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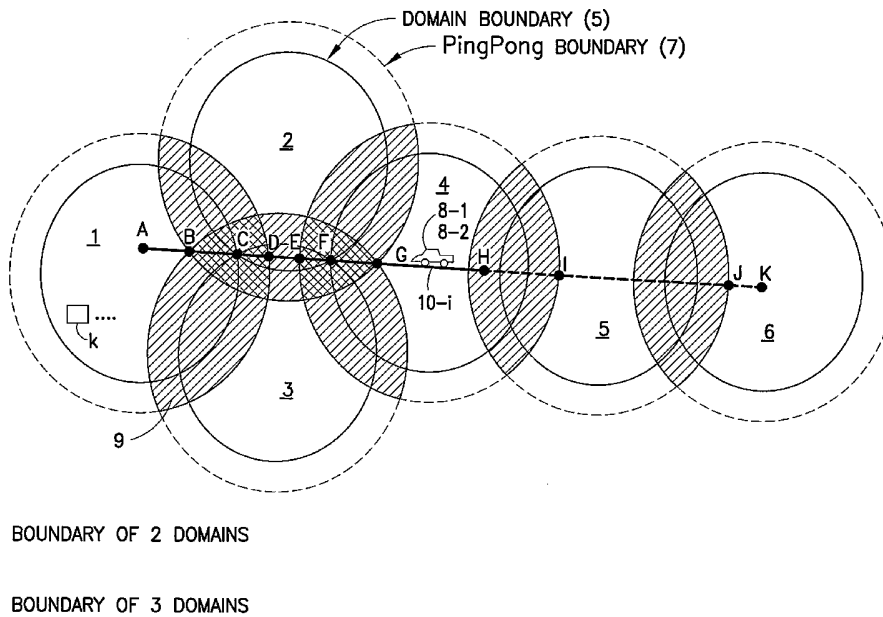
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(54) Title: A METHOD TO PREVENT ALTERNATING MOBILE NODE IDENTITY IN BORDERS BETWEEN DOMAINS IN A WIRELESS NETWORK



(57) Abstract: A system of wireless mobile stations controls the transition of a wireless communication as the mobile terminal passes between more than one domain of a network, in which the identifying parameters of a mobile terminal are retained after it passes from a first domain to a neighboring domain, until the occurrence of a triggering event. A feature of the invention is that the triggering event occurs when the MN has passed away from the domain boundary by some margin.

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A METHOD TO PREVENT ALTERNATING MOBILE NODE IDENTITY IN BORDERS BETWEEN DOMAINS IN A WIRELESS NETWORK

TECHNICAL FIELD

[0001] The field of the invention is wireless networks, in particular methods for passing a communication between neighboring base stations that belong to different domains.

BACKGROUND ART

[0002] For mobility management, a wireless network is usually divided into domains. Each Mobile Node (MN) will have a unique identity in each domain, illustratively having a portion that identifies the domain, one or more portions that identify sub-portions of the domain and a portion that identifies the individual terminal.

[0003] A wireless network is divided into domains. Each domain will have a domain identity, e.g. each ACS (Access Control Server) domain has an ACS Identity. Each MN will have a unique MN identifier, e.g. a Link Layer address (LLA).

[0004] Conventionally, a MN will receive an identifying label when it is turned on and first makes contact with its local base station and a new identity will be assigned to the MN when the MN moves to a new domain. In bordering cells between two domains, the state of the radio channel may potentially cause the MN to switch back and forth (ping-pong) between these two domains. In that case, the MN will have to request an assignment and re-assignment of the identifier (MN Identity ping-pong). The procedures to obtain new MN identity may be expensive since it requires over the air signaling, involves delay and may require (re)authentication. In areas that belong to multiple ACS domains and where the terrain causes substantial variation in signal strength over a short

distance, switching base stations and the associated re-assignment of identifiers may be the cause of a significant amount of system overhead.

[0005] Each domain has its own domain identity which is broadcast in cells throughout the domain as part of the system information. The MN stores this broadcasted domain identity and is addressed by its unique MN identity (8-1), which is a combination of the domain identity and a MN identifier, or node identifier, (8-2) for that particular MN, such as a Link Layer Address in current technology; i.e. in paging messages, in delivering the user plane frames, etc. When a MN moves to a new domain, a new unique MN identity will be assigned to the MN.

[0006] Currently, the MN identity is statically assigned (through an assigned prefix) such as U-RNTI that is composed of a globally unique SRNC identity and a locally unique s-RNTI (see 3GPP TS 25.401 V6.1.0) that makes the U-RNTI globally unique and inflexible.

[0007] The art would benefit from a system of assigning MN identities and limiting re-assignment that reduces the amount of unnecessary system overhead while maintaining the quality of transmissions.

SUMMARY OF THE INVENTION

[0008] The foregoing and other problems are overcome, and other advantages are realized, in accordance with embodiments of this invention.

[0009] In an aspect thereof this invention provides a MN having means for exchanging messages with at least one base station of a set of base stations in each of at least two overlapping domains. The MN is movable between cells corresponding to individual base stations, The message exchanging means comprises wireless transceiver means adapted to transmit to and receive message signals from the set of base stations, where the message signals comprise MN identities comprising at least a domain identity and a MN identifier. The MN further includes address storage means for storing a domain identity

initially received by said MN and subsequently changed; comparison means for comparing said stored domain identity with a domain identity set broadcast by base stations in a domain overlap area, the domain identity set comprising the identity of domains that overlap within said overlap area; and change means within the MN for changing a MN identifier from the stored value to a new value when the domain identity set does not contain the stored domain identity. The MN, having an old domain identity, is operable to preserve its MN identifier after entering a new domain until such time as it enters a cell of a base station that does not broadcast the stored domain identity.

