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(54) **LOCATION AND EVENTS REPORTING IN A WIRELESS TELECOMMUNICATIONS NETWORK**

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(57) **ABSTRACT**

A wireless telecommunications network **(10)** that is operable to collect and report data relating to the status and use of a wireless phone **(34)** or other telecommunications device in near real-time in response to data collection requests made by subscribers or other authorized persons.

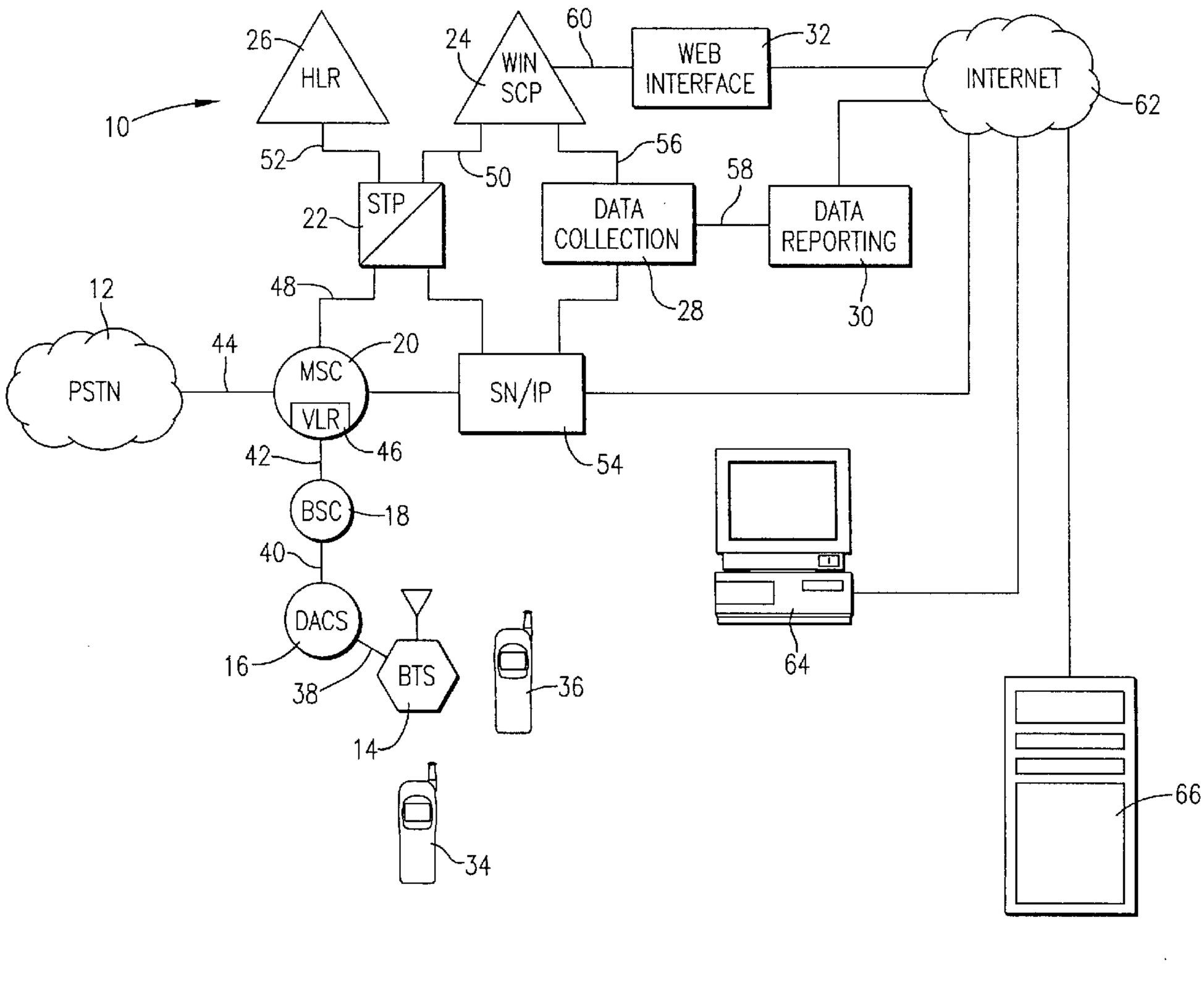
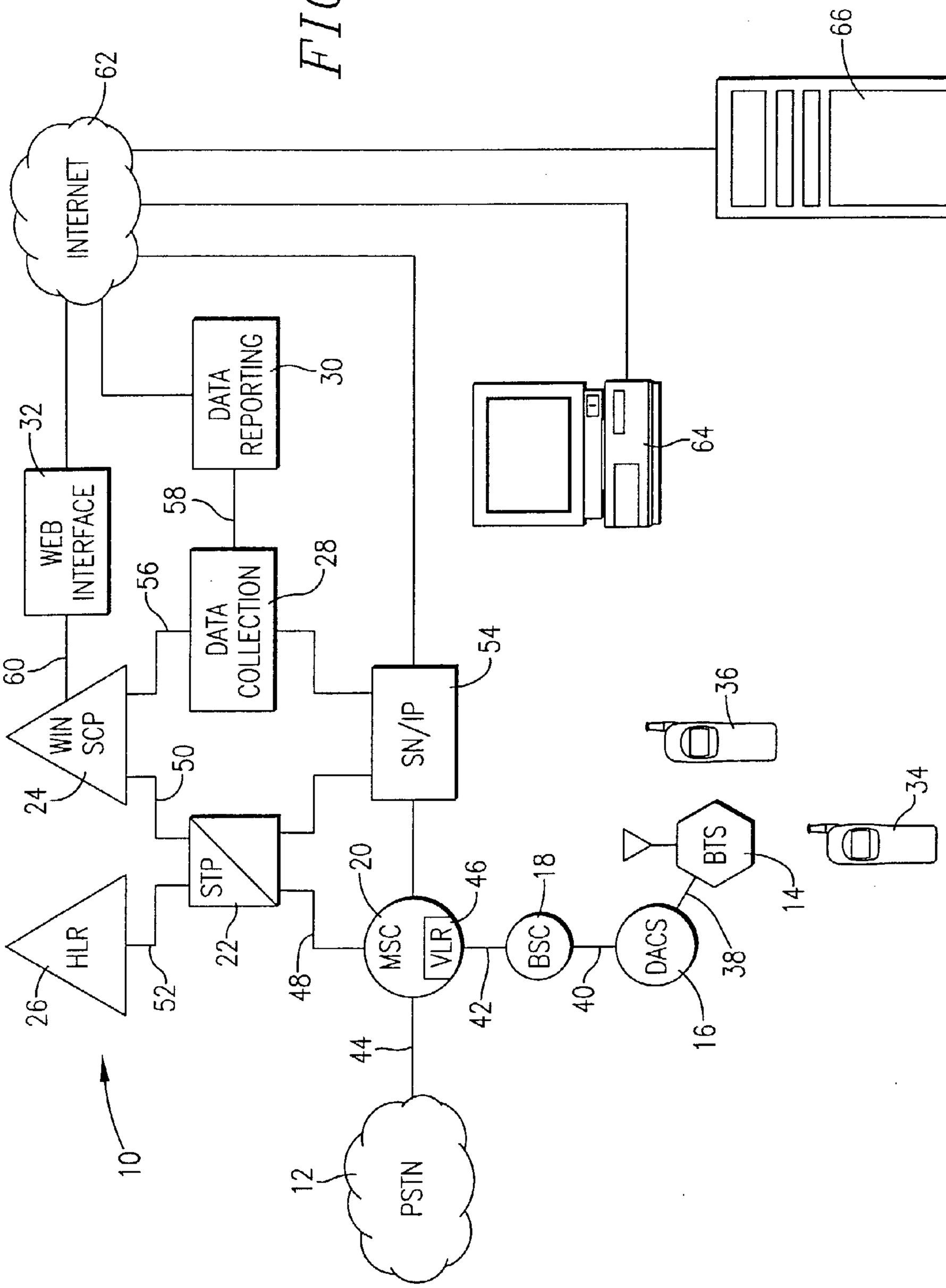


