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(19) **United States**(12) **Patent Application Publication**
Eng et al.(10) **Pub. No.: US 2004/0243503 A1**(43) **Pub. Date: Dec. 2, 2004**(54) **METHOD AND A SYSTEM FOR
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New York, NY 10176 (US)(73) Assignee: **Arbinet-thexchange, Inc.**(21) Appl. No.: **10/816,365**(22) Filed: **Apr. 1, 2004****Related U.S. Application Data**(63) Continuation-in-part of application No. 09/996,837,
filed on Nov. 29, 2001, now Pat. No. 6,731,729,
which is a continuation-in-part of application No.
09/692,769, filed on Oct. 18, 2000, now Pat. No.
6,542,588, which is a continuation of application No.
09/129,413, filed on Aug. 5, 1998, now Pat. No.
6,226,365, which is a continuation-in-part of appli-
cation No. 08/927,443, filed on Sep. 11, 1997, now
Pat. No. 6,005,926, and which is a continuation-in-
part of application No. 08/920,567, filed on Aug. 29,
1997, now abandoned.Said application No. 09/996,837 is a continuation-in-
part of application No. 09/551,190, filed on Apr. 17,
2000, now Pat. No. 6,442,258, which is a continua-
tion of application No. 09/213,703, filed on Dec. 17,
1998, now Pat. No. 6,144,727, which is a continua-
tion-in-part of application No. 09/129,413, filed on
Aug. 5, 1998, now Pat. No. 6,226,365, which is a
continuation-in-part of application No. 08/927,443,
filed on Sep. 11, 1997, now Pat. No. 6,005,926, and
which is a continuation-in-part of application No.
08/920,567, filed on Aug. 29, 1997, now abandoned.**Publication Classification**(51) **Int. Cl.⁷ G06F 17/60; H04M 15/00**
(52) **U.S. Cl. 705/37; 705/30**(57) **ABSTRACT**

A method of settling accounts of buyers and sellers of telecommunication services by an online exchange system includes storing data representing a financial account of at least one seller and at least one buyer, wherein the financial account includes at least one of accounts receivable and cash receipts. A service node receives an offer to sell the services from the at least one seller and requests to buy the services from the at least one buyer. The service node then matches the offers and requests in accordance with one or more parameters specified in the offers and requests. A route table is generated based on the routes specified in the matched offers and requests and a switch node is configured based on the route table. Fees are computed based on the usage of the matched routes and the financial accounts of the at least one seller and at least one buyer based on the computed fees.

INITIAL TRADING DATE (INFORMATION DUE 3 DAYS PRIOR TO): 3/1/97					
CARRIER: USAGLOBAL	ID #: A45B6F9	PASSWORD: *****	SUBMITTED: 2/24/97		
312	304	310	318	306	308
U.S. TO*:	QUALITY A#	PRICE/CAPACITY	#	101k-500k**	TIME AVAILABLE
AFGHANISTAN (CC 93)	1.200	M-F 17-3/SS all	24	1.185	M-F 14-10/SS all
314	318	322	324	320	
ALBANIA (CC 355)	0.625	M-F 22-8/SS12-18	175	0.598	M-F 20-24/SS5-18
Tirane (42)	0.601	M-F 22-8/SS12-18	90	0.555	M-F 20-24/SS5-18
Durres (52)	0.625	M-F 22-8/SS12-18	50	0.598	M-F 20-24/SS5-18
Elbassan (545)	0.625	M-F 22-8/SS12-18	25	0.598	M-F 20-24/SS5-18
314 Korce (824)	0.625	M-F 22-8/SS12-18	50	0.598	M-F 20-24/SS5-18
Shkoder (224)	0.625	M-F 22-8/SS12-18	90	0.598	M-F 20-24/SS5-18
*CARRIER WILL CHOOSE U.S./FOREIGN ORIGINATION, CAPACITY RANGES AND QUALITY DESCRIPTION OFFERED ON TEMPLATE, AND WILL ENTER SPECIFIC DATA ACCORDINGLY.					
**CARRIER WILL CHOOSE CAPACITY NUMBERS, IN MULTIPLES OF 100k.					
#RATES WILL BE GUARANTEED TO MEET DEFINING QUALITY CONSIDERATIONS.					

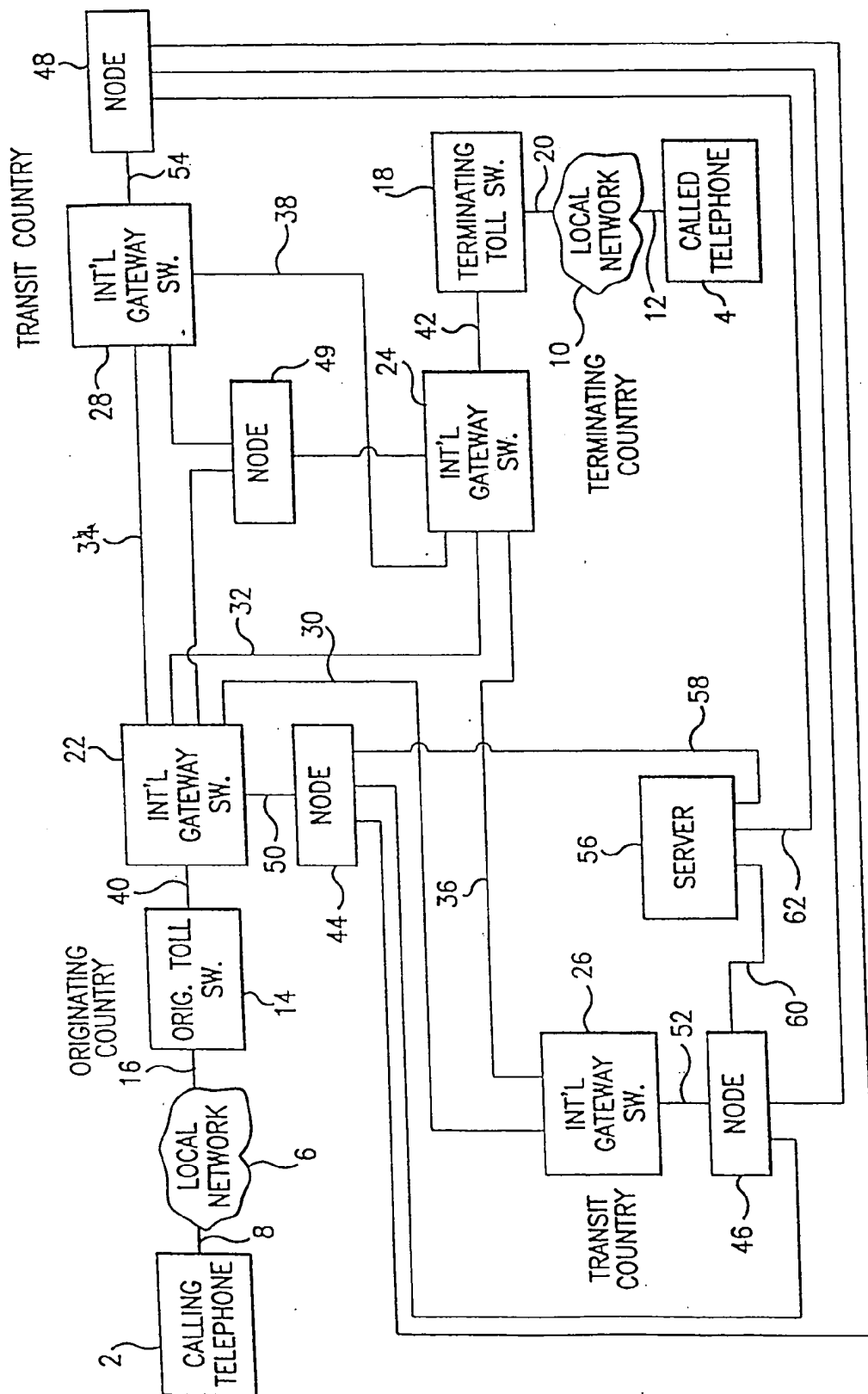


FIG. 1A

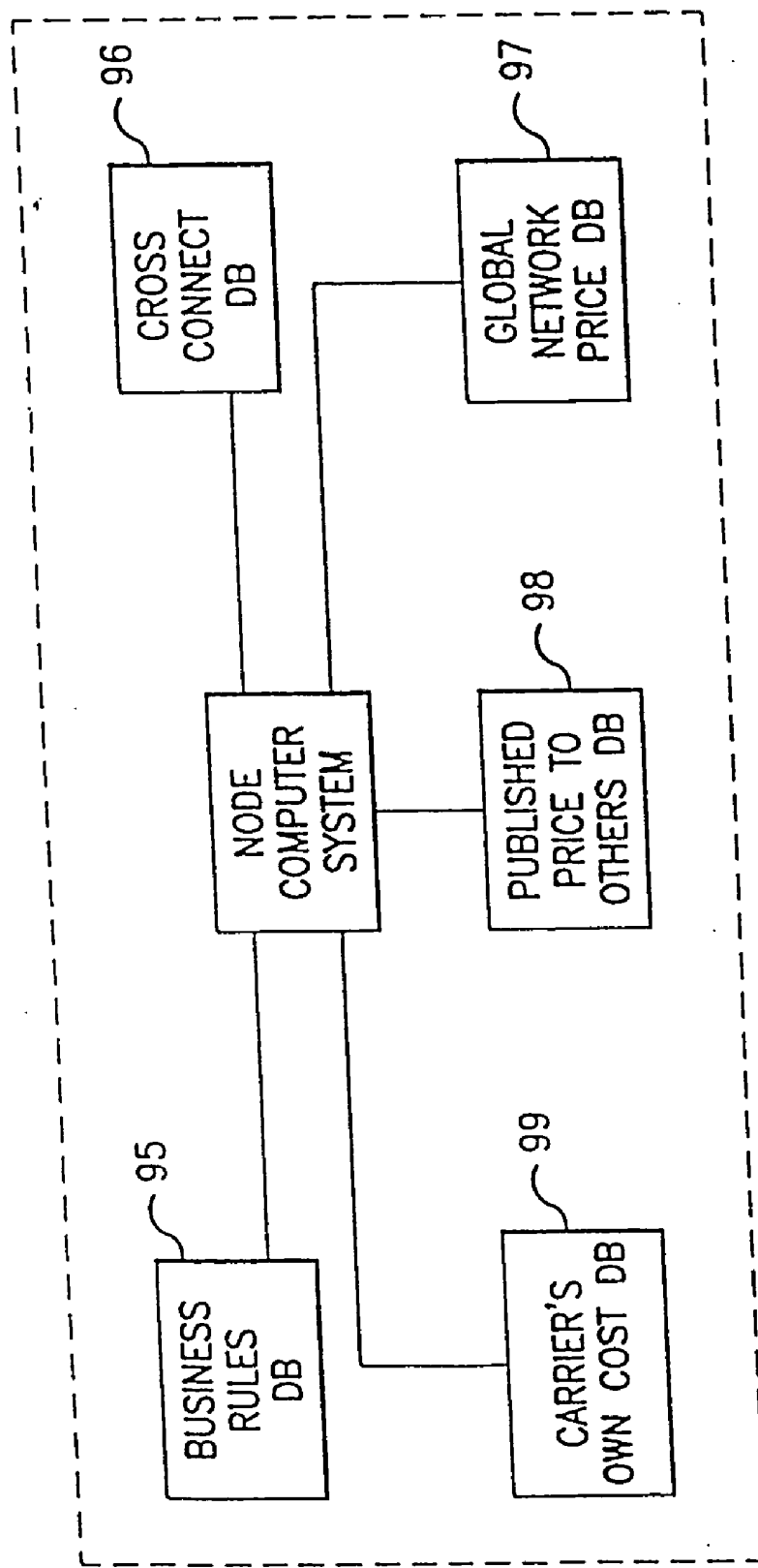


FIG. 1B

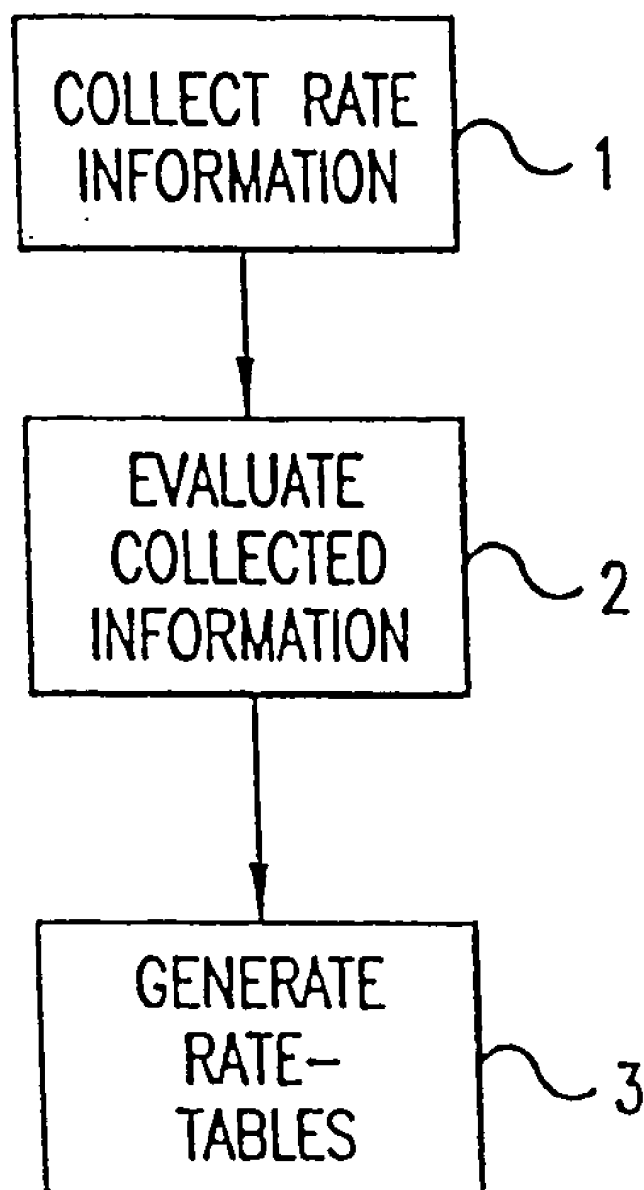


FIG.2

302

INITIAL TRADING DATE(INFORMATION DUE 3 DAYS* PRIOR TO): 3/1/97

CARRIER: USAGLOBAL	ID #:	A45B6F9	PASSWORD: *****	SUBMITTED: 2/24/97		
312	304	QUALITY A #	PRICE/CAPACITY	318 #	306	318
U.S. TO*:		LIST:	1k-100k **	TIME AVAILABLE	CIRCUITS	101k-500k **
AFGHANISTAN (CC 93)		1.200	M-F 17-3/SS all	24	320	1.185 M-F 14-10/SS all
314	318	322	324	320		
314	1k-300k **	300k-800k **				
ALBANIA (CC 355)	0.625	M-F 22-8/SS12-18	175	0.598	M-F 20-24/SS5-18	100
Tirane (42)	0.601	M-F 22-8/SS12-18	90	0.555	M-F 20-24/SS5-18	100
Durres (52)	0.625	M-F 22-8/SS12-18	50	0.598	M-F 20-24/SS5-18	100
Elbassan (545)	0.625	M-F 22-8/SS12-18	25	0.598	M-F 20-24/SS5-18	100
314 Korce (824)	0.625	M-F 22-8/SS12-18	50	0.598	M-F 20-24/SS5-18	100
Shkoder (224)	0.625	M-F 22-8/SS12-18	90	0.598	M-F 20-24/SS5-18	100

* CARRIER WILL CHOOSE U.S./FOREIGN ORIGINATION, CAPACITY RANGES AND QUALITY DESCRIPTION OFFERED ON TEMPLATE, AND WILL ENTER SPECIFIC DATA ACCORDINGLY.

** CARRIER WILL CHOOSE CAPACITY NUMBERS, IN MULTIPLES OF 100k.

RATES WILL BE GUARANTEED TO MEET DEFINING QUALITY CONSIDERATIONS.