[0010] In another aspect thereof the invention provides a MN having circuitry for exchanging messages with at least one base station of a set of base stations in each of at least two overlapping domains, where the MN is movable between cells corresponding to individual base stations. The message exchanging circuitry comprises a wireless transceiver adapted to transmit to and receive message signals from the set of base stations, where the message signals comprise MN identities comprising at least a domain identity and a MN identifier. The MN further includes a memory for storing a domain identity and MN identifier and a processor coupled to the memory for maintaining the stored MN identifier after entering a new domain until such time as the MN enters a cell of a base station that does not broadcast the stored domain identity.

[0011] In a still further aspect thereof the invention provides a computer program product that is embodied on a computer readable medium and that comprises program instructions for causing a MN to exchange message signals with at least one base station of a set of base stations having at least two overlapping domains. The program instructions perform operations of using message signals comprising a set of MN identities comprising at least a domain identity and a MN identifier; storing a domain identity; comparing the stored domain identity with domain identities that comprise a domain identity set broadcast by base stations in a domain overlap area and changing a MN identifier from the stored value to a new value only when the broadcast overlap domain identities do not contain the stored domain identity.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figure 1 illustrates a set of neighboring domains in a wireless network.

[0013] Figure 2 illustrates portions of a pair of neighboring network domains.

[0014] Figure 3 illustrates a block diagram of a typical base station and MN.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0015] As will be made apparent below, an aspect of this invention relates to a method of controlling the transition of a wireless communication as a Mobile Terminal passes between more than one domain of a network. A further aspect of this invention relates to the retention of identifying parameters of a Mobile Terminal after it passes from a first domain to a neighboring domain, at least until the occurrence of a triggering event. The triggering event may occur when the Mobile Terminal has passed away from the domain boundary by some spatial and/or temporal margin.

[0016] According to preferred but non-limiting embodiments of this invention, in bordering cells of multiple domains each Base Station (BS) or Access Point (AP) broadcasts the identities of the bordering domains, in addition to the identity of its own domain (e.g. the set of its own domain and at least one neighboring domain). A Mobile Node (MN), also referred to herein as a Mobile Terminal (MT) receiving multiple domain identities compares the stored domain identity that it has stored when it made contact with its previous domain with the broadcasted domain identities. If one of the broadcasted identities matches the stored domain identities, the MN knows that it is still in the border and can keep its assigned MN identity (both the domain identity and the local MN identifier). If none of the broadcasted domain identities matches the stored domain identity, it is an indication (or triggering event) that the MN has passed through the boundary area into the new domain and the MN needs to acquire a new MN identity in the new domain. At this point it is expected that the ping-pong problem will no longer exist.

[0017] Thus, according to the invention, the adoption by a MN of a new domain identity is deferred until it has passed out of the border area. This reduces the amount of system overhead devoted to assigning and re-assigning new domain identities.

[0018] The use of the invention applies to wireless telephone systems and also to other systems using similar technology.

[0019] As a concrete example, consider the region around New York City, NY, USA. The states of New Jersey (NJ), New York (NY) and Connecticut (CT) lie close together. A MN traveling from NJ to CT will pass through NY, but be physically close to the other states. Thus, for a substantial fraction of the time spent crossing NY, the MN will be in the border area and will receive broadcast domain identities from NJ and from CT, as well as NY.

[0020] Figure 1 illustrates the example of neighboring domains of the preceding paragraph. For purposes of discussion, domain 1 (having domain identity 1) will be located in NJ and domains 4, 5 and 6 will be located in CT. The remaining domains 2 and 3 will be located in NY.

[0021] The path taken by the MN (10-i) is from domain 1 through points A, B, C, D, E, F, G and H. The solid-lined circles 5 represent the boundaries of domains and the dash-lined circles 7 represent the boundaries where the ping-pong effect is possible. For reference, box k represents a cell in one of the domains. A base station within the overlap area will be considered to be in one domain or another according to an administrative boundary that is not shown in this Figure. A base station in the overlap area between circle 1 and circle 2 will broadcast the domain identity of both NJ and NY. A base station in the checkered shaded area between points B and D will broadcast three domains - 1 from NJ and 2 from NY. According to the invention, a MN coming from NJ along path A - H in that area will keep its NJ identification (and a MN coming from NY will keep its NY identification).

[0022] According to prior art systems, the MN of our example would switch its

domain to NY as it passed point C and would switch back to NJ if it passed through an area in which the signal strength from the local NY base station decreased below threshold, i.e. between C and D.

[0023] According to aspects of this invention, the MN traveling from point A to point H will keep its NJ identification up to point D where there is almost no possible MN Identity ping-pong effect, after which it will switch to a NY identification (selecting domain 3 or domain 2). That NY identification will be kept past point E, F until point G, after which it will take a CT identification (i.e. the domain will be 2 or 3, switching to domain 4 when it reaches point G).

[0024] As discussed below, in connection with Figure 2, such a base station may communicate with a higher level node (such as an Access Router) that is located in NY or in NJ. For example, a call from California to the traveling MN may pass through a NJ chain of nodes or through a NY chain of nodes. This Figure does not indicate that relationship. When the MN is located at point A, the California call will pass down a chain of nodes in NJ. When the MN switches to a NY base station, (and keeps its NJ domain identity and its NJ MN identifier), the packets of the California call will pass initially through a chain of nodes in NJ and will be forwarded to NY at some convenient level in the chain of nodes. This illustrates an advantageous feature of the invention that even through a call in the border overlap area may flip between base stations, the workload on the higher level nodes will not increase. In the past, the ping-pong effect would cause the higher level nodes to make a bookkeeping change every time the MN flipped from one domain to another, which imposed an extra load on the higher level nodes.