FIG. 1.


66
62
INTERNET
DATA REPORTING
30
32
WEB INTERFACE
58
56
DATA COLLECTION
28
54
SN/IP
64
60
WIN SCP
24
50
STP
22
HLR
26
52
48
MSC
20
VLR
46
BSC
18
DACS
16
42
40
BTS
14
38
36
34
44
PSTN
12
10

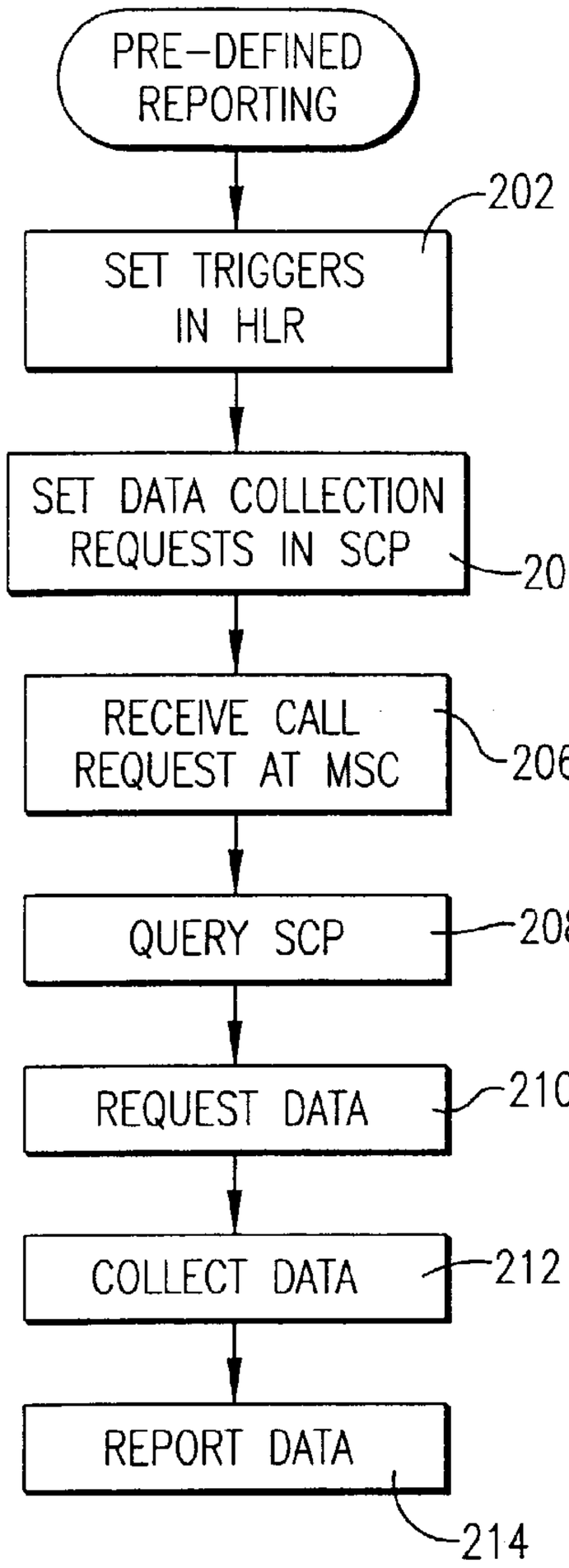

PRE-DEFINED REPORTING
202
SET TRIGGERS IN HLR
SET DATA COLLECTION REQUESTS IN SCP
204
RECEIVE CALL REQUEST AT MSC
206
QUERY SCP
208
REQUEST DATA
210
COLLECT DATA
212
REPORT DATA
214

FIG. 2.

