
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22
20
A
A
21
2
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A
20
21
2
23
24
NETWORK B
26
B
B
25
2
22
SCP
18
22
2
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26
25
B
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27
A
21
MT
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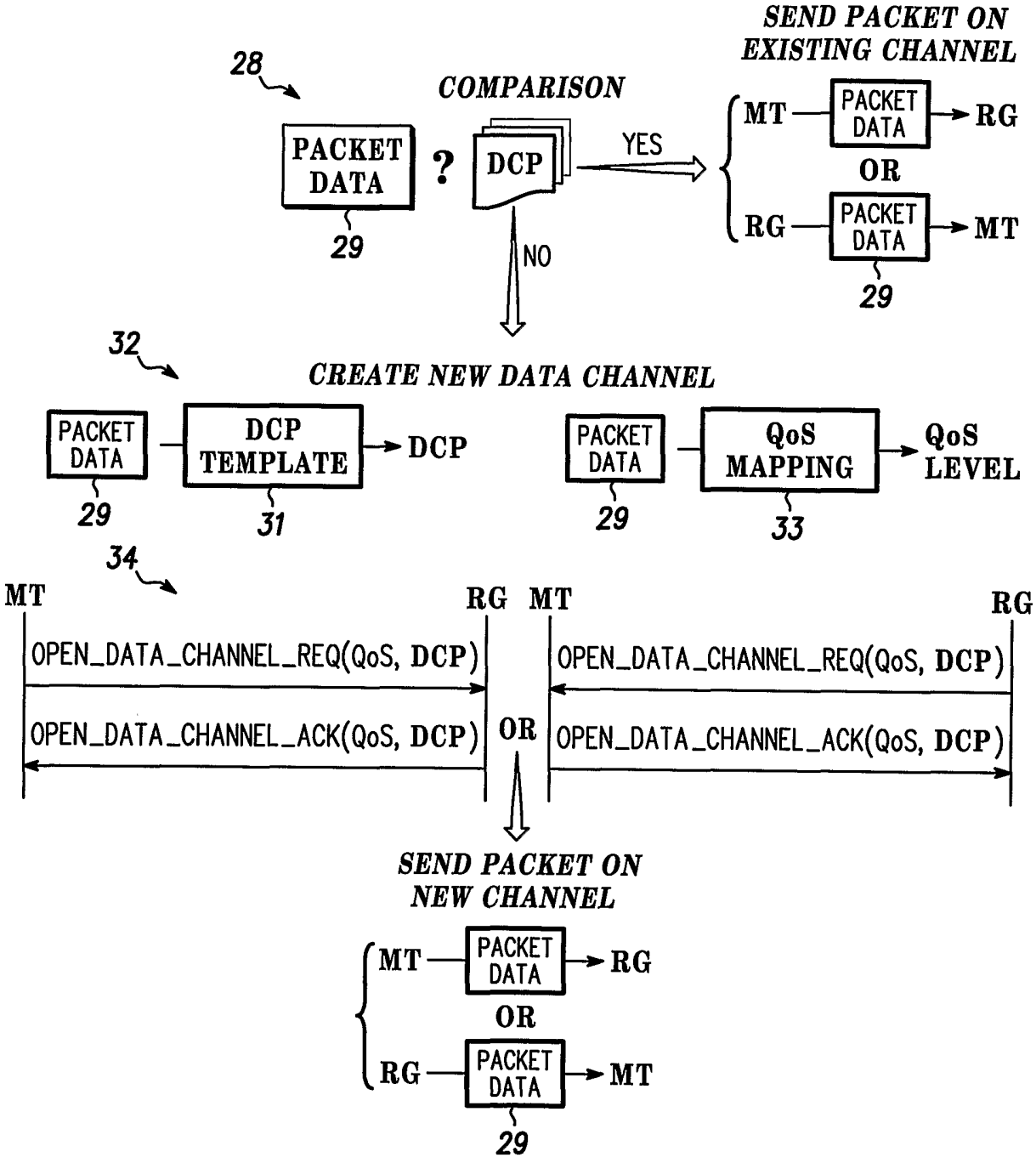
A

FIG. 3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COMPARISON
PACKET DATA
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?
DCP
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PACKET DATA
RG
OR
RG
PACKET DATA
MT
29
32
CREATE NEW DATA CHANNEL
PACKET DATA
29
DCP TEMPLATE
31
DCP
PACKET DATA
29
QoS MAPPING
33
QoS LEVEL
34
MT
RG
MT
RG
OPEN_DATA_CHANNEL_REQ(QoS, DCP)
OPEN_DATA_CHANNEL_ACK(QoS, DCP)
OR
OPEN_DATA_CHANNEL_REQ(QoS, DCP)
OPEN_DATA_CHANNEL_ACK(QoS, DCP)
SEND PACKET ON NEW CHANNEL
MT
PACKET DATA
RG
OR
RG
PACKET DATA
MT
29

FIG. 4