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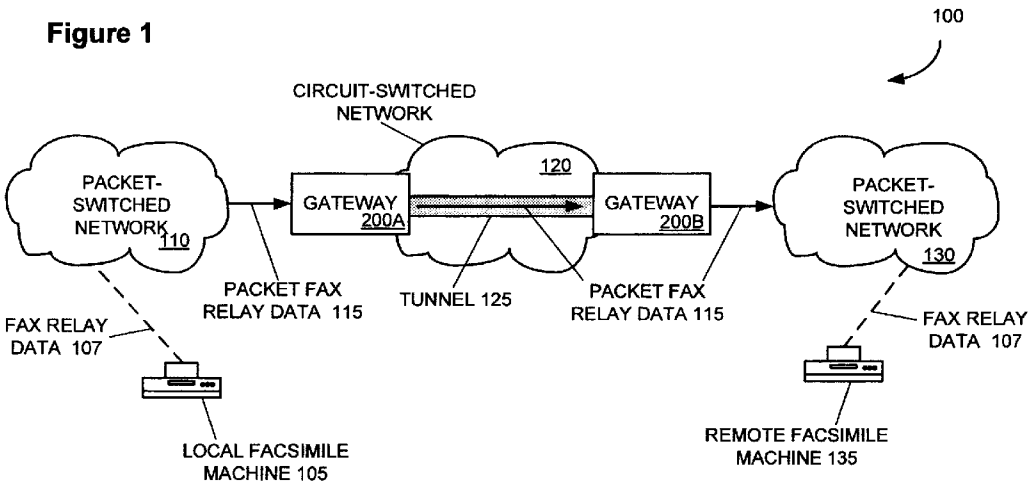
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(54) Title: FAX RELAY TUNNELING

Figure 1



(57) Abstract: A system comprising a first network gateway coupled to a circuit-switched network, the first network gateway to initiate a tunnel through the circuit-switched network responsive to packetized fax relay data received from a packet-switched network, and a second network gateway couple to the circuit-switched network, the second network gateway to receive packetized fax relay data through a tunnel over the circuit-switched network from the first network gateway.

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FAX RELAY TUNNELING

FIELD OF THE INVENTION

This invention relates generally to network communications.

BACKGROUND

Real time fax relay, for example, implemented with a T.30 protocol, allows a local facsimile machine to send fax pages over one or more networks to a remote facsimile machine, such that the remote facsimile machine receives the fax pages while the local facsimile machine is still transmitting the fax pages. Due to real time nature of these fax transmissions, the T.30 protocol includes timeout functionality that allows the local facsimile machine to retransmit data from a fax page that was incorrectly received by the remote facsimile machine.

When there is excessive transmission delay over the communication network, the remote facsimile machine will trigger timeouts requesting the local facsimile machine retransmit the delayed data. This transmission delay may be caused when at least one of the networks are bandwidth constrained, or by other inherent properties of the networks. For instance, when one of the networks is an IP network, the total transmission delay increases with demodulation, packetization, and remodulation of fax data as well as the addition of de-jitter buffers. Previously, IP gateways spoofed the local facsimile machine into a "hold off" condition, forcing a postponement of the retransmission of fax data until the transmission delay lessened.

Fax pages are often transmitted through multiple tandemly coupled communication networks, such as a TDM network coupled between IP networks, requiring a conversion from packet encoding to an analog signal that adds to the total transmission delay. The transmission delay due to network conversion further

increases with each additional tandemly coupled network. Since the transmission delay due to network conversion is systemically-based according to network configuration, many IP gateways will spoof or "hold off" retransmissions indefinitely thus locking up real time fax relay.

DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates an example system implementing fax relay tunneling.

Figure 2 illustrates example embodiments of a gateway shown in Figure 1.

Figure 3 shows an example method for implementing fax relay tunneling.

DETAILED DESCRIPTION

Overview

In network communications, an example system implementing fax relay tunneling includes a first network gateway coupled to a circuit-switched network, the first network gateway to initiate a tunnel through the circuit-switched network responsive to packetized fax relay data received from a packet-switched network, and a second network gateway couple to the circuit-switched network, the second network gateway to receive packetized fax relay data through a tunnel over the circuit-switched network from the first network gateway.

