MOBILE IP REGISTRATION PROCESS FOR ALWAYS-ON DEVICE

The application relates to the provision of IP (Internet Protocol) connectivity for wireless devices, and in particular to registering wireless devices on a MIP (Mobile IP) network.

MIP (Mobile IP) is a protocol that was originally proposed by the IETF (Internet Engineering Task Force) and is described in "RFC 2002 - IP Mobility Support". In a MIP network, a HA (home agent) typically assigns a static home IP address to each associated mobile device. As a mobile device roams in the MIP network, it registers with a FA (foreign agent), which provides a COA (care-of-address). The HA is informed of the mobile device's COA through the registration procedure. The FA maintains a binding of the home IP address to COA for a certain length of time called a registration lifetime. A tunnel is established between the HA and the mobile device enabling the HA to send packets to the mobile device by means of the FA; therefore, the mobile device is reachable via its home IP address. As long as the mobile device re-registers before the registration lifetime expires, a PPP (point to point protocol) connectivity is maintained.

In a SIP (Simple IP) network, mobile devices are assigned geographically dependent IP addresses dynamically by a visited PDSN (Packet Data Serving Nodes). As the mobile device roams it will be assigned a new geographically dependent IP address for a duration that may not be known to the mobile device. MIP provides a number of advantages over SIP (Simple IP) such as enabling communication with the mobile device using its non-geographically dependent home IP

address. The elimination of the need to know the mobile device's current geographical point of attachment greatly enhances roaming capabilities and enables different application servers to reach the mobile device via its known home IP address regardless of its current point of attachment to the MIP network. Also, MIP enables multiple user profiles with different user ID/password etc.

A mobile device that is configured as "Mobile IP only" may encounter a number of registration issues in a network - both in home and in roaming. If such situations are not handled properly, then it may lead to disruption in data connectivity resulting in a poor user experience in case of an "always-on" mobile device. On the other hand, brute force retry attempts by the mobile device to re-register with the MIP network can cause unwarranted MIP network access, a reduced battery life of the mobile device, and congestion of the MIP network.

A Diameter application that allows a Diameter server to authenticate, authorize and collect accounting information for Mobile IPv4 services rendered to a mobile node is disclosed in Pat R. Calhoun et al., Diameter Mobile Ipv4 Application, Internet Engineering Task Force vol. 20, August 2004. Combined with the Inter-Realm capability of the base protocol, this application allows mobile nodes to receive service from foreign service providers. Diameter Accounting messages will be used by the foreign and home agents to transfer usage information to the Diameter servers.

Protocol enhancements that allow transparent routing of IP datagrams to mobile nodes in the Internet are disclosed in Ed. C. Perkins, IP Mobility Support for Ipv4, Internet Engineering Task Force, August 2002. Each mobile

node is always identified by its home address, regardless of its current point of attachment to the Internet. While situated away from its home, a mobile node is also associated with a care-of address, which provides information about its current point of attachment to the Internet. The protocol provides for registering the care-of address with a home agent. The home agent sends datagrams destined for the mobile node through a tunnel to the care-of address. After arriving at the end of the tunnel, each datagram is then delivered to the mobile node.

Mobility Management Techniques For Use In An Internet Protocol-Based Multimedia Mobile Network are disclosed by United States patent US 6,735,202. In a mobility management aspect of the invention, several unique mobility management control messages are defined for use in performing various mobility management functions in the communications system with respect to the mobile user stations and network nodes. These messages may comprise: (i) a Location Update Message (LUM); (ii) a Location Confirm Message (LCM); (iii) a Location Query Message (LQM); (vi) a Location Reply Message (LRM); (v) a Registration Message (RM); and (vi) a Registration Reply Message. One or more of these messages are used in the IP-based system to perform mobility management functions such as location management, mobile access and in-call mobility management.

Methods, terminals and circuits for updating provisioning data of a mobile terminal are disclosed by International Publication WO 2004/049664. A network initiated subsequent provisioning message requesting that the mobile terminal initiate a session to update the provisioning data of the mobile terminal is received and it is determined if the mobile terminal is executing a foreground data application utilizing a current registered

Internet Protocol (IP) session. An IP session is selectively initiated to update the provisioning data of the mobile terminal based on the determination of whether the mobile terminal is executing a foreground data application utilizing a current registered IP session.

