

METHOD OF AND SYSTEM FOR EXTENDING INTERNET TELEPHONY OVER VIRTUAL PRIVATE NETWORK DIRECT ACCESS LINES

BACKGROUND

5 The present invention relates generally to the field of virtual private networks, and more particularly to a method of and system for providing a virtual private network in which a portion of each call is transported through an internet protocol network.

DESCRIPTION OF THE PRIOR ART

10 Some larger organizations with farflung sites and locations use virtual private networks (VPNs) as an alternative to traditional long distance services for their intra-organizational telephone communications. Virtual private networks are created within the public switched telephone system but they provide a communication system that appears from the users prospective to be private.

15 Referring to Fig. 1, there is shown a simplified block diagram of a virtual private network. An intra-location telephone system includes a plurality of telephones 11 operably connected to a private branch exchange (PBX) 13. As is well known to those skilled in the art, several or even hundreds of telephones may be operably connected to PBX 13.

20 PBX 13 provides intra-site communication between telephone and other telephones at the site. Additionally, a user of a telephone 11 may make a local or long distance call outside of the location by entering a digit, such as "9", to obtain an outside line. Additionally, a user of telephone 11 may make a VPN call by entering another digit, such as "8", to reach a member of the organization at another location. The other location may be in a separate city, state, or even country. Typically, VPN numbers have the appearance of local seven digit telephone numbers. A
25 three digit prefix number identifies a location and the remaining four digits identify a telephone within the location.

30 In the example of Fig. 1, a user of telephone 11 at a location located in, for example, California, wishes to place a VPN call to a telephone 15 located at a site of the organization in, for example, New York. The telephones 15 of the site in New York are operably connected to a PBX 17 that services the site. For purposes of illustration, the VPN number associated with telephone 15 is 555-1234. To initiate the call, a user takes telephone 11 off hook and receives a

dial tone from PBX 13. The user enters "8" to identify the call as a VPN call and receives another dial tone. Then, the user enters the digits 555-1234. PBX 13 forwards the call to a switch 19 of a public switched telephone network (PSTN) 21 over a direct access line (DAL 23). Switch 19 is identified in PSTN 21 by a unique originating switch identifier (OSID). DAL 23 is identified by an originating truck group (OTG) identifier. When switch 19 receives the dialed digits on the DAL 23, it must consult a service control point (SCP) 25 for routing instructions. SCP 25 uses the OSID and the OTG to determine the identity of the VPN customer and provides routing instructions to switch 19 based on the customer identification and the dialed digits. Switch 19 routes the call through PSTN 21 to an appropriate terminating switch 27. Switch 27 is operably connected to PBX 17 to complete the call to telephone 15.

One of the problems with VPN service is that the public switched telephone network does not extend reliably to all parts of the world. Because of the unreliability of the PSTN in certain parts of the world, certain locations of organizations particularly, those located in developing nations, are unable to use VPN services.

Recently, organizations have begun to build and use packet switched data networks, such as private intranets and the Internet itself, for mission critical communications. Even in regions without reliable access to the public switched telephone system, organizations have built or have gained access to robust high speed data networks for the transfer of data and electronic communications, such as e-mail, between locations.

It is an object of the present invention to provide a system that extends VPN services through data networks, such as private intranets and the Internet.

SUMMARY

The present invention provides a virtual private network (VPN) that includes an internet protocol (IP) network and a public switched telephone network (PSTN). An egress enterprise gateway is operably connected to the IP network. The egress enterprise gateway is operably connected to a switch of the PSTN through a direct access line (DAL). The set-up signaling for virtual private network calls and the calls themselves are transported across the IP network and the PSTN through the DAL. An intelligent layer in the IP network has the ability to route IP network originated calls to a traditional PSTN DAL.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram illustrating a virtual private network of the prior art.

Fig. 2 is a block diagram illustrating a virtual private network according to the present invention.

Fig. 3 is a block diagram illustrating the operation of enterprise gateways according to the present invention.