Description

Figure 1 illustrates an example system 100 implementing fax relay tunneling. Referring to Figure 1, a real time fax relay system 100 includes a local facsimile machine 105 to send fax relay data 107 to a remote facsimile machine 135 over at least a plurality of networks 110, 120, and 130. For instance, the networks 110, 120, and 130 may be tandem networks where a circuit-switched network 120 is coupled between two packet-switched networks 110 and 130 along the path from the local facsimile machine 105 to remote facsimile machine 135. Although not shown in

Figure 1, many additional networks may be coupled between local facsimile machine 105 and packet-switched network 110, and/or between remote facsimile machine 135 and packet-switched network 130.

The local facsimile machine 105 transmits fax relay data 107 to a gateway 200A over the packet-switched network 110. In some embodiments, the fax relay data 107 may be converted to packet fax relay data 115 by an intermediate gateway or other networking device (not shown) prior to traversing the packet-switched network 110. The packet fax relay data 115 may correspond to at least a portion of fax pages scanned for real time fax relay protocol transmission, e.g., T.30 protocol, to the remote facsimile machine 135. The local facsimile machine 105 may packetized the fax relay data 107 or the packetization may be performed by another device (not shown) located in the packet switched network 110 or between the packet-switched network 110 and the local facsimile machine 105.

The gateway 200A receives packet fax relay data 115 from the packet-switched network 110 and forwards the data over the circuit-switched network 120 for eventual receipt by the remote facsimile machine 135. The gateway 200A identifies another gateway 200B capable of receiving the packet fax relay data 115 in a tunnel 125 through the circuit-switched network 120. In some embodiments, the gateway 200A identifies that gateway 200B is coupled to another packet-switched network 130 and that the gateway 200B may forward the packet fax relay data 115 towards the remote facsimile machine 135 over the packet-switched network 130. When a suitable gateway endpoint for receiving the packet fax relay data 115 in a tunnel 125 through the circuit-switched network 120 cannot be identified, the gateway 200A may convert the packet fax relay data 115 to analog signals, e.g., TDM bearer signals, for transport over the circuit-switched network 120.

The gateway 200A initiates a tunnel 125 through the circuit-switched network 120 for transporting packet fax relay data 115 to gateway 200B. The gateway 200B may send the packet fax relay data 115 received in tunnel 125 to the remote facsimile machine 135 over the packet-switched network 130 according to the real time fax relay protocol. The packet fax relay data 115 received in tunnel 125 may be provided to the remote facsimile machine 135 over one or more additional networks (not shown) and may require additional data conversion and/or tunneling prior to reception at the remote facsimile endpoint 135. In some embodiments, the packet fax relay data 115 may be converted to fax relay data 107 by an intermediate gateway or other networking device (not shown) located in the packet-switched network 130 prior to being forwarded to the remote facsimile endpoint 135 over at least one additional network (not shown).

By tunneling the packet fax relay data 115 through the circuit-switched network 120, instead of converting them to TDM bearer signals, the gateway 200B does not have to reconvert the TDM bearer signals back to packet fax relay data 115 when received from the circuit-switched network 120. Furthermore, since conversions from packet encoding to analog signal encoding require de-jitter buffering of the packet fax relay data 115 to ensure synchronous analog signals are provided over the circuit-switched network 120, tunneling the packet fax relay data 115 through the circuit-switched network 120 may reduce the overall delay in the transmission of fax relay data 107 between local facsimile machine 105 and remote facsimile machine 135.

Figure 2 illustrates example embodiments of a gateway 200 shown in Figure 1. Referring to Figure 2, the gateway 200 includes a packet-switched network interface 210 for exchanging data over a packet-switched network 110 or 130. The

packet-switched network interface 210 may receive packet fax relay data 115 from the packet-switched network 110 for transmission over the circuit-switched network 120 to a recipient endpoint, such as gateway 200B or other networking device. The packet-switched network interface 210 may provide a packet indicator 215 to a signaling controller 220 responsive to the receipt of the packet fax relay data 115. In some embodiments, the packet-switched network interface 210 may include a de-jitter buffer (not shown) for storing and organizing the received packet fax relay data 115.