Summary

According to one broad aspect, the application provides a method in a wireless device (105) comprising: automatically attempting (200,201) to establish a wireless protocol session, the wireless protocol operating using static addressing; for each error category of a plurality of error categories, upon failure to establish the wireless protocol session due to an error in that error category, executing automatically at least one respective error category specific step (204,205,206).

In some embodiments, the wireless protocol is MIP (mobile Internet Protocol).

In some embodiments, the method comprises: a) initialising for MIP (Mobile Internet Protocol) registration (200); b) sending a MIP registration request (201); wherein for at least one of the error categories, the at least one respective error category specific step (204,205,206) comprises returning automatically to step a); and wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step b).

In some embodiments, the method comprises: for at least one of the error categories, returning to step a) for some conditions and to step b) for other conditions (417,515,505).

In some embodiments, for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step a) after a first backoff time (408,415,506,518); and wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step b) after a second backoff time (406,506).

In some embodiments, the plurality of error categories comprise no registration response (301), out-of-sync errors (302), provisioning errors (303), and temporary network errors (304).

In some embodiments, the method further comprises: defining at least two groups of RRP codes, each group of RRP codes defining an error category of said plurality of error categories; receiving an RRP code in response to a failed registration attempt and determining the error category using the RRP code (203).

In some embodiments, initialising for MIP registration is performed upon expiry of a MIP registration lifetime and when the wireless device moves to a new MIP network.

In some embodiments, initialising for MIP registration is performed when the wireless device is powered on and when the wireless device switches to a new user profile.

In some embodiments, the method further comprises: defining at least two user profiles (703) on the wireless device one of which is an active user profile at a given time; wherein for at least one error category, the respective at least one error category specific is defined differently for each of the at least two user profiles (702).

In some embodiments, each user profile is a NAI (network access identifier) profile.

In some embodiments, the method further comprises: maintaining a retry history for each user profile, the retry history comprising an identification of networks that have not allowed registration; and for at least one error category, executing the at least one respective error category specific step as a function of the retry history.

In some embodiments, for no registration response, the at least one error category specific step comprises re-sending a registration request; for out-of-sync errors the at least one error category specific step (414,514) comprise: a) requesting a challenge if a current challenge is unknown, missing, or stale, and then re-sending a registration request; or b) adjusting a time stamp if there

is a registration identification mismatch, and then re-sending the registration request; for temporary network errors the at least one error category specific step (415,515) comprise: a) sending the registration request with a lifetime of zero if a prior MIP session exists; b) freeing up resources used in the attempt to register the wireless device with the network, and then re-attempting to register the wireless device; and for provisioning errors the at least one error category specific step (416,516) comprise: a) sending the registration request with a lifetime of zero if a prior MIP session exists; b) freeing up resources used in the attempt to register the wireless device with the network; c) adding the network to a list of networks not allowing packet data access, then waiting to acquire a network not found on the list, and then retrying the method of registering the wireless device.

In some embodiments, the error categories of out-of-sync error, provisioning error, temporary network error are each defined by a respective group of RRP codes.

In another embodiment, a wireless device is provided that is adapted to implement one of the methods summarized above.

In another embodiment, a computer readable medium having computer executable instructions stored thereon is provided for execution on a wireless device so as to implement one of the methods as summarized above.

Brief Description of the Drawings

Preferred embodiments will now be described with reference to the attached drawings in which:

Fig. 1 is a schematic of an example MIP (Mobile IP) network;

Fig. 2 is a flow chart of a method of registering a mobile device on a MIP network in accordance with an embodiment of the application;

Fig. 3 is a plurality of flow charts providing example error category specific actions in accordance with an embodiment of the application;

Fig. 4 is a flow chart of a method of initially registering a mobile device on a MIP network in accordance with an embodiment of the application;

Fig. 5 is a flow chart of a method of re-registering a mobile device on a MIP network in accordance with an embodiment of the application;

Fig. 6 is a chart providing example RRP (registration reply) code categories in accordance with an embodiment of the application; and

Fig. 7 is a block diagram of an example mobile device.

