SWITCH-IN OF CENTRALISED INFRASTRUCTURE FOR MANAGEMENT FOR WIRELESS COMMUNICATIONS

BACKGROUND OF INVENTION

[0001] An enterprise with a computer network may wish to provide its employees with access to the enterprise network using remote wireless devices. There are a variety of wireless network carriers serving different geographical areas. Historically, to provide enterprise network access by wireless devices, an enterprise could first determine the required geographic coverage. Next, the enterprise could identify one or more wireless carriers which, together, provide the required geographic coverage. The enterprise could then approach each of the identified carriers and arrange a private communication line between the enterprise network and the wireless carrier (often referred to as a leased line). Thereafter, wireless devices within the geographic scope of the wireless network of one of these wireless carriers could access the enterprise network using the wireless network and the communication line set up between the wireless network and the enterprise network.

[0002] An obvious drawback with this approach is that an enterprise that wished to allow wireless communication with the enterprise network over a broad geographic area must make, and maintain, arrangements with many different wireless carriers. Further, a message intended for a wireless device that was disconnected (e.g., off or not in any of the coverage areas) would need to be retained by the enterprise network. This is for the reason that it would not be known with which wireless carrier the wireless device would next register (consequent upon entering, or being turned on within, the coverage area of the wireless carrier). As an enterprise network may not be configured to handle, or to handle efficiently, undeliverable messages until they can be sent, this could prove problematic. Also, any given wireless device will normally be assigned a different (typically IP) address when entering each of the different wireless networks. It may fall on the enterprise network to keep a mapping to the current address of each wireless device.

[0003] To address these and other difficulties, a centralised infrastructure was conceived in order to provide centralised management services for wireless communications. Connections were negotiated between the centralised infrastructure and many different wireless carriers in order to provide comprehensive geographic coverage. Further, for an enterprise subscribing to the centralised management services, the

centralised infrastructure will receive messages from the enterprise network intended for any wireless device, whether or not the wireless device is currently connected. Where a given wireless device is disconnected, the centralised infrastructure will store the message and forward it to the given wireless device whenever it next registers with one of the included wireless carriers. Additionally, the centralised infrastructure, by holding appropriate mapping tables, allows the enterprise network to communicate with each authorised wireless device no matter what address a given wireless carrier may assign to the wireless device. Yet further, historically, wireless carriers employ web-browser technology. As such, a message to a wireless device registered with a given wireless carrier is stored by the wireless carrier and must be actively retrieved from the wireless carrier by the wireless device. In contrast, using technology described in US6,701,378 issued March 2, 2004 to Gilhuly *et al.*, the contents of which are incorporated by reference herein, the centralised infrastructure may be configured to push the message onto a wireless device.

[0004] With the advent of virtual private networks (VPNs) over the public Internet, the need for a leased line between an enterprise and a wireless carrier has, in many instances, disappeared. This, together with inter-carrier agreements, may make it less difficult to ensure a broad geographic coverage even by concluding a service agreement with only one wireless carrier. Further, newer wireless carriers might employ push technology, might handle disconnects by storing and forwarding messages, and might off-load wireless device addressing problems from the enterprise network. With such high capability wireless carriers and inter-carrier agreements, the aforedescribed centralised infrastructure could become an unwanted added expense.

[0005] This invention seeks to ameliorate this potential problem.

SUMMARY OF INVENTION

[0006] After a wireless device registers with a wireless carrier, a registration process is initiated with a provisioning server. The provisioning server, based on at least one of a device identifier for the wireless device and an identifier of the wireless carrier, retrieves database information from a database. This information may be used by the provisioning server to decide whether to return (i) address information for a relay server which provides centralised management services or (ii) address information for an enterprise network.

[0007] According to the present invention, there is provided a method of handling communications, comprising: receiving from a wireless carrier network at least one of a wireless device identifier and a wireless carrier network identifier; based on at least one of said device identifier and said wireless carrier network identifier, retrieving database information from a database; based at least in part on said database information, returning one of (i) address information for a server which provides centralised management services and (ii) address information for an enterprise network.. A computer readable medium is also provided which contains computer executable instructions which instructions, when executed by a processor of a provisioning server, cause the provisioning server to implement the described method.

[0008] In a further aspect, there is provided a provisioning server comprising: a database; a processor operable to: receive from a wireless carrier network at least one of a wireless device identifier and a wireless carrier network identifier; based on at least one of said device identifier and said wireless carrier network identifier, retrieve database information from said database; based at least in part on said database information, return one of (i) address information for a server which provides centralised management services and (ii) address information for an enterprise network.