[0025] Since each MN can keep its assigned MN identity (8-2) in the bordering cells, the uniqueness of the MN identity passing through a kth domain must be assured within the neighboring domains; i.e. the MN identifiers are unique within the neighboring domains (meaning those that overlap with the kth domain). As discussed above, contemporary technology uses a LLA. For purposes of the following discussion, the more general term identifier will also be used, which is not necessarily the same as LLA. To ensure uniqueness, a set of MN identifiers

can be assigned to each domain. A larger domain may have a larger share of MN identifiers.

[0026] An optional feature of the invention is that the number of MN identifiers is not fixed. When the kth domain runs out of MN identifiers, i.e. the number of MN identifiers comes within a domain margin number of the number of MN identifiers in the kth domain, the kth domain can borrow from one of the neighboring domains a temporary subset of MN identifiers. The borrowed MN temporary subset of identifiers will be returned to the domain owner when they are no longer necessary.

[0027] Each LLA in the set is unique within both the neighboring ACS domains and can be reused in non-neighboring ACS domains (the LLA is not necessarily globally unique). If an ACS domain runs out of LLAs, this ACS domain can borrow a subset of LLAs only from a neighboring domain. The borrowed LLAs should be returned to the ACS where they were borrowed.

[0028] Another alternative is to have a centralized LLA manager. An ACS requests a LLA (or a set of LLAs) when it is needed to the centralized LLA manager and returns a LLA (or a set of LLAs) to the centralized LLA manager when it is no longer used. If two ACS domains request a LLA (or a set of LLAs) at the same time, the centralized LLA manager must give a different LLA (or a different set of LLAs) to each of the requesting ACS domains. The ACS (or similar manager in a domain) will monitor the number of unallocated MN identifiers. When the number of unallocated identifiers falls below a lower margin, the ACS will request additional identifiers from the centralized LLA manager. Optionally, if the number of unallocated identifiers rises above an upper margin, the ACS may return surplus identifiers to the centralized LLA manager.

[0029] Thus, according to embodiments in accordance with this invention a base station need not concern itself with the domain identity of the MNs that it handles. The base station pages and transmits packets to the MN identifier, since the system according to the embodiments of the invention has assured that the MN identifier will be locally unique within neighboring ACS domains.

[0030] In a wireless network using the invention, the MN monitors the signaling strength of the neighboring cells. When the signaling strength changes, the MN may select another cell. In bordering cells of multiple ACS domains the MN may select a new cell that belongs to the previous ACS domain. Since the selected cell broadcasts the ACS domain identity that matches the stored domain identity in the MN, the MN can retain its LLA. The MN does not have to request a MN identity re-assignment. If the MN selects a new cell that belongs to the new ACS domain and is also outside the border area, the new cell broadcasts the new ACS domain identity, which does not match the stored domain identity in the MN. This mismatch between broadcast and stored ACS identity triggers the MN to request a new LLA and to store the new ACS domain identity.

Consultation Among Domains:

[0031] The MN of the example will be assigned a unique MN identifier in domain 1. According to the invention, the base stations in the border area treat the newly added MNs the same as MNs that initiated contact in the new domain; i.e., communicating through the local MN identifier. Before the MN identity is assigned, domain 1 assures that the MN identifier is unique. If identifier borrowing is not allowed, the local station simply assigns a number from its assigned set of numbers. If identifier borrowing is allowed, the base station consults domains 2 and 3 (neighboring domains) to assure the uniqueness of the MN identity within these neighboring domains (domains 1, 2, and 3). Beside the MN identity, the MN will also receive domain identity 1 in the system information. The MN stores the domain identity in its memory.

[0032] Assume by way of a non-limiting example that domain 1 is allocated MN Identifiers numbers 100 - 199, domain 2 is allocated MN Identifiers numbers 200-299, domain 3 is allocated MN Identifiers numbers 300-399, and domain 4 is allocated MN Identifiers numbers 400-499. In the example, the MN has been assigned MN Identifier number 110.

[0033] According to the example, when the MN moves from domain 1 to domain 2, between points B and D, it retains its old MN identity up to point D. In case the MN moves back to a serving cell that belongs to domain 1, or the fluctuation of radio signal strength in the bordering cells makes the MN alternate the serving cell within the border area, the MN does not have to do anything. The MN keeps the current MN identifier (110) and the current domain identity in its memory.

[0034] Beyond point D, the MN receives only domain identity 2 and 3 in the system information. Since there is no domain identity that matches the stored domain identity (1) in the MN, the MN requests a new MN identity and stores the new domain identity in its memory. In this case, the MN selects the first domain identity in the system information (domain 2), corresponding to the domain that will assign a new MN identity. Before assigning a new MN identity, intelligence in domain 2 consults intelligences in the domains 1, 3 and 4 to assure the uniqueness of the new MN identity within these neighboring domains. Assume further that the MN is assigned a new MN Identity 225. This identity is valid when the MN moves past point F up to point G, or goes back to point D up to point B.

[0035] Beyond point G, the MN receives only domain identity 4, which does not match the stored domain identity (2) in the MN. Therefore the MN requests a new MN identity and stores the new domain identity (domain identity 4) in its memory. Assume that the MN is assigned a new MN Identity 435 that is valid when the MN moves past point G up to point I or goes back to point G up to point E.

Reusable MN identity:

[0036] In case the MN continues to move toward point K and domain 5 runs out of MN Identifiers, the domain can borrow unused MN identifiers from the neighboring domains, e.g. domains 4 and 6. Assume that domain 5 borrows unused MN identifier 110 from domain 6. Although domain 6 is allocated a set of reused MN Identifiers (100-199), similar to domain 1, the MN identity 110 is still unique within domain 5 and its neighboring domains 4 and 6, since the domain 1

is not a neighboring domain to domain 5. Domain 5 can only borrow from its neighboring domains (e.g. domains 4 and 6) but not from domain 1 or other non-neighboring domains.