FIG. 3A

CUSTOMER ID: 000151
PASSWORD: EX4936
ORIGINATING: US
TERMINATING: HUNGARY
TERMINATING AREA CODES: ALL
REQUIRE LOCAL TERMINATION: NO
REQUIRE SETTLEMENT: YES
HOURS OF OPERATION: 0300 TO 1600
NUMBER OF MINUTES (PER MONTH): 200k
QUALITY: A (TOLL)
MAXIMUM PDD: 12 SECONDS
ALLOW PRIVATE LINE: YES
IF NO MATCH, SORT BY CLOSEST: SIZE OF COMPANY
LENGTH OF CONTRACT: 6 MOS.
ACCEPTABLE CARRIERS: ALL

FIG.3B

400

SERVICE: VOICE			
QUALITY A: Country	USA Global	RSL (ITC)	Primus
AFGHANISTAN (CC 93)	1.2010	1.6047	1.2500
ALBANIA (CC 355)	0.6195	0.5288	0.5540
Tirane (42)	0.6003	0.5288	0.5540
Durrës (52)	0.6195	0.5288	0.5540
Elbassan (545)	0.6195	0.5288	0.5540
Korce (824)	0.6195	0.5288	0.5540
Shkoder (224)	0.6195	0.5288	0.5540
ALGERIA (213) rest	0.6589	0.4650	0.5540
Bejaia (5)			
AMERICAN SAMOA (all)	0.6667	0.4984	0.6510
ANDORRA (FRANCE) (all)	0.4057	0.2438	0.5000

FIG.4

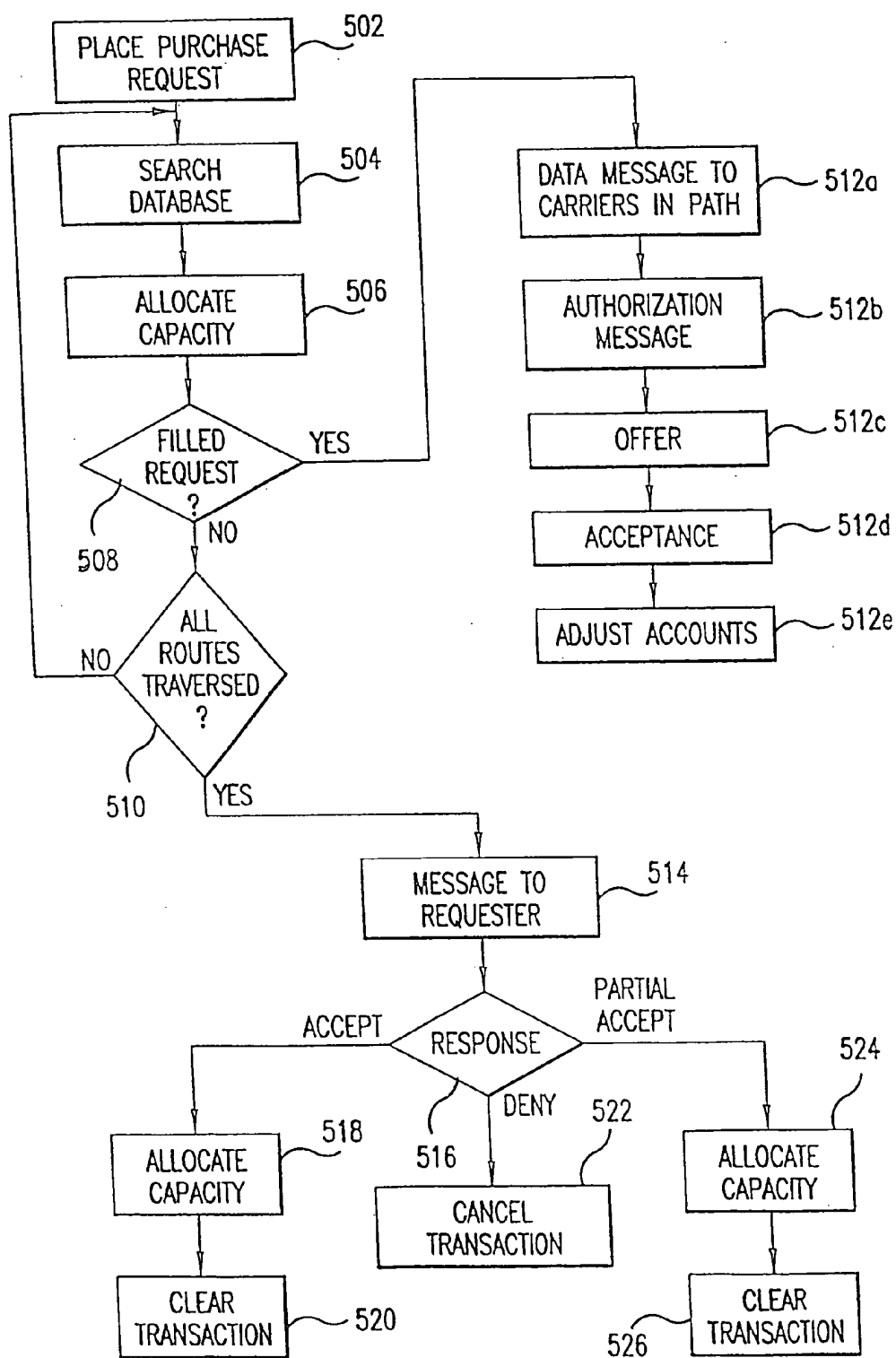


FIG.5

ROUTING	PRICE/MIN.	Q	R	TOTAL CAPACITY	AVAIL. CAP.	ALLOCATED CAP.
US-GERMANY	18 ¢	A	B	8	2	6
US-GERMANY	22 ¢	A	B	40	4	36
US-GERMANY	23 ¢	A	B	6	4	2
US-GERMANY	28 ¢	A	B	16	12	4
US-GERMANY	32 ¢	A	B	9	8	1
US-GERMANY	50 ¢	A	B	27	12	15

FIG. 6A

ROUTING	PRICE/MIN.	Q	R	TOTAL CAPACITY	AVAIL. CAP.	ALLOCATED CAP.
US-GERMANY	18 ¢	A	B	8	0	8
US-GERMANY	22 ¢	A	B	40	0	40
US-GERMANY	23 ¢	A	B	6	0	6
US-GERMANY	28 ¢	A	B	16	12	4
US-GERMANY	32 ¢	A	B	9	8	1
US-GERMANY	50 ¢	A	B	27	12	15

FIG. 6B

ROUTING	PRICE/MIN.	Q	R	TOTAL CAPACITY	AVAIL. CAP.	ALLOCATED CAP.
US-GERMANY	18 ¢	A	B	8	2	6
US-GERMANY	22 ¢	A	B	40	4	36
US-GERMANY	28 ¢	A	B	6	4	2
US-GERMANY	28 ¢	A	B	16	12	4
US-GERMANY	32 ¢	A	B	9	8	1
US-GERMANY	50 ¢	A	B	27	12	15

