US006980801B1

(12) **United States Patent**
Soininen et al.

(10) **Patent No.: US 6,980,801 B1**
(45) **Date of Patent: Dec. 27, 2005**

(54) **SELECTION MOBILITY AGENT IN ACCESS NETWORK**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 403 days.

(21) Appl. No.: **09/980,781**

(22) PCT Filed: **Jun. 6, 2000**

(86) PCT No.: **PCT/FI00/00504**

§ 371 (c)(1),
(2), (4) Date: **Dec. 6, 2001**

(87) PCT Pub. No.: **WO00/76234**

PCT Pub. Date: **Dec. 14, 2000**

(30) **Foreign Application Priority Data**

Jun. 7, 1999 (FI) 991297

(51) **Int. Cl.**[7] **H04Q 7/20**
(52) **U.S. Cl.** **455/435.1**; 455/433; 455/432.1; 455/445; 370/228; 370/328; 370/329; 370/331; 370/338; 370/401; 709/220; 709/222; 709/223; 709/224; 709/225
(58) **Field of Search** 455/445, 435.1, 455/432.1, 436, 439, 433; 370/338, 349, 370/352–356, 278, 328, 329; 709/220, 222

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(57) **ABSTRACT**

In an access network which supports macro mobility management, an access node checks during an attach procedure of a mobile station whether the mobile has macro mobility capability, i.e., whether there is a potential need for a macro mobility services. If there is no macro mobility capability, a normal attach procedure is preformed. However, if there is macro mobility capability, the access node selects a suitable mobility entity to the mobile station, sends the identity of the selected mobility entity to the mobile station and requests the initiation of a packet protocol context activation in the system.