DETAILED DESCRIPTION

Referring now to Fig. 2, a VPN according to the present invention is designated generally by the numeral 31. A portion of VPN 31 is implemented in a traditional PSTN environment. The PSTN part of network 31 includes a switch 33 that is served by a SCP 35. Switch 33 is operably connected to a PSTN 37, which in turn is operably connected to a switch 39. Switch 39 is operably connected to a PBX 41 at a location of an organization through a DAL 45. PBX 41 is operably connected to a plurality of telephones, even though only one is shown as telephone 43.

According to the present invention, a portion of VPN 31 is also implemented in an IP network environment. The IP network environment of VPN 31 includes an IP network, which is generally designated by the numeral 47. IP network 47 may comprise a private intranet, the Internet, or a combination of a private intranet and the Internet. IP network 47 provides traditional Internet and web-based services, as well as IP telephony services.

A local organization's telephone system includes a PBX 51 and a plurality of telephones, even though only one is shown as telephone 53. Telephone 53 operates in the normal way. A user can use telephone 53 to call other telephone extensions within PBX 51. PBX 51 can also provide a telephone 53 with an outside line on which the user of telephone 53 can make local and long distance calls.

According to the present invention, a user can use telephone 53 and PBX 51 to make VPN calls. PBX 51 is operably connected to an ingress enterprise gateway (EG) 55. Although gateway 55 is labeled as an "ingress" EG, it is a bidirectional EG and the label "ingress" is only for identification relative to the call flow from telephone 53 to telephone 43. Referring to Fig. 3, EG 55 includes a signaling gateway 57 and a media gateway 59. Signaling gateway 57 provides bi-directional protocol translation from a telephony signaling protocol, such as SS7, ISDN, or channel associated signaling (CAS), depending upon the signaling protocol used by PBX 51, to an

Internet telephony signaling protocol, such as session initiation protocol (SIP) or H.323. The preferred embodiment of the present invention is based upon the SIP signaling protocol. However, other embodiments are contemplated based on other protocol, such as H.323. Media gateway 59 provides bi-directional protocol translation between traditional telephony time division multiplexed voice circuits to an IP transport protocol such as real-time transport protocol (RTP). In the case of ISDN or SS7 signaling, signaling gateway 57 is connected to PBX 59 by a signaling link, which is either an SS7 signaling link or an ISDN D-channel. In the case of CAS signaling, signaling gateway 57 receives signaling information from media gateway 59.

SIP and RTP packets are transported across IP network 47 to an egress enterprise gateway EG 61. Although gateway 55 is labeled as an "ingress" EG, it is a bidirectional EG and the label "ingress" is only for identification relative to the call flow from telephone 53 to telephone 43. EG 61 includes a signaling gateway 63 and a media gateway 65. Signaling gateway 63 and media gateway 65 perform bi-directional protocol translations in the manner described with respect to signaling gateway 57 and media gateway 59, respectively. Referring again to Fig. 2, EG 61 is connected to switch 33 of PSTN 27 by DAL 23.

Referring again to Fig. 2, a VPN call can be placed from telephone 53, located for example in Malaysia, to a telephone 43, located for example in New York. A user takes telephone 53 off hook and dials a VPN number in the normal way. For example, the user dials 8-777-4321. PBX 51 sends a normal set up message with the dialed digits 777-4321 to EG 55. EG 55 performs a protocol translation and formulates a SIP invite message of the form:

INVITE:7774321@xyzus.com

FROM:5551234@xyzmalaysia.com

TO:7774321@xyzus.com

In the preferred embodiment, SIP URLs are of the form "telephone_number@gateway." Thus, EG 55 is identified as xyzmalaysia.com and EG 61 is identified at xyzus.com. The SIP invite message is transported across IP network 47 to EG 61. EG 61 performs a protocol translation and sends set up message for VPN number 777-4321 to switch 33 over DAL 23. Switch 33 recognizes the call as a VPN call and consults SCP 35 for routing instructions. SCP 35 uses the dialed digits, the OSID of switch 33, and the OTG of DAL 23 to provide routing instructions to switch 33. Based upon the instructions received from SCP 35, the call is set up across PSTN 37 to telephone 43 using normal telephony signaling. During call setup, egress enterprise gateway 61

passes IP telephony signaling through IP network 47 back to ingress enterprise gateway 55.

