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(54) Title: RADIO LINK SHORT HOLD MODE FOR MOBILE CIRCUIT DATA APPLICATIONS

(57) Abstract

A method and apparatus for providing a call circuit connection between a mobile station (15) and a remote application host (65) is disclosed. Once a call circuit connection is initially established between a mobile station (15) and remote application host (65) to enable data to transfer therebetween, the call circuit connection is monitored for detection of an idle condition. Upon detection of the idle condition, identifying information for the call circuit connection is stored, and a first portion (15) of the call circuit connection is disconnected while maintaining a second portion (35) of the connection. Upon a request for reconnection of the call circuit connection, the first portion (15) of the call circuit connection is reestablished with the second portion (35) to enable continued data transfer.

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RADIO LINK SHORT HOLD MODE FOR MOBILE
CIRCUIT DATA APPLICATIONS

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates to call circuit connections between wireless and wireline communication networks, and more particularly, to a method for maintaining

5   a wireline portion of the call circuit connection while disconnecting a wireless portion of the call circuit connection during an idle period.

Description of Related Art

Circuit-switched data access has been available for some time within personal digital cellular (PDC) applications. Circuit-switched data access services provide the

10   user with the ability to transmit data between a remote host location and a mobile station for display on an attached terminal device. A prime example of this would be the ability to provide a user wireless access to the Internet through a hand-held mobile station.

At present, widespread acceptance of circuit-switched data access has not been

15   achieved. Reasons for this vary, but a prime reason involves the long setup time required to establish the circuit connection. In even modest data transfer situations, an end user must select between having very long session durations, which can be very expensive, or reconnecting each time a new batch of data must be downloaded and disconnecting after the data has been received, which is time consuming. Long setup

20   times are expensive for the end user since they are charged for the time it takes to reestablish the connection to an application host. Some method for speeding the

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manner in which a user may connect or reconnect to a remote application and

minimize the costs involved would greatly benefit the expansion of circuit switched

data access available within PDC services.

5   SUMMARY OF THE INVENTION

The present invention overcomes the foregoing and other problems with a

method and apparatus for controlling a call circuit connection between a mobile station

and a remote application host.   Initially, a call circuit connection is established

between a mobile station and a remote application host. This is accomplished using

10   a radio communications link between the mobile station and a base station transceiver.

A mobile switching center (MSC) provides a communications link between the base

station and an external network.

The communications link between the MSC and the external network is

enabled using a connection with an interworking unit ((IWU))) that enables data to

15   be transferred between the differing communication protocols of the external network

and the public land mobile network (PLMN) including the base station, MSC and

mobile station. The connections between the base station mobile switching center and

interworking unit are referred to as the PLMN portion of the call circuit connection

and the connection through the PSTN to the remote host application is referred to as

20   the modem portion of the call circuit connection.

The interworking unit monitors the call circuit connection to detect the

presence of an idle condition indicating that no data is presently being transmitted

between the remote host application and the mobile station.   In the preferred

embodiment, this is accomplished by monitoring the ARQ frames within the call

circuit connection. An idle condition is indicated by continuous retransmission of the last successfully transmitted frame (with unchanged frame numbers so the contents need not be checked).

Upon detection of the idle condition, the radio link and PLMN portions of the

5   call circuit connection are disconnected. Identifying data for the call circuit connection consisting of identifying information for the mobile station, the number of the called party and an (IWU) line identifier are stored within a register of the mobile switching center for future reference. The PSTN portion of the call circuit connection between the MSC and the remote application host is maintained.

10   Upon receipt of a further call connection request from the mobile station, an initial determination is made of whether the connection request is to the previously accessed remote application host by comparing the request to the identifying data stored within the register of the MSC. If the call is not to the same host, the modem portion of the call circuit connection is dropped, and a new call circuit connection is

15   established to the called number. If the connection request is to the previously accessed remote application host, the radio link and PLMN portions of the call circuit connection are reestablished with the modem portion of the call circuit connection to provide for further data transfer between the mobile station and the remote application host. In this way, a faster connection may be achieved while minimizing associated

20   connection costs.

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BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, reference is made

to the following detailed description taken in conjunction with the accompanying

drawings wherein:

5   FIGURE 1 is a block diagram illustrating a call circuit connection of data

terminal equipment to a remote application host in a standard manner;

FIGURE 2 is a block diagram illustrating a call circuit connection using the

short hold mode of the present invention;

FIGURE 3 is a flow diagram illustrating the method for disconnecting a call

10   circuit connection upon detection of an idle condition and reconnection of the call

circuit connection upon a request for further use of the connection; and

FIGURE 4 is a signaling diagram illustrating the disconnection and

reconnection procedures between the various units within the call circuit connection.