[0037] Beyond point J, the MN is assigned a new identity (let's say MN identifier 120) by domain 6 and the borrowed MN Identity 110 is returned by domain 5 to domain 6.

[0038] Referring now to Figure 2, there is shown a block diagram of portions of two neighboring domains at a boundary 100. This Figure need not represent an actual systems architecture, but is presented to illustrate the different paths over which data flows.

[0039] On the left of boundary 100, system 110 has on the bottom level a set of MNs 10-1 through 10-n. These MNs are in communication with a set of base stations 12-1 through 12-n. Base stations 12-i receive and send data packets to a level 1 router 14. The level 1 router 14 communicates through a chain of routers to level N router 16.

[0040] On the right of boundary 100, counterpart MNs 20-1 through 20-n communicate with base stations 22-1 through 22-n that, in turn, pass data to and from a chain of routers Level 1 through Level N.

[0041] At the top of the Figure 2, a block 30 labeled Inter-Domain represents a network backbone or other long-haul link. Line 130 connecting to block 30 represents data coming in from remote systems. In the context of the example above, the data packets from a California call would come in on line 130 and be routed through the system on the right or on the left.

[0042] When a MN (MN 10-1, say) crosses boundary 100, it may continue to communicate with station 12-1 for a while, until local signal conditions cause it to switch to the closest base station, station 22-1. While MN 10-1 is in communication with station 12-1, the data packets from the California call will pass down the chain from Level N unit 16 to Level 1 unit 14 to station 12-1.

When the MN switches to base station 22-1, (while keeping the old identity of MN identifier 110 since base station 22-1 is in the boundary area) the system will forward the data packets to the units on the right of the boundary 100, just as it does with any call that is forwarded.

[0043] If local channel conditions cause MN 10-1 to switch back to base station 12-1, the data packets from (and to) California will flow down on the left side of the boundary, without the need to (re)acquire a new MN identifier.

[0044] When the MN passes out of the boundary area and no longer receives the old domain identity, it will request a new identity in the domain 120 and the system will do the appropriate bookkeeping as it currently does to send the California packets up and down on the right side.

[0045] In the boundary overlap area, the invention as described above reduces system overhead. In addition, when a MN switches base stations that are in different domains, the call will be forwarded, i.e. the packets will come from California on line 130, be intercepted and sent to domain 120.

[0046] Horizontal lines 32, 34 and 36 represent an optional feature of the invention in which two neighboring base stations that are in different domains have a direct connection (cable or wireless) that permits inter-BTS (Base Transceiver Station) forwarding packets (outside the standard IP routing system) even when the BTS is in another domain in Figure 2.

[0047] It may be assumed that a system operator learns by experience where frequent switching between base stations in different domains takes place, and can put such direct connections in where the cost is justified by the reduction in the load on higher levels. In that case, when a MN switches base stations, the packets will continue to flow through the old domain, then along the direct connection.

[0048] As described above, a change of the MN identifier is initiated by a comparison within the MN. Alternatively, the MN could initiate contact with a local

base station using the old stored domain identity and the comparison would be made within the base station; i.e. the base station would compare the domain identity transmitted by the MN with the set of stored domain identities that overlap it. For example, if the base station is in domain 3 (outside the border area) of Figure 1 and is contacted by a MN from domain 1, it would compare domain 1 with its list of acceptable domains. Since this particular station is outside the border, it will respond with a new MN identity including a domain 3 domain identity and a new MN identifier, together with a command to the MN to adopt the new identity.

[0049] The foregoing has been explained in some detail to clarify that the benefit of the invention is the reduction of the overhead associated with the ping-pong of switching identities and that the data packets continue to flow as before.

[0050] Figure 3 illustrates in simplified form a base station 12-I and a MN 10-i that communicate with one another. Each block has a transceiver, denoted generally with numeral 310 for sending and receiving RF signals carrying the relevant data. The base station transceiver will differ in structure from the MN transceiver, as is known in the art, at least for the reason that the base station transceiver will typically be more powerful.

[0051] Each unit also has storage 320 for storing domain identities, the allowed list of MN identifiers and the like. The base station will have stored the set of domain identities that it broadcasts and the MN will store the current domain identity that it uses. The hardware that carries out the storage function may well be differently structured in the base station and the MN, since power conservation and non-volatile storage are more important for a MN.

[0052] Each unit will also have data processing hardware (e.g., a CPU 350) to handle the messages received and sent and other functions performed by the unit. It is assumed that the CPUs 350 operate under control of stored programs for executing the methods, procedures and protocols in accordance with the embodiments of this invention.

[0053] The MN will also have a compare module 330 for comparison of the stored domain identity and the broadcast domain identity set and an address change module 340 for changing the MN identifier of that MN from a stored value to a new value when leaving an overlap area.

[0054] Those skilled in the art will be aware that the functions of various blocks may be combined in a single hardware unit. For example, the comparison in unit 330 and address change in unit 340 may be performed within the same ALU or CPU 350 that carries out the other data processing functions.

[0055] Although the invention has been described with respect to a limited number of embodiments, those skilled in the art will appreciate that other embodiments may be constructed within the spirit and scope of the following claims.