The system of the present invention also provides VPN services initiated from telephones 43 served by PSTN 37 to telephones 53 served by IP network 47. A user takes telephone 43 off hook and dials a VPN number, for example, the user dials 8-555-1234. PBX 51 sends a set up message with the dialed digits 555-1234 to switch 39 over DAL 45. Switch 39 recognizes the call as a VPN call and consults a SCP 63 for routing instructions. SCP 63 uses the dialed digits, the OSID of switch 39, and the OTG of DAL 45 to provide routing instructions to switch 39. Based upon the instructions received from SCP 63, switch 39 sends an SS7 initial address message (IAM) to 33. Switch 33 sends a setup message to EG 61. EG 61 performs a protocol translation and formulates a SIP invite message of the form:

INVITE:5551234@xyzmalaysia.com

FROM:7774321@xyzus.com

TO:5551234@xyzmalaysia.com

The SIP invite message is transported across IP network 47 to egress enterprise gateway 55. EG 55 performs a protocol translation and sends set up message for VPN number 555-1234 to PBX 51.

From the foregoing, it may be seen that the present invention uses IP telephony to extend the architecture and infrastructure of virtual private networks to areas with unreliable access to the PSTN. A portion of the call is setup and transported across an IP network using a layer of intelligence that routes the call and its signaling to an appropriate enterprise gateway. A portion of the call is setup and transported across the PSTN using traditional VPN infrastructure. Additionally, the present invention may be used to provide virtual private network services to Internet devices and appliances, such as IP phones 65 and IP telephony enabled personal computers 67.

The present invention has been illustrated and described with respect to a presently preferred embodiment. Those skilled in the art will recognize alternative embodiments given the benefit of the foregoing disclosure. Accordingly, the foregoing disclosure is for purposes of illustration and not of limitation.

Thus, having fully described the present invention by way of example with reference to attached drawings figures, it will be readily appreciated that many changes and modifications may be made to the invention and to any of the exemplary embodiments shown and/or described herein

without departing from the spirit or scope of the invention, which is defined in the appended claims.

WHAT IS CLAIMED IS:

- 1 1. A virtual private network, which comprises:
2 an internet protocol network;
3 an enterprise gateway operably connected to said internet protocol network;
4 a direct access line operably connected to said gateway; and
5 a switch of a public switched telephone network operably connected to said direct access
6 line.
- 1 2. The virtual private network as claimed in claim 1, wherein said gateway comprises:
2 a signaling gateway; and
3 a media gateway.
- 1 3. The virtual private network as claimed in claim 2, wherein said signaling gateway
2 comprises means for converting internet protocol call set-up messages to telephone call set-up
3 messages.
- 1 4. The virtual private network as claimed in claim 2, wherein said signaling gateway
2 comprises means for converting internet session initiation protocol messages to telephone call set-
3 up messages.
- 1 5. The virtual private network as claimed in claim 1, comprising:
2 a second enterprise gateway operably connected to said internet protocol network; and,
3 an originating public branch exchange operably connected to said second gateway.
- 1 6. The virtual private network as claimed in claim 5, wherein said second gateway comprises:
2 a signaling gateway; and
3 a media gateway.

1 7. The virtual private network as claimed in claim 6, wherein said signaling gateway of said
2 second gateway comprises means for converting telephone call set-up messages to internet
3 protocol call set-up messages.

1 8. The virtual private network as claimed in claim 6, wherein said signaling gateway of said
2 second gateway comprises means for converting telephone call set-up messages to internet
3 session initiation protocol messages.

1 9. The virtual private network as claimed in claim 1, comprising:
2 a terminating private branch exchange operably connected to said public switched
3 telephone network.