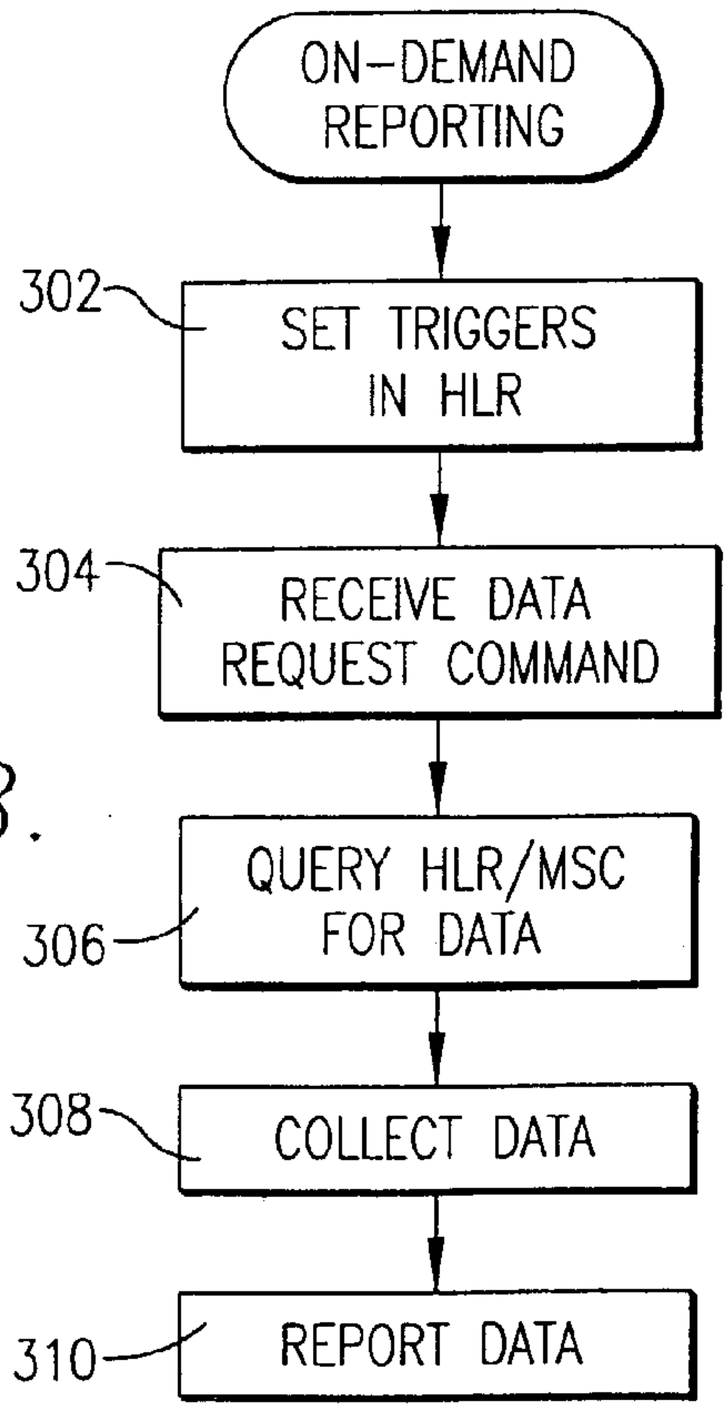

ON-DEMAND REPORTING
302
SET TRIGGERS IN HLR
304
RECEIVE DATA REQUEST COMMAND
306
QUERY HLR/MSC FOR DATA
308
COLLECT DATA
310
REPORT DATA

FIG. 3.

LOCATION AND EVENTS REPORTING IN A WIRELESS TELECOMMUNICATIONS NETWORK

RELATED APPLICATIONS

[0001] The present application is a continuation and claims priority benefit, with regard to all common subject matter, of an earlier-filed U.S. patent application titled "LOCATION AND EVENTS REPORTING IN A WIRELESS TELECOMMUNICATIONS NETWORK", Ser. No. 09/401,933, filed Sep. 23, 1999. The identified earlier-filed application is hereby incorporated by reference into the present application.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to wireless telecommunications networks, and more particularly, to a wireless telecommunications network operable to collect and report data relating to the status or use of a telecommunications device in near real-time.

[0004] 2. Description of the Prior Art

[0005] Many subscribers of wireless telecommunications network services desire to obtain information regarding the use of their wireless phones for billing and other purposes. Similarly, many persons or organizations that allow others to use their phones or that pay for wireless phone services for others, such as parents who allow their children to use their phones and companies that provide work phones to their employees, desire to obtain information regarding when, where, and for what purpose the phones are being used.

[0006] Unfortunately, however, existing wireless networks only provide such information periodically in historical reports, typically in billing reports at the end of each month. Moreover, the information that is provided typically only includes the originating and/or destination phone numbers and the length of calls but does not include other desirable information such as location tracking for the phone and other status information.

OBJECTS AND SUMMARY OF THE INVENTION

[0007] The present invention solves the above-described problems and provides a distinct advance in the art of wireless telecommunications networks. More particularly, the present invention provides a wireless telecommunications network that is operable to collect and report data relating to the status and use of a wireless phone or other telecommunications device in near real-time in response to data collection requests made by subscribers or other authorized persons.

[0008] The wireless telecommunications network of the present invention broadly includes: a base transceiver station operable for transmitting wireless communications to and receiving wireless communications from at least one telecommunications device served by the network; a mobile switching center coupled with the base transceiver station and operable for switching and coordinating communications between the base transceiver station and other network components and for launching call routing queries; and a service control point coupled with the mobile switching center and operable for receiving the call routing queries and for providing routing instructions to the mobile switching center in response to the call routing queries.

[0009] In accordance with one aspect of the present invention, the service control point is operable for receiving a data collection request for data relating to the use or status of a telecommunications device, for collecting data from other components of the network in accordance with the data collection request, and for allowing access to the data collected in substantially real-time. In preferred forms, the network also includes a web interface coupled with the service control point and accessible via the internet. The web interface is operable for receiving data collection requests from authorized persons via the internet and for forwarding the data collection request to the service control point. The network may also be provided with a data collection device and a data reporting device coupled with the SCP and accessible via the internet for collecting the requested data and organizing the data in predefined reports.

[0010] The data collection and reporting functions of the present invention can be implemented to provide numerous new network reporting services. For example, the network can collect and report information relating to the current location of a particular phone in the network on a call-by-call basis. A subscriber or other authorized person can use this service to periodically receive location tracking information for a phone or to issue a data request to the network via the internet or other medium to determine the current location of their phone on a near real-time basis. Moreover, such information can be collected and reported by the network even if calls are not made by the phone.