15   DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIGURE 1, there is illustrated a block diagram of a method

for interconnecting data terminal equipment 10 to a remote application host 65. Data

terminal equipment 10, such as a personal computer or personal data assistant,

generates a request for access to data or services provided by a remote application host

20   65 and transmits this request to an attached mobile station 15. The mobile station 15

generates a radio air interface connection 20 with a base station 25. The base station

25 transmits the connection request to the application host 65 through a mobile

switching center (MSC) 30. The mobile switching center 30 recognizing that a

connection between the wireless public and mobile network (PLMN) of which the

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mobile station 15 is a member and the public-switched telephone network/integrated

services digital network (PSTN/ISDN) 55 containing the application host 65 must be

made in order to complete the circuit connection.

In order to facilitate the call circuit connection between the wireless and

5   wireline networks, which utilize differing communications protocols, the MSC 30

contacts via connection 35 an interworking unit ((IWU)) 40. The interworking unit

40 enables transmission and protocol adaptations between one telecommunications

network, such as a connected PSTN/ISDN 55, and another, such as a public land

mobile network. The (IWU) 40 may be located with the mobile switching center 30

10   serving a designated geographic area or may be implemented as a separate

telecommunications node. The (IWU) 40 includes internal circuitry 42 enabling

adaptation of transmissions and protocols between the PSTN/ISDN 55 and the PLMN

containing the mobile station 15. The adapted protocol information is transmitted

back to the MSC 30 via a connection 45.

15   With the help of the (IWU) 40, the MSC 30 establishes a connection to the

PSTN/ISDN network 55 and subsequently to a modem 60 associated with the

application host 65. In order for the user at the data terminal equipment 10 to maintain

access to the application host 65, one of two situations must occur. The user must

continuously maintain the circuit connection between the data terminal equipment 10

20   and the application host 65 by maintaining the radio air interface 20 and connections

50, 45, and 35, comprising the call circuit connection. This is quite expensive in the

situation where a user may be accessing the application host 65 over a long period of

time, such as when a user is surfing the Internet. Alternatively, the user of the data

terminal equipment 10 may reestablish the connection each time additional data

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services must be accessed at the application host 65. This is time consuming and

requires the user to pay for multiple connection times. During these connection times,

the User is charged for establishing the connection and cannot work until the

connection is reestablished.

5   Referring now to FIGURES 2 and 3, there are illustrated the method and

apparatus for incorporating the present invention in the system of FIGURE 1. Initially,

a first circuit connection is established at step 70 between the data terminal equipment

10 and application host 65 as described previously with respect to FIGURE 1. As part

of this initial connection an interconnection is provided at step 75 with the (IWU) 40

10   to enable communication between the PLMN containing the mobile station 15, base

station 25, mobile switching center 30, and the PSTN/ISDN 55 enabling connection

to the application host 65.

            After the initial call circuit connection has been established and any requested

data downloaded to the data terminal equipment 10 from the application host 65, the

15   interworking unit 40 monitors for a period of inactivity over the call circuit connection

by examining the contents of ARQ protocol frames transmitted between the mobile

station 15 and interworking unit 40. A monitoring application 82, which may be

implemented in hardware or software, within both the mobile switching center 30 and

interworking unit 40 monitor the ARQ protocol frames. The ARQ protocol frames

20   enable automatic retransmission of data when an error is detected in a data stream.

            The period of inactivity (timeout period) is indicated by the ARQ protocol

frames by continuous retransmission of the last successfully transmitted from (with

unchanged frame numbers, so the contents need not be checked). Alternative methods

include transmitting a series of zeros indicating that the frames are idle or ceasing the

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transmission of ARQ protocol frames such that no frames would be detected. Once

the timeout period is detected at step 80, the radio and PLMN portions are

disconnected at step 85 up to the (IWU) 40. Thus, the air interface connection 20

between the mobile station 15 and base station 75 is discontinued. The connection 45

5   is maintained between the MSC 30 and (IWU) 40. The connection between the IWU

40 through the MSC 30 to the PSTN/ISDN network 55 is maintained as is the

PSTN/ISDN network connection to modem 60 and application host 65.

The (IWU) 40 initiates disconnection through a signaling connection control

part (SCCP) based signal, such as a mobile application part (MAP) signal. At the

10   same time, information identifying the original circuit connection is stored within a

register 88 of the MSC 30. The information stored in the register 88 includes, but is

not limited to, the calling mobile station identifier/mobile station number (MSI/MSN),

the called party (application host) number, and the (IWU) line identifier (e.g., T.1/E.1

trunk and slot ID. The connection remains idle until a second call circuit connection

15   request is received at step 90.

