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(54) **METHOD AND APPARATUS FOR EXTENDED MANAGEMENT OF STATE AND INTERACTION OF A REMOTE KNOWLEDGE WORKER FROM A CONTACT CENTER**

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(57) **ABSTRACT**

A network system for managing remote agents of a communication center includes a primary server connected to the network the primary server controlling at least one routing point; one or more secondary servers distributed on the network and accessible to the remote agents, the secondary server or servers having data access to agent computing platforms and communication peripherals; and, a software suite distributed in part to the secondary server or servers and distributed in part to one or more agents computing platforms and peripherals, the software suite including protocol for reporting agent status data. The system monitors agents computing platforms and peripherals for activity state through the one or more secondary servers whereupon the one or more secondary servers exchange control messaging and event related data using ISCC protocols with the pri-
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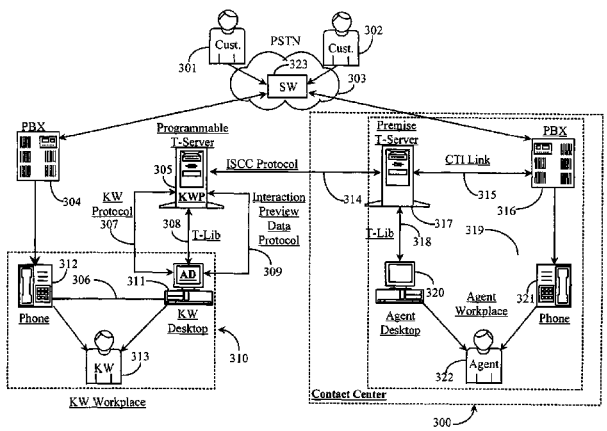

mary server over the network for intelligent routing purposes.

39 Claims, 19 Drawing Sheets

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See application file for complete search history.