20 Claims, 2 Drawing Sheets

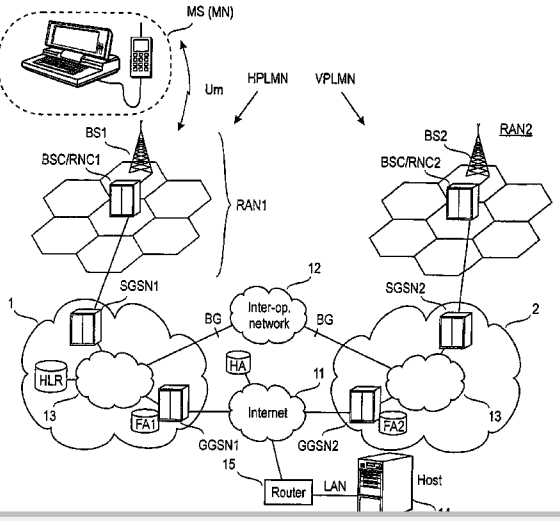


Fig. 1

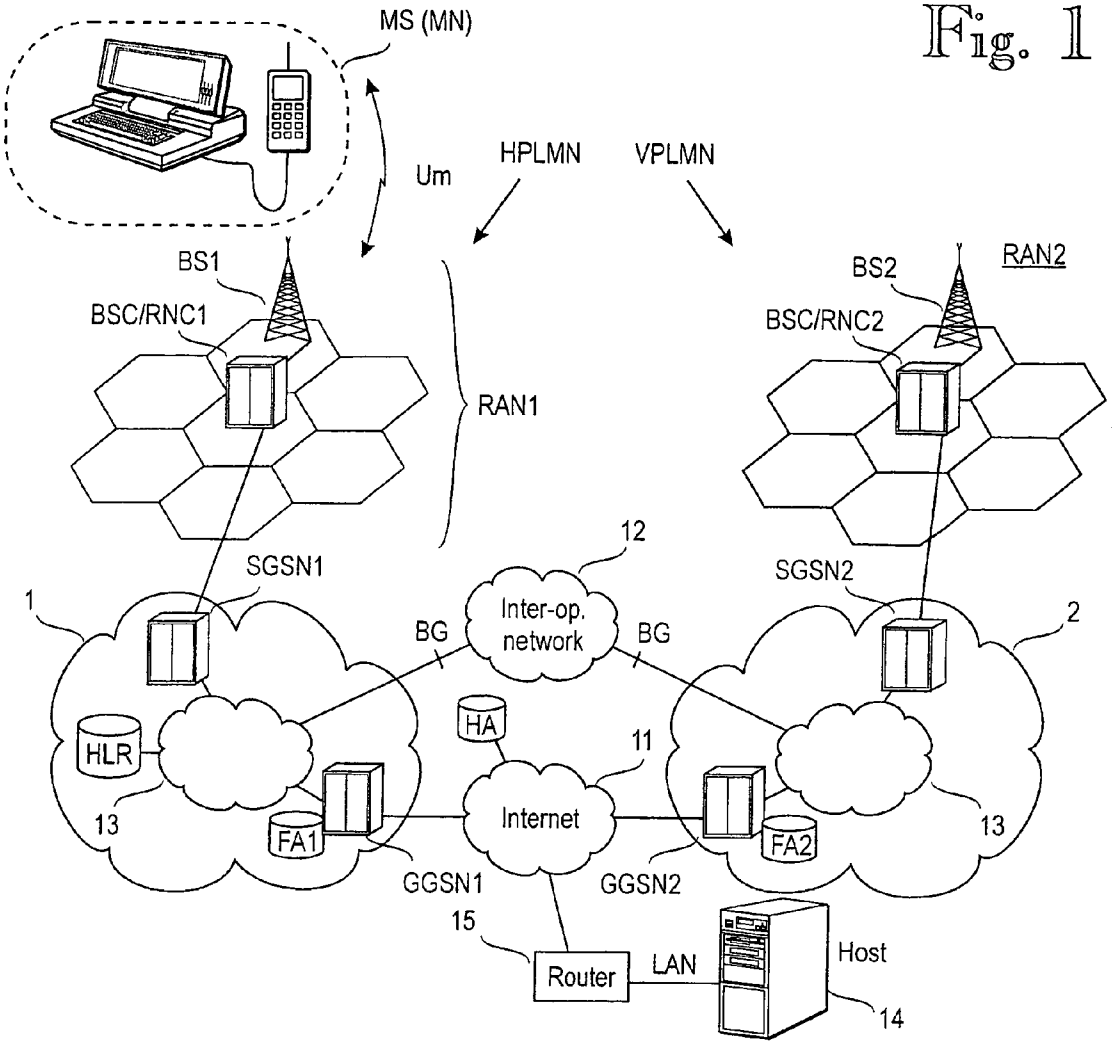


Fig. 2

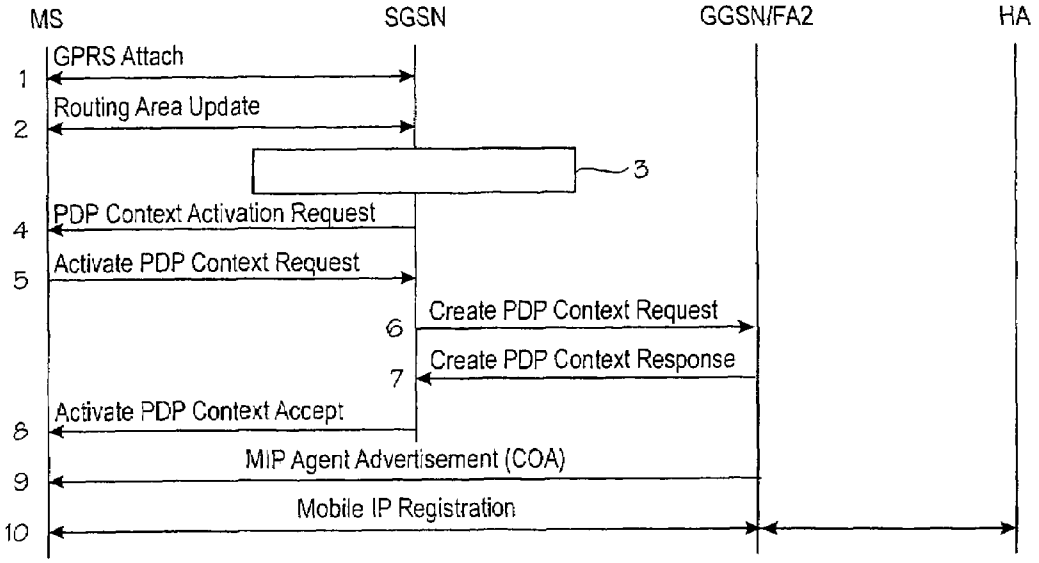
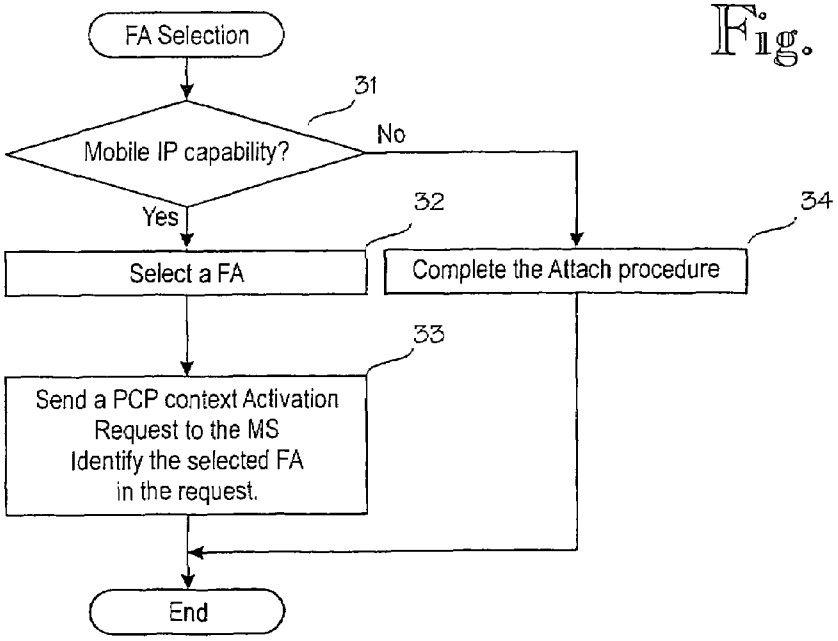


Fig. 3



SELECTION MOBILITY AGENT IN ACCESS NETWORK

This is the U.S. National Stage of International Application PCT/F100/00504 which was filed on Jun. 6, 2000 and published in the English language.

FIELD OF THE INVENTION

The invention relates to a mechanism for the selection of a mobility agent for routing of higher protocol layer traffic, such as an Internet-type protocol traffic, in an access network.

BACKGROUND OF THE INVENTION

Mobile communications system refers generally to any telecommunications system which enables a wireless communication when users are moving within the service area of the system. A typical mobile communications system is a Public Land Mobile Network (PLMN). Often the mobile communications network is an access network providing a user with a wireless access to external networks, hosts, or services offered by specific service providers.

The general packet radio service GPRS is a new service in the GSM system (Global System for Mobile Communication). A subnetwork comprises a number of packet data service nodes SN, which in this application will be referred to as serving GPRS support nodes SGSN. Each SGSN is connected to the GSM mobile communication network (typically to a base station controller BSC or a base station BTS in a base station system) so that the SGSN can provide a packet service for mobile data terminals via several base stations, i.e. cells. The intermediate mobile communication network provides radio access and packet-switched data transmission between the SGSN and mobile data terminals. Different subnetworks are in turn connected to an external data network, e.g. to a public switched data network PSPDN, via GPRS gateway support nodes GGSN. The GPRS service thus allows to provide packet data transmission between mobile data terminals and external data networks when the GSM network functions as a radio access network RAN.

Third generation mobile systems, such as Universal Mobile Communications system (UMTS) and Future Public Land Mobile Telecommunications system (FPLMTS), later renamed as IMT-2000 (International Mobile Telecommunication 2000), are being developed. In the UMTS architecture, a UMTS terrestrial radio access network, UTRAN, consists of a set of radio access networks RAN (also called radio network subsystem RNS) connected to the core network (CN). Each RAN is responsible for the resources of its set of cells. For each connection between a mobile station MS and the UTRAN, one RAN is a serving RAN. A RAN consists of a radio network controller RNC and a multiplicity of base stations BTS. One core network which will be using the UMTS radio access network is the GPRS.