1 10. A method of providing virtual private network services, which comprises the steps of:
2 transporting a called party number to an enterprise gateway through an internet protocol
3 network; and,
4 transporting said called party number from said gateway to a switch of a public switched
5 telephone network switch through a direct access line.

1 11. The method as claimed in claim 10, wherein said public switched telephone network
2 switch is identified by an originating switch ID (OSID).

1 12. The method as claimed in claim 11, wherein said direct access line is identified by an
2 originating trunk group (OTG) identifier.

1 13. The method as claimed in claim 12, comprising the step of:
2 routing a call through said public switched telephone network based upon said called party
3 number, said OSID, and said OTG.

1 14. The method as claimed in claim 10, wherein said step of transporting said called party
2 number to said gateway comprises the steps of:

3 receiving said called party number in a telephony signaling protocol at a second enterprise
4 gateway; and

5 translating said called party number from said telephony signaling protocol to an internet
6 protocol for transport over said internet protocol network.

1 15. The method as claimed in claim 14, comprising the step of:

2 generating a URL with said called party number at said second gateway.

1 16. The method as claimed in claim 15, wherein said URL includes said called party number
2 and a domain name corresponding to said gateway.

1 17. The method as claimed in claim 10, wherein said step of transporting said called party
2 number to said gateway through said internet protocol network comprises the step of:

3 sending a Session Initiation Protocol INVITE message including said called party number
4 to said gateway.

18. An apparatus for providing virtual private network services, comprising:
 - an enterprise gateway, wherein the enterprise gateway includes an internet protocol network interface,
 - a direct access line operably connected to the enterprise gateway; and
 - a switch of a public switched telephone network operable connected to the direct access line.
19. The apparatus of claim 18, wherein the enterprise gateway includes an internet protocol network interface.
20. The apparatus of claim 18, wherein the enterprise gateway includes a packet switched network interface.
21. The apparatus of claim 18, wherein the enterprise gateway comprises:
 - a signaling gateway; and
 - a media gateway.
22. The apparatus of claim 21, wherein the signaling gateway comprises means for converting internet protocol call set-up messages to telephone call set-up messages.
23. The apparatus of claim 21, wherein the signaling gateway comprises means for converting internet session initiation protocol messages to telephone call set-up messages.
24. The apparatus of claim 18, comprising:
 - a second enterprise gateway operably connected to the internet protocol network;
 - and,
 - an originating public branch exchange operably connected to the second enterprise gateway.
25. The apparatus of claim 24, wherein the second enterprise gateway comprises:
 - a signaling gateway; and
 - a media gateway.

26. The apparatus of claim 25, wherein the signaling gateway of the second enterprise gateway comprises means for converting telephone call set-up messages to internet protocol call set-up messages.

27. The apparatus of claim 25, wherein the signaling gateway of the second enterprise gateway comprises means for converting telephone call set-up messages to internet session initiation protocol messages.

28. The apparatus of claim 18, comprising:

a terminating private branch exchange operably connected to the public switched telephone network.

29. A virtual private network apparatus for providing virtual private network services between a public switched telephone network and an internet protocol network, comprising

a signaling gateway configured to receive telephony signaling protocol signals, the telephony signaling protocol signals providing call signaling for a call initiated by a caller, the signaling gateway being configured to convert the telephony signaling protocol signals to internet telephony signal protocol signals to thereby establish a session between the caller and a callee; and

a media gateway coupled to the signaling gateway, the media gateway configured to receive telephony time division multiplexed signals providing call content, the media gateway being configured to convert the telephony time division multiplexed signals to internet protocol transport signals to thereby exchange the call content between the caller and callee during the session.

30. The apparatus of claim 29, wherein the telephony signaling protocol signals are signaling system 7 signals.

31. The apparatus of claim 29, wherein the telephony signaling protocol signals are ISDN signals.

32. The apparatus of claim 29, wherein the telephony signaling protocol signals are

channel associated signaling signals.