The signaling controller 220 may generate tunneling signals 225 responsive to the packet indicator 215. The tunneling signals 225 may be sent to gateway 200B over the circuit-switched network 120 via a circuit-switched network interface 230 or through out-of-band signaling. When the tunneling signals 225 are sent in-band over the circuit-switched network 120, the signaling controller 220 embeds the tunneling signals 225 into, e.g., a TDM data stream, without affecting the voice or fax quality of the TDM connection. In some embodiments, the signaling controller 220 may embed the tunneling signals 225 in every voice or data 8 samples.

The tunneling signals 225 may request identification of a recipient endpoint, i.e., gateway 200B, including whether the recipient endpoint is capable of receiving tunneled packet fax relay data 115. The recipient endpoint may respond to the tunneling signals 225 affirming that it is capable of receiving tunneled packet fax relay data 115 from the gateway 200.

In some embodiments, the signaling controller 220 may generate tunneling signals 225 that broadcast the capabilities of the gateway 200. The broadcasting may be performed periodically, intermittently, sporadically, etc. Thus, all gateways 200 receiving the broadcast will understand the capabilities of the transmitting gateway 200.

In some embodiments, the signaling controller 220 may access a tunnel memory 260 to determine if there is a recipient endpoint that has previously received tunnel data from the gateway 200. The tunnel memory 260 may include one or more identifiers associated with recipient endpoints capable of receiving tunneled data. When there is a recipient endpoint identified in the tunnel memory 260, the signaling controller 220 may generate a tunneling signal 225 that alerts the recipient endpoint of a tunnel and data that the gateway is going to provide. In some embodiments, the signaling controller 220 determines to not generate tunneling signals 225 responsive to identifying the recipient endpoint in the tunnel memory 260. The tunnel memory 260 may also identify recipient endpoints that cannot receive tunnel data. The signaling controller 220 may determine to not send tunneling signals 225 responsive to identifying a recipient endpoint that cannot receive tunnel data.

When receiving tunneling signals 225, the circuit-switched network interface 230 forwards them to a signaling detector 240 for analysis. The signaling detector 240 may determine to send the packet fax relay data 115 to the recipient endpoint responsive the tunneling signals 225 and prompt a tunneling mechanism 250 to initiate a tunnel through the circuit-switched network 120 for the transport of the packet fax relay data 115. In some embodiments, the tunneling mechanism 250 may include a de-jitter buffer (not shown) for storing and organizing packet fax relay data 115 received from the packet-switched network interface 210 when prompted by the signaling detector 240, for example, during non-tunneling events.

The signaling detector 240 may also provide information to the signaling controller 220 for use in updating the tunnel memory 260 or for responding to the received tunneling signals 225. In some embodiments, when there is a broadcast by a gateway 200 received at circuit-switched network interface 230, the receiving

gateway 200 may update the tunnel memory 260 according to the contents of the broadcast.

The tunneling mechanism 250 may include some signaling (not shown) within transmissions through the circuit-switched network 120 indicating to the recipient endpoint that the data included is packet encoded. This signaling may be similar to the tunneling signals 225 sent by the signaling controller 220. In some embodiments, the signaling controller 220 provides the signaling (not shown) within transmissions through the circuit-switched network 120 indicating to the recipient endpoint that the data included is packet encoded

Figure 3 shows an example method for implementing fax relay tunneling. Referring to Figure 3, in a block 310, a gateway 200A receives packet fax relay data 115 from a packet-switched network 110. The packet fax relay data 115 may be at least a portion of a fax page in transit between a local facsimile machine 105 and a remote facsimile machine 135.