One of the main targets in the development of mobile communication networks is to provide an IP (Internet Protocol) service with a standard IP backbone which would use a combination of a Mobile IP and mobile network mobility management in the mobile networks. The basic IP concept does not support the mobility of the user: IP addresses are assigned to network interfaces in dependence on their physical location. In fact, the first field of an IP address (the

mobile host) from keeping its address while moving over different Internet subnets, i.e. while changing the physical interface.

In order to enhance mobility in the Internet, a Mobile IP protocol for IP version 4 has been introduced by the Internet Engineering Task Force (IETF) in the standard RFC2002. A Mobile IP enables the routing of IP datagrams to mobile hosts, independently of the point of attachment in the subnetwork. The Mobile IP protocol introduces following new functional or architectural entities.

'Mobile Node MN' (also called Mobile Host MH) refers to a host that changes its point of attachment from one network or subnetwork to another. A mobile node may change its location without changing its IP address; it may continue to communicate with other Internet nodes at any location using its (constant) IP address. 'Mobile Station (MS)' is a mobile node having a radio interface to the network. 'Tunnel' is the path followed by a datagram when it is encapsulated. The encapsulated datagram is routed to a known decapsulation agent, which decapsulates the datagram and then correctly delivers it to its ultimate destination. Each mobile node is connected to a home agent over a unique tunnel, identified by a tunnel identifier which is unique to a given Foreign Agent/Home Agent pair.

'Home Network' is the IP network to which a user logically belongs. Physically, it can be e.g. a local area network (LAN) connected via a router to the Internet. 'Home Address' is an address that is assigned to a mobile node for an extended period of time. It may remain unchanged regardless of where the MN is attached to the Internet. Alternatively, it could be assigned from a pool of addresses.

'Mobility Agent' is either a home agent or a foreign agent. 'Home Agent HA' is a routing entity on a mobile node's home network which tunnels packets for delivery to the mobile node when it is away from home, and maintains current location information for the mobile node. It tunnels datagrams for delivery to a mobile node, and, optionally, detunnels datagrams from it, when the mobile node is away from home. 'Foreign Agent FA' refers to a routing entity in a mobile node's visited network which provides routing services to the mobile node while registered, thus allowing a mobile node to utilise its home network address. The foreign agent detunnels and delivers packets to the mobile node that were tunnelled by the mobile node's home agent. For datagrams sent by a mobile node, the foreign agent may serve as a default router for registered mobile nodes.

RFC2002 defines 'Care-of Address' (COA) as the termination point of a tunnel toward a mobile node, for datagrams forwarded to the mobile node while it is away from home. The protocol can use two different types of care-of addresses: a "foreign agent care-of address" is an address announced by a foreign agent with which the mobile node is registered, and a "co-located care-of address" is an externally obtained local address which the mobile node has acquired in the network. An MN may have several COAs at the same time. An MN's COA is registered with its HA. The list of COAs is updated when the mobile node receives advertisements from foreign agents. If an advertisement expires, its entry or entries should be deleted from the list. One foreign agent can provide more than one COA in its advertisements. 'Mobility Binding' is the association of a home address with a care-of address, along with the remaining lifetime of that association. An MN registers its COA with its HA by sending a Registration Request. The HA

A single generic mobility handling mechanism that allows roaming between all types of access networks would allow the user to conveniently move between fixed and mobile networks, between public and private networks as well as between PLMN's with different access technologies. Therefore, mechanisms supporting the Mobile IP functionality are being developed also in mobile communication systems, such as UMTS and GPRS.

It is desired that the Mobile IP will be implemented as an overlay of the UMTS/GPRS network while maintaining backwards compatibility with present systems, assuming minimal modifications in the GPRS standards and on networks whose operators do not want to support the MIP. FIG. **1** illustrates the minimum configuration for a GPRS operator who wishes to offer the mobile IP service. The current GPRS structure is kept and it handles the mobility within the PLMN, while MIP allows the user to roam between other systems, such as LAN's, and the UMTS without loosing an ongoing session. In FIG. **1** the foreign agents FA are located at GGSN's. All GGSN's may not have FA's. The SGSN and the GGSN may also be co-located. One FA in a PLMN is sufficient for offering MIP service, but for capacity and efficiency reasons, more than one FA may be desired. This means that the MS must request a PDP context to be set up with a GGSN that offers FA functionality. While setting up the PDP context, the MS is informed about network parameters of the FA, e.g. the care-of address.