Once a second call circuit connection request is received at step 90, a new call

circuit connection is initiated using standard connection procedures. The MSC 30

compares at step 95 the MSI/MSN and the called party number of the new call

connection request to the MSI/MSN and called party number information used in the

20   first call circuit connection that are stored in register 88. If the same connection is

requested, the call is routed to the existing modem connection with the application

host 65 at step 100. If a different MSI/MSN or called party number is detected at

inquiry step 95, the previous modem connection is released at step 105, and a new call

circuit connection is established at step 110.

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Reconnection of the existing (IWU) connection at step 100 occurs when the

MSC 30 requests reestablishment of the radio air interface connection 20 and the

PLMN connections 35 and 45 through a signaling connection control part (SCCP)

based signal such as a MAP signal. In response to this request, the (IWU) 40 also

5   reinitiates the ARQ protocol on the circuit connection (according to the (IWU) line

identifier).

In order to avoid tying up system resources for extended periods of time, two

additional mechanisms may optionally be included somewhere within the system. A

long timer 112 (shown generally in phantom), established by the operator, may

10   disconnect the modem connection if no traffic has been exchanged for a preselected

period of time. Also, if the (IWU) 40 runs out of modem resources, the modem

connection that has been idle for the longest period of time may be dropped.

Referring now to FIGURE 4, there is illustrated a signaling diagram describing

the procedures for disconnection and reconnection of a call circuit connection between

15   a mobile station 30 and an application host 65. Initially, a data communications mode

is provided between the DTE 10 and application host 65 at 130. The data

communications mode enables data transfers between the DTE 10 and application host

65. Once the (IWU) 40 detects a period of inactivity (timeout period) it requests the

release of the radio link using a MAP signal at 135. The MSC 30 releases the radio

20   link at 140 indicating to the MS 15 that this is a soft release, and the MS shall not

perform a disconnect procedure towards the DTE 10. This is necessary to avoid

having the DTE 10 application lose synchronization with the host application which

is not notified of the disconnect. The MSC 30 then updates its register 88 with the call

circuit connection identifying information. While the radio link is disconnected, the

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modem connection between the (IWU) 40 and the modem at the application host 65

is maintained.

The reconnection procedure is initiated by new data 150 being transmitted

between the data terminal equipment 10 and mobile station 15. This initiates a radio

5   connection setup procedure 155 between the mobile station 15 and MSC 30. Once the

radio connection has been reestablished, the MSC 30 looks within its register 88 to

determine if the calling MSN/MSI already has a modem connection associated with

the called party number. If so, the MSC 30 transmits a MAP setup request 160 to the

(IWU) 40 to reestablish an ARQ connection with the mobile station 15. The (IWU)

10   40 establishes an ARQ and (IWU) connection with the mobile station 15 at 170 in

response to the setup request 160 and ties the connection with the maintained modem

connection. This provides the connection 180 from the application host 65 to the data

terminal equipment 10 through mobile station 15. Data communications 190 may then

be carried out between the data terminal equipment 10 and application host 65 via the

15   reestablished connection.

Although a preferred embodiment of the method and apparatus of the present

invention has been illustrated in the accompanying Drawings and described in the

foregoing Detailed Description, it is understood that the invention is not limited to the

embodiment disclosed, but is capable of numerous rearrangements, modifications, and

20   substitutions without departing from the spirit of the invention as set forth and defined

by the following claims.

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WHAT IS CLAIMED IS:

1.   A method for providing a call circuit connection between a mobile station and a remote application host, comprising the steps of:

establishing the call circuit connection between the mobile station and the remote application host to enable the transmission of data therebetween;

monitoring the call circuit connection for an idle condition; and

disconnecting a first segment of the call circuit connection while maintaining a second segment of the call circuit connection in response to detection of the idle condition.

2.   The method of Claim 1 further including the steps of:

receiving a request for reestablishing the call circuit connection with the second segment of the call circuit connection.

3.   The method of Claim 1 wherein the step of establishing further comprises the steps of:

establishing the first segment of the call circuit connection from the mobile station to an interworking function; and

establishing the second segment of a call circuit connection from the interworking function to the remote application host.

4.   The method of Claim 1 wherein the step of monitoring further includes the step of monitoring ARQ frames for an indication of the idle condition.

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5.   The method of Claim 4 wherein the step of monitoring further includes the step of monitoring for continuous retransmission of an ARQ frame for indication of the idle condition.