In a block 320, the gateway 200A identifies at least one remote gateway 200B to receive the packet fax relay data 115 in a tunnel through a circuit-switched network 120. The gateway 200A may identify that gateway 200B can receive tunnel packet fax relay data 115 by sending tunneling signals 225 to the gateway 200B requesting a response including the capabilities of the gateway 220B, or by accessing a tunnel memory 260 to determine whether the gateway 200B has received tunneled data previously or if the gateway 200B sent a previous broadcast of its capabilities.

The gateway 200A may also determine whether gateway 200B should receive packet fax relay data 115 in tunnel 125 through circuit-switched network 120. For instance, when gateway 200B is not coupled to another packet-switched network 130 in a tandem IP network configuration, the gateway 200A may optionally determine to

convert the packet fax relay data 115 instead of tunnel the data 115 through circuit-switched network 120.

In a block 330, the gateway 220A transmits the packet fax relay data 115 to gateway 200B in a tunnel 125 through the circuit-switched network 120. The gateway 220A may initiate the tunnel 125 responsive to identifying that gateway 200B can receive tunneled packet fax relay data 115, as described above referencing block 320.

One of skill in the art will recognize that the concepts taught herein can be tailored to a particular application in many other advantageous ways. In particular, those skilled in the art will recognize that the illustrated embodiments are but one of many alternative implementations that will become apparent upon reading this disclosure. Although Figures 1-3 describe tunneling through a circuit-switched network with fax relay data, embodiments of present invention may tunnel other types of data and/or with different protocols.

The preceding embodiments are exemplary. Although the specification may refer to "an", "one", "another", or "some" embodiment(s) in several locations, this does not necessarily mean that each such reference is to the same embodiment(s), or that the feature only applies to a single embodiment.

CLAIMS

1. A device comprising:

a packet-switched network interface to receive packetized fax relay data from a packet-switched network, the packetized fax relay data exchanged between multiple facsimile machines implementing a real time relay fax protocol; and

a tunneling mechanism to initiate a tunnel through a circuit-switched network for transmission of the packetized fax relay data.

2. The device of claim 1 including a signaling unit to provide tunneling signals to at least one remote networking device over the circuit-switched network, the tunneling signals to indicate availability to tunnel through the circuit-switched network.

3. The device of claim 2 where the tunneling signals include tunneling capabilities of the device.

4. The device of claim 2 where the tunneling signals include a media type associated with the tunneling.

5. The device of claim 1 including a signaling unit to provide out-of band tunneling signals to at least one remote networking device located over the circuit-switched network, the tunneling signals to indicate availability to tunnel through the circuit-switched network.

6. The device of claim 1 including a tunneling memory to store identifiers of remote networking devices that have tunneling capabilities and a signaling unit to provide tunneling signals to the remote networking device associated with the identifiers that alert the remote networking device of an impending tunneling event through the circuit-switched network.

7. The device of claim 1 including a signal detector to receive tunneling signals from at least one remote networking device over the circuit-switched network, the tunneling signals to request tunneling through the circuit-switched network.

8. A method comprising:

receiving packetized fax relay data from a packet-switched network, the packetized fax relay data exchanged between multiple facsimile machines implementing a real time relay fax protocol;

identifying at least one remote networking device to receive the packetized fax relay data in a tunnel through a circuit-switched network; and

transmitting the packetized fax relay data over the circuit-switched network through the tunnel.

9. The method of claim 8 includes providing tunneling signals to at least one remote networking device over the circuit-switched network, the tunneling signals to indicate availability to tunnel through the circuit-switched network.

10. The method of claim 9 where the tunneling signals include tunneling capabilities of the device.

11. The method of claim 9 where the tunneling signals include a media type associated with the tunneling.

12. The method of claim 8 includes providing out-of band tunneling signals to at least one remote networking device located over the circuit-switched network, the tunneling signals to indicate availability to tunnel through the circuit-switched network.

13. The method of claim 8 includes

storing identifiers of remote networking devices that have tunneling capabilities; and

providing tunneling signals to the remote networking device associated with the identifiers that alert the remote networking device of an impending tunneling event through the circuit-switched network.

14. The method of claim 8 includes

receiving tunneling signals from at least one remote networking device over the circuit-switched network; and

detecting that the tunneling signals to request tunneling through the circuit-switched network.