FIG. 6C

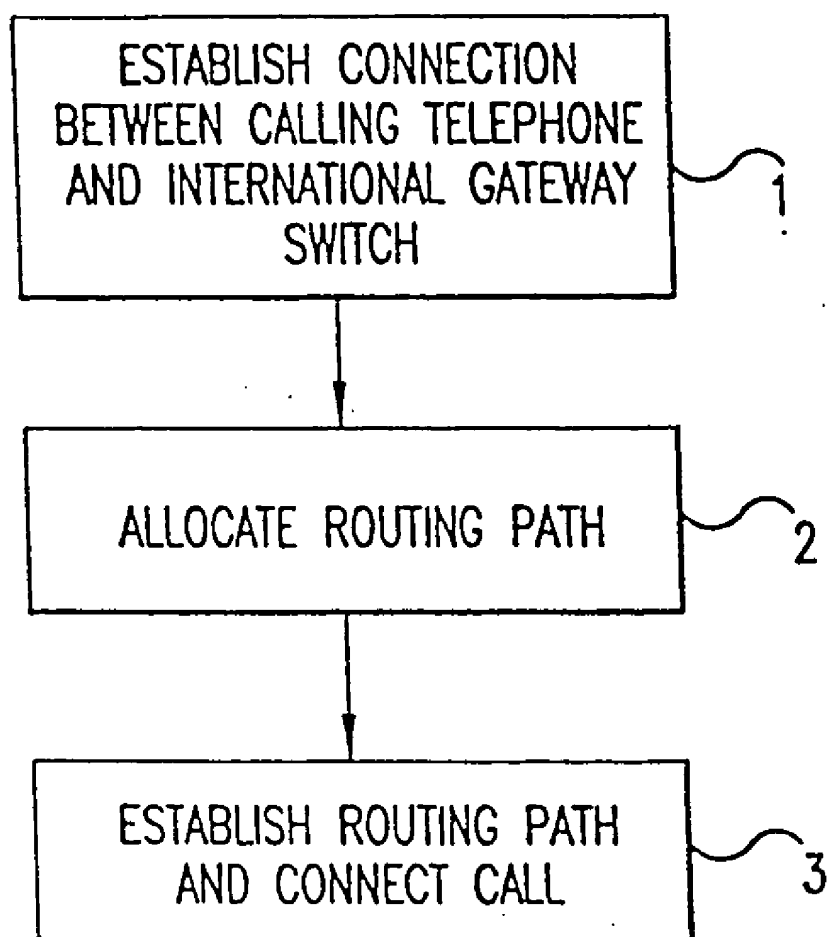


FIG.7

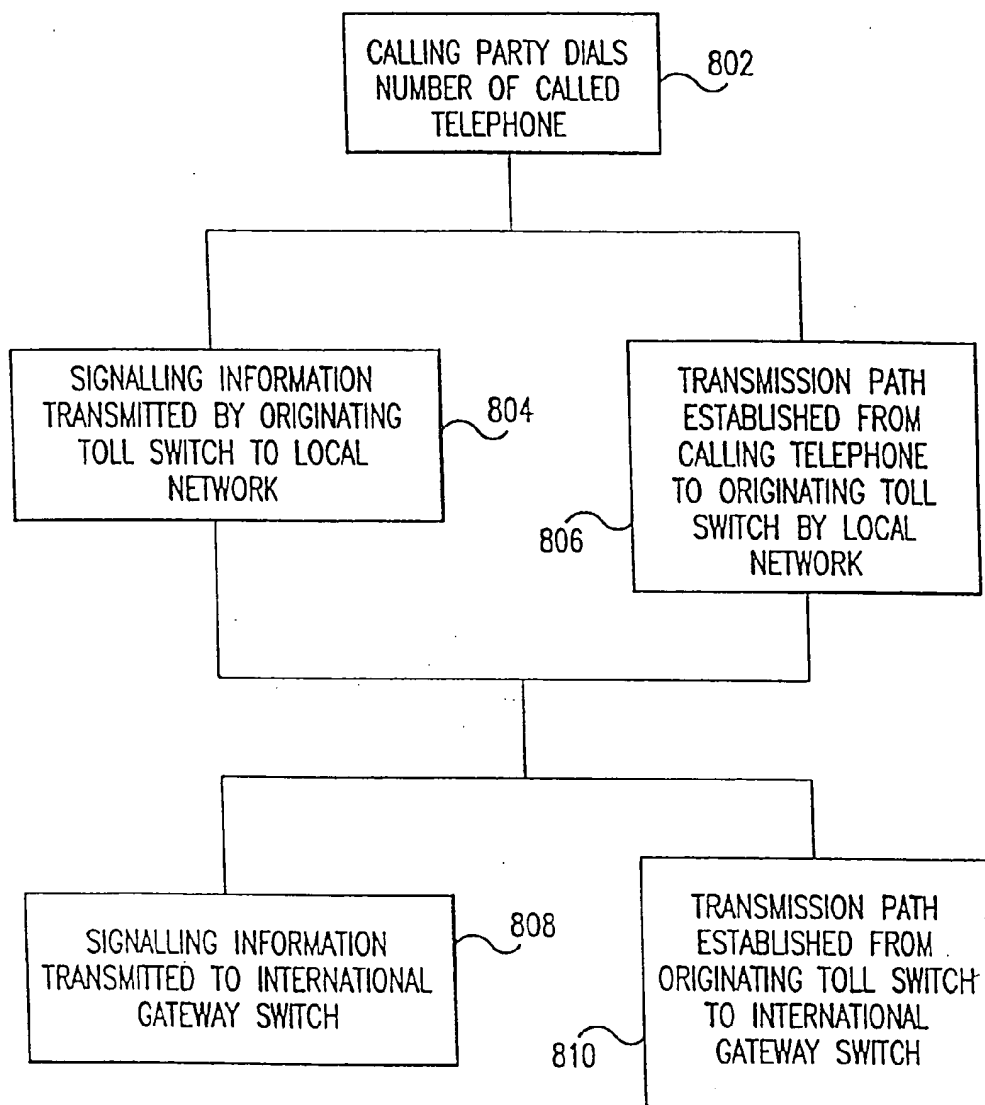


FIG.8

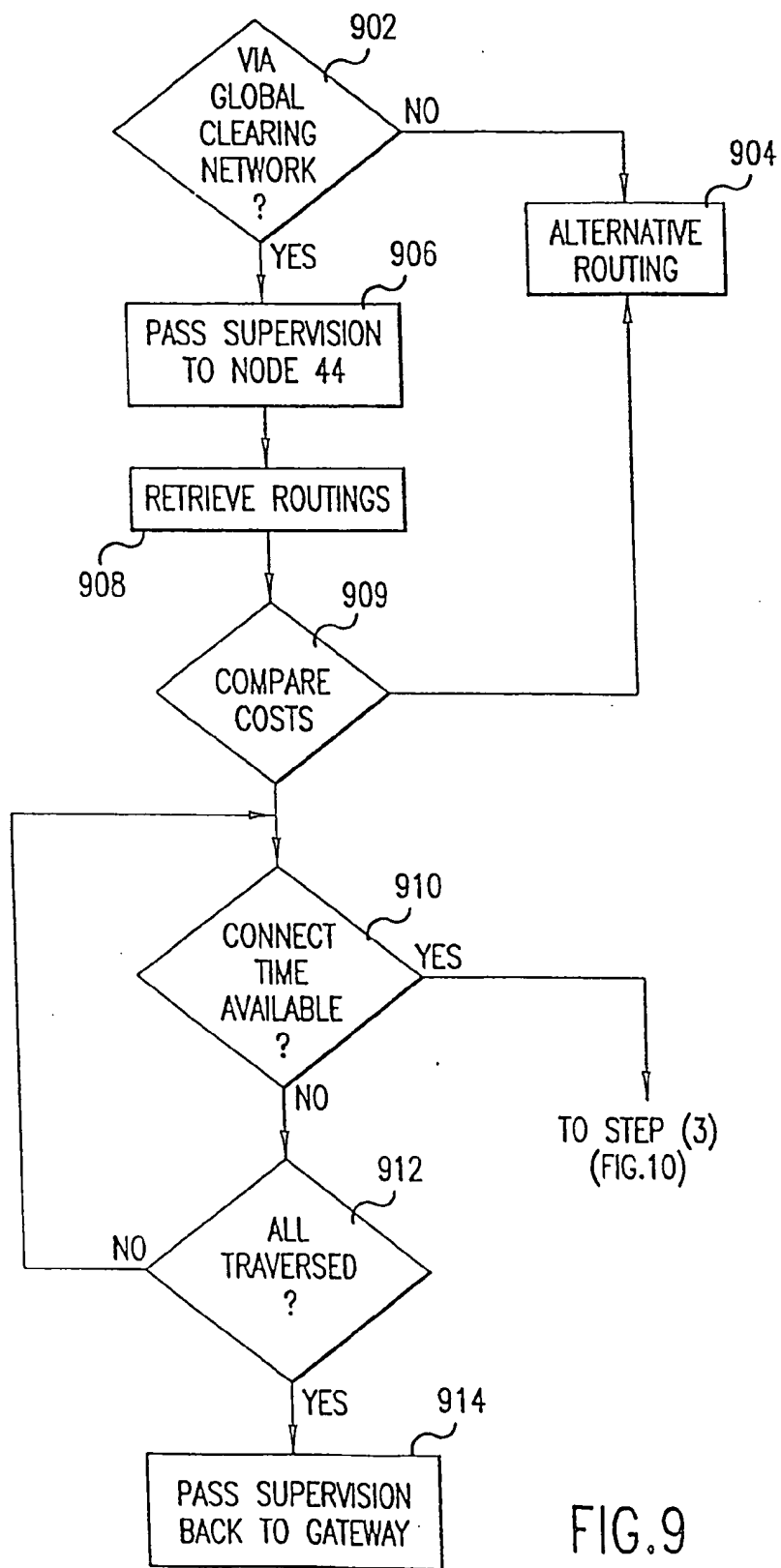


FIG.9

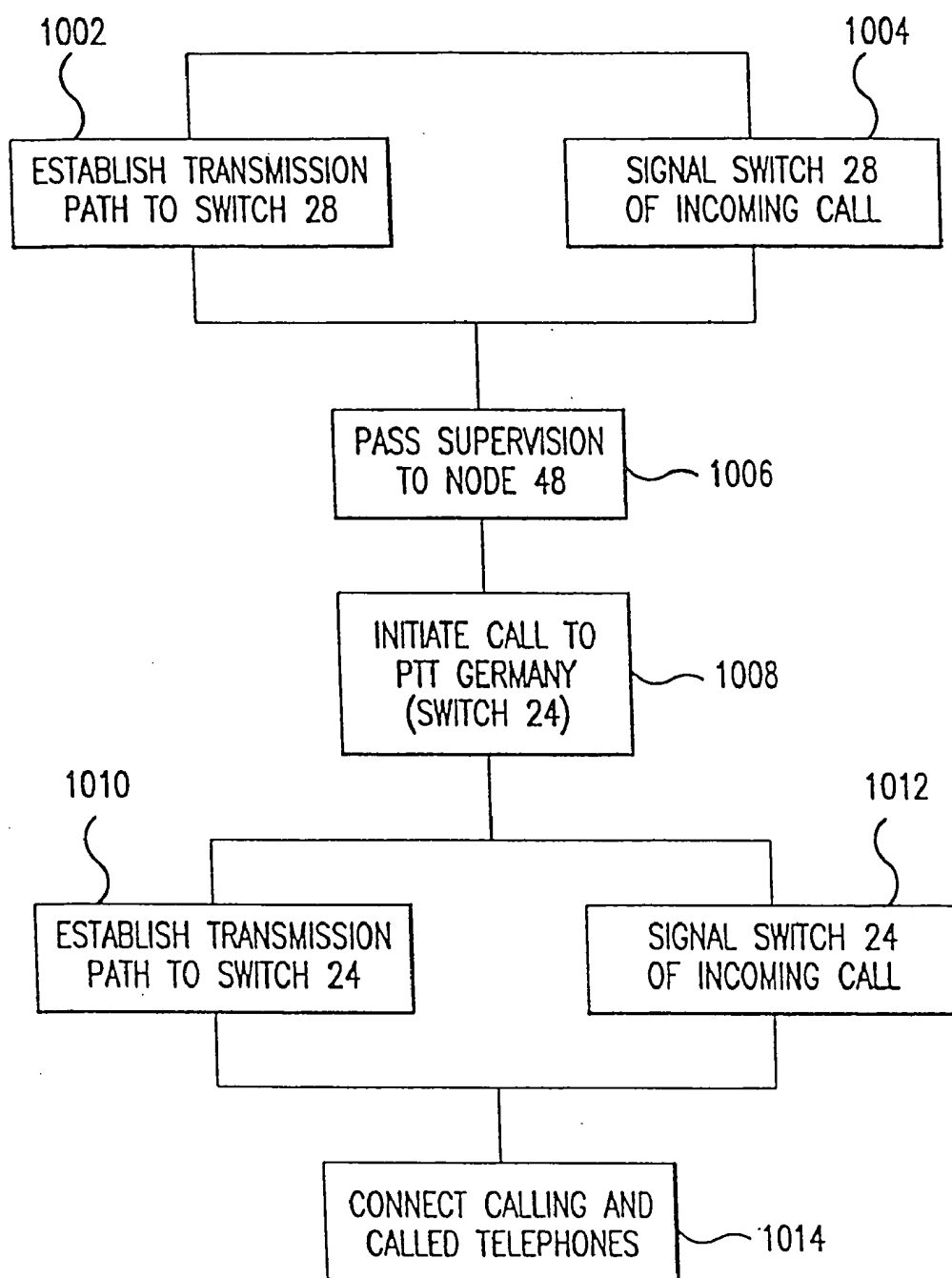


FIG.10

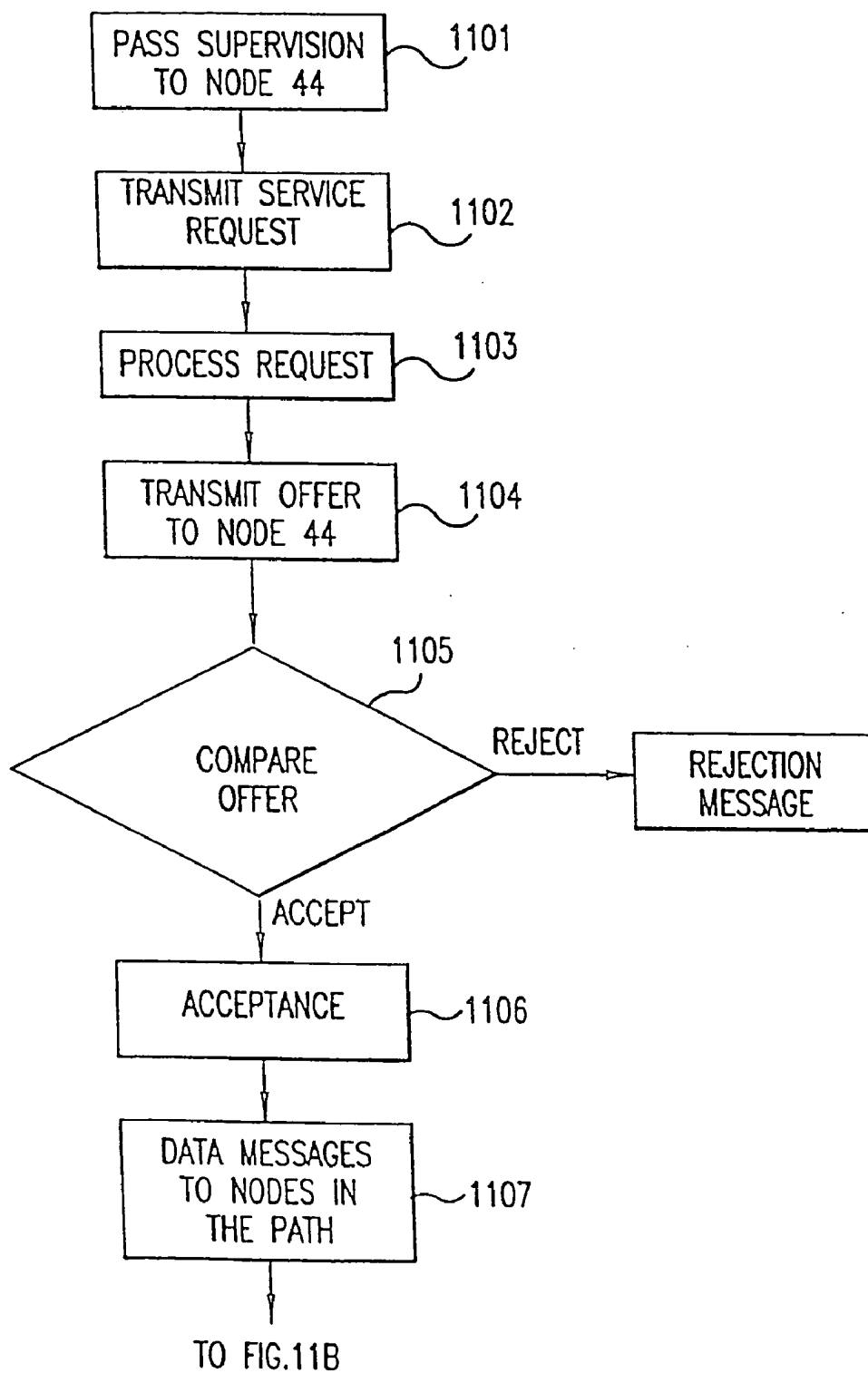


FIG. 11A

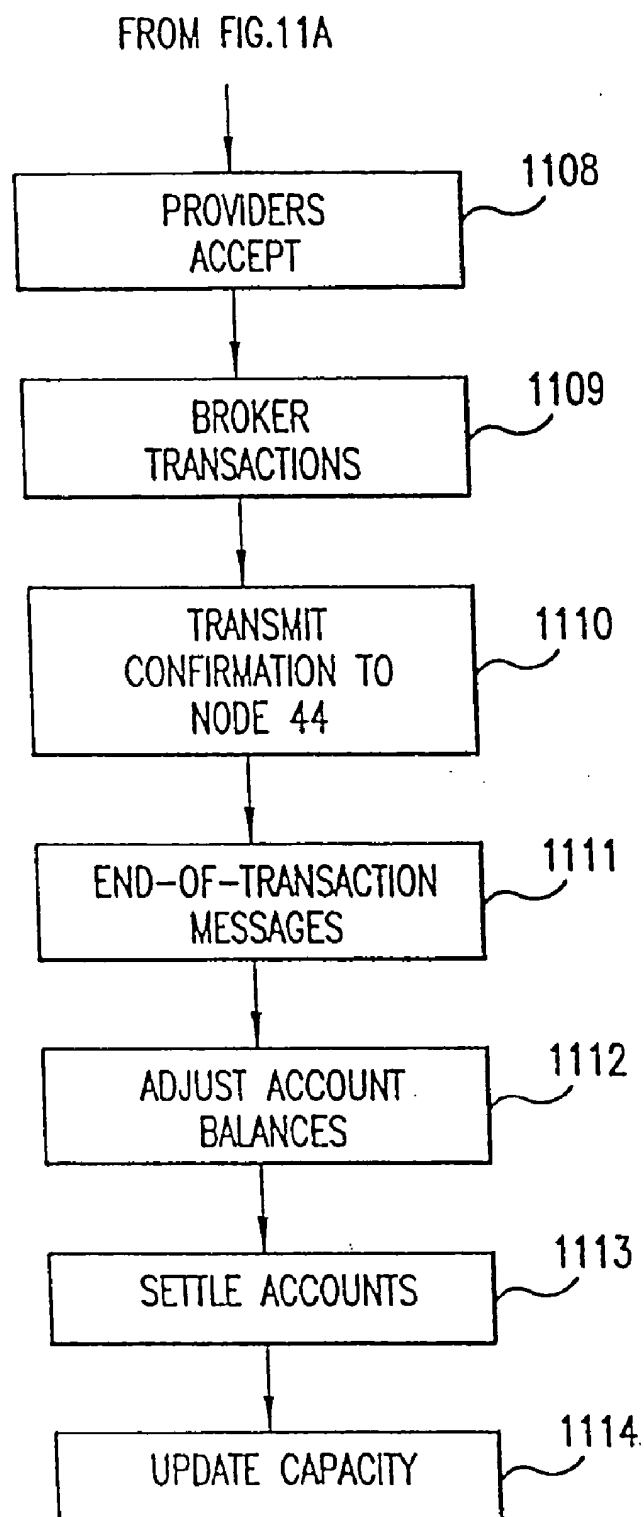


FIG.11B

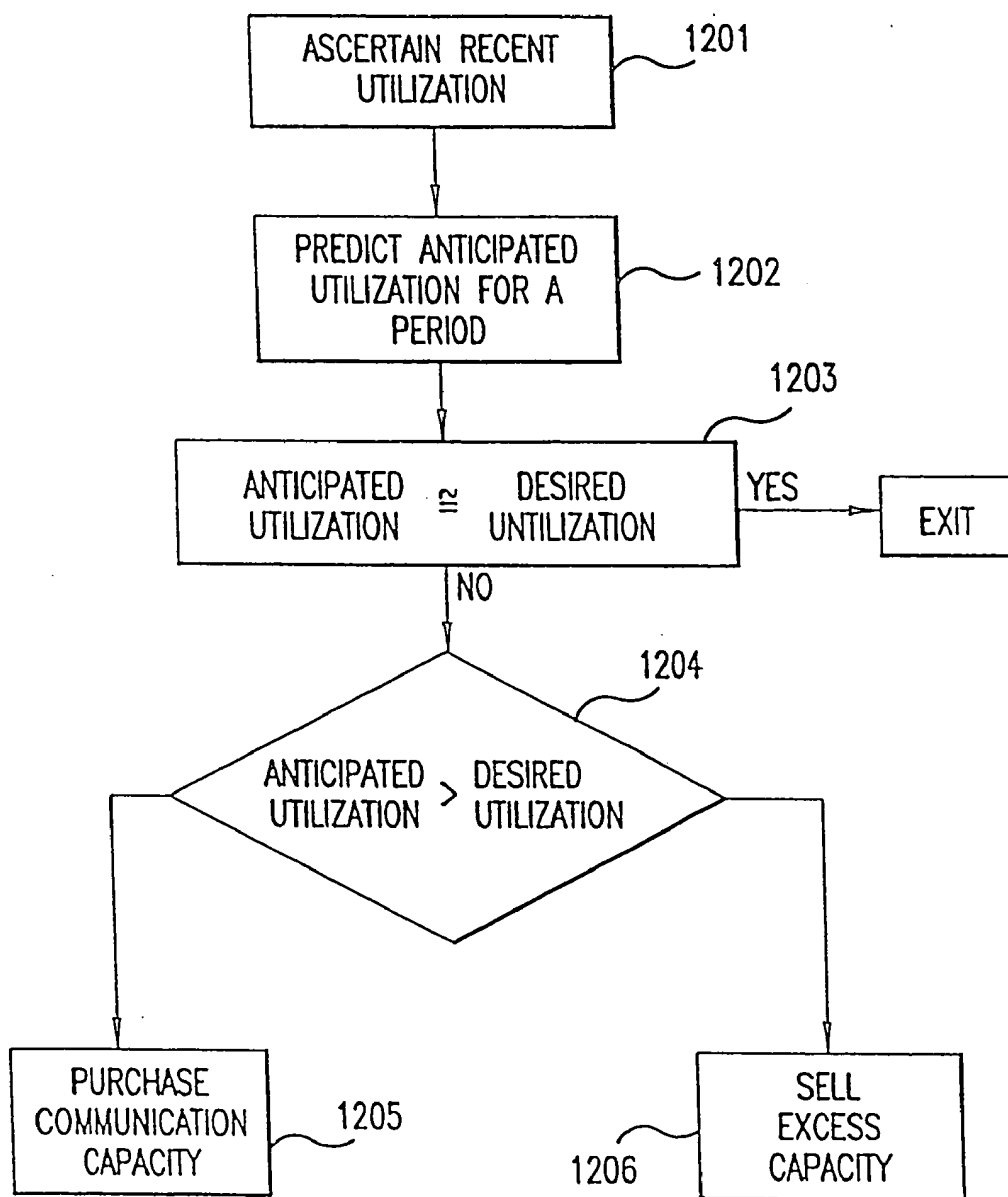


FIG.12

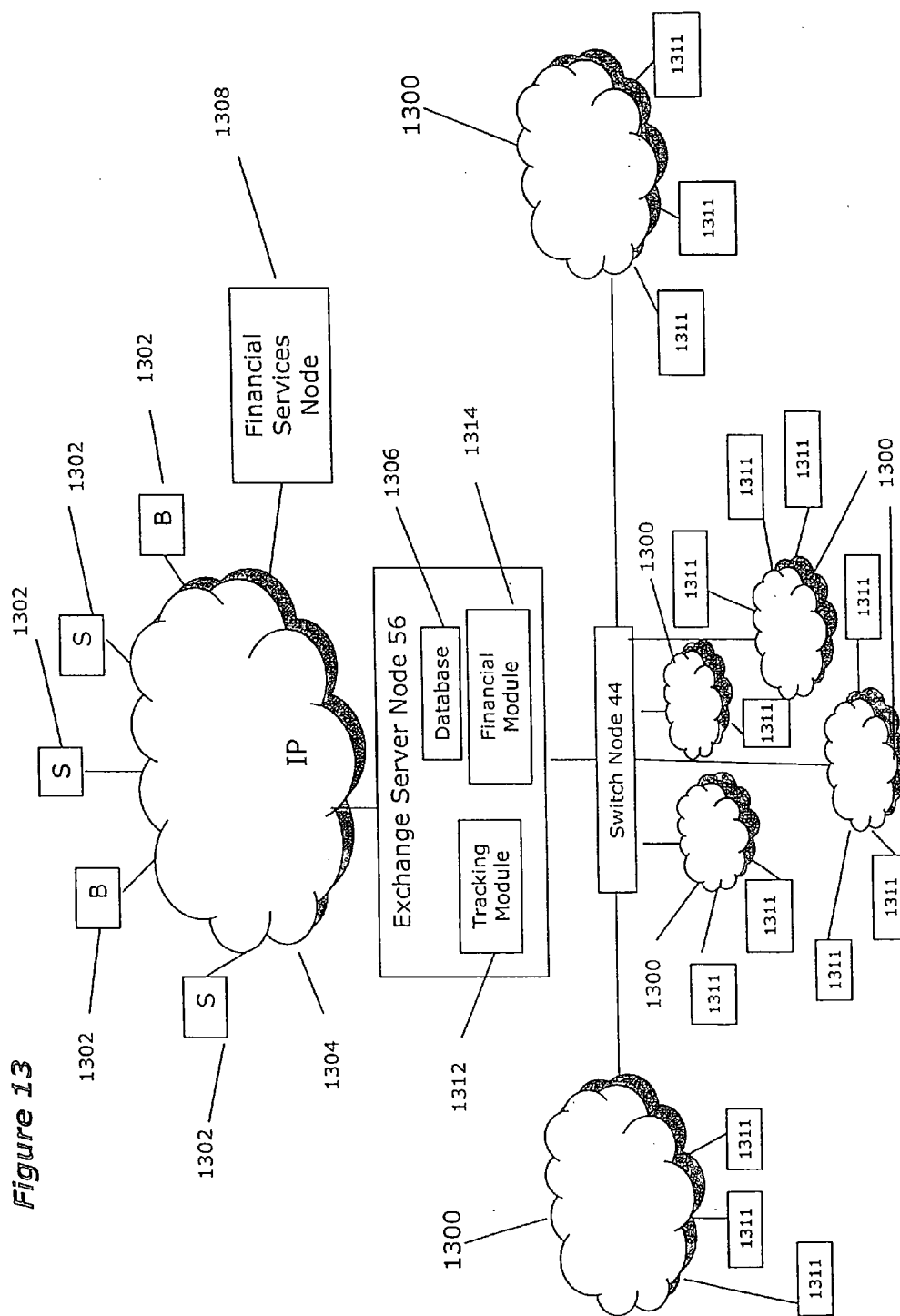


Figure 14

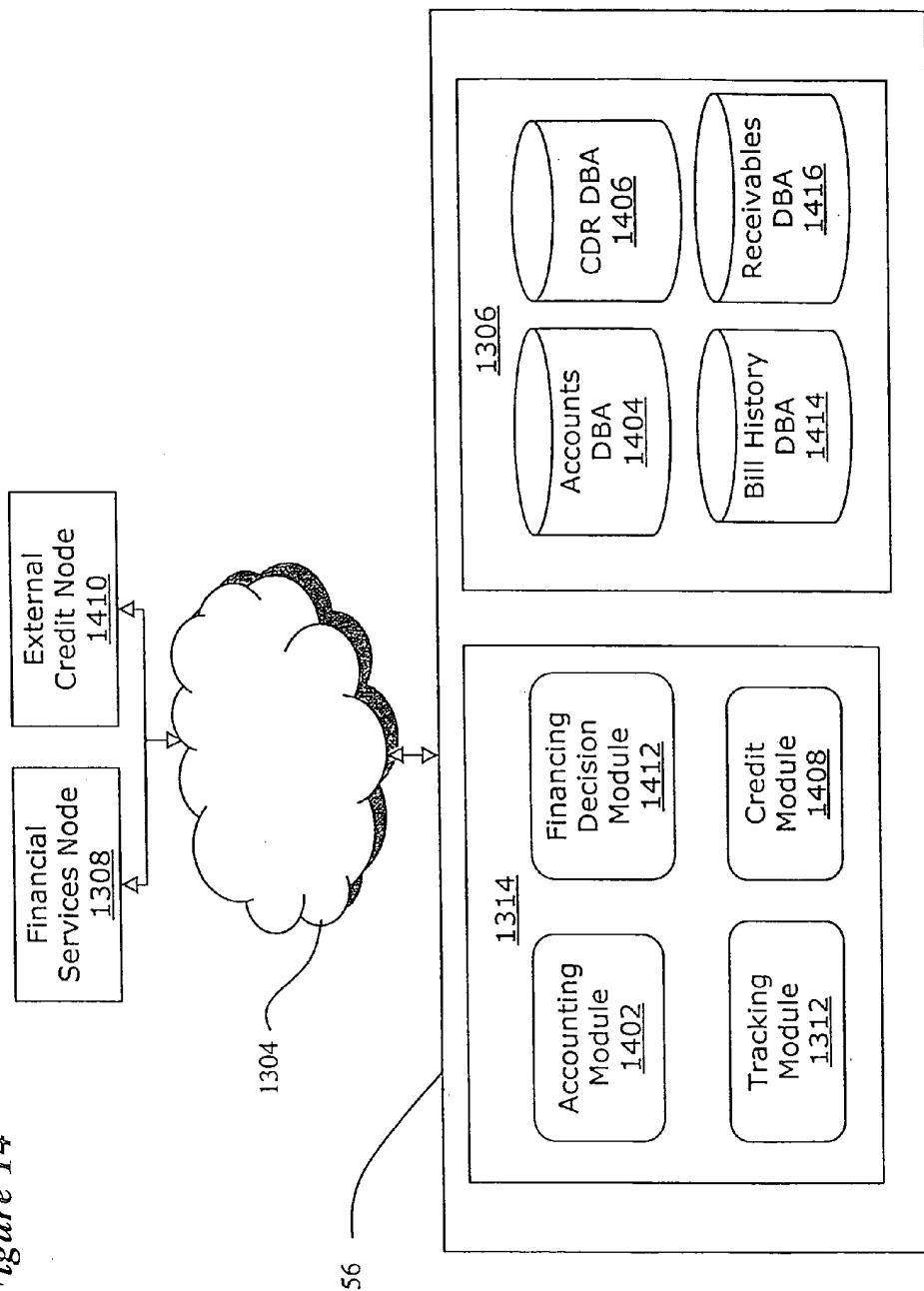
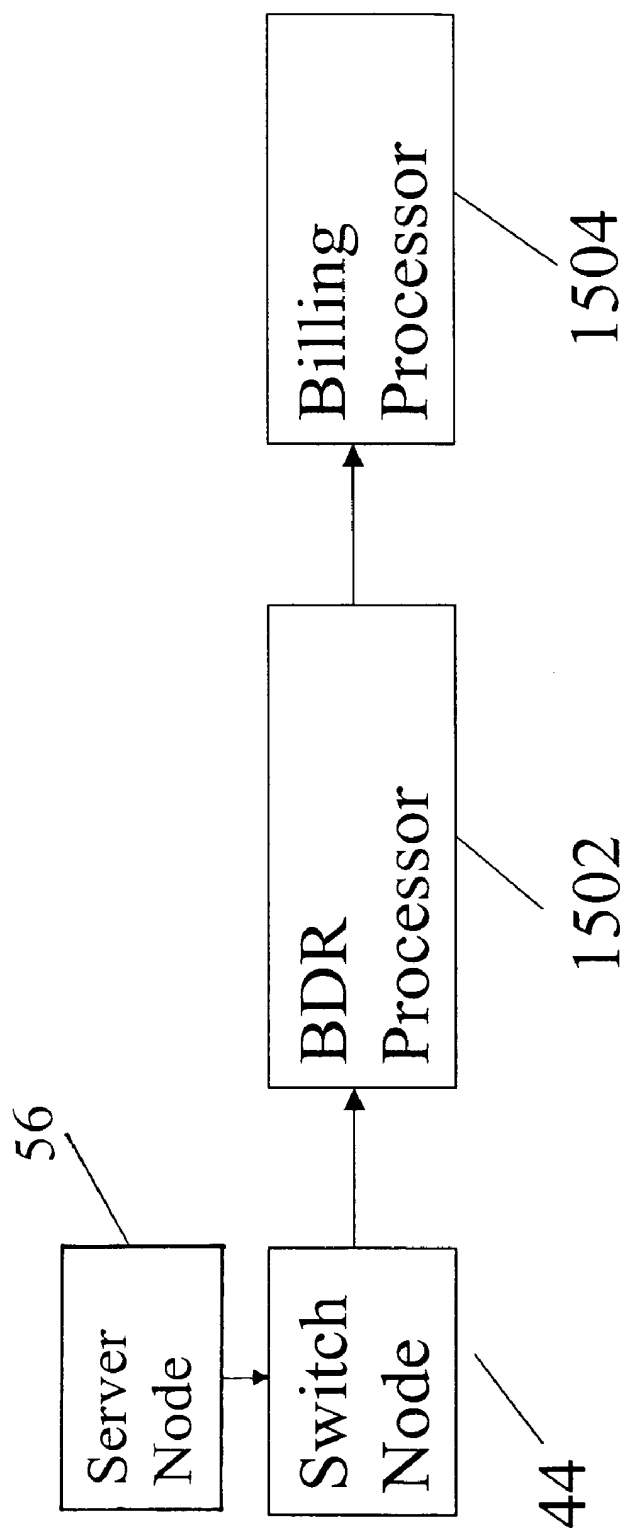


Fig. 15



METHOD AND A SYSTEM FOR SETTLEMENT OF TRADING ACCOUNTS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This is a continuation-in-part (CIP) application of U.S. Ser. No. 09/996,837, filed Nov. 29, 2001.

[0002] U.S. Ser. No. 09/996,837 is a CIP of U.S. Ser. No. 09/692,769 filed Oct. 18, 2000, which is a continuation of U.S. Ser. No. 09/129,413 filed on Aug. 5, 1998, which is a CIP of U.S. Ser. No. 08/927,443 filed Sep. 11, 1997, and a CIP of U.S. Ser. No. 08/920,567 filed Aug. 29, 1997. U.S. Ser. No. 09/996,837 is also a CIP of U.S. Ser. No. 09/551,190 filed Apr. 17, 2000, which is a continuation of U.S. Ser. No. 09/213,703 filed Dec. 17, 1998, which is a CIP of U.S. Ser. No. 09/129,413 filed on Aug. 5, 1998, which is a CIP of U.S. Ser. No. 08/927,443 filed Sep. 11, 1997, and a CIP of U.S. Ser. No. 08/920,567 filed Aug. 29, 1997.

BACKGROUND OF THE INVENTION

[0003] 1. Field of the Invention

[0004] The present invention relates to online trading exchange systems and, more particularly, to an online telecommunications trading exchange that is capable of automatically settling trading accounts for buyers and sellers of telecommunications services.

[0005] 2. Description of the Related Art

[0006] The cost of a long distance telephone call is usually paid by the calling party rather than by the called party. Payment for the call is typically collected from the calling party by the carrier that originated the service, either directly or through the agency of the caller's local telephone service provider. Consequently, when a call is placed from a first location served by an originating carrier to a second location served by a different terminating carrier, provision must be made to share with the terminating carrier some of the revenue collected by the originating carrier from the calling party.

[0007] For international telephone calls, this revenue sharing has traditionally been accomplished through the use of settlement agreements. Settlement agreements typically establish an accounting rate related to the cost of connecting the call between the countries, and specify how the accounting rate will be split between the two carriers. This split is typically 50-50.

[0008] For example, assume that a United States carrier and an overseas carrier negotiate a settlement agreement with a one dollar per minute accounting rate and a 50-50 revenue split. In accordance with the agreement, the U.S. carrier must pay 50 cents for every minute of connect time to called locations serviced by the overseas carrier. Conversely, the overseas carrier must pay 50 cents for every minute of connect time on calls terminated by the U.S. carrier.

[0009] As has been recognized, however, the negotiated accounting rate is frequently significantly higher than the actual cost of completing the international call. See, e.g., Frieden, Accounting Rates: The Business of Intentional Telecommunications and the Incentive to Cheat, 43 Federal Communications Law Journal 111, 117, which is hereby

incorporated by reference. For this reason, and because outbound calling volumes from the United States are significantly greater than inbound calling volumes from many foreign countries, U.S. carriers make large outbound payments to overseas carriers. In large measure, these charges are ultimately passed on to rate payers.

[0010] This payment imbalance is exacerbated when overseas carriers route inbound U.S. traffic under their control via private telephone lines into the United States. In this way, the overseas carriers are able to avoid paying high accounting rate settlements for calls to the United States from their countries, while receiving high accounting rate settlements from U.S. carriers who are forced to route outbound U.S. traffic through the overseas carrier because the overseas carrier is a monopolist in its home country. Moreover, overseas carriers often employ these alternative less-expensive routings for inbound U.S. traffic despite express contractual provisions in settlement agreements prohibiting such behavior.

[0011] To date, U.S. carriers have been forced to suffer such payment imbalances and have no immediate way to respond to breaches of contract by overseas carriers because of the significant time and expense required to reconfigure the global network to reroute calling traffic. The cumbersome reconfiguration process gives foreign carriers the opportunity to route inbound U.S. traffic via private lines, and otherwise run up settlement balances, without fear of retaliation from U.S. carriers.

[0012] More generally, this inflexible routing structure precludes telephone service providers from taking advantage of fluctuations in world-wide telephone rates. It would be desirable to provide a way for dynamic routing in response to rate changes so as to pass the savings onto the consumer. There is also a need to provide telephone companies with means to dynamically purchase and sell blocks of telephone connection bandwidth.

[0013] The need for flexible allocation of connection routes and for an ability to trade connection bandwidth accordingly exists not only in the international arena but in any internal market allowing competition in the field of communications.

SUMMARY OF THE INVENTION

[0014] The present invention provides a system and method for flexibly routing communications transmissions between networks of different service providers in an efficient manner.

[0015] In a preferred embodiment, service providers submit to a server node through a wide-area network offers to sell telecommunications services and requests to purchase telecommunications services. Each of the service offers and service requests includes price or rate information and the level of quality associated with a telecommunications route defined by an origination location and a destination location. The server node matches the service requests to the service offers and, preferably at the end of each trading cycle, generates a routing plan or rate table based on the matched service requests and service offers. The routing plan is translated or otherwise encoded into a set of routing instructions for a network switch or router connected to the networks of the service providers. Upon receipt of the

instructions, the network switch or router routes communications (e.g., voice, fax, or data packets) from a requesting service provider (i.e., buyer) to the corresponding matched offering service provider(s) (i.e. seller) according to the instructions. The network switch or router may include a module for measuring or monitoring the level of quality of transmission of a route through the seller's network. In the case where the seller's network is a circuit switched network, network performance parameters such as Post Dial Delay (PDD), Answer Seizure Ratio (ASR), and Average Call Duration (ACD). These quality measurements are then fed back to the server node, which then determines whether the seller's specified level of quality for the route differs from the quality measurements. If the quality measurements fall below the specified level, a new routing plan will be generated such that the buyer's telecommunications traffic will be routed through another seller's network that meets the quality requirements specified by the buyer. If subsequent quality measurements of the original seller's network indicate compliance once again, a new routing plan is generated such that the buyer's telecommunications traffic will be once again routed through the original seller's network.

[0016] The server node may be programmed to substantially optimize the routing plan or rate table with respect to one or more parameters such as price, network utilization, traffic volumes, etc.

[0017] Telecommunications services such as connect time (e.g., minutes of usage or a fixed period of usage) may be purchased on a transaction-by-transaction (e.g., call-by-call) basis or in larger blocks. Service requests may be submitted manually by an operator of the requesting service provider through a wide-area network such as the Internet, or automatically by a telecommunications node associated with the requesting service provider. The telecommunications node may also be programmed to dynamically monitor current volume and sale or purchase of communication time or bandwidth on the basis of actual and predicted network requirements.