[0011] The network can also collect and report information relating to the status or use of a phone such as when a phone moves into or out of a particular service area, how long the phone is in a particular service area, the originating phone number of calls received by the phone, the destination phone numbers of calls made by the phone, etc. A subscriber or other authorized person can use this service to determine, for example, when a phone first registers with a provider in a certain area so that they know that the phone and the person operating it has safely arrived in the area. Similarly, a subscriber can be immediately notified when a phone is used to dial a particular number such as **911** so that they can take appropriate action.

[0012] Additionally, the network of the present invention can be used to track the location of devices attached to certain assets such as vehicles, railroad cars, packages, etc. without calls being made from the devices. The network can even be used to collect and report various user inputted responses to announcements sent to a phone such as in tele-voting or market sampling without asking the location of the phone because the network can immediately determine the location of the phone.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

[0013] A preferred embodiment of the present invention is described in detail below with reference to the attached drawing figures, wherein:

[0014] **FIG. 1** is a schematic diagram of a wireless telecommunications network constructed and configured in accordance with a preferred embodiment of the present invention.

[0015] **FIG. 2** is a flow diagram broadly illustrating the steps performed to collect and report data relating to the status or use of a telecommunications device in the wireless telecommunications network in accordance with pre-defined data collection requests.

[0016] **FIG. 3** is a flow diagram broadly illustrating the steps performed to collect and report data relating to the status or use of a telecommunications device in the wireless telecommunications network in accordance with on-demand data collection requests.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

System Architecture

[0017] Turning now to the drawing figures, and particularly **FIG. 1, a** wireless telecommunications network **10** constructed in accordance with a preferred embodiment of the invention is illustrated. The wireless telecommunications network is coupled with a conventional public switched telephone network (PSTN) **12** and is preferably a code division multiple access (CDMA) PCS wireless intelligent network such as the PCS network owned and operated by Sprint PCS. The PSTN **12** merely refers to the entire local, long distance, and international landline phone system used in the United States.

[0018] The wireless telecommunications network **10** broadly includes a base transceiver station (BTS) **14**, a digital access and cross-connect system (DACS) **16**, a base station controller (BSC) **18**, a mobile switching center (MSC) **20**, a signal transfer point (STP) **22**, a service control point (SCP) **24**, and a home location register (HLR) **26**. In accordance with one aspect of the present invention, the network also includes a data collection device **28**, a data reporting device **30**, and a web interface **32**, which cooperate with the SCP and other components of the network for providing certain data collection and reporting functions described below.

[0019] In more detail, the BTS **14** provides wireless communications to and from mobile telecommunications devices in a telecommunications cell such as the illustrated PCS or AMPS phones **34**,**36**. The BTS includes a plurality of transceivers coupled with one or more antennas that together provide wireless communications within the cell. The cell is preferably subdivided into three sectors and is part of a CDMA PCS telecommunications network such as the Sprint PCS network described above. The BTS is operable to control transmission and reception of CDMA PCS traffic independently in the three sectors using selected ones of a defined set of codes for each sector. The codes may include, for example, Walsh codes. An example of a BTS that may be used with the present invention is the Nortel CDMA Outdoor 1900 MHZ base station. Those skilled in the art will appreciate that the wireless network may include numerous BTSs positioned in telecommunications cells throughout the country.

[0020] The DACS **16** is a digital switching device that is coupled with the BTS **14** with signaling data links and trunk circuits **38**. The DACS is operable for routing and switching control messages between the BTS and the other components in the wireless network. Additional DACS may be positioned at other concentration points in the network and is well known in the art.

[0021] The BSC **18** is coupled with the DACS **16** with signaling data links and trunk circuits **40** and is operable to control operation of the DACS and the BTS **14**. The BSC is a high-capacity switch that provides total overview and control of wireless functions supported by the network **10** such as call handover control, cell configuration management, and BTS and mobile phone power level management. The BSC multiplexes signals from multiple BTSs into transmission signals that are sent to the MSC **20**. The BSC also routes network signals and calls from other components of the wireless network to the appropriate BTS for transmission to the mobile stations.

[0022] The MSC **20** is coupled with the BSC **18** and other base station controllers with signaling data links and trunk circuits **42** and is operable to coordinate the establishment of calls to and from the mobile stations and to handle transmission facilities management, mobility management, and call processing. The MSC is also connected with the PSTN **12** by signaling data links and trunk circuits **44** to provide switching between the wireless network and the PSTN.