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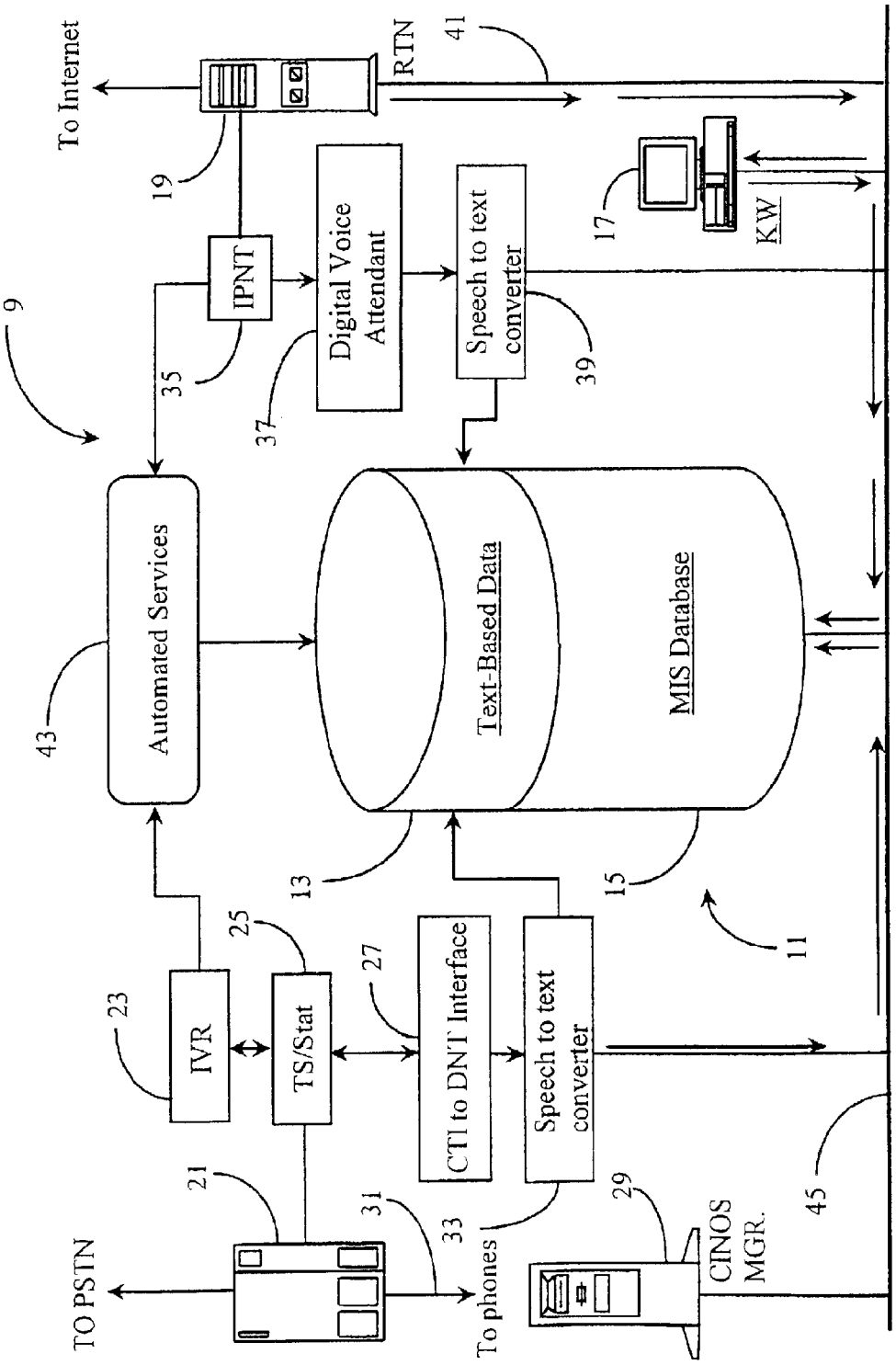
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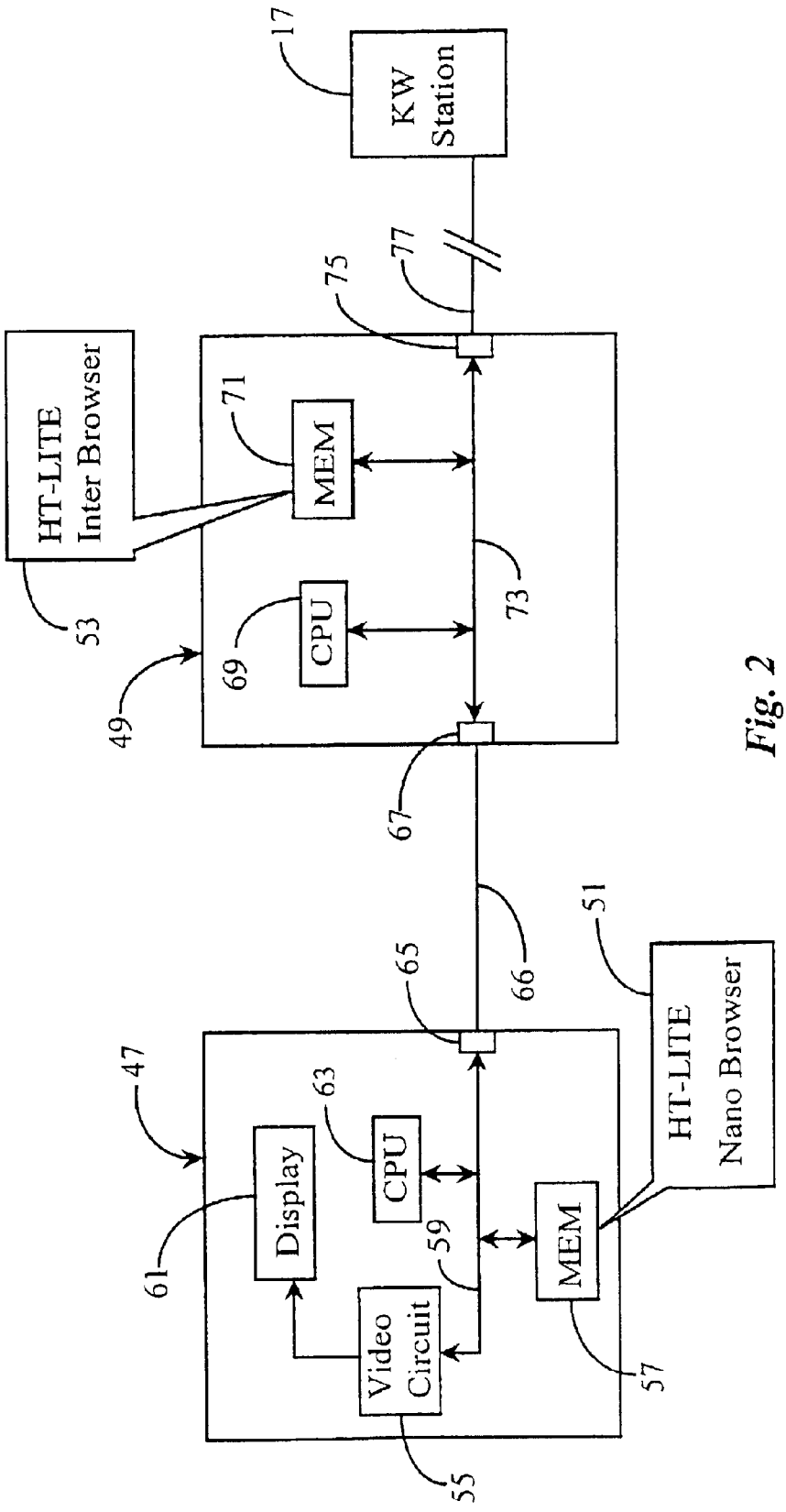