15. The method of claim 8 includes

identifying a connection to a remote networking device generates a tandem IP network configuration; and

sending data to the remote networking device in a tunnel through the circuit-switched network.

16. A system comprising:

a first network gateway coupled to a circuit-switched network, the first network gateway to initiate a tunnel through the circuit-switched network responsive to packetized fax relay data received from a packet-switched network; and

a second network gateway couple to the circuit-switched network, the second network gateway to receive packetized fax relay data through a tunnel over the circuit-switched network from the first network gateway.

17. The system of claim 16 where the first network gateway includes a signaling unit to provide tunneling signals to the second network gateway over the circuit-switched network, the tunneling signals to request a tunnel between the first network gateway and the second network gateway through the circuit-switched network.

18. The system of claim 16 where the first network gateway includes a signaling unit to provide out-of band tunneling signals to the second network gateway, the tunneling signals to request a tunnel between the first network gateway and the second network gateway through the circuit-switched network.

19. The system of claim 16 where the first network gateway includes a tunneling memory to store an identifier of the second network gateway, the identifier indicating that the second network gateway has tunneling capabilities, the first

network gateway to provide tunneling signals to the second network gateway alerting the second network gateway of an impending tunneling event through the circuit-switched network.

20. The system of claim 16 where the second network gateway includes a signal detector to receive tunneling signals from the first network gateway over the circuit-switched network, the tunneling signals to request tunneling through the circuit-switched network.