33. The apparatus of claim 29, wherein the internet telephony signaling protocol signals are session initiation protocol signals.

34. The apparatus of claim 29, wherein the internet telephony signaling protocol signals are session initiation protocol signals.

35. The apparatus of claim 29, wherein the internet protocol transport signals are real-time transport protocol signals.

36. The apparatus of claim 29, wherein the signaling gateway comprises means for converting internet protocol call set-up messages to telephone call set-up messages.

37. The apparatus of claim 29, wherein the signaling gateway comprises means for converting internet session initiation protocol messages to telephone call set-up messages.

38. The apparatus of claim 29, wherein the signaling gateway is also configured to convert telephone call set-up messages to internet protocol call set-up messages.

39. The apparatus of claim 29, wherein the signaling gateway is also configured to convert telephone call set-up messages to internet session initiation protocol messages.

40. A virtual private network apparatus for providing virtual private network services between a public switched telephone network and an internet protocol (IP) network, comprising:

a signaling gateway configured to receive internet telephony signal protocol signals, the internet telephony signal protocol signals providing call signaling for a call initiated by a caller, the signaling gateway being configured to convert the internet telephony signal protocol signals to telephony signaling protocol signals to thereby establish a call between a caller and a callee; and

a media gateway coupled to the signaling gateway, the media gateway being configured to receive internet protocol transport signals, the internet protocol transport

signals being configured to transport call content, the media gateway being configured to convert the internet protocol transport signals into telephony time division multiplexed signals to exchange the call content between the caller and the callee.

41. The apparatus of claim 40, wherein the telephony signaling protocol signals are signaling system 7 signals.

42. The apparatus of claim 40, wherein the telephony signaling protocol signals are ISDN signals.

43. The apparatus of claim 40, wherein the telephony signaling protocol signals are channel associated signaling signals.

44. The apparatus of claim 40, wherein the internet telephony signaling protocol signals are session initiation protocol signals.

45. The apparatus of claim 40, wherein the internet protocol transport signals are real-time transport protocol signals.

46. The apparatus of claim 40, wherein the signaling gateway comprises means for converting internet protocol call set-up messages to telephone call set-up messages.

47. The apparatus of claim 40, wherein the signaling gateway comprises means for converting internet session initiation protocol messages to telephone call set-up messages.

48. The apparatus of claim 40, wherein the signaling gateway is also configured to convert telephone call set-up messages to internet protocol call set-up messages.

49. The apparatus of claim 40, wherein the signaling gateway is also configured to convert telephone call set-up messages to internet session initiation protocol messages.

50. A method for providing virtual private network services in a virtual private, network that includes a public switched telephone network (PSTN) and an internet

protocols network, the method comprising:

receiving a call from a first portion of the virtual private network virtual private network, call signaling being provided by telephony signaling protocol signals and call media being transmitted by telephony time division multiplexed signals;

converting the telephony signaling protocol signals to internet telephony signal protocol signals to thereby establish a session between the caller and a callee disposed in a second portion of the virtual private network; and

converting the telephony time division multiplexed signals to internet protocol transport signals to thereby exchange call content media between the caller and the callee during the session.

51. The method of claim 50, wherein the telephony signaling protocol signals are signaling system 7 signals.

52. The method of claim 50, wherein the telephony *signaling* protocol signals are ISDN signals.

53. The method of claim 50, wherein the telephony signaling protocol signals are channel associated signaling signals.

54. The method of claim 50, wherein the internet telephony signaling protocol signals are session initiation protocol signals.

55. The method of claim 50, wherein the internet protocol transport signals are real-time transport protocol signals.

56. The method of claim 50, further comprising:

converting internet protocol call set-up messages to telephone call set-up messages.

57. The method of claim 50, further comprising:

converting internet session initiation protocol messages to telephone call set-up messages.

58. The method of claim 50, further comprising converting telephone call set-up messages to internet protocol call set-up messages.

59. The method of claim 50, further comprising converting telephone call set-up messages to internet session initiation protocol messages.