5   - 6.   The method of Claim 1 wherein the step of disconnecting further includes the step of notifying the mobile station that the disconnection is in response to the idle condition.

7.   The method of Claim 1 wherein the step of disconnecting further

10   includes the step of requesting disconnection of the first segment using a MAP signal.

8.   The method of Claim 1 wherein the step of disconnecting further includes the step of storing identifying data associated with the call circuit connection.

15   9.   The method of Claim 8 further including the steps of:

receiving a request for establishing a second call circuit connection;

determining if the call circuit connection request is for the call circuit connection host associated with the stored identifying data;

reestablishing the first segment of the call circuit connection with the

20   second segment of the call circuit connection to reconnect the call circuit connection if the request is for the call circuit connection associated with the stored identifying data; and

establishing a new call circuit connection if the request is to a new remote location.

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10.   The method of Claim 8 wherein the identifying data includes at least

one of the following: a calling MSI/MSN, called party number, and an interworking

unit line identifier.

11.   The method of Claim 9 wherein the first segment comprises a radio

link.

12.   The method of Claim 9 wherein the step of reestablishing further

includes the step of requesting reconnection of the first segment using a MAP signal.

13.   The method of Claim 1 further including the step of disconnecting the

second segment upon continuation of the idle condition and expiration of a preselected

time-out period.

14.   The method of Claim 1 further including the step of disconnecting the

second segment in response to a need for system resources utilized by the second

segment.

15.   A method for controlling a call circuit connection between a mobile

station and a remote application host, comprising the steps of:

        establishing a call circuit connection between the mobile station and the

remote application host to enable the transmission of data therebetween, the call circuit

connection including a radio portion between the mobile station and a base station; a

PLMN portion between the base station, a mobile switching center and an

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interworking unit; and a modem portion between the mobile switching center and the

remote application host;

        monitoring the PLMN portion of the call circuit connection for an idle

condition indicating no data is being transferred over the call circuit connection;

5   disconnecting the radio and PLMN portions of the call circuit

connection in response to detection of the idle condition;

        receiving a request for reestablishing a call circuit connection; and

        reestablishing the radio and PLMN portions of the call circuit

connection with the modem portion in response to the request.

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        16.   The method of Claim 15 wherein the step of monitoring further

includes the step of monitoring ARQ frames for an indication of the idle condition.

        17.   The method of Claim 15 wherein the step of monitoring further

15   includes the step of monitoring for an absence of ARQ frames for an indication of the

idle condition.

        18.   The method of Claim 15 wherein the step of disconnecting further

includes the step of storing identifying data associated with the call circuit connection.

20

        19.   The method of Claim 18 wherein the step of reestablishing further

included the steps of:

        determining if the call circuit connection request is to the remote

application host associated with the stored identifying data;

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reestablishing the radio and PLMN portions of the call circuit

connection with the modem portion of the call circuit connection to reconnect the call

circuit connection if the request is to the remote application host; and

reestablishing a new call circuit connection if the request is to a new

remote location.

20.   The method of Claim 15 further including the step of disconnecting the

modem portion upon continuation of the idle condition and expiration of a preselected

time-out period.

21.   The method of Claim 15 further including the step of disconnecting the

modem portion in response to a need for system resources utilized by the second

segment.

22.   A system for providing a call circuit connection between a mobile

station and a remote application host, comprising:

a base station for establishing a radio link portion of the call circuit

connection with the mobile station;

a mobile switching center for establishing a first connection with the

base station and for establishing a second connection with the remote application host;

an interworking function for establishing a third connection with the

mobile switching center to enable data transfer between the mobile switching center

and the remote application host; and

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means for disconnecting the radio link connection, the first connection

and the third connection in response to detection of an idle condition within the call

circuit connection and for reconnecting the radio link connection, the first connection

and the third connection in response to a reconnection request.

5   -

23.   The system of Claim 22 wherein the mobile switching center further

including means for storing identifying data associated with the call circuit connection.