CLAIMS

We claim:

1. A wireless system for passing messages between individual ones of a set of Mobile Nodes (MNs) (10-i) and a set of at least one base station (12-i) in each of at least two overlapping domains (1,2), in which said MNs (10-i) are adapted to move between cells (k) corresponding to individual ones of said set of base stations (12-i), comprising:

transceiver means (310) in said at least one base station (12-i) and in said MNs (10-i) adapted to transmit and receive message signals from said set of MNs employing a set of MN identities (8-1) comprising at least a domain identity (1) and a MN identifier (8-2);

said transceiver means (310) within base stations (12-i) in a domain overlap area (9) being adapted for broadcasting a broadcasted overlap domain identity set (1,2,3) of at least two domains that overlap within said overlap area (9);

comparison means (330) in said set of MNs for comparing a stored domain identity (1) with said broadcasted domain identity set (1,2,3); and

address change means (340) within said MNs (10-i) for changing a MN identifier (8-2) from a stored value to a new value when said broadcasted overlap domain identity set (1,2,3) no longer contains said stored domain identity (1).

2. A system according to claim 1, in which said MN (10-i) performs said comparison of said stored domain identity (1) with said broadcasted domain identity set (1,2,3).

3. A system according to claim 2, in which said MN (10-i) initiates a request for a new identity when said stored domain identity (1) does not match a member of said broadcasted domain identity set (2,3,4).

4. A system according to claim 1, in which said set of at least one base station (12-i) communicate with MNs (10-i) having unique MN identifiers (8-2).

5. A system according to claim 1, in which said set of at least one base station (12-i) communicate with MNs (10-i) having at least two groups of MN identifiers (8-2) that are associated with said at least two corresponding

overlapping domains (1,2).

6. A system according to claim 1, in which said base station (12-i) communicates with MNs (10-i) having at least two different domain identities (1, 2).
7. A system according to claim 1, further comprising a centralized MN identity manager that controls the distribution of MN identifiers to domains; in which each domain has a set of MN identifiers, and each domain is adapted to monitor the number of domain identifiers and is adapted to request additional MN identifiers from said centralized MN identity manager when the number of unallocated identifiers falls below a threshold amount.
8. A system according to claim 1, in which each domain is adapted to control the allocation of domain identifiers to base stations within said domain.
9. A system according to claim 1, in which each domain is adapted to return domain identifiers to said centralized MN identity manager that controls the distribution of MN identifiers when the number of unallocated domain identifiers rises above an upper margin.
10. A Mobile Node MN (10-i) for exchanging messages with at least one base station (12-i) of a set of base stations (12-i) in each of at least two overlapping domains (1,2), said MN (10-i) being adapted to move between cells (k) corresponding to individual base stations (12-i) and employing transceiver means (310) adapted to transmit and receive message signals from said set of base stations (12-i) employing a set of MN identities (8-1) comprising at least a domain identity (1) and a MN identifier (8-2);
in which MN (10-i), address storage means (320) stores a domain identity (1) received by said MN (10-i) during startup and subsequently changed;
comparison means (330) within said MNs (10-i) for comparing said stored domain identity (1) with a broadcasted domain identity set (1,2,3) broadcast by base stations in a domain overlap area (9) which broadcast the identity of all domains (1,2,3) that overlap within said overlap area (9); and
address change means (340) within said MN (10-i) for changing a MN identifier

(8-2) from said stored value to a new value when said broadcasted domain identity set (1,2,3) no longer contains said stored domain identity (1).

11. A MN (10-i) according to claim 10, in which said MN (10-i) performs said comparison of said stored domain identity (1) with said broadcasted domain identity set (1,2,3).

12. A MN (10-i) according to claim 11, in which said MN (10-i) initiates a request for a new identity when said stored domain identity (1) does not match said broadcasted domain identity set (1,2,3).

13. A MN (10-i) according to claim 10, in which said MN (10-i) has a MN identifier (8-2) that is unique within neighboring domains (1,2,3).

14. A MN (10-i) according to claim 10, said MN (10-i) adopts a new MN identity (8-1) in response to a command from a base station (12-i) when said stored domain identity (1) does not match said broadcasted domain identity set (1,2,3).

15. A method for exchanging messages between a Mobile Node MN (10-i) and at least one base station (12-i) of a set of base stations (12-i) in each of at least two overlapping domains (1,2,3), said MN (10-i) being adapted to move between cells (k) corresponding to individual base stations (12-i) and employing transceiver means (310) adapted to transmit and receive message signals from said set of base stations (12-i) employing a set of MN identities (8-1) comprising at least a domain identity (1) and a MN identifier (8-2); comprising the steps of:
storing by said MN (10-i) during a startup sequence in address storage means (320) a stored domain identity (1);
comparing said stored domain identity (1) with said broadcasted domain identity set (1,2,3) broadcast by base stations (12-i) in a domain overlap area (9) which broadcast the identity of all domains (1,2,3) that overlap within said overlap area (9); and
changing a MN identifier (8-2) from said stored value to a new value only when said broadcasted overlap domain identities (1,2,3) no longer contain said stored domain identity (1).

16. A method according to claim 15, in which said MN (10-i) communicates with a local base station (22-i) in a new domain (4) using said stored domain identity (1) and receives data from said local base station (22-i) that transmits said data associated with said stored domain identity (1).

17. A method according to claim 16, in which said MN (10-i) performs said comparison of said stored domain identity (1) with said broadcasted domain identity set (1,2,3).

18. A method according to claim 17, in which said MN (10-i) initiates a request for a new identity (8-2) when said stored domain identity (1) does not match said broadcasted domain identity set (1,2,3).

19. A method according to claim 15, in which said set of at least one base station (12-l) communicate with MNs (10-i) having MN identifiers (8-2) that are unique within neighboring domains (1,2,3).