The problem is to know whether the SGSN has an associated GGSN with Foreign Agent (FA) capabilities and to open a PDP address to the correct one of several FAs, such as the nearest one.

Similar problems may be encountered in any mobility management and routing on a system level overlaying the mobility management of an access network. These various overlaying mobility managements are commonly referred to as macro mobility management herein.

SUMMARY OF THE INVENTION

An object of the present invention is to overcome or alleviate the above described problems.

The object is achieved with a method, a system and an access node characterized by what is disclosed in the attached independent claims. Preferred embodiments of the invention are disclosed in the attached dependent claims.

In the present invention a support node, or more generally any access node, checks preferably during an attach procedure of a mobile station whether the mobile concerned has macro mobility capability, i.e. whether a potential need for a mobility entity or a macro mobility capability can be assumed. Mobility entity may be any entity which provides a point of attachment on the macro mobility level, such as a mobility agent in the mobile IP type mobility management. If there is no mobility capability, a normal attach procedure is performed. However, if there is a macro mobility capability, the access node selects a suitable mobility entity to the mobile station and sends the identity of the selected mobility entity to the mobile station in association with an access context establishment. The access context establishment may be, for example, the creation of a packet protocol (PDP) context, and the access node may request the mobile station to initiate an activation of a packet protocol (PDP) context in the system. The mobility entity identity is preferably sent in the PDP context activation request so that no extra message is required. Also other mobility entity attributes may be sent to the mobile station. If the mobile station really is interested in using the macro mobility, it performs a PDP

In the preferred embodiment of the invention the macro mobility management is Mobile IP type mobility management. A typical feature of the mobility agent in the Mobile IP is that it periodically transmits agent advertisement messages to the mobile nodes in order to advertise its services. The mobile nodes use these advertisements to determine the current point of attachment to the Internet. The connection established to the selected mobility agent allows the agent advertisement messages sent by the selected mobility agent to be received by the mobile node, and thereby the mobile node is able to initiate a standard mobile IP registration.

In an embodiment of the invention, when the mobile station is not interested in using the macro mobility, e.g. because it has no associated mobile node (e.g application or device using mobile IP) at the moment, it may ignore the PDP activation request. The mobile station may further store the received mobility entity information to be used later. When the mobile station at a later stage wishes to make the registration according to the specific macro mobility management, it can the use the stored information.

The selection of the mobility entity may be based on any suitable criterion. For example, a mobility entity associated with the nearest gateway node may be selected in order to optimize the routing of the macro layer traffic. Another criterion may be a current loading of the mobility entities so that mobility entity with a light traffic load is preferred to heavily loaded mobility agents in order to distribute the traffic in the network. Selection may be based on mobility entity data stored in the access node, or on information or an overriding command received from another network element, or on a combination of these.

The checking of the macro mobility capability may be based on subscriber data stored in a subscriber data base or on information provided by said mobile station in said attach procedure. For example, the mobile station may indicate the Mobile IP capability in the attach request, e.g. by means of a Mobile Station Classmark. As a further example, the Mobile IP capability may be checked by interrogating a home subscriber data base. Generally, the checking includes all measures which indicate the Mobile IP capability of the mobile station to the access node.

One of the benefits of the invention is that the mobile station does not need to know the mobility agents beforehand but it is informed of a suitable one when accessing the network. A further advantage of the invention is that the new inventive functionality at the access node enables to detect the need for a mobility entity, to select the most optimal mobility entity in each part of the network and to change it, without any non-standard signalling or procedure being needed in other elements of the packet radio network or on the Mobile IP level. The optimal selection of the mobility entity may further result in more optimal routing which allows transmission mobility entity resources to be saved or used more effectively in the packet radio system, and possibly also to make the connection faster as the connection leg between the access node and the mobility entity is shorter.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in greater detail by means of preferred embodiments with reference to the accompanying drawings, in which

FIG. **1** illustrates GPRS network architecture,

FIG. **2** is a signalling diagram illustrating the method according to the invention, and

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