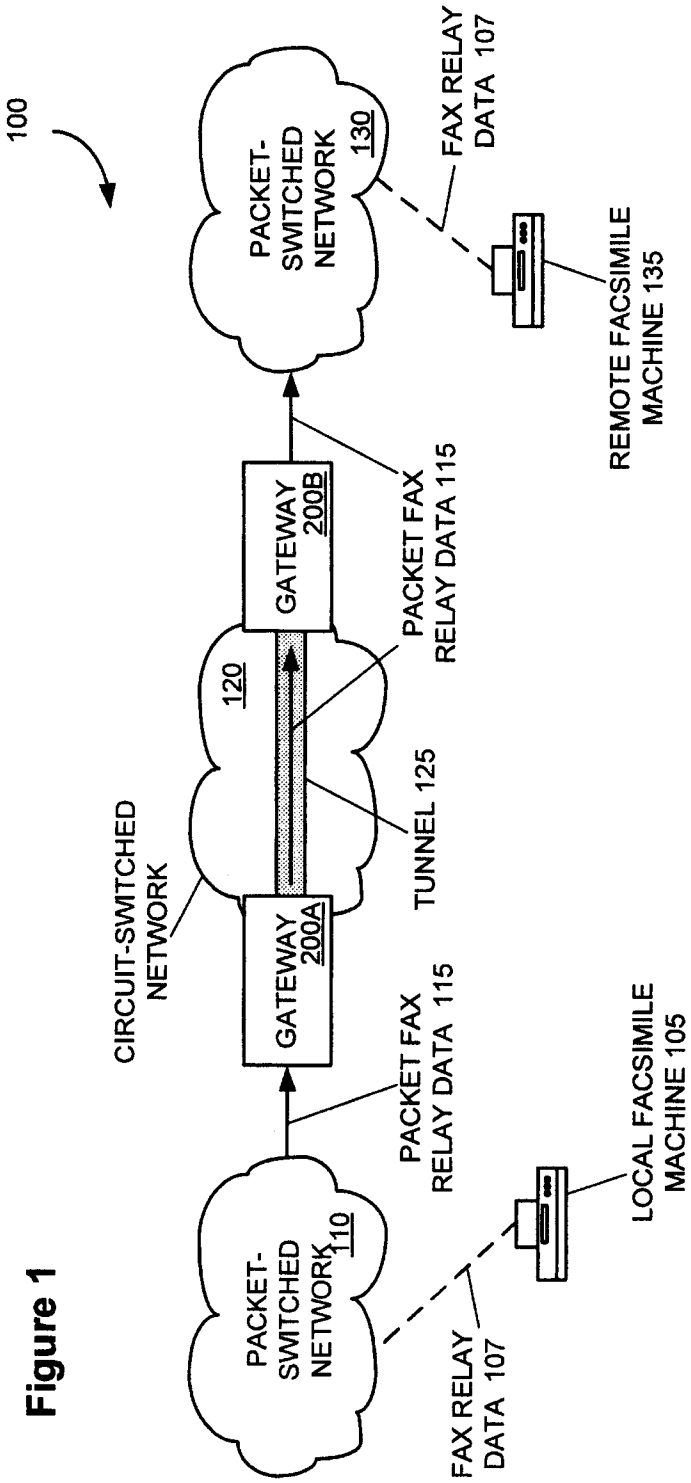

100
PACKET-SWITCHED NETWORK 130
FAX RELAY DATA 107
REMOTE FACSIMILE MACHINE 135
GATEWAY 200B
PACKET FAX RELAY DATA 115
120
CIRCUIT-SWITCHED NETWORK
TUNNEL 125
GATEWAY 200A
PACKET FAX RELAY DATA 115
PACKET-SWITCHED NETWORK 110
LOCAL FACSIMILE MACHINE 105
FAX RELAY DATA 107

Figure 1

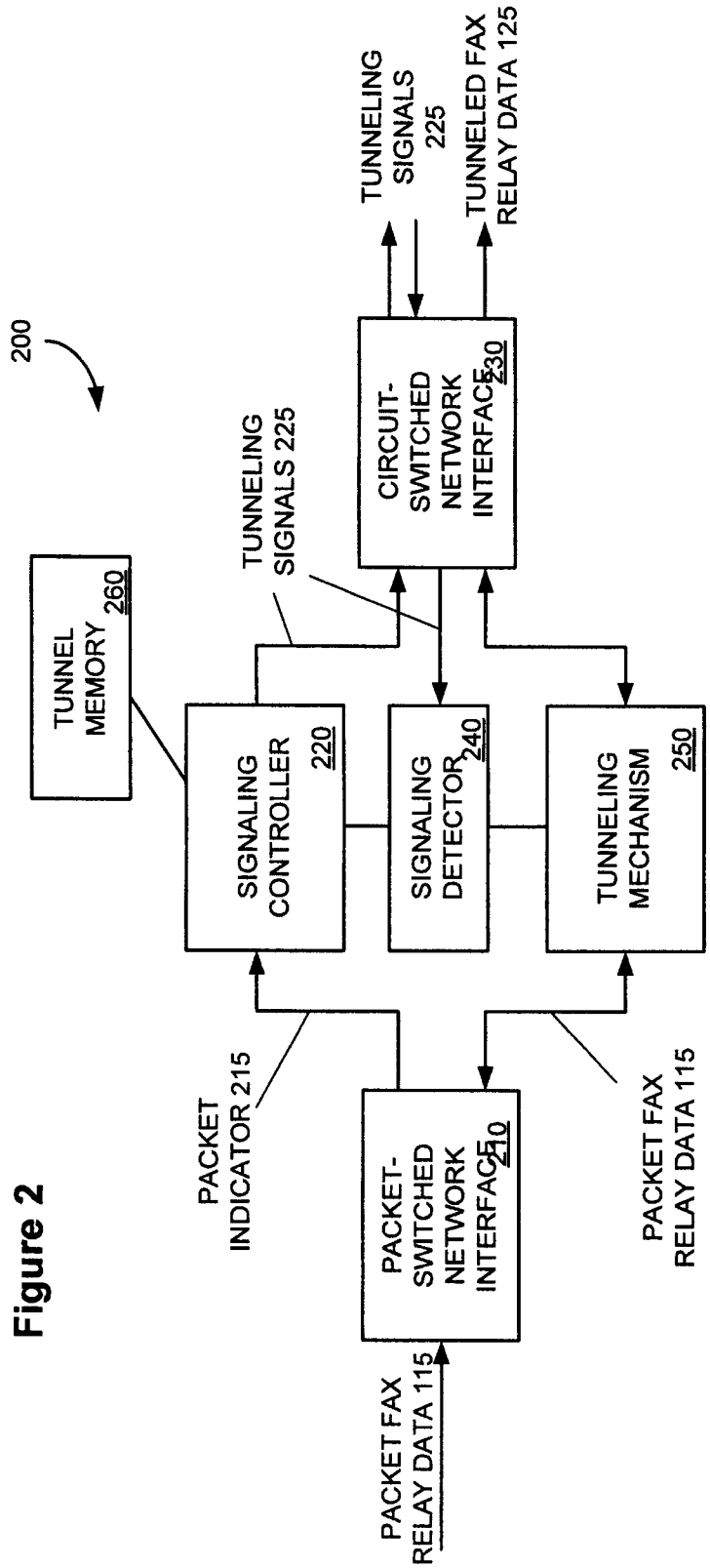
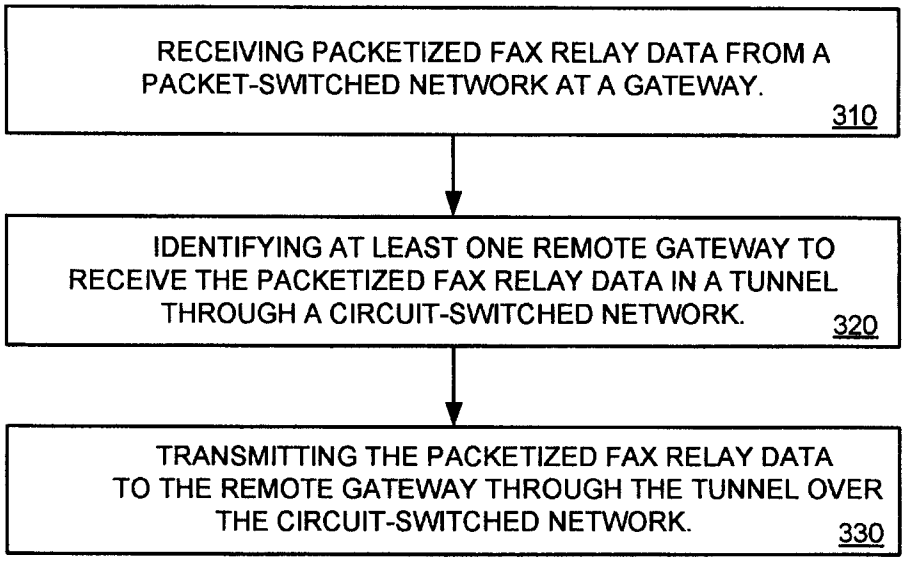