20. A method according to claim 16, in which said set of at least one base station (12-i) communicate with MNs (10-i) having at least two groups of MN identifiers (8-2) that are associated with said each of said at least two overlapping domains (1,2,3) said base station having a set of reserved MN identifiers (8-2) that are unique within neighboring domains and further comprising the steps of sending by a first domain (1) having limited domain identities a domain identity transfer request to at least one neighboring domain (2) and receiving from said at least one neighboring domain (2) a temporary subset of MN identifiers, whereby a temporary shortage of domain identities in said first domain is relieved.

21. A method according to claim 20, in which said first domain (1) initiates said domain identity transfer request when the number of domain identities allocated by said first domain (1) is within a domain margin number of the number of MN identifiers (8-2) in the set of reserved MN identifiers (8-2) of said first domain.

22. A method according to claim 21, in which said first domain (1) returns said temporary subset of MN identifiers (8-2) received in response to said domain identity transfer request when the number of domain identities allocated by said

first domain (1) is below the amount of domain identities in the set of reserved MN identifiers of said first domain (1) by a domain margin number.

23. A method according to claim 15, in which said base station (12-i) performs said comparison of said stored domain identity (1) with said broadcasted domain identity set (1,2,3) and sends to said MN (10-i) a command to assume a new identity (8-2) when said stored domain identity (1) does not match said broadcasted domain identity set (1,2,3).

24. A method according to claim 23, in which said set of at least one base station (12-i) communicate with MNs (10-i) having at least two groups of MN identifiers (8-2) that are associated with said each of said set of at least two overlapping domains (1,2) has a set of reserved MN identifiers (8-2) that are unique within neighboring domains and further comprising the steps of sending by a first domain (1) having limited MN identifiers a domain identity transfer request to at least one neighboring domain (2) and receiving from said at least one neighboring domain (2) a temporary subset of MN identifiers (8-2), whereby a temporary shortage of MN identities (8-2) in said first domain is relieved.

25. A method according to claim 24, in which said first domain (1) initiates said domain identity transfer request when the number of domain identities allocated by said first domain is within a domain margin number of the number of MN identifiers (8-2) in the set of reserved MN identifiers (8-2) of said first domain.

26. A method according to claim 25, in which said first domain (1) returns said temporary subset of MN identifiers (8-2) received in response to said domain identity transfer request when the number of MN identifiers (8-2) allocated by said first domain is below the amount of MS identifiers (8-2) in the set of reserved MN identifiers (8-2) of said first domain by a domain margin number.

27. A Mobile Node MN, comprising means for exchanging messages with at least one base station of a set of base stations in each of at least two overlapping domains, said MN being movable between cells corresponding to individual base stations, said message exchanging means comprising wireless transceiver means adapted to transmit and receive message signals from said set of base stations,

where said message signals comprise MN identities comprising at least a domain identity and a MN identifier; further comprising address storage means for storing a domain identity initially received by said MN and subsequently changed; comparison means for comparing said stored domain identity with a domain identity set broadcast by base stations in a domain overlap area, the domain identity set comprising the identity of domains that overlap within said overlap area; and further comprising change means within said MN for changing a MN identifier from said stored value to a new value when said domain identity set does not contain the stored domain identity.

28. A Mobile Node MN, comprising circuitry for exchanging messages with at least one base station of a set of base stations in each of at least two overlapping domains, said MN being movable between cells corresponding to individual base stations, said message exchanging circuitry comprising a wireless transceiver adapted to transmit and receive message signals from said set of base stations, where said message signals comprise MN identities comprising at least a domain identity and a MN identifier, said MN further comprising a memory for storing a domain identity and MN identifier and a data processor coupled to the memory for maintaining a stored MN identifier after entering a new domain until such time as the MN enters a cell of a base station that does not broadcast the stored domain identity.

29. A computer program product embodied on a computer readable medium and comprising program instructions for causing a Mobile Node MN to exchange message signals with at least one base station of a set of base stations having at least two overlapping domains, comprising operations of:

using message signals comprising a set of MN identities comprising at least a domain identity and a MN identifier;

storing a domain identity;

comparing the stored domain identity with domain identities that comprise a domain identity set broadcast by base stations in a domain overlap area; and changing a MN identifier from the stored value to a new value only when the broadcast overlap domain identities do not contain the stored domain identity.