[0018] In one embodiment, the server node administers all aspects of the network including authentication of carriers, risk management, financial transactions, settlement, and contract management. The server node is connected to a database that maintains accounting information including its cash receipt accounts, account receivables of each buyer and account payables of each seller, etc. The server node is also connected to a financial service node operated by, for example, a bank. The financial service node maintains financial accounts for the buyers, the sellers, and the server node. When the server node determines a trade has been cleared, e.g., when bids and asks have been matched and calls from a buyer have been routed through a seller's telecommunications network, the server node informs the financial service node the appropriate amount (based on, for example, Call Detail Records information) to credit and debit from the accounts of the respective buyer and seller. The server node then adjusts the balance of the accounts of the buyer and seller stored in its database.

[0019] In the case where the buyer wishes to pay the seller only after a period of, for example, thirty (30) days, from the date the trade is cleared, and the seller wants a shorter payment period, there will be a pre-approved procedure for

settling the buyer's and seller's accounts. In one embodiment, the server node transmits a pledge to the financial service node, pledging its cash receipt accounts and/or account receivables as collateral or security in exchange for advance payments from the financial service node to the seller who requires a shorter payment period. Upon receipt of the pledge, the financial service node charges the server node's account a previously agreed fee and credits the seller's account by the amount of the advance payment. In turn, the server node debits the buyer's account, maintained in its database, the amount of the advance payment plus the fee incurred by the advance payment.

[0020] Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not necessarily drawn to scale and that, unless otherwise indicated, they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] The above summary of the invention will be better understood when taken in conjunction with the following detailed description and accompanying drawings, in which:

[0022] FIG. 1A is a block diagram of a telephone system architecture suitable for implementing the global network of the present invention;

[0023] FIG. 1B is a block diagram of a telecommunication node and associated databases;

[0024] FIG. 2 is a flowchart depicting the steps performed in determining a rate-table of cost-efficient routing paths;

[0025] FIG. 3A is a schematic representation of a template for entering rate information;

[0026] FIG. 3B is a schematic representation of a template for placing a service request;

[0027] FIG. 4 is a schematic representation of a rate-table database;

[0028] FIG. 5 is a flowchart depicting the steps performed in brokering sale of telephone connect time;

[0029] FIGS. 6A-C schematically represent illustrative states of rate-table database 400 at various points in a telephone connect time transaction;

[0030] FIG. 7 is a flowchart depicting a call-routing operation of the global network of the present invention;

[0031] FIG. 8 is a flowchart depicting in greater detail a first portion of the call-routing operation depicted in FIG. 7;

[0032] FIG. 9 is a flowchart depicting in greater detail a second portion of the call-routing operation depicted in FIG. 7;

[0033] FIG. 10 is a flowchart depicting in greater detail a third portion of the call-routing operation depicted in FIG. 7;

[0034] FIGS. 11A-B are a flowchart of a protocol for purchasing connect time on a transaction-by-transaction basis;

[0035] FIG. 12 is a flowchart depicting dynamic control of available communication capacity by a telecommunication node;

[0036] FIG. 13 diagrammatically illustrates an exchange system incorporating a credit risk management system in accordance with another embodiment of the present invention; and

[0037] FIG. 14 diagrammatically illustrates additional features of the embodiment of FIG. 13.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

[0038] FIG. 1A shows a communications system architecture, which may for example be a telephone system architecture, suitable for implementing the global network of the present invention. As shown in FIG. 1A, the architecture preferably comprises a calling telephone 2 from which a calling party may place a telephone call to a called telephone 4. Calling telephone 2 is connected to a local telephone network 6 by a local loop or another connection, such as an ISDN line, represented schematically by line 8. Local telephone network 6 and line 8 are both typically owned and maintained by the caller's local telephone service provider. Called telephone 4 is similarly connected to a local telephone network 10 via a local loop or another connection, schematically represented by line 12. Local telephone network 10 and line 12 are typically owned and maintained by the called party's local telephone service provider.

[0039] Also shown in FIG. 1A is an originating toll switch 14 typically maintained by a long distance carrier. Originating toll switch 14 is connected to local telephone network 6 preferably via both signalling and transmission lines, which are jointly schematically represented by line 16. The signalling lines may, for example, form part of the SS7 network. The transmission lines carry voice and data transmissions between local telephone network 6 and originating toll switch 14.

[0040] FIG. 1A also shows a terminating toll switch 18 typically maintained by the called party's long distance provider. Terminating toll switch 18 is connected to local telephone network 10 via both signalling and transmission, which are jointly schematically represented by line 20. The signalling lines may, for example, form part of the SS7 network. The transmission lines carry voice and data transmissions between local telephone network 10 and originating toll switch 18.

[0041] The system architecture also comprises an originating international gateway switch 22 which routes and carries overseas calls placed from calling telephone 2. Originating international gateway switch 22 forms part of a global network of international gateway switches which includes terminating international gateway switch 24, as well as transit country international gateway switches 26, 28. Each pair of gateways in the international gateway network is preferably linked by signaling and transmission lines, represented schematically by lines 30-38.

[0042] As will be recognized, the international gateway switch, toll switch (terminating or originating), and local

network in a particular location may be owned and maintained by the same or different business entities, depending on the location's regulatory environment.

[0043] Originating international gateway switch 22 is preferably connected to originating toll switch 14 via signalling and transmission lines, schematically represented by line 40. Similarly, terminating international gateway switch 24 is preferably connected to terminating toll switch 18 via signalling and transmission lines, schematically represented by line 42. The signalling lines may, for example, form part of the SS7 network. The transmission lines carry voice and data transmissions between the two international gateway switches and their respective toll switches.

[0044] Although FIG. 1A shows only four international gateway switches (22-28), a person skilled in the art will understand the architecture presented here may be generalized for any number of such gateways. Also, a person skilled in the art will understand that the status of a gateway as original, terminating, or transit will be determined by the SS7 signalling network or other data message such as a data message transmitted in accordance with a proprietary signalling protocol. In addition, the person skilled in the art will understand the structure of an analogous network architecture in a domestic market having different communication providers.

[0045] The system architecture further comprises a network of telecommunications nodes 44-48. Each node in the network may be associated with one of the international gateway switches 22-28 and may be connected to its respective international gateway switch via data lines 50-54. Alternatively, a telecommunication node may incorporate an international gateway switch, as for example node 49. As described in further detail below, nodes 44-49 comprise an overlay network which co-exists with the gateway network and manages the routing of certain calls carried via the gateway network.

[0046] As shown in FIG. 1B, each node 44-49 is preferably provided with:

[0047] a carrier's-own-cost database 99 (one for each carrier associated with the node), which stores information regarding the internal cost to a carrier to connect a call from potential originating locations to potential terminating locations;

[0048] a published-price-to-others database 98 (one for each carrier associated with the node), which stores the price published by a carrier for connecting potential originating locations to potential terminating locations;

[0049] a global-network-cost database 97, which stores information regarding the cost of various routes for connecting potential originating locations with potential terminating locations. As described in more detail below, this information is received from server node 56 in FIG. 1A.