[0023] The MSC **20** either includes an integrated visitor location register (VLR) **46** or is coupled with a stand-alone VLR. The VLR includes a database that contains information relating to mobile phones that are resident in their home service area, roaming outside of their home service area, or roaming in another wireless network. When a mobile phone is active in any service area, it automatically registers with the base station or mobility controller in that area. The local provider in the service area then queries the HLR **26** through the STP **22** using Signaling System #7 (SS7) or other signaling to retrieve information needed to verify the legitimacy of the mobile phone and to obtain a profile of the features associated with the mobile phone. The HLR responds to the query by transferring the necessary data to the VLR. This information is maintained in the VLR of the MSC as long as the mobile phone remains active within that coverage area. The HLR also updates its own database to indicate the current location of the mobile phone so that it can forward calls to the phone through the local provider in the service area. The querying process in the preferred wireless network is accomplished via SS7 links using the STP and SCP **24** as described below.

[0024] The STP **22** is connected between the MSC **20** and the SCP **24** by signaling data links **48**, **50** and is operable to route signaling messages therebetween. STPs are well known in the art with an example being the DSC Megahub.

[0025] The SCP **24** is coupled with the STP **22** to exchange signaling messages with the MSC **20** and other mobile switching centers. The SCP includes, or is operable to access, a plurality of databases for providing intelligence and routing information to the wireless network **10** and PSTN **12**.

[0026] In accordance with one aspect of the present invention, the SCP **24** is programmed or otherwise configured to receive data collection requests relating to the status or use of one of the mobile devices **34** or **36** or any other device served by the network, for collecting data from other components in the network in accordance with the request, and for allowing access to the collected data in substantially real-time as described in more detail below. Some or all of the data collection and reporting functions of the SCP may also be implemented in a service node or intelligent peripheral device **54**.

[0027] The HLR **26** may be a database residing on the SCP **24** or may be a stand-alone database or service control point coupled with the STP **22** by signaling data links **52** for servicing several SCPs. In either case, the HLR includes a database containing subscriber data and information used to identify a subscriber of the wireless network and subscriber data relating to features and services available to the subscriber. The HLR, which represents the "home" database for subscribers, may, for example, contain a record for each home subscriber that includes location information, subscriber status, subscribed features, and directory numbers. The HLR is used in conjunction with the VLR as described above to support mobility management features to which the user has subscribed when that user is in or roaming outside of his home area.

[0028] Some or all of the location information stored in the HLR **26** may also be stored in a mobile position center (MPC) or position device equipment (PDE) resident in or coupled with the SPC **24**. The MPC or PDE may include, for example, cell sector information and other location information such as GPS readings for a mobile device.

[0029] As is well known in the art, the MSC **20**, STP **22**, SCP **24**, HLR **26**, and VLR **46** all communicate via out of band signaling, typically using IS-41, SS7 or TCP/IP protocols to facilitate the routing of calls through the wireless network **10**. The signaling allows the network elements to exchange information to more quickly and efficiently route calls over the network.

[0030] The data collection device **28** is coupled with the SCP **24** by data links **56** and is configured for communicating with the SCP using IS-41, SS7, or TCP/IP protocols. The data collection device is operable for storing and collecting data initially collected by the SCP. The data collection device is preferably a computer-based device coupled with an internal or external database. Alternately, the data collection device may be an integral component of the SCP or other network component.

[0031] The data reporting device **30** is coupled with the data collection device **28** by data links **58** and is configured for communicating with the data collection device using IS-41, SS7, or TCP/IP protocols. The data reporting device is operable for arranging the data collected by the SCP **24** and the data collection device into reports that can then be accessed by a subscriber of the network or other person as described in more detail below. The data reporting device is preferably a computer-based device coupled with an internal or external database. Alternately, the data reporting device may be an integral component of the data collection device **28**, SCP, or other network component.

[0032] The web interface **32** is coupled with the SCP **24** by data links **60** and is configured for communicating with the SCP using IS-41, SS7, or TCP/IP protocols. The interface may be coupled directly with the SCP or indirectly via one or more internet gateways or firewalls. The web interface serves as an interface between the SCP and the internet so that components external to the network **10** can communicate with the SCP via the internet as described below.

[0033] To provide the data collection and reporting functions of the present invention, the SCP **24**, data reporting device **30**, web interface **32**, and service node/intelligent peripheral **54** are all operable to receive requests and other information from subscribers of the network and other authorized persons via the internet **62**. For example, a subscriber of the network may operate a personal computer **64** or an administrator or billing representative of the network may operate a call processing or billing computer **66** to issue data collection requests to the network **10** via the internet as described below.

Operation

[0034] The components of the wireless telecommunications network **10**, including the SCP **24**, the data collection device **28**, the data reporting device **30**, and the MSC **20**, are programmed to perform the data collection and reporting functions of the present invention. The software that performs and/or controls the steps of the present invention is stored on computer-readable memory devices resident on or accessible by the components of the network.