24.   The method of Claim 23 wherein the identifying data includes at least

10   one of the following: a calling MSI/MSN, called party number, and interworking unit
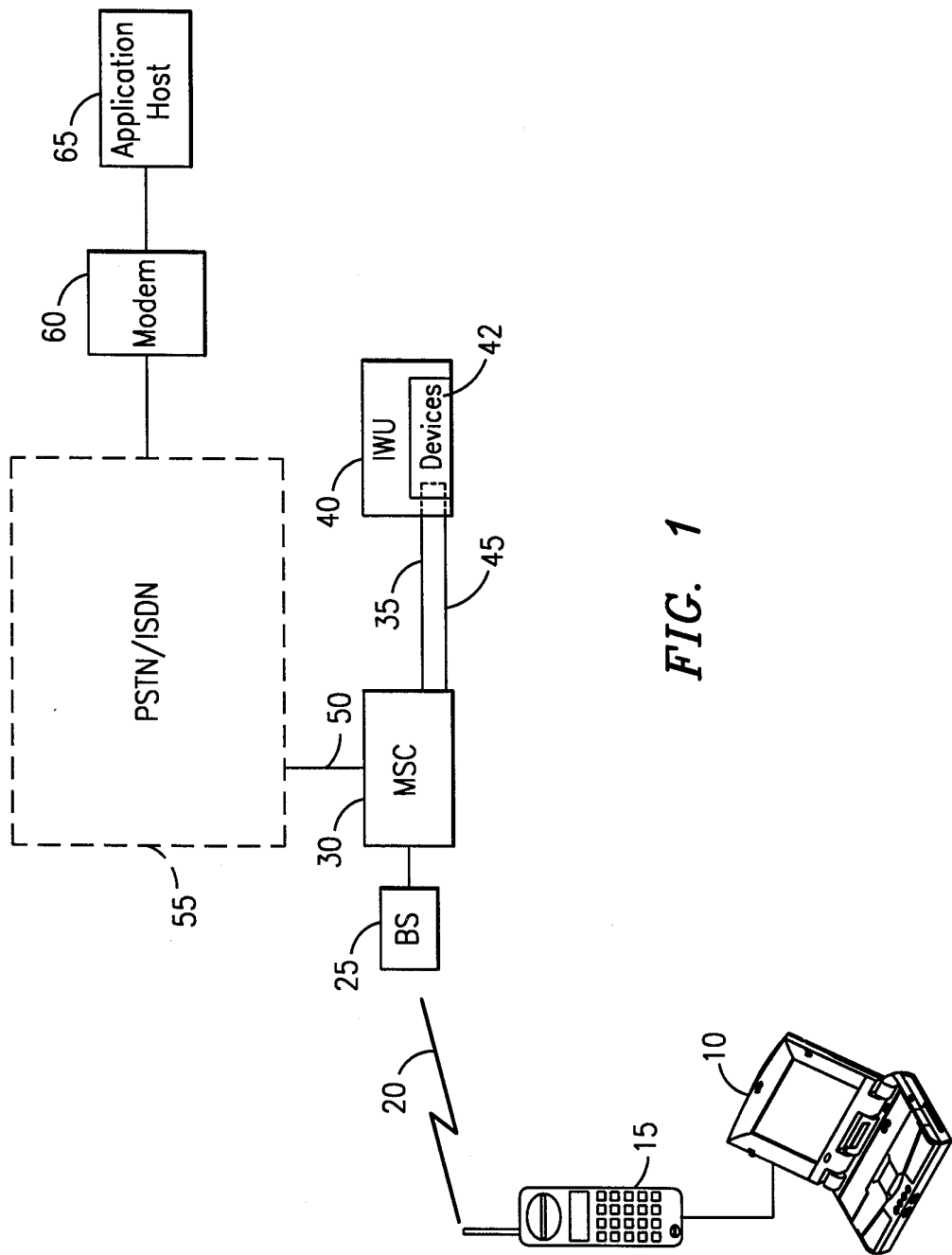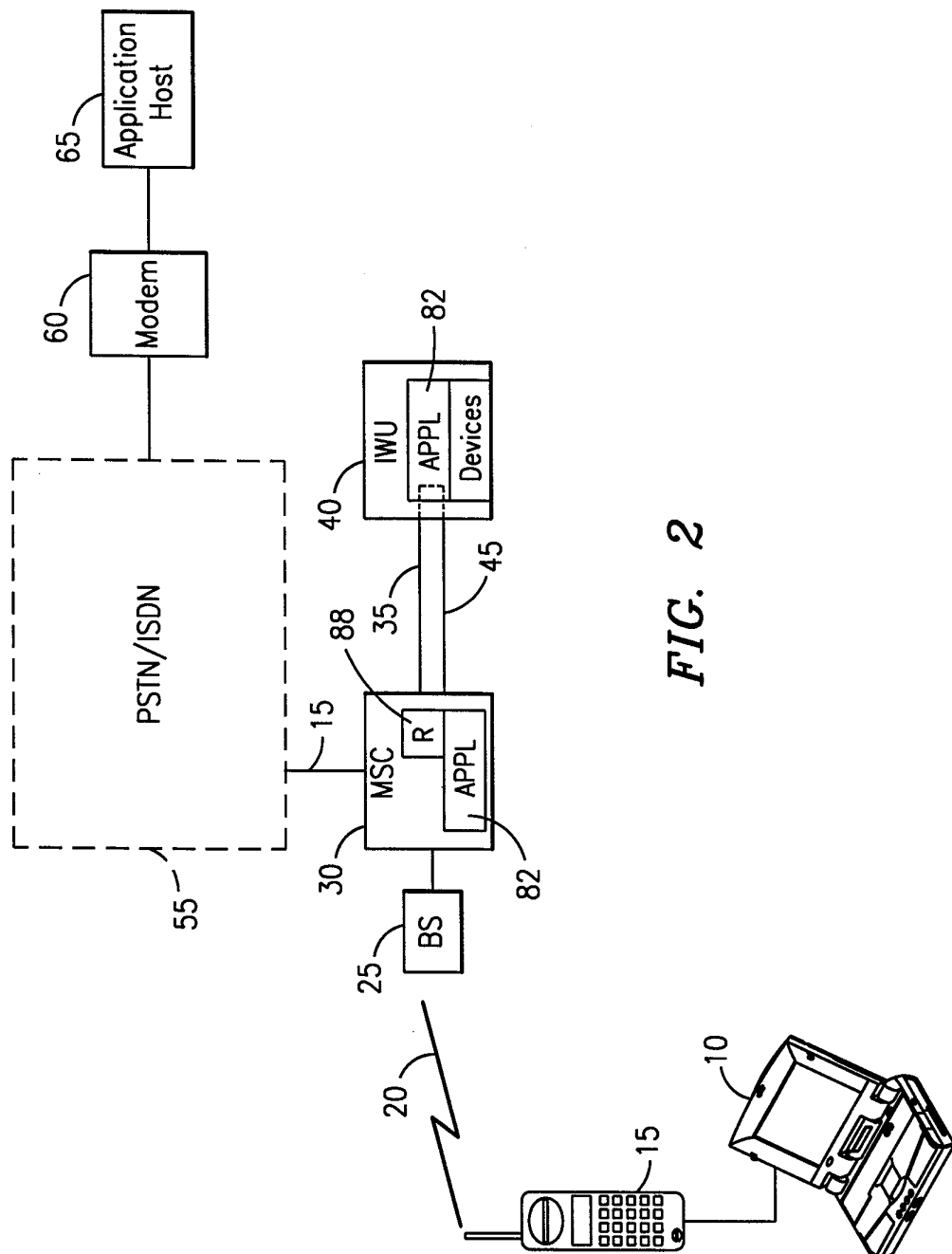