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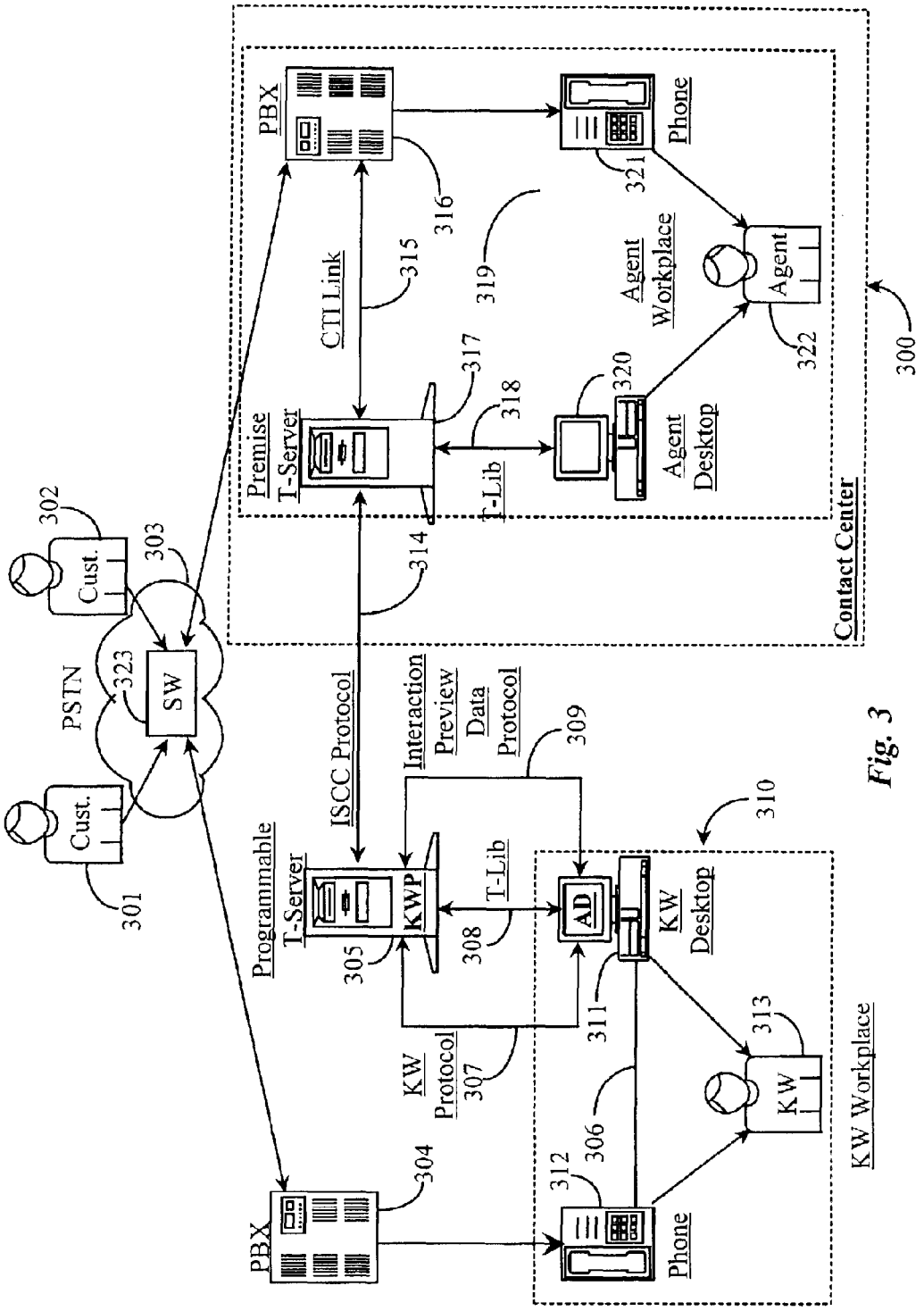
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Fig. 3