Detailed Description

Referring now to Fig. 1, a schematic of an example MIP (Mobile IP) network 100 is shown. The MIP network 100 has a HA (home agent) 101 coupled with a home network 102, and a FA (foreign agent) 103 coupled with a foreign network 104. The home agent 101 is coupled with the foreign agent 103 through one or more networks 106. Although it is not shown in the drawing, a plurality of foreign networks 104 is typically present, each foreign network 104 having an associated FA 103 (not shown). A mobile device 105 is drawn

near the foreign network 104 as to represent that it is visiting the foreign network 104. A plurality of mobile devices is typically present (not shown).

In operation, the mobile device 105 uses two IP addresses: a home IP address and a COA (care-of address). MIP session establishment involves agent discovery, registration with the FA 103 using the COA, and tunnelling establishment between the HA 101 and the FA 103. The home IP address is typically static once it is provisioned and is managed by the HA 101. The COA is maintained by the FA 103 and represents the point of attachment to the foreign network 104. The COA dynamically changes as the mobile device 105 roams among different foreign networks 104. The FA 103 notifies the home agent 101 of the COA so that the mobile device 105 is reachable with its home IP address by means of tunnelling.

As part of the agent discovery process, the FA 103 sends an ICMP (Internet Control Message Protocol) AAM (agent advertisement message) to the mobile device 105. The AAM has a MIP agent advertisement extension and may also comprise a FA challenge extension, which is used for authentication. The MIP agent advertisement extension includes one or more COAs, a registration lifetime, and a plurality of feature sets supported by the FA 103 (e.g. reverse tunnelling support by the FA 103). After the mobile device 105 receives the information about the FA 103 capability, it sends a MIP RRQM (registration request message) to the FA 103. The RRQM is a RRQ (registration request) and contains the home IP address, an IP address of the HA 101, a requested COA, and a number of parameters related to authentication. The RRQM may also contain indications, typically during initial provisioning, that the home IP address and an IP address of

the HA are not assigned yet. After initial authentication, the FA 103 forwards this information to the HA 101 through the network 106. Once the mobile device 105 is authenticated successfully, the HA 101 sends a RRPM (registration response message) to the mobile device 105 via the FA 103 indicating whether or not registration is successful. If the FA 103 or the HA 101 decide not to accept the registration request, then the reason why is indicated by a RRP (registration reply) code contained in the RRPM.

In some embodiments, a CDMA (Code-Division Multiple Access) technology is used as the wireless network connected to the MIP network 100. However, the employment of other technologies is possible and is within the scope of this application.

Automatic Retry Method

Turning now to Fig. 2, a flow chart of a method of registering the mobile device 105 on the MIP network 100 in accordance with an embodiment of the application is shown. The mobile device 105 performs initialisations at step 200 in preparation for registering with the MIP network 100. Next, the mobile device 105 attempts to register with the MIP network 100 at step 201. A successful registration is typically acknowledged in some manner. If registration is successful at step 202, then the method ends. However, it is possible that registration will be unsuccessful, which may be indicated by receiving a reply message indicating unsuccessful registration or by not receiving any reply message at all. If registration is unsuccessful at step 202, then the method categorises the error at step 203. The absence of a reply message and receipt of a reply message indicating unsuccessful registration are both examples of error categories for unsuccessful registration.

In general, a plurality of error categories is possible. Fig. 2 illustrates N categories represented by steps 204, 205, and 206. In each of steps 204, 205, and 206, actions are performed that are specific to the error category. These actions are preferably executed automatically without any input from a user. After completing these actions, the method continues. The particulars of how the method continues are application specific. For example, for some error categories, the method might continue by returning to A meaning initialisation is performed. For other error categories, the method might continue by returning to B meaning a new registration attempt is made without re-initialising. More generally, the method might continue to A for some conditions and continue to B for other conditions. In some embodiments, for at least one error category the method continues by returning A and for at least one other error category the method continues by returning B.