[0050] In addition, nodes 44-49 are further preferably provided with:

[0051] a cross-connect database 96 (one for each carrier associated with the node), which stores information regarding the physical transmission facilities maintained by a carrier, the technologies the facili-

ties support (e.g., voice, ATM, internet, etc.), and the names and locations of other carriers with which the carriers facilities interconnect. This information is used by the system to map the available physical interconnections of the global network.

[0052] Nodes 44-49 are also preferably provided with a business-rules database 95 (one for each carrier associated with the node), for storing business rules, the purpose of which are described below.

[0053] The telecommunications node network further comprises a server node 56. Although shown in FIG. 1A as a single node, server node 56 may instead be implemented as a distributed network of servers. Components of the distributed network may be incorporated in nodes 44-48. Each node 44-48 in the telecommunications node network is connected to server node 56 by data lines 58-62 respectively. Each data line preferably has a bandwidth of at least 64 Kb/s. As described in more detail below, server node 56 stores rate and possible routing information and determines cost-efficient routing paths for calls transmitted via the network. Server node 56 also clears transactions and coordinates the routing of all calls managed by the overlay telecommunications node network. Call routing is determined on the basis of parameters specified in service requests submitted by requesting carriers.

[0054] As shown in FIG. 2, server node 56 determines cost-efficient routing paths for calls connected via the international gateway network in three steps: (1) collecting rate information; (2) evaluating the collected information; and (3) generating from the collected information and a network topology map, a rate-table comprising cost-efficient routings for every pair of switches in the international gateway network.

[0055] In step (1), the system collects rate information from international carriers around the world. Each record of rate information includes the price charged by a carrier to route a call from a first location to a second location as well as call-volume capacity and service related particulars such as quality, reliability, and security of the transmission, legal restrictions (e.g., termination restrictions), post dial delay (PDD), type of service (e.g., voice, fax, data, video), and the technology employed on the link (e.g., ISDN, ATM).

[0056] Preferably, carriers will enter rate information via a template 300 which may be accessed at a world-wide-web site maintained by server node 56. Alternatively, carriers who own and maintain international gateway switches, such as switches 22, 26, and 28, or who own and maintain a node 44-48, may transmit rate information to server node 56 via telecommunications nodes 44-48. FIG. 3A illustrates one suitable arrangement for such a template. As shown in FIG. 3A, the template comprises a plurality of fields for entering information regarding an offer of service. Illustratively, these fields may include:

- [0057] carrier name field 302;
- [0058] carrier identification number field 304;
- [0059] password field 306;
- [0060] date submitted field 308;
- [0061] quality field 310 (stores quality rating of the connection);

[0062] from field 312 (stores the originating location for the offered service);

[0063] to field 314 (stores the destination location for the offered service; this may take the form of a country code, if the service is available to anywhere in the country, a country and area code, if the service is available only to particular areas in the country, or an entire destination number, if service is provided only to particular called telephones);

[0064] time-available field 318 (stores the time available in minutes per month at a certain price);

[0065] number-of-circuits field 320 (stores the maximum concurrent number of calls that can be handled by the carrier);

[0066] price field 322;

[0067] hours-of-operation field 324 (stores the hours of operation during which purchased connect time may be used).

[0068] In addition, the template may preferably comprise the following fields:

[0069] service-type field (stores the type of service offered, e.g., voice, fax, data, video);

[0070] post-dial-delay (PDD) field;

[0071] valid-until field (stores the date until which the offer is open);

[0072] legal-restrictions field (stores information on legal restrictions that may affect use of the connect time);

[0073] payment terms field (stores any special payment terms required by the provider);

[0074] compression-level field (stores the maximum level of compression that will be employed in transmission);

[0075] equipment-type field (stores the type of equipment employed by the service provider);

[0076] signalling-compatibility field (stores the signalling protocols which the provider can handle, e.g., SS7, IN); and

[0077] maximum-latency field (latency in this context is the delay due to congestion at a router).

[0078] Also, the template may preferably further comprise:

[0079] provide-local-termination? field;

[0080] provide-settlement? field;

[0081] via-private-line? field;

[0082] length of contract field;

[0083] via satellite? field; and

[0084] termination options? field,

[0085] the purposes of which are described below.

[0086] As those skilled in the art will recognize, the above list of fields is merely illustrative of fields which template 300 may comprise. Template 300 may comprise a field for

additional or different information which would aid server node **56** in making routing decisions and brokering transactions between provider carriers and requester carriers.

[0087] In a preferred embodiment, three levels of passwords are issued by the server. A first level password permits the password holder to access published rates, but does not permit the password holder to either buy or sell time via the server. A second level password permits the password holder to buy, but not sell, connect time through the server. A third level password entitles the password holder to either buy or sell connect time via the server. Thus, carriers submitting template **300** would be required to possess a third level password.

[0088] In a preferred embodiment, all routes listed on a single template are of the same quality. Thus, as shown for example in **FIG. 3A**, each template is preferably provided with only a single quality field. Carriers who wish to offer additional routes of a different quality, would do so on a different template. Also, all routes listed on a single template are preferably for the same service type.

[0089] Similarly, in a preferred embodiment, all routes listed on a single template are from the same originating location. Thus, as shown for example in **FIG. 3A**, each template is preferably provided with a single originating location field **312**. Carriers who wish to offer connectivity from additional originating locations, would do so on a different template.

[0090] As shown in **FIG. 3A**, template **300** may comprise two or more time available fields, number of circuits fields, price fields, and hours of operation fields for each route listed by a carrier. This permits carriers to offer different prices for service at different times of the day and week. It also accommodates the practice of many carriers to employ a graduated pricing scale. In a graduated pricing scale, the rate charged for connect time up to a certain capacity (e.g., 300k minutes/month) is different than the rate for connect time above that capacity.

[0091] Illustratively, as shown in **FIG. 3A**, a carrier might list more than one price for service from the United States to Korce (city code **824**) in Albania (country code **355**). For example, for purchases under 300K minutes per month, the carrier might charge 62.5 cents per minute for calls Monday through Friday 10 P.M. to 8 A.M. and Saturday and Sunday 12 noon to 6 P.M. In contrast, for purchases above 300K minutes per month, the carrier might charge 59.8 cents per minute for calls Monday through Friday 8 P.M. to 12 midnight, and Saturday and Sunday from 5 A.M. to 6 P.M.

[0092] Also shown in **FIG. 3A** is an initial trading date field **326**, which is filled out by server node **56** prior to transmitting template **300** to a carrier. This date reflects the first day that connect time entered on the template will be offered for sale by the global network. As noted on template **300**, sellers are required to submit rate information some predetermined amount of time prior to the initial trading date (e.g., three days). This gives server node **56** time to process received rate information, and generate rate-tables therefrom, as described in more detail below.

[0093] As noted, the template may comprise additional fields not shown in **FIG. 3A**. For example, template **300** may comprise a field provide-local-termination? which stores a boolean value indicative of whether the carrier can

provide local termination for the call in the location stored in to field **314**. Local termination might not be possible for several reasons. For example, termination might be forbidden by local regulation or the carrier might not have the equipment necessary to terminate calls in a particular location.

[0094] Template **300** may further comprise a boolean provide-settlement? field. Certain carriers are required by law to route calls in a manner such that a settlement agreement with the terminating country is invoked. Settlement agreements are invoked when a call is transmitted via the Public Switched Telephone Network (PSTN) but not when routed via private or data lines. It may therefore be important for the server to establish whether a particular route offered by a service provider will trigger settlement.

[0095] Template **300** may further comprise a boolean via-private-line? field. As described in more detail below, this permits server node **56** to accommodate carriers who do not want to purchase connect time on routes which employ private lines.

[0096] Template **300** may further comprise a boolean via-satellite? field. As noted below, server node **56** may combine services provided by more than one carrier to create a calling route from a first location to a second location. As known in the art, the quality and post dial delay of a connection employing two satellite links in a route are often unacceptable. This field permits server node **56** to identify services which rely on a satellite link and avoid routing paths which employ more than one satellite link to connect the calling location and the called location.

[0097] Template **300** may further comprise a termination-options field. Illustratively, a carrier might offer fax bypass capability as a termination option. Fax bypass provides a way for substantially decreasing the cost of fax transmissions. Typically, fax transmissions are sent via telephone lines which are subject to settlement at high accounting rates. In fax bypass, a node in the route recognizes the fax tone of the fax transmission and reroutes the call via a data line. In this way, the fax may be transmitted at significantly reduced cost. In addition, as those skilled in the art will recognize, other termination options might be listed such as voice over IP.

[0098] It should be noted that the price charged by carriers may depend on the communications service offered. For example, a carrier might offer connect time at a first rate for voice calls, and at other rates for calls providing services such as: voice mail, conferencing, paging, e-mail access, internet access, fax retrieval, fax transmission, PPP access, universal personal assistant (universal mailbox). Furthermore, various levels of voice service may be provided, for example, dedicated lines and ISDN lines.

[0099] After collecting rate information from carriers around the world regarding cost and service parameters of routing various classes of calls from a first location to a second location, the system proceeds to step (2) of **FIG. 2**. In step (2), the system evaluates the received information, in particular the service-related information such as transmission quality and reliability, and determines the accuracy of the provided parameters. Since server node **56** acts as the clearing house for telecommunication transactions, it is important that carriers purchasing time from server node **56**

trust the accuracy of server node 56's published service parameters. Consequently, server node 56 independently evaluates the service parameter information received from carriers and assigns for each parameter (e.g., quality) a rating such as "A," "B," "C," etc. The evaluation is based on information about the services of the carriers previously stored at server node 56. The server node 56 may upgrade or downgrade assigned parameters based on various considerations, e.g., the historical reliability of a particular carrier. Thus, for example, if the server node 56 generally assigns satellite connections a "B" reliability rating, it might assign a particular satellite connection an "A" rating if that connection historically exhibits a higher level of reliability.

[0100] In step (3), server node 56 derives rate-tables from the collected rate information which list the cost of connecting any two locations within the telecommunication node network via various routes, and any service parameters associated with each route. Preferably, server node 56 derives separate rate-tables for each class of service that may be provided by the global network (e.g., voice, data, video conferencing, etc.). This information is then stored in a rate-table database located in server node 56. FIG. 4 illustratively represents one possible arrangement for some of the data in rate-table database 400 representative of rates charged by different carriers for various routes.

[0101] As noted in U.S. Pat. No. 6,088,436, which is incorporated herein in its entirety by reference, it will be recognized that a call from an originating location to a terminating location may be connected via a call routing path comprising several calling legs, each leg bridging two locations in a call routing path. Furthermore, as taught therein, each leg may be completed in either the forward or reverse direction. Thus, the routing paths determined and stored in rate-table database 400 will frequently be formed by combining services provided by carriers around the world.

[0102] For example, if a first carrier submits a template to server node 56 offering service from the United States to the United Kingdom at a first price, and a second carrier submits a template to server node 56 offering service from the United Kingdom to Germany at a second price, server node 56 may combine the two and offer the combination as a route from the United States to Germany at a price equal to the sum of the first price and the second price.

[0103] The associated service parameter information for a route takes into account both the evaluated parameters of the submitted rate information as well as other factors that may affect a parameter assigned to a route. For example, although a route may be comprised of two "A" quality legs, the two legs in combination may not constitute an "A" quality connection because of substantial delays in establishing the two-leg call.

[0104] Also, it should be noted that the latency of the application determines in large measure the parameters which are of importance to the call. Thus, for example, the parameters which are important for a voice call are different than those for transmitting, e.g., a fax.

[0105] As further noted in U.S. Pat. No. 6,088,436, the total number of possible routing paths between any two nodes in a network rises steeply as the number of nodes increases. Thus, unless the number of telecommunication

nodes in the telecommunication node network is small, it is not practical to determine and store routing information for every potential route connecting any two nodes in the network. As those skilled in the art will recognize, however, the number of routes for which rate-table entries need be calculated and stored may be kept to a manageable number for several reasons.

[0106] First, although the number of theoretically possible routes may be extremely high, many routes may be immediately excluded from the rate-table calculus because of legal or other constraints. For example, local regulations may prohibit certain transactions, such as terminating traffic originated via a private line or terminating traffic except through the local gateway switch. Rate-table entries for such calling routes need not be calculated or stored.

[0107] Moreover, as those skilled in the art recognize, heuristic techniques exist for identifying with a reasonable degree of accuracy cost-efficient routes connecting two nodes in a network. Using such known heuristic techniques, the system may choose a reasonable number of cost-efficient routing paths, and calculate and store the cost and service parameters associated with each of these routing paths.

[0108] Furthermore, as known in the art, these heuristic techniques can be employed to find approximately optimum routes with respect to one parameter while imposing constraints with respect to other parameters. Thus, for example, such heuristic techniques may identify the most cost-efficient routes for each of several quality or security levels.

[0109] Illustratively, the system might calculate the costs of five (or more, depending on anticipated traffic volumes) cost-efficient routes connecting each pair of nodes for each defined level of quality and service. These five routes would be ranked according to price, and stored in rate-table database 400 at server node 56. Also, as transactions are made and routes fill up, the system may determine additional routes given the new state of the network.

[0110] Furthermore, in accordance with the teachings of copending application U.S. Ser. No. 08/727,681, which is incorporated herein by reference in its entirety, a routing path may be constructed of several calling legs each of which employs a different technology. For example, a routing path might comprise a first leg transmitted over the public switched telephone network (PSTN), a second leg transmitted over the internet, and third leg transmitted over an Asynchronous Transfer Mode (ATM) network. As taught in copending U.S. application Ser. No. 08/727,681, calling legs of different technologies may be transparently linked to provide end to end connectivity between a calling party and a called party, even though some of the intermediate legs of the routing path comprise technologies with which neither the calling party nor the called party is compatible.

[0111] Once the rate-tables have been computed and stored in the rate-table database 400, copies of the database may be transmitted to each node 44-49 in the telecommunication node network. Alternatively, each node may receive only a subset of the rate-tables calculated by server node 56 on request. For example, nodes in the United States may only receive rate-tables relating to routes originating from the United States.

[0112] Updated rate-tables are preferably generated by the system on a periodic basis, for example, bi-weekly. Alter-

natively, if the speed and power of the system's computer hardware and software permit, rate-table generation may be performed more frequently. Indeed, with sufficient computational power, the system may update its rate-tables each time a rate or service parameter in the network changes.

[0113] Server node **56** permits carriers to purchase blocks of connect time to remote locations or to purchase connect time on a transmission-by-transmission basis. In this capacity, server node **56** acts as a clearinghouse for clearing transactions between provider-carriers who wish to sell connection services and requesting-carriers who wish to purchase connection services. This aspect of the invention facilitates an open market for connection rates allowing a carrier to purchase bandwidth at the lowest available price. The transaction clearing aspect of the present invention will be described in connection with two illustrative examples. The first example illustrates a purchase of a block of connect time by a carrier, and connection of a call using a portion of the purchased connect time. The first illustrative example will be described in connection with **FIGS. 5 and 6A-C**. The second example illustrates purchase of connect time on a call-by-call basis.

[0114] Beginning with the first illustrative example, assume that a U.S. carrier wishes to purchase 10 million minutes of "A"-level quality and "B"-level reliability connect time to Germany for the month of September at a price not greater than 23 cents per minute. In step **502**, the U.S. carrier places a purchase request with server node **56** requesting purchase of 10 million minutes of connect time to Germany on the above terms.

[0115] Preferably, carriers will enter purchase requests via a template **350** which may be accessed at a world-wide-web site maintained by server node **56**. Alternatively, carriers who own and maintain international gateway switches, such as switches **22**, **26**, and **28**, may transmit purchase requests to server node **56** via telecommunications nodes **44-48**.

[0116] **FIG. 3B** illustrates one suitable arrangement for such a template. As shown in **FIG. 3B**, the template comprises a plurality of fields for entering information regarding a purchase request. In a preferred embodiment, template **350** may comprise the following fields:

- [0117] customer identification number field **352**;
- [0118] password field **354**;
- [0119] originating location field **356**;
- [0120] terminating location field **358**;
- [0121] require-local-termination? field **360**;
- [0122] require settlement? field **362**;
- [0123] hours of operation field **364**;
- [0124] number of minutes field **366**;
- [0125] quality field **368**;
- [0126] maximum post dial delay (PDD) field **370**;
- [0127] allow private line? field **372**;
- [0128] sort-by field **374**;
- [0129] length of contract field **376**; and
- [0130] acceptable carriers field **378**.

[0131] As those skilled in the art will recognize, the above list of fields is merely illustrative of fields which template **350** may comprise. Template **350** may comprise a field for any information that would aid server node **56** in making routing decisions and brokering transactions between provider carriers and requester carriers.

[0132] As noted above, some provider carriers may not be able to provide local termination for certain calls. Require-local-termination? field **360** permits a requester carrier to indicate that it can provide its own local termination in the terminating location, and thus can employ carriers without termination capability to transmit the call to the called location.

[0133] As noted above, some providers may require that calls be terminated in a manner that invokes a settlement agreement. Require-settlement? field **362** permits carriers to provide that information.

[0134] Number of minutes field **366** stores the number of minutes that the carrier desires to purchase.

[0135] Maximum PDD field **370** stores the maximum number of seconds the carrier is willing to accept for connecting a calling party to a called party. This may affect the routes that may be allocated to a call since some routes, in particular those with many calling legs or satellite links may take longer to connect, than others.

[0136] As noted above, some carriers may not wish a call to be transmitted via a private line. Allow private line? field **372** permits the requesting carrier to enter this information.

[0137] In sort-by field **374**, the carrier ranks in order of importance the fields in the template relating to service parameters. For example, the carrier may rank quality as the most important field, maximum PDD as second most important, etc. As described below, server node **56** uses this information when it is unable to exactly match the service request from the requesting carrier.

[0138] In length of contract field **376**, the carrier may enter the desired number of months for which it wishes to buy connect time.

[0139] In acceptable carrier field **378**, the requesting carrier may place constraints on the carriers via which its traffic may be routed. For example, a requesting carrier may request that its traffic be transmitted only via a top **5** carrier with respect to some parameter (e.g., quality) as ranked by server node **56**. In another example, if a carrier needs to buy connect time to carry overflow traffic, it may request that it not be resold time on its own network that had originally been sold to a third party.