200
TUNNEL MEMORY 260
TUNNELING SIGNALS 225
CIRCUIT-SWITCHED NETWORK INTERFACE 230
TUNNELING SIGNALS 225
TUNNELED FAX RELAY DATA 125
SIGNALING CONTROLLER 220
SIGNALING DETECTOR 240
TUNNELING MECHANISM 250
PACKET INDICATOR 215
PACKET-SWITCHED NETWORK INTERFACE 210
PACKET FAX RELAY DATA 115
PACKET FAX RELAY DATA 115

Figure 2

Figure 3


RECEIVING PACKETIZED FAX RELAY DATA FROM A PACKET-SWITCHED NETWORK AT A GATEWAY.
310
IDENTIFYING AT LEAST ONE REMOTE GATEWAY TO RECEIVE THE PACKETIZED FAX RELAY DATA IN A TUNNEL THROUGH A CIRCUIT-SWITCHED NETWORK.
320
TRANSMITTING THE PACKETIZED FAX RELAY DATA TO THE REMOTE GATEWAY THROUGH THE TUNNEL OVER THE CIRCUIT-SWITCHED NETWORK.
330

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/058844

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/66

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 01/97481 A (NOKIA CORP [FI]; LEHTO PEKKA [FI]) 20 December 2001 (2001-12-20) page 2, line 7 - line 22	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search	Date of mailing of the international search report
2 September 2008	08/09/2008

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/058844

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0197481 A	20-12-2001	AU 5681300 A	24-12-2001
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