[0009] Other features and advantages of the invention will become apparent from the following description in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] In the figures which illustrate example embodiments of the invention,

[0011] **FIG 1** is a schematic view of a known network configuration,

[0012] **FIG 2** is a schematic view of a network configuration, which embodies teachings of the subject invention,

[0013] **FIG. 3** is a schematic view of a portion of the network of **FIG. 2**, and

[0014] **FIG. 4** is a sequence diagram showing operation of the system of **FIG. 2**.

DETAILED DESCRIPTION

[0015] Turning to **FIG. 1**, an enterprise **10** has a hub and spoke enterprise network **12** with a number of communication devices **14** (such as suitably configured personal computers – PCs) connected to a central enterprise server **16**. The enterprise server **16** is connected to the public Internet **22**. A number of wireless carrier networks **24a, 24c**

operated by wireless carriers also connect to the public Internet as does a relay server **26**. Additional wireless carrier networks, such as wireless carrier network **24b**, are accessed by a leased line, such as line **25**. Wireless communications devices **30** may be connected to one or other of the wireless carrier networks. Each of the wireless devices **30** may have become associated with enterprise **10**. A wireless device may become associated with enterprise **10** by directly connecting the wireless device to a PC **14** of the enterprise network **12** while running an association process at the PC. The result is the uploading of a device identifier for the wireless device to the enterprise network and the downloading of an enterprise identifier from the network **12** to the wireless device. The device identifier, which may be referred to as a PIN, is a characteristic of each wireless device (i.e, a PIN is burned into each wireless device). The enterprise identifier, which may be referred to as a user ID, or UID, also normally does not change. Another characteristic of each wireless device is a home address.

[0016] To provide centralised wireless management services, the relay server **26** has an established communication path with a number of wireless carrier networks. Specifically, relay server **26** may have an established communication path with each of the wireless carrier networks **24a, 24c** that is connected to the public Internet **22** through a VPN. Further each wireless carrier network accessible only over a private line will have a private line to the relay server **26**. Thus, for example, wireless carrier network **24b** has an established communication path with relay server **26** over leased line **25**.

[0017] Enterprise **10** may take advantage of centralised management services for wireless communications by installing a wireless communications management server **20** with a connection between enterprise server **16** and the public Internet **22**. The management server **20** provides the enterprise identifier (UID) and the current enterprise address to relay server **26**. A database in the relay server is populated with the device identifiers along with the enterprise identifier and current enterprise address (namely, the address for the wireless communication server **20** of network **12** of enterprise **10**).

[0018] With the described set-up, wireless communications management server **20** with relay server **26** may provide centralised management of wireless communications, as follows. When a wireless device **30** registers (in conventional fashion) with one of the wireless carrier networks **24a, 24b, 24c** with which the relay server **26** has an established communications path, the device **30** will be provisioned with a (typically IP) wireless network carrier address. The device will send a registration message to its home address

with its device identifier (PIN) and enterprise identifier (UID). The home address may point to the relay server or, more typically, to a registration server which re-directs the message to the relay server. This message which is received by the relay server **26** will include an indicator of the wireless carrier network.. The wireless carrier network identifier could be implicit in the source address of the message (i.e., the wireless carrier network address) or may be explicitly contained in the message. On receiving this message, the relay server associates the wireless network carrier address with the PIN and returns a message to the wireless device with its own address. Any subsequent message sent by the wireless device **30** is addressed to the relay server. These subsequent messages may include a UID. Utilising the UID (received in the message or associated with the PIN at the relay server), the relay server looks up the appropriate enterprise address and forwards the message to network **12** via wireless communications server **20**.

[0019] A message from enterprise network **12** intended for a given wireless device **30** is addressed by network **12** to the relay and includes the device identifier (PIN) of the wireless device. The message is forwarded to the relay server via wireless communications management server **20**. If the relay server holds an association of the device identifier with a given wireless carrier network address, the message is forwarded to that wireless carrier network address. On the other hand, if there is no association, this indicates that the intended recipient wireless device is not currently connected to (i.e., registered with) any of the included wireless carrier networks. In such circumstances, the relay server simply stores the message until it becomes aware of an association of the recipient wireless device with one of the included wireless carrier networks.

[0020] From the foregoing, it will be apparent that the relay server allows the enterprise network to simply direct messages to all wireless devices to the relay. Further, the relay server allows messages to be stored for disconnected wireless devices until they are again connected to one of the wireless carrier networks (i.e., store and forward services). Additionally, the relay server allows connection through a number of wireless carrier networks, and hence broad geographic coverage, whereas the enterprise **10** need only administer a single arrangement with the centralised service.