In some embodiments, a first backoff time is implemented before returning to B and a second backoff time is implemented before returning to A, the second backoff time being longer than the first backoff time. In a particular example, one error category of the method is defined to be the absence of any response whatsoever to the MIP registration attempt. This method continues at B, with the first backoff time being implemented between each MIP registration attempt. If a pre-configured number of failed attempts have been experienced for this particular error category, then the method continues at A after the second backoff time. In another particular example, one error category of the method relates to out-of-sync errors indicated by received error codes. When such an error occurs, the method returns to A after waiting the second

backoff time. However, under certain conditions, the method may return to B after the first backoff time.

Error Category Specific Actions

Turning now to Fig. 3, another overall retry method is illustrated in the form of a plurality of flow charts providing example error category specific actions in accordance with an embodiment of the application. In operation, the mobile device 105 sends a RRQM in order to register with the MIP network 100. If the mobile device 105 receives a RRPM indicating that registration is successful, then the mobile device 105 is registered for duration of the registration lifetime. At step 301, actions are executed if no response whatsoever is received by the mobile device 105.

Steps 302, 303, and 304 indicate other example error category specific actions. At step 302, actions are executed when a RRPM is received indicating an out-of-sync error. At step 303, actions are executed when a response is received indicating a temporary network error. At step 304, actions are executed when a response is received indicating a provisioning error. In one embodiment, the error category specific actions of steps 301, 302, 303, and 304 are all implemented. In another embodiment, the error category specific actions of steps 301 together with at least one of steps 302, 303, and 304 are implemented.

Further details of these example error category specific actions are provided later with the aid of Fig. 4 and Fig. 5.

User Profiles

In some embodiments, each mobile device 105 supports a plurality of user profiles. An example of a user

profile is a NAI (network access identifier), each NAI profile comprising a userID, a password, and a shared secret. The mobile device 105 can switch between several NAI profiles, but preferably only one NAI profile is active at a given time.

In some embodiments, a retry history is maintained for each NAI profile. The retry history contains, for example, a list of networks that do not allow a MIP session to be established. For example, if the mobile device 105 with an active NAI profile "x" is not able to establish a MIP session, then the mobile device 105 will record on the list that the network does not allow the NAI profile "x" to establish a MIP session. If a particular NAI profile is re-provisioned, then all of its associated retry history is erased. Examples of re-provisioning include explicit user-initiated provisioning attempts, or network-initiated provisioning attempts such as IOTA (Internet over the air).

In some embodiments, the retry method executed by the mobile device 105 is a function of the active NAI profile and/or the retry history associated with the NAI profile. Different retry methods can be configured for each profile. Then, when a given RRP code is received, the retry method that is executed is the one for the received RRP code and the active profile and/or retry history.

Automatic Retry Method for Initial Registration

Turning now to Fig. 4, a flow chart of a method of initially registering the mobile device 105 on the MIP network 100 in accordance with an embodiment of the application is shown. Initial registration is performed in order to establish a PPP session for the mobile device 105. In order to maintain "always-on" status, the mobile device

105 preferably triggers initial registration automatically for example whenever it is powered on or switches to another NAI profile. The method begins at step 401 when the MIP session set-up is initiated. At step 402, the mobile device 105 is informed of the FA 103 capability by receiving the AAM from the FA 103. Using this information, the mobile device 105 requests registration by sending the RRQM to the FA 103 at step 403. At step 404, the mobile device 105 attempts to receive the RRPM from the FA 103. If the RRPM is not received, then the mobile device 105 will determine whether or not it should re-send the RRQM by determining whether or not a maximum RRQM timeout has been reached. If the maximum RRQM timeout has not been reached, then the mobile device 105 will re-send the RRQM after a time delay. At step 406, the mobile device 105 sets a RRQM retry back-off timer and waits for it to expire before the mobile device 105 re-sends the RRQM at step 403. However, if the maximum RRQM timeout has been reached at step 405, then the mobile device 105 sets a failure code at step 407 and proceeds to step 408. At step 408, the mobile device 105 makes preparations to retry MIP initial registration from the beginning after a time delay. The mobile device 105 tears down the PPP stack with a LCP terminate message in order to free up resources, sets a MIP retry back-off timer, and waits for the MIP retry back-off timer to expire. Once the MIP retry back-off timer has expired, MIP initial registration is re-attempted by looping back to step 401.