[0140] Upon receipt of the purchase order at server node **56**, the system proceeds to step **504**, where server node **56** searches rate-table database **400** in ascending-price order for routes which meet the requesting-carrier's requirements and which have available connect time for sale. When server node **56** identifies a route with available capacity it allocates that capacity to fill the requesting-carrier's purchase request, as depicted in step **506**. Steps **504-506** are repeated until either the purchase request is filled or until all available routes which meet the requesting-carrier's requirements have been traversed, as depicted in steps **508** and **510**, respectively.

[0141] For example, assume that FIG. 6A represents the state of a portion of rate-table database 400 at the time that the purchase request for 10 million voice minutes is received from the requesting carrier. In that case, server node 56 would complete the loop described by steps 504-510 three times in filling the requesting carrier's 10 million minute request. At the conclusion of the third loop, two million minutes of capacity from the least expensive route, four million minutes of capacity from the second least expensive route, and four million minutes of capacity from the third least expensive route would have been allocated to fill the requesting-carrier's purchase request. FIG. 6B represents the state of rate-table database 400 at the conclusion of this illustrative example.

[0142] In step 512a, server node 56 sends a data message to every carrier participating in the routing path informing the carrier that a buyer has been found for the allocated block of connect time. In step 512b, the provider carriers transmit an authorization message to server node 56, authorizing the transaction. Alternatively, the server node 56 may be preauthorized to sell any time submitted by the carriers to the global network.

[0143] In step 512c, server node 56 transmits a service offer to originating node 44 offering for sale the block of allocated connect time. In step 512d, originating node 44 transmits an acceptance message to server node 56. In step 512e, server node 56 clears the transaction by adjusting the account balances of every carrier in the transaction to reflect the transfer of the allocated connect time to the requesting carrier, and the transfer of the cost of the allocated connect time to the provider carriers, as described in more detail below, and transmits a confirmation message to all parties.

[0144] In contrast, assume instead that rate-table database 400 is as shown in FIG. 6C. In that event, server node 56 would complete the loop described by steps 504-510 twice, during which two million minutes from the least expensive route and four million minutes from the second least expensive route are allocated to fill the requesting-carrier's request. In the example of FIG. 6C, however, the cost of all other routes connecting the U.S. and Germany is greater than 23 cents per minute. Consequently, after the second loop traversal, step 510 fails and the system proceeds to step 514.

[0145] In step 514, server node 56 transmits a data message to the requesting carrier, informing it that its request can not be completely filled at 23 cents per minute or less. The message also provides the requesting carrier the next best price available to secure connect time between the United States and Germany (e.g., 28 cents per minute). As depicted in step 516, the requesting carrier may respond to the message from server node 56 in three ways. First, the requesting carrier may transmit an acceptance, in which case server node 56 allocates the connect time (including the connect time at 28 cents per minute) to fill the requesting-carrier's purchase request (step 518). In step 520, server node 56 clears the transaction in a manner similar to that described in steps 512a-e.

[0146] Second, the requesting carrier may transmit a denial, in which case, server node 56 cancels the transaction, as depicted in step 522.

[0147] Third, the requesting carrier may accept the available minutes of connect time that satisfy its price require-

ment even though the amount of connect time is less than originally requested. In that event, server node 56 allocates the connect time which meets the requesting carrier's terms to the requesting carrier, as depicted in step 524. In step 526, server node 56 clears the transaction in a manner similar to that described in steps 512a-e.

[0148] Server node 56 maintains a running account with each carrier that either buys or sells connect time via the global network of the present invention. Thus, once authorization of a transaction has been given by server node 56 to the requesting-carrier, server node 56 adjusts the balances of the requesting-carrier and the provider-carriers to reflect the purchase of service by the requesting-carrier from the provider-carriers. Periodically (e.g., monthly), server node 56 sends bills to carriers with negative balances and forwards payments to carriers with positive balances. In this way, server node 56 manages settlement of all accounts. The server node also manages credit risks associated with the transactions. This may be accomplished in combination with a financial services company.

[0149] If a carrier that purchased a block of connect time finds that it cannot use the purchased capacity, it may resell the connect time (either as a block or one connect-transaction at a time) at a higher or lower rate than it originally paid depending on market conditions at the time of resale. The server may also support futures and derivatives markets for connect time. Carriers may also employ hedging techniques to protect themselves from large price fluctuations.

[0150] As those skilled in the art will recognize, the protocol described above for the purchase of a block of communication time is illustrative, and other protocols may alternatively be employed. For example, the carrier may request a block of connection time satisfying particular service parameter requirements without specifying a price. In that event, server node 56 may identify a block of communication time via one or more routes with the best available price which most closely matches the service parameters requested, and offer the block to the carrier.

[0151] An overview of a call-routing operation of the global network of the present invention will now be described in connection with FIG. 7. Each of the stages shown in FIG. 7 will then be explained in greater detail in connection with FIGS. 8-10.

[0152] As shown in FIG. 7, a preferred embodiment employs a three-step process for routing any call from a calling telephone to a called telephone. In step (1), a connection is established between calling telephone 2 and originating international gateway switch 22. In step (2), the system allocates a routing path to connect the call to the called location. In step (3), the routing path is established and the calling party is connected to the called party.

[0153] The three step process will be described using an illustrative example showing the routing for one exemplary call from an originating location to a terminating location. As those skilled in the art will recognize, this example presents a relatively simple set of potential call routings. However, as noted in U.S. Pat. No. 6,088,436, a call from an originating location to a terminating location may be connected via a call routing path comprising many calling legs, each leg bridging two locations in a call routing path. Furthermore, as taught therein, each leg may be completed

in either the forward or reverse direction based on the availability of connect time and of the service type requested.

[0154] When the present application is taken together with U.S. Pat. No. 6,088,436, those skilled in the art will recognize how the teachings of the present invention may be applied to the desired call routings, including ones with many calling legs, both in the forward and reverse direction.

[0155] The illustrative call routing example will now be described in connection with FIG. 1A. Turning to FIG. 1A, assume that the originating location for the call from calling telephone 2 to called telephone 4 is the United States and that originating toll switch 14 and originating international gateway switch 22 are owned and maintained by AT&T®. Assume further that the terminating location for the call is Germany, and that terminating toll switch 18 and terminating international gateway switch 24 are owned and maintained by a German telephone company which is a monopolist. Assume further that international gateway switch 28 is located in the United Kingdom (U.K.) and is operated by British Telecom™. (BT). Finally, assume that international gateway switch 26 is located in Belgium and is operated by Belgacom™., a Belgian carrier.

[0156] Assume further that the 10 million minutes of purchased connect time described above in connection with FIG. 5, is divided between three routing paths which connect AT&T's international gateway switch 22 to the German telephone company's international gateway switch 24. With reference to FIG. 1A, the first routing path connects the call directly to Germany's international gateway switch 24 via line 32. The second routing path connects the call to international gateway switch 24 via international gateway switch 28 in the U.K. and lines 34, 38. The third routing path connects the call to international gateway switch 24 via international gateway switch 26 in Belgium and lines 30, 36.

[0157] Step (1) of the process shown in FIG. 7 will now be described in more detail in connection with the flowchart shown in FIG. 8. Turning to FIG. 8, in step 802, the caller dials the telephone number of called telephone 4 from calling telephone 2. The dialed number will typically comprise a prefix (such as 011) signifying that the call is an international telephone call. The dialed number will further comprise a country code (e.g., 49 for Germany) and area code (89 for Munich) representative of the overseas location to which the call is being placed. Local telephone network 6 is programmed to recognize overseas calls and to route such calls to the caller's long distance carrier.

[0158] Thus, in step 804, local telephone network 6 transmits appropriate SS7 signalling information regarding the call to originating toll switch 14 via line 16. Supervision is thus passed to originating toll switch 14. Concurrently, in step 806, local telephone network 6 creates a path through the local network's transmission lines to establish a connection between calling telephone 2 and originating toll switch 14.

[0159] From the signalling information, originating toll switch 14 recognizes the call as an overseas call, and routes the call to originating international gateway switch 22. In particular, in step 808, originating toll switch 14 transmits appropriate SS7 signalling information to originating inter-

national gateway switch 22, thereby transferring supervision to switch 22. Concurrently, in step 810, the long distance network creates a path through its transmission lines to establish a connection between calling telephone 2 and originating international gateway switch 22.

[0160] Thus, as described above, in step (1) a transmission connection is established between calling telephone 2 and originating international gateway switch 22, and supervision for the call is passed to originating international gateway switch 22.

[0161] In step (2), the system allocates a route for the call from calling telephone 2 to called telephone 4. Step (2) is described in more detail in connection with the flowchart shown in FIG. 9.

[0162] Turning to FIG. 9, in step 902, originating international gateway switch 22 determines whether the called location is one to which it may route calls via the global network. If decision step 902 fails, international gateway switch 22 employs alternate means for connecting to the called location, as depicted in step 904. Otherwise, if decision step 902 succeeds, international gateway switch 22 passes supervision to originating telecommunication node 44, as depicted in step 906, for routing the call to the terminating location.

[0163] In step 908, node 44 retrieves from memory the routing paths on which the originating carrier has purchased connect time. As noted above, in connection with FIG. 1B, node 44 is provided with several databases 99-97 which store information on the network cost, published cost, and global network cost for connecting calls to the called location. Thus, in decision step 909, node 44 compares the various costs retrieved from databases 99-97, and determines whether to route the call via its own network connections or via a route purchased through the global network.

[0164] Decision step 909 may incorporate a procedure which applies sophisticated business rules to determine which route should be chosen to carry the traffic. For example, node 44 might be programmed to route the call via a global network route, unless the cost of that route is greater than 90% of the network cost of connecting the call.

[0165] If decision step 909 fails, the system proceeds to connect the call via an alternative route. If, however, decision step 909 succeeds, the system proceeds to step 910, where node 44 identifies a first one of the routing paths purchased via the global network and determines whether connect time is available to connect the call from calling telephone 2 to called telephone 4 via the routing path. This determination is made by transmitting a routing request to server node 56. Server node 56 queries each node in the path as to the availability of ports to carry the call. If connect time is available, server node transmits a message to that effect to node 44 and the system proceeds to step (3) where the call is connected via the routing path, as described below. Otherwise, node 44 returns to step 910, identifies a second one of the routing paths and determines whether connect time is available to connect the call from calling telephone 2 to called telephone 4. Step 910 is repeated until either a routing path with available connect time is identified or until all routes on which the carrier has purchased time have been traversed (step 912). If step 912 fails (i.e., there are no

routing paths with available connect time), the system proceeds to step **914** where supervision is passed back to gateway **22** which typically may route the call via an alternative route such as the regular settlement route or other overflow route. If no other route is available, a message may be transmitted to calling telephone **2** informing the caller that all circuits are busy and asking the caller to place his call again at a later time.

[**0166**] Once a route with available connect time is identified, the system proceeds to step (**3**) of **FIG. 7**, where the identified route is established and the caller is connected to the called party. Step (**3**) of **FIG. 7** will be described in detail in connection with **FIG. 10**.

[**0167**] As noted in the background of the invention above, it has not been possible to date to cost-effectively and dynamically route calls via the international gateway network because of the lengthy contractual negotiations and physical reconfiguration which were required to establish new call routings. Without reconfiguration, the international gateway switches were unable to distinguish incoming terminating traffic from incoming transit traffic or redirect on the fly without human intervention. As a result, all incoming traffic was treated as terminating traffic subject to high settlement agreement accounting rates or was based on existing prenegotiated contracts and links which could not be easily modified. As described in more detail below, the present invention overcomes this drawback of the prior art and permits dynamic routing of transit and terminating traffic to gateway switches in the gateway network or any other network.

[**0168**] For purposes of this example, assume that the routing decision made in step (**2**) of **FIG. 7** above is that the call from calling telephone **2** to called telephone **4** should be routed via international gateway switch **28** in the U.K.

[**0169**] The system then proceeds to step **1002** of the flowchart depicted in **FIG. 10**. In step **1002**, AT&T's international gateway switch **22** establishes a transmission path to carry the call to international gateway switch **28** based on instructions from node **44** regarding routing, signalling, the appropriate port with which to connect, and the destination number to employ. Concurrently, in step **1004**, node **44** transmits an SS7 (or C7 or other appropriate protocol) message to international gateway switch **28** via line **34**.

[**0170**] The C7 message comprises a code which informs international gateway switch **28** that the call is not for termination in the U.K. (i.e., that the call is a transit call), and instructs switch **28** to pass supervision of the call to telecommunications node **48**.

[**0171**] The particular C7 code used to inform international gateway switch **28** that the call is a transit call is unimportant as long as the gateway switch is configured to recognize the C7 code as indicating a transit call. At present, however, at least two potential codes for accomplishing this task are contemplated. First, the system may employ a fictitious area code which does not exist in the U.K. as a prefix to the dialed number transmitted as part of the C7 message. Also, a special country code can be used for this purpose. When international gateway switch **28** sees the fictitious area code, it immediately recognizes the call as a transit call, and passes supervision to node **48**. Alternatively, a new class of service code may be defined and transmitted as part of the C7

message. The U.K. gateway switch recognizes the service code and identifies the call as a transit call.

[**0172**] Also, some telecommunication nodes may acquire a point code, thus permitting a gateway to direct traffic to the node without employing one of the codes described above.

[**0173**] In either event, the system proceeds to step **1006** wherein international gateway switch **28** passes supervision of the call to node **48**. In step **1008**, node **48** initiates a call via international gateway switch **28** to the telephone number of called telephone **4** in Germany. Node **48** may be informed that the call is to be routed to Germany via the SS7 network or alternatively via line **62**.

[**0174**] In step **1010**, international gateway switch **28** establishes a transmission path to carry the call to Germany's international gateway switch **24**. Concurrently, in step **1012**, international gateway switch **28** transmits an C7 signalling message to international gateway switch **24** informing switch-**24** of an incoming call for termination in Germany. In step **1014**, International gateway switch **24** routes the call through terminating toll switch **18** and local network **10** to called telephone **4**, thus establishing a connection between the calling party and the called party.

[**0175**] When a call is terminated, every participating node in the routing path transmits a data message to server node **56** informing node **56** of the details of the call, including the length of the call. Server node **56** uses this information to update account balances for every carrier who participated in the routing path.

[**0176**] As noted in U.S. Pat. No. 6,088,436, the speed of the system may be increased by synchronizing the concurrent establishment of two or more calling legs in a routing path. Thus, in the illustrative example given above, several of the steps might be performed in parallel such as establishing transmission paths from the U.S. to the U.K. and from the U.K. to Germany, in order to increase the speed of the system. For example, upon receiving a request or instruction to route a call, the U.K. node may verify that trunks are available to transmit the call to Germany, and that the destination, such as called phone **4**, is available.

[**0177**] It should be noted that when the gateway switches described above are IN compatible, server node **56** is aware of this fact and informs node **44**. Node **44** may then interact directly with the U.K. gateway using IN signalling rather than SS7 or C7. In this event, node **44** need not interact with U.K. node **48**. Moreover, node **44** may employ IN signalling to communicate directly with gateway **24** to determine, for example, whether called telephone **4** is off-hook.

[**0178**] More generally, when the present disclosure is taken in combination with U.S. Pat. No. 5,710,809, which is incorporated herein by reference in its entirety, it will be recognized that the present invention employs data lines to provide data signalling external to the communications network in order to facilitate the efficient routing of calls. As will be recognized, the degree to which external data signalling is required will depend on the ability of the network signalling capability to carry the data messages necessary to operate the overlay network of the present invention.

[**0179**] In the first illustrative example described above, a requesting carrier purchased a block of connect time. Alternatively, the purchase of connect time may be on a call by

call basis. A second example illustrating such a transaction will now be described in connection with FIGS. 11A-B.

[0180] As shown in FIGS. 11A-B, the system employs a 14-step protocol to clear a call-by-call connection transaction. In step 1101, when a call is received at gateway 22, it passes supervision over the call to node 44. In step 1102, node 44 transmits a service request to at least one server node 56. For purposes of this illustrative example, it will be assumed that node 44 transmits a request to only one server node 56. As explained in greater detail below, however, node 44 may transmit a service request to a plurality of server nodes 56, each of which may be optimized for a different parameter, such as price or network utilization.

[0181] In step 1103, server node 56 processes the request and identifies the routing path which best meets the requirements of the requesting node given the optimization priorities of server node 56. For example, assuming that server node 56 is programmed to optimize routes by price, server node 56 would identify the least expensive routing path which meets the service parameter requirements of node 44.

[0182] In step 1104, server node 56 transmits an offer of service to node 44 comprising the particulars of the identified route.

[0183] In decision step 1105, node 44 compares the offer to other potential routes which might be employed to connect the call from calling telephone 2 to called telephone 4. This determination may be based on sophisticated business rules supplied to node 44 by the requesting carrier. For example, as noted above in connection with FIG. 1B, node 44 is provided with a network cost database which stores the carriers internal cost of connecting a call from gateway 22 to the called location. Node 44 might be programmed to accept the offer from server node 56 only if it is 10% less expensive than the network's own internal cost of completing the call.

[0184] If decision step 1105 fails, node 44 transmits a rejection message to server node 56. This ends the protocol.

[0185] Otherwise, if decision step 1105 succeeds, the system proceeds to step 1106 where node 44 transmits an acceptance to server node 56.

[0186] In step 1107, server node 56 transmits data messages to every node in the routing path requesting service to connect the call. In step 1108, the nodes in the path agree to provide the service, and transmit a data message to server node 56 to that effect.

[0187] In step 1109, server node 56 brokers the financial transactions resulting from establishment of the routing path. As part of step 1109, server node 56 reserves a portion of the requesting carrier's credit limit to cover the cost of the call. The reserved dollar amount is chosen based on an estimate of how long the call will last. This estimate may be based on historical call lengths.