[0021] It may be, however, that wireless carrier network **24c** is upgraded so as to be able to provide one or more of services provided by the centralised service. For example, it may be connected to the public Internet and configured to do one or more of the following: store and forward messages, use PINs and UIDs in addressing messages

between wireless devices and an enterprise, inter-operate with one or more other wireless carrier networks to communicate messages between an enterprise and wireless devices associated with the enterprise, and push messages to the wireless devices.

[0022] To more inexpensively service a customer, the network configuration of **FIG. 1** may be modified as illustrated in **FIG. 2**. Turning to **FIG. 2**, wherein like parts have been given like reference numerals, a provisioning server **50** is connected to the public internet **22** – as is relay server **26**. To provide the option of centralised management services, the provisioning server **50** (rather than relay **26**) has an established communication path with a number of wireless carrier networks. Specifically, the provisioning server **50** may have an established communication path with each of wireless carrier networks **24a, 24c** over the public Internet **22** through a VPN. Further, each wireless carrier network accessible only over a private line will have a private line to the provisioning server **50**. Thus, for example, wireless carrier network **24b** may have an established communication path with the provisioning server **50** over leased line **25**. The relay server **26** has an established communication path with the provisioning server **50**, as for example over the public internet **22** via a VPN. Further, where the home address of each wireless device points to a registration server, the registration server will be configured to re-direct it to the provisioning server. Alternatively, the registration server itself could act as the provisioning server. Where the home address points directly to the relay server, the provisioning server is substituted for the relay server so that the home address now points to the provisioning server.

[0023] With this set-up, and a wireless communications management server **20** installed in enterprise **10**, the enterprise may be able to take advantage of centralised management services by providing its enterprise identifier, current enterprise address and the device identifiers of wireless devices currently associated with the enterprise. As illustrated in **FIG. 3**, the enterprise identifier (UID) and current address for enterprise network **12** – and specifically, for wireless communications management server **20** of the enterprise network -- populates a database **28** in the relay server **26** and a database **48** in the provisioning server. Each device identifier populates database **48** in the provisioning server **50**. Additionally, a quality of service (QOS) indicator is associated with each device identifier and is stored in database **48** of the provisioning server **50**. The QOS indicators are provided by an administrator of the centralised management services and each QOS indicator indicates the service level to which each wireless device is entitled

(by virtue of the service plan subscribed to). Furthermore, the database **48** in the provisioning server is also populated with capability information for each wireless carrier network with which it has an established connection. For each wireless carrier network, this capability information includes an indication of (i) whether or not the wireless carrier network can store and forward messages, (ii) whether or not the wireless carrier network can use PINs and UIDs in addressing messages between an enterprise and a wireless device, (iii) whether or not the wireless carrier network inter-operates with one or more other wireless carrier networks to communicate messages between an enterprise and wireless devices associated with the enterprise, and (iv) whether or not the wireless carrier network pushes messages to the wireless devices. During operation, the relay server **26** periodically sends load information to the provisioning server **50** which indicates the extent to which the capacity of the relay server is currently utilised. This load information is stored by the provisioning server in its database **48**.

[0024] The provisioning server **50** may comprise a processor operating under program control. The program, and information for database **48**, may be loaded from computer readable media **52**, which media may be, for example, a computer readable diskette, a memory chip, or a file downloaded over a VPN on the public Internet.

[0025] As before, after a wireless device **30** registers with one of the wireless carrier networks **24a, 24b, 24c** with which the provisioning server **50** has an established communications path, the device **30** sends a registration message with its device identifier to its home address. Now, however, this message is received by provisioning server **50**. Consequently, with reference to **FIG. 4**, a registration (set-up) message **110** originating from device **30**, which includes an identifier of the wireless carrier network, is sent to the provisioning server **50**. As is typical with a registration message, the message includes not only the device identifier, but also information on the capabilities of the wireless device **30** itself.

[0026] The provisioning server **50** will then make a decision as to whether the wireless device **30** should utilise the centralised management services provided by relay **26** in communicating with the enterprise network (via wireless communications management server **20**) or should communicate directly with the enterprise network **12** (via wireless communications management server **20**). This decision is based on one or more of the following criteria: (i) the capabilities of the wireless carrier network with which the wireless device **30** has registered (as revealed by the wireless carrier network capability

information of database **48**); (ii) the current load on the relay server (based on the latest information received from the relay server in this regard and stored in database **48**); (iii) the capabilities of the wireless device (as indicated in message **110**); and (iv) the QOS to which the wireless device is entitled (as stored in database **48**).