If the mobile device 105 receives the RRPM in step 404, then the mobile device 105 determines whether or not the RRP code contained in the RRPM indicates that MIP initial registration is successful at step 409. If the MIP session is successfully established, then the method ends at step 410 and the mobile device 105 is registered for

duration given by the registration lifetime. The mobile device 105 stores the registration lifetime, which is used to trigger re-registration. If the MIP initial registration is not successful, then the mobile device 105 executes a course of action based on the received RRP code starting at step 411.

If the mobile device 105 determines from the RRP code that there is an out-of-sync issue at step 411, then the out-of-sync issue is addressed at step 414. The mobile device 105 determines whether or not it has experienced the out-of-sync issue too many times by determining whether or not a max out-of-sync counter has been exceeded at step 417. If the max out-of-sync counter has not been exceeded then the mobile device 105 will re-send the RRQM at step 403. Otherwise, the mobile device 105 makes preparations to retry initial registration from the beginning after a time delay. At step 415, the mobile device 105 tears down the PPP stack with the LCP terminate message, sets the MIP retry back-off timer, and waits for the MIP retry back-off timer to expire. Once the MIP retry back-off timer has expired, MIP initial registration is re-attempted by looping back to step 401.

If there is not an out-of-sync issue, then the mobile device 105 determines at step 412 whether or not the RRP code indicates a temporary network error. If there is a temporary network error, then the mobile device 105 makes preparations to retry initial registration from the beginning after a time delay at step 415, which has already been discussed.

If there is not a temporary network error, then the mobile device 105 determines at step 413 whether or not the RRP code indicates a provisioning error. If there is a provisioning error, then the mobile device 105 makes

preparations to retry initial registration from the beginning. At step 416, the mobile device 105 tears down the PPP stack with the LCP terminate message, records on a list the network that does not allow access, and waits until a new network not found on the list is acquired. Once step 416 is completed, MIP initial registration is re-attempted by looping back to step 401.

In some embodiments, the RRP code is analysed against a different set of error categories than is implemented in steps 411, 412 and 413. The method is scalable to amend or add error categories. More generally, the retry method operates as a function of the received RRP code. Preferably, the retry method is performed automatically without input from a user. It is to be understood that Fig. 4 is a specific embodiment while numerous other embodiments are possible. Specific details of preferred error categories are discussed later with the aid of Fig. 6.

Automatic Retry Method for Re-Registration

Turning now to Fig. 5, a flow chart of a method of re-registering the mobile device 105 on the MIP network 100 in accordance with an embodiment of the application is shown. In this case, the mobile device 105 has an existing PPP session with as assigned home IP address (x.y.z.w). The mobile device 105 automatically re-registers its home IP address (x.y.z.w) prior to the expiration of the registration lifetime starting at step 500. At step 503, the mobile device 105 requests re-registration of its home IP address (x.y.z.w) by sending the RRQM. In a typical scenario, an RRP code is received at step 504 and indicates at step 509 that the MIP re-registration is successful and

the mobile device 105 is re-registered at step 510 for another registration lifetime.

Steps 501 through 507 and steps 509 through 513 in Fig.5 are substantially identical to steps 401 through 407 and steps 409 through 413, respectively. Therefore, details of these steps are not discussed here. Other steps relate to the retry method of the mobile device 105 in the event that that an RRP code indicating successful MIP re-registration isn't received. The retry method of mobile device 105 is preferably different for re-registration than initial registration.