[0188] In step 1110, server node 56 transmits a confirmation message to node 44, confirming purchase of connect time on the identified routing path. The message also preferably comprises information concerning the port on gateway 22 via which the call is to be routed, as well as destination numbers and other service data necessary to complete the call to the called location.

[0189] In step 1111, at the conclusion of the call, each node in the routing path transmits an end-of-transaction message to server node 56 which may preferably include the length of the call.

[0190] In step 1112, server node 56 adjusts the account balances of all carriers and node operators participating in the routing to reflect the cost of the call. In step 1113, server node 56 settles the accounts of all carriers and node operators by transmitting payment to parties with positive balances and bills to parties with negative balances. Step 1113 may be performed periodically, e.g., monthly.

[0191] In step 1114, server node 56 updates capacity to reflect that ports that had been employed to carry the call are now clear and records the number of minutes of network time that were used to carry the call.

[0192] The nodes may also provide routing decisions based on sophisticated business considerations submitted by a requester carrier to its local node. Assume, for example, that a carrier only wishes to buy connect time via the global network if the cost is below 20% below its own cost unless it needs the connect time for overflow traffic. This business consideration can be transmitted to its local node which will evaluate routes proposed by server node 56 in accordance with the transmitted business considerations. Server node 56, however, will generally not have access to these proprietary business considerations, unless the system is a closed network where node 56 is employed to optimize capacity, rather than price, as described, for example, below.

[0193] As noted, in the above-described embodiments originating node 44 was shown to communicate with server node 56, which constituted a single source of rate information and a single exchange for communication capacity. In other embodiments, however, several servers may be used, which communicate with node 44 in the same or similar way as discussed above. In such another embodiment each node 4449 would be connected to one or multiple servers.

[0194] In a multiple server embodiment, each server node 56 may rank potential routing paths in accordance with a particular parameter or set of parameters. For example, some servers may rank routes by price. Other servers may rank routes in a manner designed to maximize network utilization. A given company may offer its communication capacity on one server or on multiple servers. Because each server may rank routes according to different priorities, a particular service query from an originating node might yield different proposed routes from each of the server nodes 56.

[0195] Consequently, an originating node, such as node 44, connected to multiple server nodes 56 must store selection rules for determining which route to choose from among the several that may be proposed by the different server nodes 56. The decision in selecting a server may depend on various business factors and conditions specific to a carrier. For example some carriers may first transact business with servers having lower transaction surcharge, while others may prefer servers that are known for availability of high volumes of connect time for sale.

[0196] A person skilled in the art will understand that a specific selection of choices may be programmed based on a carrier's specific business needs. For example certain carriers might have an affiliation or a special volume discount with a company providing communication capacity

which is available on only one specific server. In such a case, the carrier might first attempt to purchase communication capacity from the specific server which offers the affiliated company's connections before purchasing capacity on other servers. In another example, the carrier might prefer to purchase connect time from a server with which it is affiliated, unless the price offered by that server is, e.g., 10% greater than the price available from a second server node 56 with which the carrier has no affiliation. Node 44 is programmed to implement these business rules supplied to it by the carrier.

[0197] The present invention also permits a carrier who owns or is associated with a node 44-49 to dynamically control its capacity in accordance with a set of business rules. With respect to this aspect of the invention, if a node receives a volume of calls that exceeds or is close to the limit of its previously purchased connection capacity to a given destination, the node can contact the server with a request to purchase additional minutes of connect time to accommodate this unforeseen demand. Additional capacity may either be requested automatically when a call volume reaches a specified threshold or by a system operator who monitors communication traffic conditions.

[0198] Furthermore, a node may include a capability to adjust its resources based on the actual and anticipated communication traffic conditions. It is known to keep track of call traffic volume to a given destination and to store measurements of the call volume periodically in a resource utilization database. Such data representing network utilization coupled with other variables, such as time of the day and day of the week, may provide a basis for a reasonable prediction of the capacity utilization during the next time interval, for example the next hour.

[0199] Then, if anticipated utilization exceeds a desired utilization level, the node would purchase additional capacity, e.g. connect time to a destination, for the next time interval. Conversely if the predicted utilization is lower than desired, node would offer excess minutes during the next time period for sale.

[0200] For example, if the desired utilization is 80% of the purchased capacity, a node will purchase or sell capacity so as to adjust anticipated utilization to 80%.

[0201] FIG. 12 illustrates a flowchart of this functionality. At 1201 the system ascertains recent utilization by referring to the utilization database and at 1202 predicts, based on recent utilization and other factors such as time of the day and day of the week, the anticipated utilization for the next period, e.g., an hour. At 1203, if the anticipated utilization for a period is approximately the same as the desired utilization, this execution terminates until the next period. (Of course, as discussed before, if volume rises unexpectedly the node should react to such a situation and purchase additional capacity automatically or upon operator's instruction).

[0202] If anticipated utilization materially deviates from the desired utilization (test 1204), the node proceeds to purchase or sell capacity for the next period accordingly. If utilization is predicted to exceed the desired utilization, at 1205 the node purchases additional capacity so that the anticipated utilization is at the desired level. Similarly if utilization is predicted to be lower than desired, at 1206 the system sells excess capacity to bring anticipated utilization to the desired level.

[0203] The desired utilization may take the form of a formula which incorporates business considerations. As a simple example, the node may be instructed to maintain utilization at 80% of capacity unless purchase of additional connect time is above a certain price, or sale of excess connect time is below a certain price. The business rules applied by the node may be substantially more sophisticated than the example described above, and may take into account any factor desired by the carrier.

[0204] For example, although illustrated primarily in connection with international telephone calls, the present invention may also be applied to improve the efficiency of a network located within one country.

[0205] Also, although illustrated primarily in connection with a public network comprised of a plurality of carriers, the present invention may also be employed to efficiently manage a private network, or a network made up of facilities maintained by affiliated carriers. In this context, server node 56 will frequently be programmed to rank routing paths according to a parameter other than simple price. For example, the network may rank and allocate routes in a manner designed to maximize utilization of the network facilities.

[0206] FIG. 13 illustrates another embodiment of the inventive exchange system. The exchange system includes an exchange server node 56 and one or more switch nodes 44 for routing telecommunications traffic between communications networks 1300. The server node 56 is connected to access stations 1302 of buyers and sellers of telecommunications traffic through a wide-area network such as the Internet 1304. Furthermore, the server node 56 is connected to or provided with a database 1306, which stores information including the account balances of the exchange system and each of the buyers and sellers. Preferably, the account balances are updated at a predetermined time such as when sellers' offers and buyers' requests are matched or when the buyers subsequently utilize the seller's telecommunications services. The accounts may include account receivables, i.e., money owed by the buyers to the exchange system, and cash receipts, i.e., prepayments received from the buyers.

[0207] In a particularly preferred embodiment, a financial services node 1308 is connected to or otherwise accessible by the server node 56 through, for example, network 1304, which may be a public network (e.g., Internet) or a private network. The financial services node 1308, which may be owned or operated by a financial institution such as a bank, is configured to execute on behalf of its member's financial transactions with other financial nodes connected to the network 1304. Advantageously, the exchange system maintains a prearranged relationship with the financial institution wherein the financial services node 1308 will forward to server node 56 an advance payment upon receipt of an appropriate request from server node 56. In one exemplary relationship, the financial services node 1308 forwards an advance payment to the exchange system upon receipt of a request that includes a pledge or an assignment of a sufficient amount of the exchange system's account receivables and/or cash receipts. Such an arrangement is particularly useful in the case where server node 56 would otherwise match a seller's offer to a buyer's request except that the buyer and the seller require different settlement periods (e.g., the buyer requires a five-day grace period before paying the

seller while the seller demands immediate payment from the buyer). This online advance payment method provides the funding to settle transactions with different settlement periods so as to increase the liquidity of the exchange system, i.e., enabling more buyers and sellers to trade with each other. In addition, this method may also enable the server node 56 to increase the number of matches if settlement periods specified by the buyers and sellers are used as one of the matching criteria.

[0208] The server node 56 also includes a financial module 1314 for processing various financial tasks such as, for example, adjusting account balances of buyers and sellers and the exchange, determining credit limit and risk premium for each buyer, and netting of financial accounts of each buyer and seller. Other financial functions performed by the financial module 1314 will be discussed in detail below.

[0209] A tracking module 1312 connected to or accessible by the server node 56 monitors each buyer's actual usage of a matched seller's network. The information gathered by the tracking module 1312 is then forwarded or becomes accessible by the other modules such as the financial module 1314.

[0210] The exchange system further includes a switch node 44 for routing telecommunications traffic between communications devices 1311, which are connected to buyers' and sellers' networks 1300. The switch node 44 is configured to include a switch agent for executing the route plan generated by the server node 56.

[0211] In another embodiment, the financial services node 1308 maintains or manages financial accounts for the exchange system and its users, i.e., buyers and sellers. To settle a transaction, the exchange system transmits to the financial services node 1308 a message indicating the appropriate amounts to credit and debit from the accounts of the buyers, sellers and the exchange system. The financial services node 1308 acknowledges the message, adjusts the account balances of the buyers, sellers, and the exchange system and updates the information stored in the database 1306.

[0212] In use, the server node 56 receives offers and requests of telecommunications services from access stations 1302 of the buyers and sellers through network 1304. The server node 56 then matches the offers and requests, either instantaneously or after a predetermined period of time. Once the offers and requests are matched, the server node 56 generates a route plan comprising a list of routes available to each buyer, which routes conform to the parameters previously specified by the buyer. Where routes of multiple sellers are matched to a buyer, the server node 56 may employ a conventional least cost routing algorithms to prioritize the matched routes for each buyer. The route plan is then translated into a language understood by a switch agent and then loaded into switch node 44. As the switch node 44 routes telecommunications traffic from buyers' communications devices 1311 to other communications devices through a matched seller's communications networks 1300 according to the route plan, a tracking module 1312 gathers information relating to usage of a seller's network by each buyer. The gathered information may include call detail records (CDRs), which contain information such as, for example, originating carrier identifier, terminating carrier identifier, phone numbers of the origi-

nating and terminating devices, the duration of the call, etc., relating to each call made over the network. An accounting module 1314 processes the information from the tracking module 1312 and adjusts the account balances of the buyers and sellers stored in database 1306.

[0213] In one embodiment, in the case where a buyer and a seller specified different settlement periods, the server node 56 communicates to the financial services node 1308 the amount required to pay the respective seller for usage of its network and transmits a request for that amount. In another embodiment, the server node 56 may transmit a pledge to a financial institution via the financial services node 1308 the account receivables stored in database 1306 in return for advanced receipt of funds required to pay the seller. Upon authenticating the request, the financial services node 1308 sends a message to the server node 56 indicating transfer of funds for that amount. The accounting module 1314 then adjusts the buyer's and the seller's account balances accordingly.

[0214] In another embodiment, the case where the buyers have executed letter-of-credit agreements or posted a trading deposit with the financial institution operating the financial services node 1308, the server node 56 sends a request or notification to the financial services node 1308 for payment indicating that a buyer's account has insufficient funds to cover the charges incurred by the buyer. Upon authentication of the request, the financial services node 1308 sends a payment to the exchange via the server node 56. The financial module 1308 then adjusts the account balances of the buyers and sellers stored in database 1306.

[0215] FIG. 14 diagrammatically illustrates other aspects of the embodiment of FIG. 13. As shown, an external credit node 1410 and financial services node 1308 are in communication with the exchange server node 56 through network 1304, which may be a public or a private network. The financial module 1314 includes an accounting module 1402, a financing decision module 1412, a credit module 1408, and a tracking module 1312.

[0216] The accounting module 1402 determines net outstanding balances and amount due a user (e.g., a buyer or a seller), coordinates payments between buyers and sellers, and credits and debits accounts based on, for example, transactions from financial services node 1308 and/or information from data storage 1306. The financing decision module 1412 determines the credit and financial exposure of each user based on data from external credit node 1410, financial services node 1308, external financial services organizations and/or historical and current data from the data storage 1306. Financing decision module 1412 also analyzes financial exposure in determining financial terms and rates and service and/or administrative fees for the users. The financial terms may include late payment interest rates and financing terms. The credit module 1408 scores and rates buyers' credit using data from external sources (e.g., external credit node 1410) and current and historical data from data storage 1403. The credit module 1408 also determines appropriate credit limits, risk premiums, amounts of letter of credit and/or trading deposits. Credit module 1408 may also perform real-time monitoring of actual balance against pre-approved credit limit of each buyer. The tracking module 1312 gathers all usage information for each buyer and seller on the exchange through the switch node 44.

[0217] According to one aspect of this system, the credit module 1408 scores and rates buyers' credit, determines initial credit limits, required risk premiums and/or required letters of credit or trading deposits for each member. The credit module 1408 also monitors a user's credit exposure against trade activity using information stored in database 1306 and information from the financial services node 1308 and/or external credit node 1410. The credit module 1408 interfaces with external credit node 1410, the accounts database 1404, financial services node 1308 and historical billing database 1414 to accurately determine and monitor credit exposure and credit limits. In one example, the buyers have executed letter-of-credit agreements or posted a trading deposit with a financial institution for the benefit of the exchange system such that when a buyer's trading activity exceeds a threshold or credit limit or has inadequate funds to pay for usage of a seller's telecommunications services, server node 56 transmits a notification to the financial services node 1308 requesting transfer of an appropriate amount from the financial services node 1308 to a seller and/or the exchange system, in accordance with the exchange's trading terms, letter of credit agreement terms, etc.

[0218] Database 1306 includes accounts database 1404, call detail records database 1406, billing history or historical billing database 1414, and account receivables database 1416. The accounts database 1404 stores current account information for each buyer and seller, including outstanding balances, selected payment terms, credit limits, credit ratings, financing rates and other account specific information. The call detail records database 1406 stores information such as, for example, originating carrier identifier, terminating carrier identifier, phone numbers of the originating (or calling) and terminating (or called) devices, the duration of the call, etc., for each call made over the network. The historical billing database 1414 stores all billing history, payment, credit and financing transactions for each user. Historical billing database 1414 enables the exchange to use historical billing and collection data information in its decision to extend credit or financing terms to buyers. Account receivables database 1416 stores all historical data regarding the exchange's account receivables pool, which includes historical bad debt for all buyers.

[0219] The following describes the various operations of the exchange system.

[0220] Pre-Trading Credit Approval: The credit module 1408 initially collects credit-related information of a user from the financial services node 1308, external credit node 1410, historical billing database 1414 and accounts database 1404. Using a weighted average algorithm, the credit module 1408 scores each user's credit and determines approval ranking. The approval ranking may be used for determining whether a buyer can buy, the buyer's credit limit, and/or the amount of letter of credit or trading deposit required. This information is stored for each buyer in the accounts database 1404.

[0221] Definition of Trading Limits, Trading Deposit or Letter of Credit Requirements: The credit module 1408 collects a user's credit information from financial services node 1308, external credit node 1410, historical billing database 1414 and accounts database 1404 and, using both estimated trade volumes and a conventional weighted aver-

age algorithm, determines if a user qualifies for a non-secured credit limit or the appropriate amount of letter of credit, deposit or bond. The credit module 1408 may determine that the user is eligible for selling but not qualified to buy through the exchange. This information is stored for each user in the accounts database 1404.

[0222] Credit Authorization: The credit module 1408 transmits a message (via server node 56) to the financial services node 1308 requesting a "letter of credit" or credit authorization for a user prior to the server node 56 authorizing trading rights to the user. When approved, the financial services node 1308 transmits a message to the server node 56 indicating the amount of credit available to the user and a confirmation regarding the completion of the transaction (e.g., the "letter of credit" being posted with either the financial services node 1308 or a third-party financial institution). The credit module 1408 may set the user's credit limit to be no more than the amount of credit specified in the message from the financial services node 1308. The server node 56, then enables the user to commence trading. The credit information may be stored in the accounts database 1404.

[0223] Trading Deposit Transaction: When the credit module 1408 determines that a buyer must post a trading deposit prior to being authorized to trade, the credit module 1408 transmits a request to the financial services node 1308 requesting a cash deposit prior to authorizing trading rights to the buyer. The financial services node 1308 transfers funds into a trading account, which may be owned either by a third-party financial institution or by the exchange, and sends a confirmation to the credit module 1408 regarding completion of the transaction. The credit module 1408 may set the user's credit limit to be no more than the amount of cash deposit or funds received from the financial services node 1308. The server node 56 then enables the user to commence trading. The deposit information may be stored in the accounts database 1404. The transfer of funds can be accomplished using conventional techniques such as wire transfer, Automated Clearing House (ACH) or other automated funds transfer mechanisms.

[0224] Underwriting of Users: If the credit module 1408 determines that a user qualifies for a non-secured or non-collateralized credit limit, the exchange may, for a fee, have a third-party financial institution underwrite (i.e., insure) the credit risk of the user. The credit module 1408 sends a message to the financial services node 1308 requesting that the third-party financial institution insures this user up to the credit limit determined by the credit module 1408. The financial services node 1308 transmits a message upon approval of the request for insurance. This information may be stored in the accounts database 1404. If the user does not pay the exchange after a pre-determined amount of time, the accounting module 1402 sends a message to the financial services node 1308 to automatically transfer the insured dollar amount to the operator of the exchange. The financial services node 1308 returns a confirmation message and the accounting module 1402 updates the accounts database 1404 and transfers payment record to the historical billing database 1414. Transfer of funds can be accomplished using techniques such as wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms.

[0225] Dynamic Credit Monitoring: The credit module 1408 uses information from the financial services node

1308, accounts database **1404**, historical billing database **1414** and external credit node **1410** to reassess credit scoring and financial exposure dynamically and in real-time. Credit scoring and exposure can change based on new, material external information or changes in the member's open account. Any changes are noted for each user in the accounts database **1404**. If the credit module **1408** determines that the user has surpassed or exceeded his credit limit, it may send a message to the user and the switch agent indicating that this user should no longer be allowed to buy on the exchange or send or receive telecommunications traffic through the exchange. The server node **56** may then terminate all open buy orders and limit the user's ability to place any new orders.