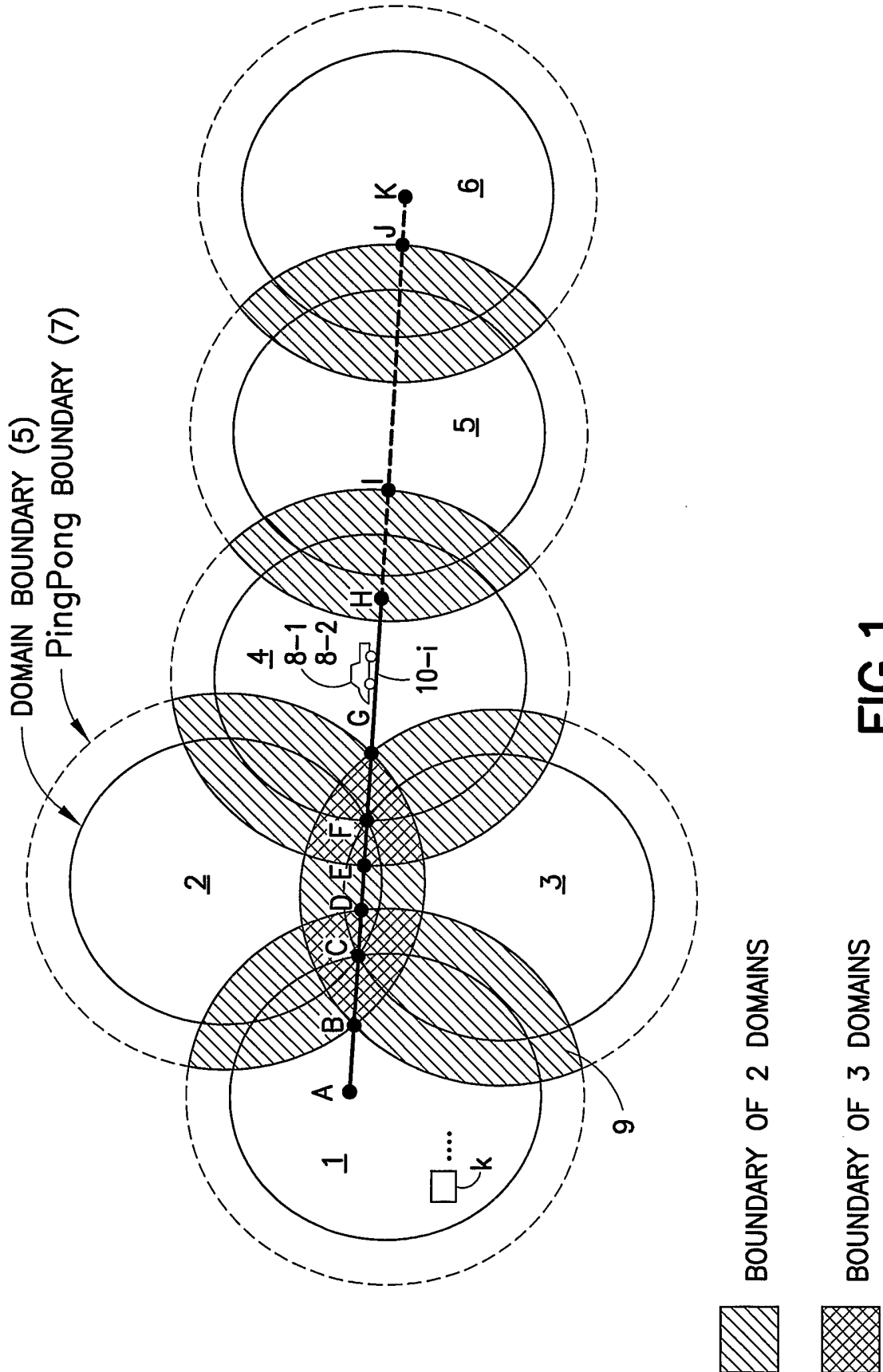


FIG.1

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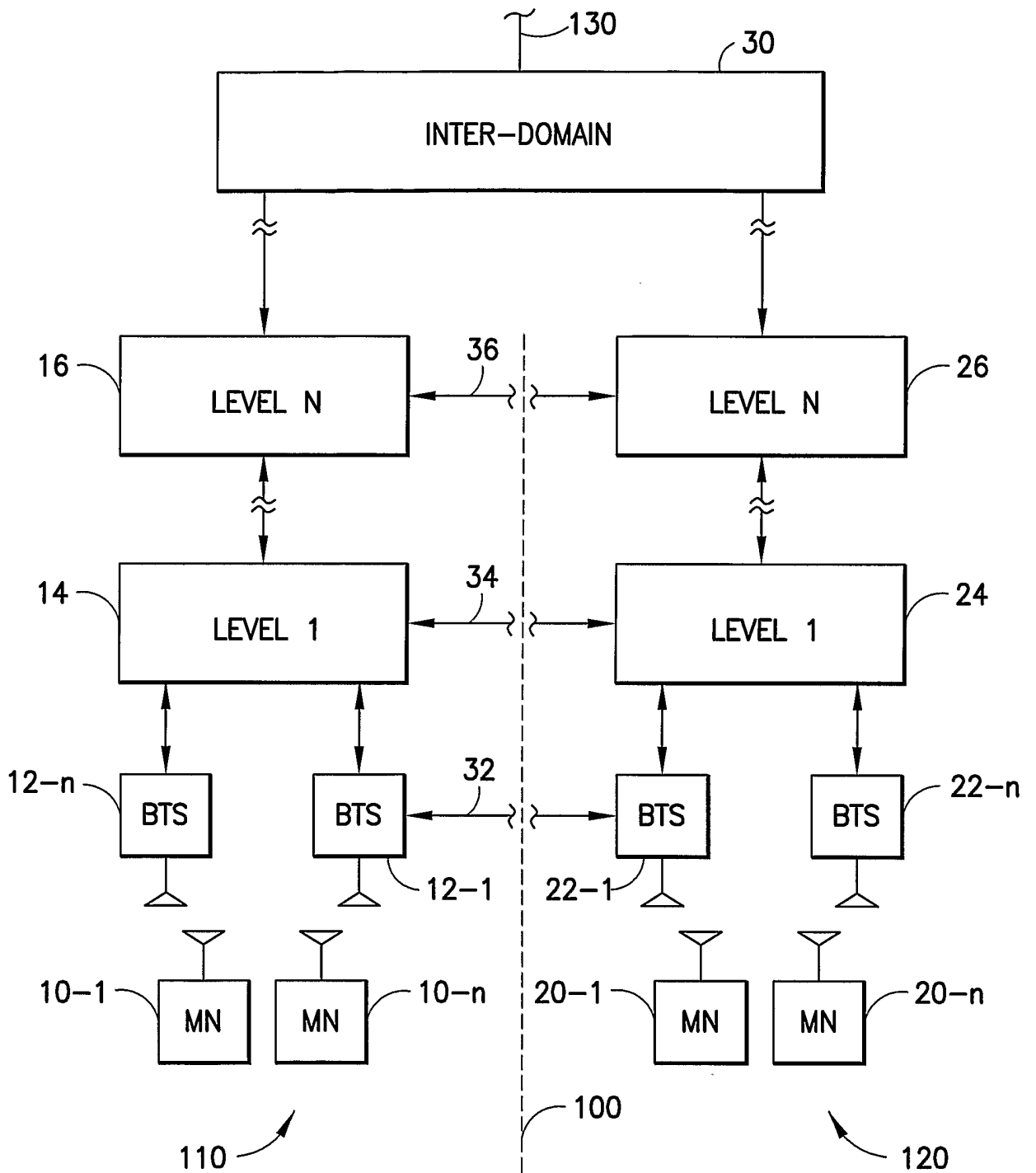