If the mobile device 105 experiences the max RRQM timeout when waiting for the RRPM, then it makes preparations to retry MIP re-registration at step 501 after a time delay. If a MIP session exists upon entering step 508, then at step 508 the mobile device 105 sends an RRQ code with a lifetime of zero in order to terminate the MIP session. The mobile device 105 then tears down the PPP stack with a LCP terminate message in order to free up resources, resets its home IP address to 0.0.0.0, sets the MIP retry back-off timer, and waits for the MIP retry back-off timer to expire. Once the MIP retry back-off timer has expired, MIP re-registration is re-attempted by looping back to step 501. After completing steps 501 and 502, the mobile device 105 at step 503 will send an RRQM containing the reset home IP address of 0.0.0.0 so that the HA 101 understands that the mobile device 105 has lost its home IP address.

If the received RRP code indicates an out-of-sync issue at step 511, then the out-of-sync issue is handled at step 514. Once the out-of-sync issue has been addressed, the mobile device 105 resends the RRQM in order to retry home IP

address (x.y.z.w) re-registration by looping back to step 503.

If the received RRP code indicates a temporary network error at step 512, then the mobile device 105 determines whether or not re-registration should be retried from step 501 or 503. If the mobile device 105 determines that the registration lifetime has not been exceeded at step 515, then it will re-send the RRQM at step 503 after a time delay given by the re-registration back-off timer. However, if the registration lifetime has been exceeded, then the mobile device 105 makes preparations at step 518 to retry re-registration at step 501. The mobile device 105 performs actions in step 518 that are substantially identical to the actions in step 508. As details of step 508 have already been discussed, details of step 518 are not discussed here. After step 518, MIP re-registration is re-attempted by looping back to step 501.

If the received RRP code indicates a provisioning error, then the mobile device 105 makes preparations at step 516 to retry re-registration at step 501. If a MIP session exists upon entering step 516, then the mobile device 105 sends an RRQ code with a lifetime of zero in order to terminate the MIP session. The mobile device 105 then tears down the PPP stack with the LCP terminate message, records on a list the network that does not allow access, and waits until a new network not found on the list is acquired. Next, MIP re-registration is re-attempted by looping back to step 501

In some embodiments, the RRP code is analysed against a different set of error categories than is implemented in steps 511, 512 and 513. The method is scalable to amend or add error categories. More generally,

the retry method operates as a function of the received RRP code. Preferably, the retry method is performed automatically without input from a user. It is to be understood that Fig. 5 is a specific embodiment while numerous other embodiments are possible. Specific details of preferred error categories are discussed with the aid of Fig. 6.

Error Categories

Turning now to Fig. 6, a chart providing example error categories in accordance with an embodiment of the application is shown. Preferably, each error is categorised by RRP code into three categories: temporary out-of-sync issues, temporary network errors, and provisioning issues. Categorisation of RRP codes according to these categories is seen in the methods of Fig. 3 and Fig. 4. If the method of Fig. 2 were to categorise error at step 203 according to RRP codes, then it might also include an additional category denoting that an RRP code is not received.

Each category of Fig. 6 contains at least one RRP code, each having a related description and an originator. The IANA (Internet Assignment Numbers Authority) provide the most up to date RRP codes at http://www.iana.org/assignments/mobileip-numbers.

It is to be understood that Fig. 6 is a very specific preferred embodiment for categorising RRP codes and that other embodiments are possible. Furthermore, the listing of RRP codes by the IANA is evolving and it is certainly possible that RRP codes will be amended, added, or removed. Therefore, it is to be understood that different embodiments of categorising RRP codes are possible especially as the IANA evolves the listing of RRP codes.

Mobile Device

Turning now to Fig. 7, a block diagram of an example mobile device 105 is shown. The mobile device 105 has functionality implementing a plurality of automatic MIP retry methods 702 coupled to a processor 701 and at least one NAI profile 703.

In operation, the automatic MIP retry methods 702 utilise the processor 701 and NAI profile 703 in order to implement any of the methods described herein. Preferably, the automatic MIP retry methods 702 comprise a computer readable medium having computer executable instructions stored thereon for instructing the mobile device 105 to implement any of the methods described herein. In another embodiment, the automatic MIP retry methods 702 comprise any appropriate combination of hardware, software, or firmware that produces any of the methods described herein.