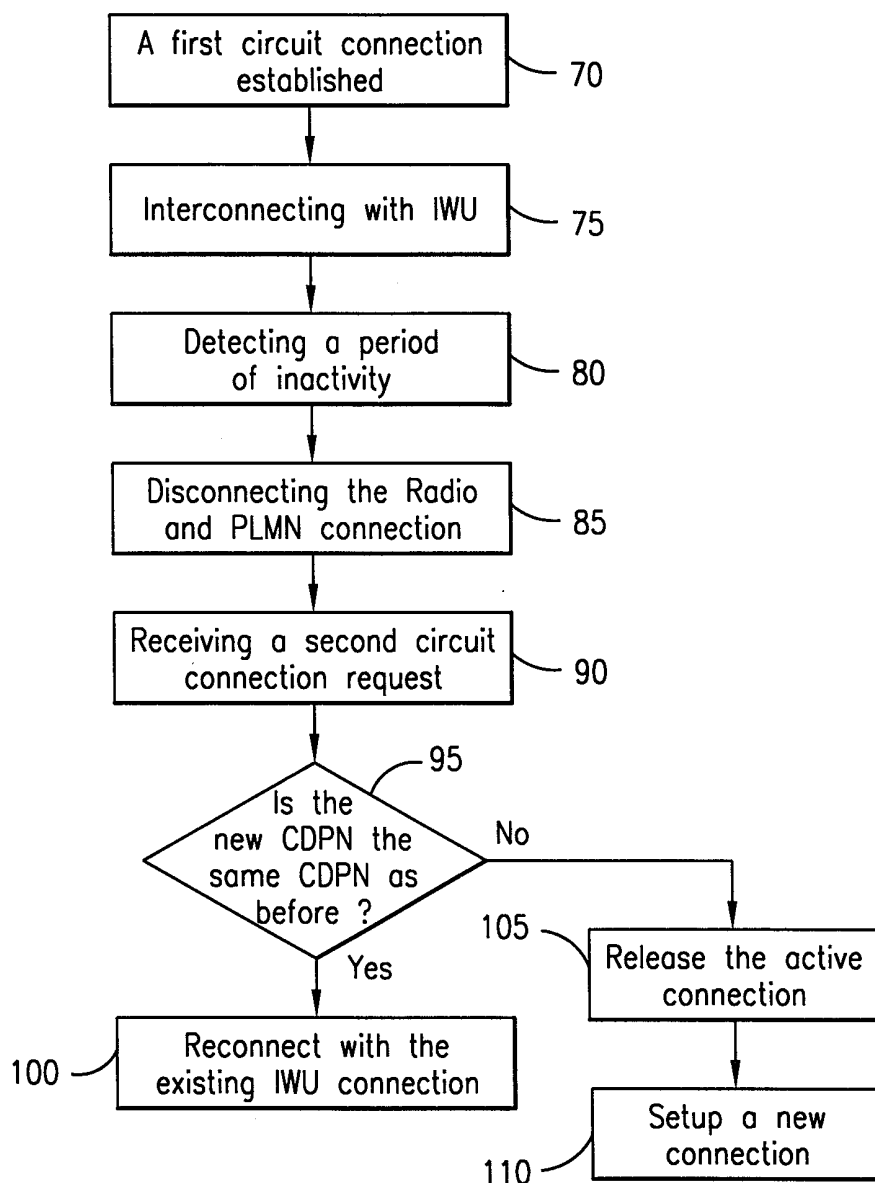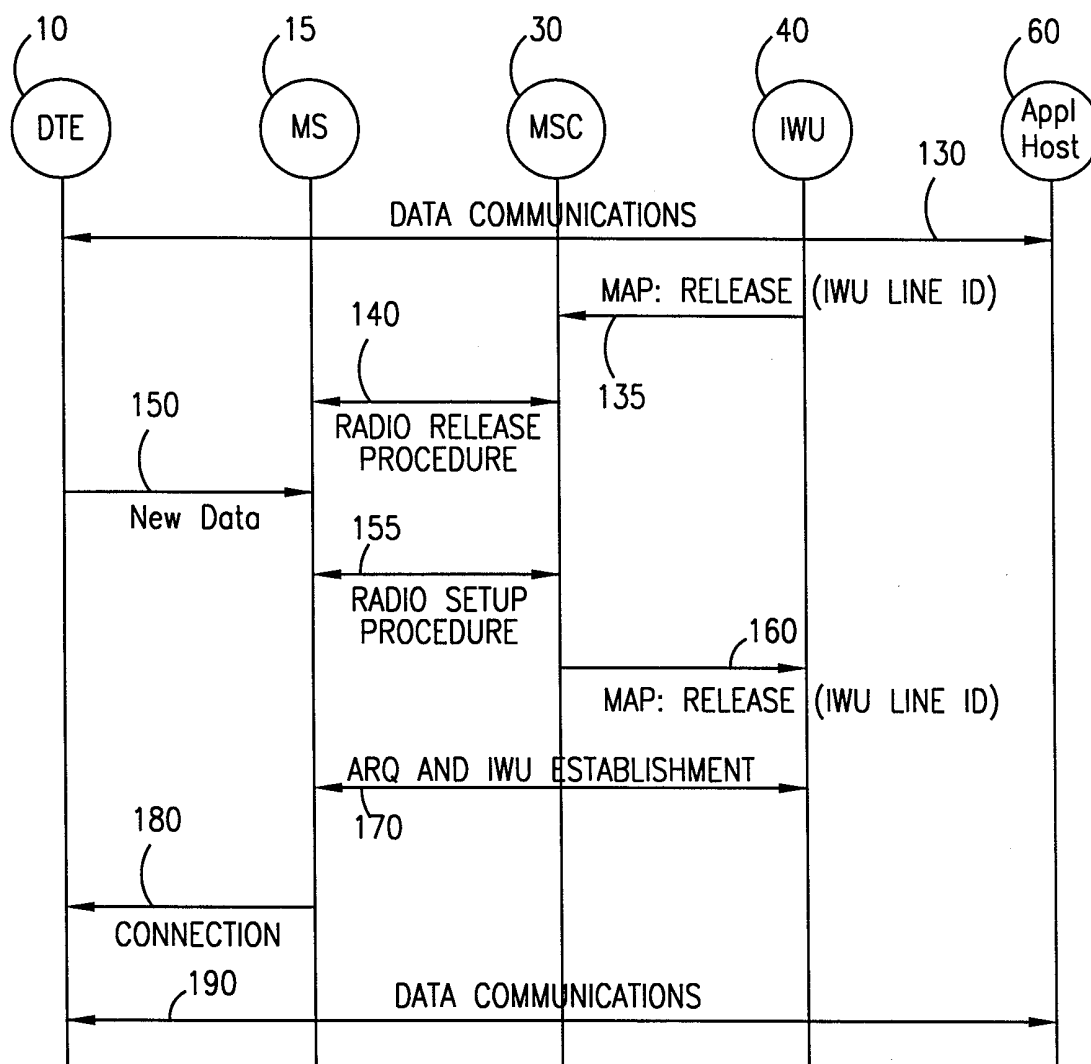
line identifier.