FIG.2

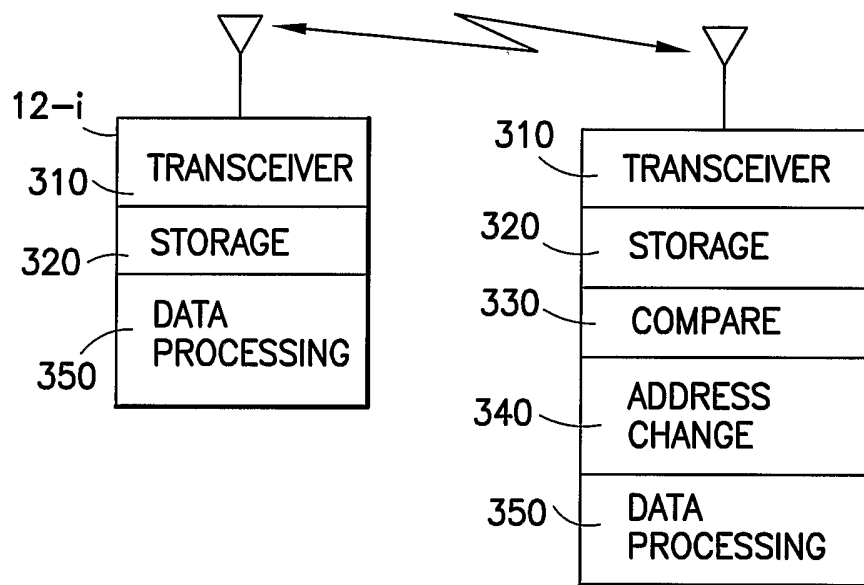
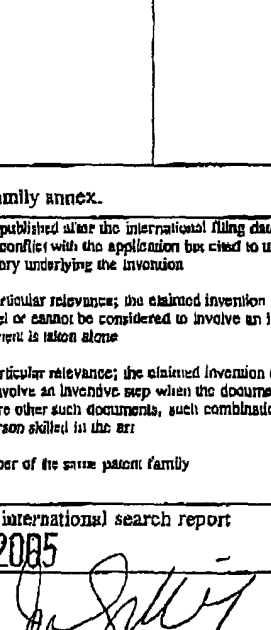


FIG.3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US05/00244

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC : H04M 1/00; H04Q 7/20 US CL : 455/552,443,33.1,445,435 According to International Patent Classification (IPC) or to both national classification and IPC</p>													
<p>B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 455/552,443,33.1,445,435</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)</p>													
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category *</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>US 5,960,365 (LEBIH et al) 28 September 1999 (28.09.1999), column 1, lines 13-17, 33-51, 56-58; column 5, lines 9-22, 29-36, 60-65.</td> <td>1,2,4,5,10,11,15,17,19,27,28,29</td> </tr> <tr> <td>A</td> <td>US 5,437,053 (SAWA et al) 25 July 1995 (25.07.1995), abstract, lines 1-12, column 1, lines 14-28, 39-41, 46-47,52-62</td> <td>1,10,15,27,28</td> </tr> <tr> <td>A</td> <td>US 6,377,804 (LINTULAMPI) 23 April 2002 (23.04.2002), abstract, lines 1-7; column 1-2, lines 66-67,1-9</td> <td>1,10,15,27,28</td> </tr> </tbody> </table>		Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	A	US 5,960,365 (LEBIH et al) 28 September 1999 (28.09.1999), column 1, lines 13-17, 33-51, 56-58; column 5, lines 9-22, 29-36, 60-65.	1,2,4,5,10,11,15,17,19,27,28,29	A	US 5,437,053 (SAWA et al) 25 July 1995 (25.07.1995), abstract, lines 1-12, column 1, lines 14-28, 39-41, 46-47,52-62	1,10,15,27,28	A	US 6,377,804 (LINTULAMPI) 23 April 2002 (23.04.2002), abstract, lines 1-7; column 1-2, lines 66-67,1-9	1,10,15,27,28
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<p><input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.</p> <table border="1"> <thead> <tr> <th>Special categories of cited documents:</th> <th></th> </tr> </thead> <tbody> <tr> <td>"A" document defining the general state of the art which is not considered to be of particular relevance</td> <td>"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</td> </tr> <tr> <td>"E" earlier application or patent published on or after the international filing date</td> <td>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>"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</td> </tr> <tr> <td>"O" document referring to an oral disclosure, use, exhibition or other means</td> <td>"Z" document member of the same patent family</td> </tr> <tr> <td>"P" document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </tbody> </table>		Special categories of cited documents:		"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	"E" earlier application or patent published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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	"O" document referring to an oral disclosure, use, exhibition or other means	"Z" document member of the same patent family	"P" document published prior to the international filing date but later than the priority date claimed	
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<p>Date of the actual completion of the international search</p> <p>25 March 2005 (25.09.2005)</p>	<p>Date of mailing of the international search report</p> <p>06 MAY 2005</p>												
<p>Name and mailing address of the ISA/US</p> <p>Mail Stop PCT, Ann: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450</p> <p>Facsimile No. (571) 272-7840</p>	<p>Authorized officer</p> <p>Emmanuel Moise </p> <p>Telephone No. (571) 272-3865</p>												