The embodiments described herein have focussed on automatic retry methods for registering the mobile device 105 on the MIP network 100. More generally, other embodiments are possible and relate to automatic retry methods for registering the mobile device 105 on other networks such as networks having a wireless protocol that deal with addressing for mobility using non-geographically dependant addressing. In such a network, the initial address may be geographically dependent, for example as assigned by a home agent, but as the mobile device 105 moves to new networks, the same address is maintained where possible.

Numerous modifications and variations of the present application are possible in light of the above teachings. It is therefore to be understood that within the

scope of the appended claims, the application may be practiced otherwise than as specifically described herein.

CLAIMS:

1. A method of automatically attempting to establish a wireless protocol session in a wireless device, the wireless protocol operating using static addressing; comprising:

a) initialising for wireless protocol registration;

b) sending a wireless protocol registration request; and

c) for each error category of a plurality of error categories, upon failure to establish the wireless protocol session due to an error in that error category, executing automatically at least one respective error category specific step;

wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step a); and

wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step b).

2. The method of claim 1, wherein the wireless protocol is MIP mobile Internet Protocol.

3. The method of claim 1 or claim 2 comprising:

for at least one of the error categories, returning to step a) for some conditions and to step b) for other conditions.

4. The method of any one of claims 1 to 3 wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step a) after a first backoff time; and

wherein for at least one of the error categories, the at least one respective error category specific step comprises returning automatically to step b) after a second backoff time.

5. The method of any one of claims 1 to 4 wherein the plurality of error categories comprise any of: no registration response, out-of-sync errors, provisioning errors, and temporary network errors.

6. The method of any one of claims 1 to 5 further comprising:

defining at least two groups of RRP codes, each group of RRP codes defining an error category of said plurality of error categories;

receiving an RRP code in response to a failed registration attempt and determining the error category using the RRP code.

7. The method of claim 2 or any one of claims 3 to 6 when dependent on claim 2 wherein initialising for MIP registration is performed upon expiry of a MIP registration lifetime and when the wireless device moves to a new MIP network.

8. The method of claim 2 or any one of claims 3 to 6 when dependent on claim 2 wherein initialising for MIP registration is performed when the wireless device is powered on and when the wireless device switches to a new user profile.

9. The method of any one of claims 1 to 8 further comprising:

defining at least two user profiles on the wireless device one of which is an active user profile at a given time;

wherein for at least one error category, the at least one respective error category specific step is defined differently for each of the at least two user profiles.

10. The method of claim 9 wherein each user profile is a NAI (network access identifier) profile.

11. The method any one of claims 1 to 10 further comprising:

maintaining a retry history for each user profile, the retry history comprising an identification of networks that have not allowed registration; and

for at least one error category, executing the at least one respective error category specific step as a function of the retry history.

12. The method of claim 5 when dependent on claim 2 or any of claims 6 to 11 when dependant on claim 5 being dependent on claim 2 wherein:

for no registration response, the at least one error category specific step comprises re-sending a registration request;

for out-of-sync errors the at least one error category specific step comprise:

a) requesting a challenge if a current challenge is unknown, missing, or stale, and then re-sending a registration request; or

b) adjusting a time stamp if there is a registration identification mismatch, and then re-sending the registration request;

for temporary network errors the at least one error category specific step comprise:

a) sending the registration request with a lifetime of zero if a prior MIP session exists;

b) freeing up resources used in the attempt to register the wireless device with the network, and then re-attempting to register the wireless device; and

for provisioning errors the at least one error category specific step comprise:

a) sending the registration request with a lifetime of zero if a prior MIP session exists;

b) freeing up resources used in the attempt to register the wireless device with the network;

c) adding the network to a list of networks not allowing packet data access, then waiting to acquire a network not found on the list, and then retrying the method of registering the wireless device.

13. The method of claim 5 when dependent on claim 2 or any of claims 6 to 11 when dependant on claim 5 being dependent on claim 2, wherein the error categories of out-of-sync error, provisioning error, temporary network error are each defined by a respective group of RRP codes.

14. A wireless device adapted to implement the method of any one of claims 1 to 13.

15. A computer readable medium having computer executable code means stored thereon for execution on a wireless device so as to implement the method of any one of claims 1 to 13.