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FIG. 1

FIG. 2

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          ┌─────────────────────────┐
          │  A first circuit connection │ ── 70
          │       established        │
          └─────────────────────────┘
                      │
                      ▼
          ┌─────────────────────────┐
          │  Interconnecting with IWU │ ── 75
          └─────────────────────────┘
                      │
                      ▼
          ┌─────────────────────────┐
          │    Detecting a period    │ ── 80
          │     of inactivity        │
          └─────────────────────────┘
                      │
                      ▼
          ┌─────────────────────────┐
          │  Disconnecting the Radio │ ── 85
          │   and PLMN connection    │
          └─────────────────────────┘
                      │
                      ▼
          ┌─────────────────────────┐
          │  Receiving a second circuit │ ── 90
          │   connection request     │
          └─────────────────────────┘
                      │
                      ▼
                    ╱95╲
                 ╱ Is the ╲
                ╱ new CDPN the ╲ ──No──┐
                ╲ same CDPN as ╱        │
                 ╲ before ? ╱           │
                   ╲     ╱              │
                     │Yes        105 ──┐│
                     ▼              ┌───▼──────────┐
          ┌─────────────────────┐   │ Release the active│
    100 ──│  Reconnect with the  │   │   connection  │
          │ existing IWU connection │ └──────────────┘
          └─────────────────────┘          │
                                           ▼
                                    ┌──────────────┐
                                    │  Setup a new  │
                                    │   connection  │
                                    └──────────────┘
                                       110 ──┘
```

FIG. 3

FIG. 4

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6   H04Q7/22

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 6   H04Q

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 837 800 A (FREEBURG THOMAS A ET AL) 6 June 1989	1-3,6, 8-11, 13-15, 18-24
Y	see column 3, line 39 - column 5, line 18 see column 5, line 56 - column 8, line 56	12
X	WO 95 08900 A (NOKIA TELECOMMUNICATIONS OY ;WARSTA MARKUS (FI); JOKIAHO TIMO (FI)) 30 March 1995	1-3,6,7, 13-15,22
Y	see page 4, line 8 - page 5, line 25 see page 6, line 35 - page 8, line 11 see page 9, line 2 - page 12, line 4	12
X	EP 0 789 499 A (TELIA AB) 13 August 1997 see the whole document	1,2,13

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| X | Further documents are listed in the continuation of box C. | X | 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

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

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"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

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"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
2 December 1998	09/12/1998

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication.where appropriate. of the relevant passages	Relevant to claim No.
A	US 5 526 399 A (KAMEDA MIHO) 11 June 1996 see the whole document	1,4,5, 15-17
A	MICHEL MOULY ET AL: "NETWORKING FOR SUPPLEMENTARY SERVICES - SHORT MESSAGES" GSM SYSTEM FOR MOBILE COMMUNICATIONS,1993, pages 299-305, 556 - 563, XP002069784 MOULY M;PAUTET M-B see page 557, line 17 - page 558, line 7 see page 560, line 1 - page 563, line 13	1,7-9,12

1

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4837800	A	06-06-1989	AT	127994 T	15-09-1995
			CA	1281078 A	05-03-1991
			DE	68924187 D	19-10-1995
			DE	68924187 T	02-05-1996
			EP	0332825 A	20-09-1989
			FI	891275 A,B,	19-09-1989
			JP	1274523 A	02-11-1989
			JP	2043652 C	09-04-1996
			JP	7071335 B	31-07-1995
WO 9508900	A	30-03-1995	FI	934115 A	21-03-1995
			AU	678534 B	29-05-1997
			AU	7658694 A	10-04-1995
			CN	1133666 A	16-10-1996
			EP	0720806 A	10-07-1996
			JP	9505951 T	10-06-1997
EP 0789499	A	13-08-1997	NO	970562 A	13-08-1997
			SE	9600499 A	13-08-1997
US 5526399	A	11-06-1996	JP	2503888 B	05-06-1996
			JP	7067175 A	10-03-1995