[0035] Data may be collected and reported either in accordance with pre-defined data requests or on-demand requests. **FIG. 2** broadly illustrates the steps performed by the network to collect and report data in accordance with pre-defined data requests. Triggers are first set in the HLR **26** for a particular telecommunications device as depicted in step **202**. For example, an origination or destination trigger may be set in the HLR for phone **34** so that the MSC **20** currently serving the phone is instructed to invoke or query the SCP **24** each time a call is originated from or directed to the phone.

[0036] Data collection requests are then set in the SCP **24** as depicted in step **204**. As is known in the art, the SCP receives much information relating to the parameters of a call. The data collection requests of the present invention instruct the SCP to collect certain subsets of this information relating to the status or use of a telecommunications device served by the network such as the phone **34**. For example, the data collection requests may instruct the SCP to collect and report information relating to: the location of the telecommunications device; the number of calls made by the telecommunications device; the number of calls received by the telecommunications device; the duration of calls made by the telecommunications device; the duration of calls made to the telecommunications device; the terminating phone numbers for calls made by the telecommunications device; the originating phone numbers for calls received by the telecommunications device; how long the telecommunications device has been in a particular location; and when the telecommunications device last made or received a call.

[0037] The data collection requests may be set in the SCP **24** by a person authorized to do so such as a subscriber operating computer **64** or a network administrator operating computer **64**. To assist in the setting of data collection triggers, the SCP may include an HTML data collection template that can be filled in to indicate the type of data or information to be gathered.

[0038] Once the query triggers have been set in the HLR **26** and the data collection requests have been set in the SCP **24**, the wireless telecommunications network **10** may begin collecting and reporting data for a particular telecommunications device as soon as that device becomes active in the network. For example, if the phone **34** is the subject of a data collection request, the network begins data collection when the MSC **20** receives a communication such as a call request

or registration attempt from the phone as depicted in step **206**. The MSC recognizes that the phone is subject to an origination trigger, and in response, sends a TCAP query message to the SCP via the STP **22** as depicted in step **208**.

[**0039**] The SCP **24** analyzes the query and recognizes that the phone **34** is subject to certain data collection requests in accordance with the information in the HTML template. The SCP receives the requested information along with additional call parameter information from the MSC **20** and/or HLR **26** either after the call has been completed or during call processing as depicted in step **210**. The SCP then sorts the requested information from the collected information in accordance with the data collection requests. For example, if the data collection requests instruct the SCP to collect information relating to the location of the phone and the terminating number of calls made by the phone, the SCP collects the location information from the HLR and the destination phone numbers from the MSC.

[**0040**] After the SCP **24** has collected and sorted the data, it periodically or immediately outputs the data to the data collection device **28** as depicted in step **212**, which in turn periodically or immediately outputs the data to the data reporting device **30** as depicted in step **214**. The data reporting device organizes the data into defined reports in accordance with the information entered into the HTML template or instructions from the requester and makes this information available to authorized persons via the internet. For example, the subscriber operating the computer **64** or the administrator operating the computer **66** may access the data reporting device **30** via the internet **62** at any time to review the collected data. Alternately, the data reporting device may automatically send the collected information to the computer **64** or **66** via the internet.

[**0041**] **FIG. 3** broadly illustrates the steps performed by the wireless telecommunications network **10** to collect and report data in response to requests for information that are not made through pre-set instructions to the SCP **24**. For example, a subscriber operating computer **64** may access the SCP via the internet **62** and the web interface **32** to request certain information on a one-time basis. As with the embodiment illustrated in **FIG. 2**, triggers are first set in the HLR **26** for a particular telecommunications device as depicted in step **302**. For example, an origination or destination trigger may be set in the HLR for phone **34** so that the MSC **20** currently serving the phone is instructed to invoke or query the SCP **24** each time a call is originated from or directed to the phone.

[**0042**] Once the triggers have been set, an authorized person may send a data request to the SCP as depicted in step **304**. For example, a subscriber may access the SCP from computer **64** and request current location information for phone **34** as well as a list of all phone numbers that have been dialed by the phone during a selected time period.

[**0043**] In response to the data collection request, the SCP **24** sorts the requested data from other information collected from the HLR **26**, the MSC **20**, or other network components as depicted in step **306**. For example, if the data request instructs the SCP to collect information relating to the location of the phone **34** and the terminating number of calls made by the phone, the SCP receives and sorts the location information from the HLR and the destination phone numbers for the phone from the MSC.