[0027] By way of example, a decision algorithm could provide a series of thresholds for load on the relay server and, associated with each higher load threshold, a higher QOS service level that must be subscribed to in order to be entitled to employ the relay **26**. For communications entitled to employ the relay, a secondary operation of the decision algorithm could provide that if the wireless carrier network capability information indicated that the wireless carrier network was capable of providing services emulating those of the relay server **26**, and the wireless device was capable of interfacing with the wireless carrier network to obtain such services, the wireless device is not entitled to employ the relay.

[0028] If, as a result of the decision algorithm, the wireless device **30** is entitled to use the relay server **26**, the provisioning server addresses a message **112** to the wireless device including an address for relay server **26** and a time-out interval.

[0029] Assuming that message **112** does include an address for the relay server, the wireless device **30** will then address future messages, such as message **114**, to the relay server and the relay server will associate the PIN for the device with the current wireless network carrier address of the device and handle communications between the wireless device and enterprise network **12** in the manner described hereinbefore.

[0030] The time-out interval prompts the wireless device to trigger a timer. When the timer times out, the wireless device is prompted to again register with the provisioning server by sending a message **116** to its home address. The manner of configuring a wireless device to operate in this fashion will be understood to those skilled in the art and is therefore not further described herein. The provisioning server therefore again decides whether the wireless device **30** should utilise the centralised management services provided by relay **26** in communicating with the wireless communications management server **20** of enterprise network **12** or should communicate directly with the enterprise network **12** (via wireless communications management server **20**). It may be that, as a result of changed circumstances, such as increased load on the relay server, the decision algorithm indicates that the wireless device is not entitled to use the relay server. The provisioning server then returns a message **118** to the wireless device including an

address for the wireless communications management server **20**. In consequence, the wireless device is prompted to address future messages, as, for example message **120**, directly to the enterprise network **12** (via wireless communications management server **20**). Thus, future communications between the wireless communications management server **20** and wireless device **30** is done directly without relay **26** intervening. Message **118** will also include a time-out interval so that the wireless device is again prompted to re-register (via, for example, message **122**), after a time interval.

[0031] The address of each of the provisioning server **50**, the relay server **26**, and the enterprise network **12** (i.e., the wireless communications management server **20**) may be network addresses such as provisioner.central.com, relay.central.com, and enterprise.central.com. In such instance, a message which is sent to such a network address will be translated by a directory name server (DNS) on the public Internet to an Internet Protocol (IP) address (e.g., 123.456.789). Alternatively, these addresses may be IP addresses. However, in such instance, these addresses may need to be updated from time-to-time. In this case where, for example, the IP address of the wireless communications management server **20** changed, this would need to be communicated from the wireless communications management server **20** to the provisioning server **50**. This may be accomplished by the network **12** passing its current address to the relay **26** which, in turn, passes this address to the provisioning server. The provisioning server would then be responsible to send an update message to any wireless devices currently communicating directly with the wireless communications management server **20**.

[0032] The provisioning server and relay server could be co-located, or could both be implemented on a single server with appropriate software control. Further, while the exemplary embodiment has been described in conjunction with a single provisioning server and a single relay server, each could be, in actuality, a server farm.

[0033] Other modifications will be apparent to those skilled in the art and, therefore, the invention is defined in the claims.

WHAT IS CLAIMED IS:

1. A method of handling communications, comprising:

receiving from a wireless carrier network a wireless device identifier and a wireless carrier network identifier;

based on said received device identifier and/or wireless carrier network identifier, retrieving database information from a database; and

based at least in part on said database information, returning one of (i) address information for a server which provides centralised management services and (ii) address information for an enterprise network.

2. The method of claim 1 wherein said database information comprises capability information for said wireless carrier network.

3. The method of claim 2 wherein said capability information comprises any one or a combination of an indication of whether or not the wireless carrier network can store and forward messages; an indication of whether or not the wireless carrier network uses characteristic identifiers for wireless devices and enterprises in addressing messages; an indication of whether or not the wireless carrier network inter-operates with one or more other wireless carrier networks to communicate messages between an enterprise and wireless devices associated with the enterprise; or an indication of whether or not the wireless carrier network pushes messages to the wireless devices.

4. The method of any one of claims 1 to 3 further comprising:

receiving load information indicating load on said server which provides centralised management services; and

storing said load information as database information in said database.

5. The method of any one of claims 1 to 4 further comprising receiving device capability information with said device identifier and wherein said step of returning address information is based in part on said device capability information.