[0226] **Determination of Risk Premium:** The credit module **1408** collects information from the financial services node **1308**, external credit node **1410**, historical billing database **1414** and accounts database **1404** and, using a weighted average algorithm, determines if risk premiums are required for each user and the appropriate monetary amount or premium. The required risk premium is stored for each user in the accounts database **1404**. The risk premium, which can be calculated either as a flat fee or as a proportion of the trade value (i.e., the amount of purchase or sale through the exchange), can be used in lieu of or as a supplement to letters of credit, cash deposits or bonds.

[0227] **Pre-Trading Financing Approval:** The financing decision module **1412** collects information from the financial services node **1308**, external credit node **1410**, historical billing database **1414** and accounts database **1404** and using a weighted average algorithm determines applicable payment financing rates and terms for each user. This information is stored for each user in the accounts database **1404**.

[0228] **Real-Time Collection of Exchange Usage and Billing Information:** The tracking module **1312** gathers all information relating to each buyer's and seller's usage and transactions processed by switch node **56** and stored in the call detail records database **1406** and other information sources. The tracking module **1312** sends this information to the accounts database **1404** where it is stored and subsequently accessed for the processing of all settlement and financial transactions.

[0229] **Netting of Accounts:** Since a user can be both a buyer and a seller during a billing cycle, the accounting module **1402** at the end of each billing cycle and/or at other regular intervals nets each user's receivable against its payable to determine the net amount owed to or by the exchange. This information may be stored in the accounts database **1404**. In the case where the user has elected to be paid by the exchange early, the accounting module **1402** calculates the total amount owed to the exchange by subtracting any applicable financing and service fees from this net amount. In the case where the user has elected to pay the exchange early, the accounting module **1402** calculates the total amount owed by the exchange by adding any applicable financing and service fees to this net amount. If a user both buys and sells on the exchange, the accounting module **1402**, on either real-time basis or at scheduled intervals, nets all sell activities against all buy activities to ensure the user does not exceed his credit limit. If a user has surpassed his trading or credit limit, the server node **56** terminates or otherwise limits his ability to buy on the exchange. Any

amount this user subsequently sells via the exchange is applied against the account receivable stored in the accounts database **1404**. The accounting module **1402** sends this information to the accounts database **1404**. The credit module **1408** determines if the credit ranking and/or credit limits should be changed based on the user's trading activities. The server node **56** allows the user to begin buying on the exchange once the amount owed is within the credit or trading limit (assuming dynamic credit ranking has not been changed).

[0230] **Automated Standard Bill Settlement with Sellers:** The accounting module **1402** reviews the billing information stored in the accounts database **1404**, and determines which sellers have requested to be paid on standard trading terms. If the seller maintains a banking account with the financial services node **1308**, the accounting module **1402** sends a message to the financial services node **1308** to automatically transfer an appropriate monetary amount from the exchange to the seller. The financial services node **1308** returns a confirmation message and the accounting module **1402** updates the accounts database **1404** and transfers payment record to the historical billing database **1414**. Transfer of funds can be accomplished via wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms. If a seller does not maintain a banking account with the financial services node **1308**, the accounting module **1402** initiates a payment process.

[0231] **Automated Early Bill Settlement with Sellers:** The accounting module **1402** reviews the billing information stored in the accounts database **1404**, and determines which sellers have requested to be paid prior to standard settlement period. The user may incur additional financing and/or service fees for early settlement. The accounting module **1402** determines the amount owed to sellers (e.g., total trade revenue minus early payment discount plus financing fees) using the financing rate determined by the financing decision module **1412** and stored in the accounts database **1404** and the number of days of early payment stored in the accounts database **1404**. If the seller maintains a banking account with the financial services node **1308**, the accounting module **1402** sends a message to the financial services node **1308** to automatically transfer an appropriate monetary amount from the exchange to the seller. The financial services node **1308** returns a confirmation message to server node **56** and the accounting module **1402** updates the accounts database **1404** and transfers payment record to the historical billing database **1414**. Transfer of funds can be accomplished using techniques such as wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms. If a seller does not maintain a banking account with the financial services node **1308**, the accounting module **1402** will initiate an invoicing and payment process.

[0232] **Automated Standard Collection from Buyer:** The accounting module **1402** reviews the billing information stored in the accounts database **1404**, determines which buyers have agreed to pay on standard trading terms. If a buyer maintains a banking account with the financial services node **1308**, the accounting module **1402** sends a message to the financial services node **1308** to automatically transfer an appropriate monetary amount from the buyer to the exchange. The financial services node **1308** then sends a confirmation message back and the accounting module **1402** updates the accounts database **1404** and transfers payment

record to the historical billing database **1414**. Transfer of funds can be accomplished using techniques such as wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms. If a buyer does not maintain a banking account with the financial services node **1308**, the accounting module **1402** will initiate a billing and collection process.

[0233] Automated Early Collection from Buyer: The accounting module **1402** reviews the billing information stored in accounts database **1404** and determines which buyers have opted to pay the exchange prior to the standard settlement period. The accounting module **1402** then determines the amount owed by the buyer using the financing rate previously determined by the financing decision module **1412** and stored in the accounts database **1404** and the number of days of early payment stored in the accounts database **1404**. If a buyer maintains a banking account with the financial services node **1308**, the accounting module **1402** sends a message to the financial services node **1308** to automatically transfer the appropriate monetary amount (e.g., trade revenue minus discount plus financing fees). The financial services node **1308** then replies with a confirmation message and the accounting module **1402** updates the accounts database **1404** and transfers payment record to the historical billing database **1414**. Transfer of funds can be accomplished using techniques such as wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms. If a buyer does not maintain a banking account with the financial services node **1308**, the accounting module **1402** will initiate a billing and collection process.

[0234] Automated Late Collection from Buyer: The accounting module **1402** reviews the billing information stored in the accounts database **1404** and determines which buyers have opted (by choice or default) to pay the exchange after the standard settlement period in return for additional financing and late settlement fees. The accounting module **1402** then determines the amount owed by the buyer using the financing rate determined by the financing decision module **1412** and stored in the accounts database **1404** and the timing of the late payment that is stored in the accounts database **1404**. If a buyer maintains a banking account with the financial services node **1308**, the accounting module **1402** sends a message to the financial services node **1308** to automatically transfer the appropriate dollar amount (trade revenue plus late payment fees). The financial services node **1308** sends a confirmation message back and the accounting module **1402** updates the accounts database **1404** and transfers payment record to the historical billing database **1414**. Transfer of funds can be accomplished via wire transfer, Automated Clearing House (ACH) or other automated transfer mechanisms. If a buyer does not maintain a banking account with the financial services node **1308**, the accounting module **1402** will initiate a billing and collection process.

[0235] Automated Payment using Letter of Credit or Cash Deposit: The accounting module **1402** reviews the information stored in the accounts database **1404** and determines which buyers are past due and/or past their trading or credit limit and were required to post a deposit or letter of credit. Using the late payment and financing terms, the accounting module **1402** determines the total amount the buyers owe the exchange. The accounting module **1402** then sends a request to the financial services node **1308** to transfer funds from a

trading deposit account or a letter of credit to the exchange. The financial services node **1308** sends a confirmation message back and the accounting module **1402** updates the accounts database **1404** and transfers payment record to the historical billing database **1414**. The accounting module **1402** may also determine that a user's total trading exposure exceeds his credit limit. If so, the accounting module **1402** will send a message to the switch agent to block future buy orders from that user or to stop further usage of the exchange system by that user.

[0236] Asset Securitization: The financial services node **1308** collects information from the account receivables database **1416** to determine the historical performance of the exchange's account receivables and uses this information to determine the financial terms when the account receivables are securitized with a third-party financial institution. The financial services node **1308** then takes the exchange's pledge of the account receivables and sends an appropriate monetary amount to the exchange's account when receivables assigned to a third party financial institution.

[0237] Automated Tracking of Collections: The server node **56** regularly tracks the amount past due and automatically queues collection agents on the appropriate next steps. The server node **56** will also notify financial services node **1308**, user and any other pertinent parties that specific collections activities, such as email, phone call, research or automated transfer of funds must occur.

[0238] Automated Notification: Whenever a transaction occurs in the exchange system, server node **56** may send a notification to the affected user. The notification may inform the user when his usage has exceeded his previously determined credit limit, a payment has been made to or by them, the financing terms have been changed, or his account is past due, etc.

[0239] While the invention has been described in conjunction with specific embodiments, it is evident that numerous alternatives, modifications, and variations will be apparent to those skilled in the art in light of the foregoing description. In another aspect of the invention shown in FIG. 15, the server node **56** transmits, via the switch node **44**, Call Detail Records (CDRs) to a batched-call detail record (BDR) processor **1502** for aggregating or consolidating the CDRs prior to the processing by an invoice or billing module, Billing Processor **1504**. As was aforementioned, the CDRs are detail records of each telephone call and the processing of a great number of CDRs for each of the several hundred members of the exchange can consume an extraordinary amount of processing power, thereby requiring the exchange to engage in costly capital expenditure on processing equipment. Advantageously, the BDR processor **1502** arranges the CDRs into groups or batches in such a way that the Billing Processor **1504**, which is configured to process each CDR separately, processes each group or batch as a single transactions. The Billing Processor **1504** will produce a greatly reduced number of batched-call detail records (BDRs) on the basis of buyers and sellers. In one embodiment, the BDR processor retrieves CDRs (after each trading period) from the CDR database module **1406** (see FIG. 14) and combines, aggregates or consolidates the CDRs for each buyer and seller for each destination listed in the CDRs. Thus, for example, the BDR processor **1502** combines CDRs of two thousand calls to Mexico from a

buyer into one BDR and the Billing Processor **1504** will process one BDR, rather than two thousand CDRs, for the buyer for his purchased termination, Mexico. The Billing Processor will also process the same for the corresponding seller for all traffic from the buyer terminating in Mexico.

[0240] Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to a preferred embodiment thereof, it will be understood that various omissions and substitutions and changes in the form and details of the devices illustrated, and in their operation, may be made by those skilled in the art without departing from the spirit of the invention. For example, it is expressly intended that all combinations of those elements and/or method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that structures and/or elements and/or method steps shown and/or described in connection with any disclosed form or embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.

What is claimed is:

1. An exchange system for settling accounts of users including buyers and sellers of telecommunication services in a plurality of communications networks, wherein the buyers and sellers input requests and offers using access stations connected to a wide area network, said exchange system comprising:

- an exchange server node connectable to the access stations of the buyers and sellers through the wide area network for matching the sellers' offers and the buyers' requests;

- at least one switch node for routing telecommunications traffic between the communications networks in response to matched offers and requests;

- a database connected to said exchange server node and storing information including account balances of the exchange system and each of the buyers and sellers; and

- a financial module connected to said exchange server node for processing financial tasks.

2. The exchange system of claim 1, wherein said financial tasks processed by said financial module include adjustment of the account balances of the exchange system and each of the buyers and sellers stored in the database, determination of the credit limit or risk premium for each of the buyers, and the netting of the financial accounts of each of the buyers and sellers.

3. The exchange system of claim 1, further comprising a tracking module for monitoring a buyer's usage of a matched seller's network and collecting information regarding the buyer's usage.

4. The exchange system of claim 3, wherein the tracking module forwards the collected information to the financial module and said database.

5. The exchange system of claim 3, wherein the collected information includes call detail records.

6. The exchange system of claim 5, further comprising a batched-call detail record processor and a billing processor,

said batched-call detail record processor receiving the call detail records from said exchange server node and arranging at least some of the call detail records into a group which is processed as one transaction by said billing processor.

7. The exchange system of claim 1, wherein said exchange server node is connectable to a financial services node through the wide area network for communicating the amount required to be paid by the buyer for a matched offer and request and receiving an indication of a transfer of funds for that amount, said financial module including means for adjusting the buyer's and seller's account balances according to the indication received from the financial services node.

8. The exchange system of claim 1, wherein said financial module includes an accounting module for determining net outstanding balances and amount due to the buyers and sellers, coordinating payments between buyers and sellers, and crediting and debiting the accounts of the buyers and sellers.

9. The exchange system of claim 1, wherein said exchange server node is connectable to a financial services node, an external credit node, and an external financial services organization through the wide area network, wherein said financial module includes a financing decision module for receiving data from one of an external credit node, an external financial services node, external financial services organizations and said database and determining the credit and financial exposure of each of the buyers and sellers.

10. The exchange system of claim 1, wherein said financial module includes a credit module for scoring and rating the buyers' credit using information from at least one of the financial services node, the external credit node, and said data storage.

11. The exchange system of claim 10, wherein said database stores a pre-approved credit limit of each of the buyers, and wherein said credit module performs real-time monitoring of actual balance against the pre-approved credit limit of each of the buyers.

12. The exchange system of claim 10, wherein said credit module determines a pre-trading credit approval of a buyer using the scoring and rating of the buyer's credit, said pre-trading credit approval indicating at least one of whether a buyer can buy, the buyer's credit limit, and the amount of letter of credit or trading deposit required.

13. The exchange system of claim 10, wherein said credit module determines whether a user qualifies for a non-secured credit limit or an appropriate amount of letter of credit, deposit, or bond.

14. The exchange system of claim 10, wherein said exchange server node is connectable to a financial services node through the wide area network, and wherein said credit module includes means for connecting to the financial services node through the wide area network and requesting a letter of credit or credit authorization for a user.

15. The exchange system of claim 10, wherein said exchange server node is connectable to a financial services node through the wide area network, said credit module comprising means for determining whether a buyer must post a trading deposit prior to being authorized to trade and transmitting a request for a cash deposit to the financial services node prior to authorizing trading rights to a buyer when it is determined that the buyer must post a trading deposit.

16. The exchange system of claim 10, wherein said credit module determines whether a user qualifies for a non-secured or non-collateralized credit limit.

17. The exchange system of claim 10, wherein said exchange server node is connectable to a financial services node and an external credit node through the wide area network, and wherein said credit module dynamically assesses and reassesses credit scoring and financial exposure of a user in real time based on information received from at least one of the external credit node, the financial services node, and said database.

18. The exchange system of claim 10, wherein said exchange server node is connectable to a financial services node and an external credit node through the wide area network, and wherein said credit module collecting information from at least one of the external credit node, the financial services node, and said database for determining a risk premium for a user.

19. The exchange system of claim 9, wherein said exchange server is connectable to a financial services node and an external credit node through the wide area network, said financing decision module collecting information from at least one of the financial services node, the external credit node, and said database for determining applicable financing rates and terms for each of the users.

20. The exchange system of claim 3, wherein said tracking module performs real-time collection of information from said at least one switch node, said information related to each of the buyers' and sellers' usage, and sends the collected information to said database.

21. The exchange system of claim 8, wherein said accounting module nets each user's receivable against payable to determine the net amount owed or due in real time and sends the net amount to the database, said exchange server node further comprising a credit module for scoring and rating the buyers' credit using said amount information from said database.

22. The exchange system of claim 8, wherein said exchange server node is connectable to a financial services node through the wide area network, wherein said accounting module performs automated bill settlement with sellers and buyers by communicating with the financial services node.

23. The exchange system of claim 12, wherein the letter of credit or cash deposit is held by the financial services node, wherein said financial module includes an accounting module for determining net outstanding balances and amount due to the buyers and sellers, coordinating payments between buyers and sellers, and crediting and debiting the accounts of the buyers and sellers, and wherein said accounting module automatically transmits to the financial services node a request to transfer funds from the letter of credit or cash deposit for past due buyers.

24. The exchange system of claim 8, wherein said exchange server node is connectable to a financial services node through the wide area network, and wherein said exchange server node tracks amounts that are past due and notifies the financial services node and other parties.

25. A method of using an online exchange system for settling accounts of users including buyer and sellers of

telecommunication services in a plurality of communication networks, wherein the buyers and sellers input requests and offers using access stations connected to a wide area network, the exchange system including an exchange server node connectable to the access stations of the users through the wide area network for matching the sellers' offer and the buyers' requests, said method comprising:

storing account information of the exchange system and each of the buyers and sellers in a database;

tracking, by a tracking module connected with the exchange server node, information indicative of buyers' and sellers' usage of the telecommunication services in real time; and

adjusting, by a financial module connected with the exchange server node, the account balances of the exchange system and each of the users stored in the database in real time based on the tracked information.

26. The method of claim 25, further comprising the step of monitoring, by a credit module, users' credit in real time based on matched offers and requests and the information indicative of the buyers' and sellers' usage.

27. The method of claim 26, further comprising the step of determining, by the credit module, a pre-trading credit approval of a buyer using the monitored credit, the pre-trading approval indicating at least one of whether a buyer can buy, the buyer's credit limit, and the amount of letter of credit or trading deposit required.

28. The method of claim 26, said method comprising dynamically assessing and reassessing, by the credit module, a credit score and financial exposure of each of the users in real time based on information received from said database.

29. The method of claim 25, wherein the exchange system includes at least one switch node for routing telecommunications traffic between communications networks, said step of tracking comprising tracking, by the tracking module, information from the at least one switch node indicative of the buyers' and sellers' usage.

30. The method of claim 25, wherein the exchange server node is connectable to a financial services node by the wide area network, said method comprising the steps of tracking amounts that are past due by user, determining whether the user have letters of credit or cash deposits, and transmitting to the financial services node a request for the transfer of funds from the letters of credit or cash deposits.

31. The method of claim 26, wherein said exchange server is connectable to a financial services node and an external credit node through the wide area network, said method comprising dynamically assessing and reassessing, by the credit module, a credit score and financial exposure of each of the users in real time based on information received from at least one of the external credit node, the financial services node, and said database.

32. The method of claim 25, wherein said step of tracking comprises tracking call detail records, arranging or grouping at least some of the call detail records into a group and processing the group of call detail records in a billing processor as a single transaction.

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