[**0044**] After the SCP **24** has collected the data, it periodically or immediately outputs the data to the data collection device **28** as depicted in step **308**, which in turn periodically or immediately outputs the data to the data reporting device **30** as depicted in step **310**. The data reporting device organizes the data into defined reports in accordance with the information entered into the HTML template or instructions from the requester and makes this information available to authorized persons via the internet. For example, the subscriber operating the computer **64** or the administrator operating the computer **66** may access the data reporting device **30** via the internet **62** at any time to review the collected data. Alternately, the data reporting device may automatically send the collected information to the computer **64** or **66** via the internet.

[**0045**] Although the invention has been described with reference to the preferred embodiment illustrated in the attached drawing figures, it is noted that equivalents may be employed and substitutions made herein without departing from the scope of the invention as recited in the claims. For example, although the data collection and reporting functions of the present invention are preferably preformed by the SCP **24** in cooperation with other components of the network **10**, some or all of these data collection and reporting functions may also be implemented in the service node/intelligent peripheral device **54** or other network device.

Having thus described the preferred embodiment of the invention, what is claimed as new and desired to be protected by Letters Patent includes the following:

1. A method of collecting and reporting data relating to a telecommunications device served by a network, wherein the network includes a switching center and a control point, the method comprising the steps of:

(a) receiving a data collection request relating to the telecommunications device;

(b) setting a trigger in the switching center for the telecommunications device;

(c) launching a query from the switching center to the control point in response to triggering of the trigger;

(d) sending a data collection query from the control point to the switching center in accordance with the data collection request;

(e) sending data relating to the telecommunications device from the switching center in response to the data collection query;

(f) collecting the data relating to the telecommunications device; and

(g) reporting the data.

2. The method as set forth in claim 1, wherein the telecommunications device is a wireless mobile unit.

3. The method as set forth in claim 1, wherein the data relates to active use of the telecommunications device.

4. The method as set forth in claim 1, wherein the data does not relate to active use of the telecommunications device.

5. The method as set forth in claim 1, wherein the trigger is an origination rigger that is triggered when a communication is originated from the telecommunications device.

6. The method as set forth in claim 1, wherein the trigger is a destination trigger that is triggered when a communication is directed to the telecommunications device.

7. The method as set forth in claim 1, wherein the data collection request specifies a particular type of data to be reported.

8. The method as set forth in claim 1, further including the step of providing a template in the form of a World Wide Web document adapted to facilitate creation and transmittal of the data collection request.

9. The method as set forth in claim 1, further including the step of sorting the data in accordance with the data collection request, wherein such sorting occurs following collecting and prior to reporting the data.

10. The method as set forth in claim 1, wherein the data is reported in the form of a World Wide Web document.

11. A method of collecting and reporting data relating to a telecommunications device served by a network, wherein the network includes a switching center and a control point, the method comprising the steps of:

(a) receiving a data collection request relating to the telecommunications device;

(b) launching a query to the control point;

(c) sending a data collection query from the control point to the switching center in accordance with the data collection request;

(d) collecting data relating to the telecommunications device from the switching center in response to the data collection query; and

(e) reporting the data.

12. The method as set forth in claim 11, wherein the telecommunications device is a wireless mobile unit.

13. The method as set forth in claim 11, wherein the data relates to active use of the telecommunications device.

14. The method as set forth in claim 11, wherein the data does not relate to active use of the telecommunications device.

15. The method as set forth in claim 11, wherein the data collection request specifies a particular type of data to be reported.

16. The method as set forth in claim 11, further including the step of providing a template in the form of a World Wide Web document adapted to facilitate creation and transmittal of the data collection request.

17. The method as set forth in claim 11, further including the step of sorting the data in accordance with the data collection request, wherein such sorting occurs following collecting and prior to reporting the data.

18. The method as set forth in claim 11, wherein the data is reported in the form of a World Wide Web document.

19. A method of collecting and reporting data relating to a telecommunications device served by a network, wherein the network includes a switching center and a control point, the method comprising the steps of:

(a) providing a template in the form of a World Wide Web document adapted to facilitate creation and transmittal of a data collection request for data relating to the telecommunications device, wherein the data collection request specifies a particular type of data to be reported;

(b) receiving the data collection request relating to the telecommunications device;

(c) launching a query to the control point;

(d) sending a data collection query from the control point to the switching center in accordance with the data collection request;

(e) collecting data relating to the telecommunications device from the switching center in response to the data collection query; and

(f) reporting the data in the form of a World Wide Web document.

20. The method as set forth in claim 19, wherein the telecommunications device is a wireless mobile unit.

21. The method as set forth in claim 19, wherein the data relates to active use of the telecommunications device.

22. The method as set forth in claim 19, wherein the data does not relate to active use of the telecommunications device.

23. The method as set forth in claim 19, further including the step of sorting the data in accordance with the data collection request, wherein such sorting occurs following collecting and prior to reporting the data.

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