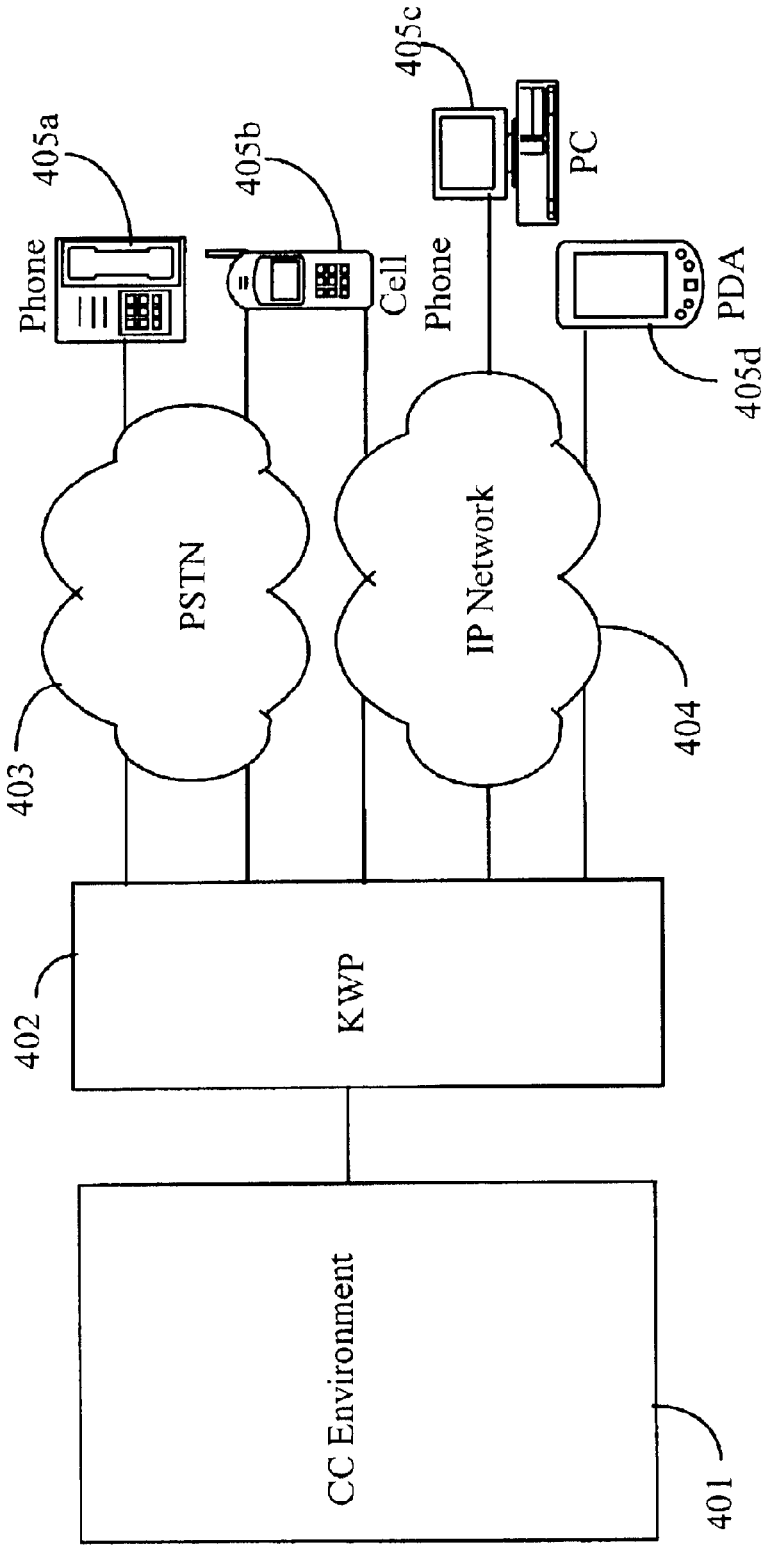
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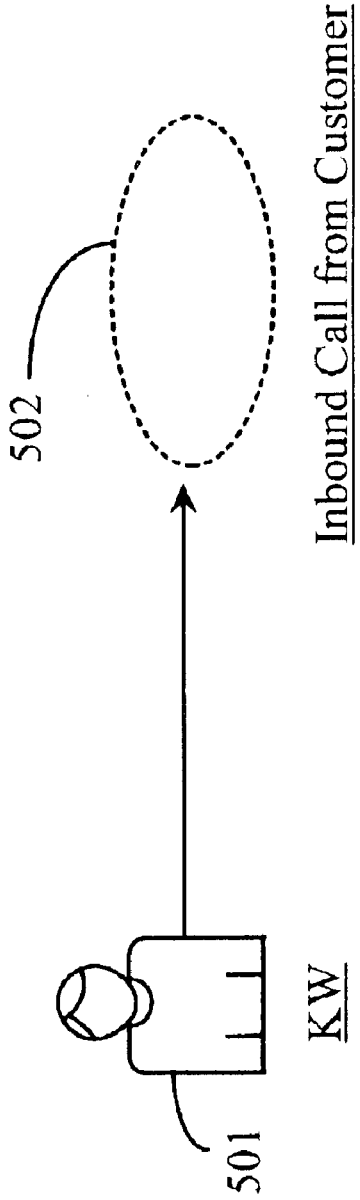
Fig. 4



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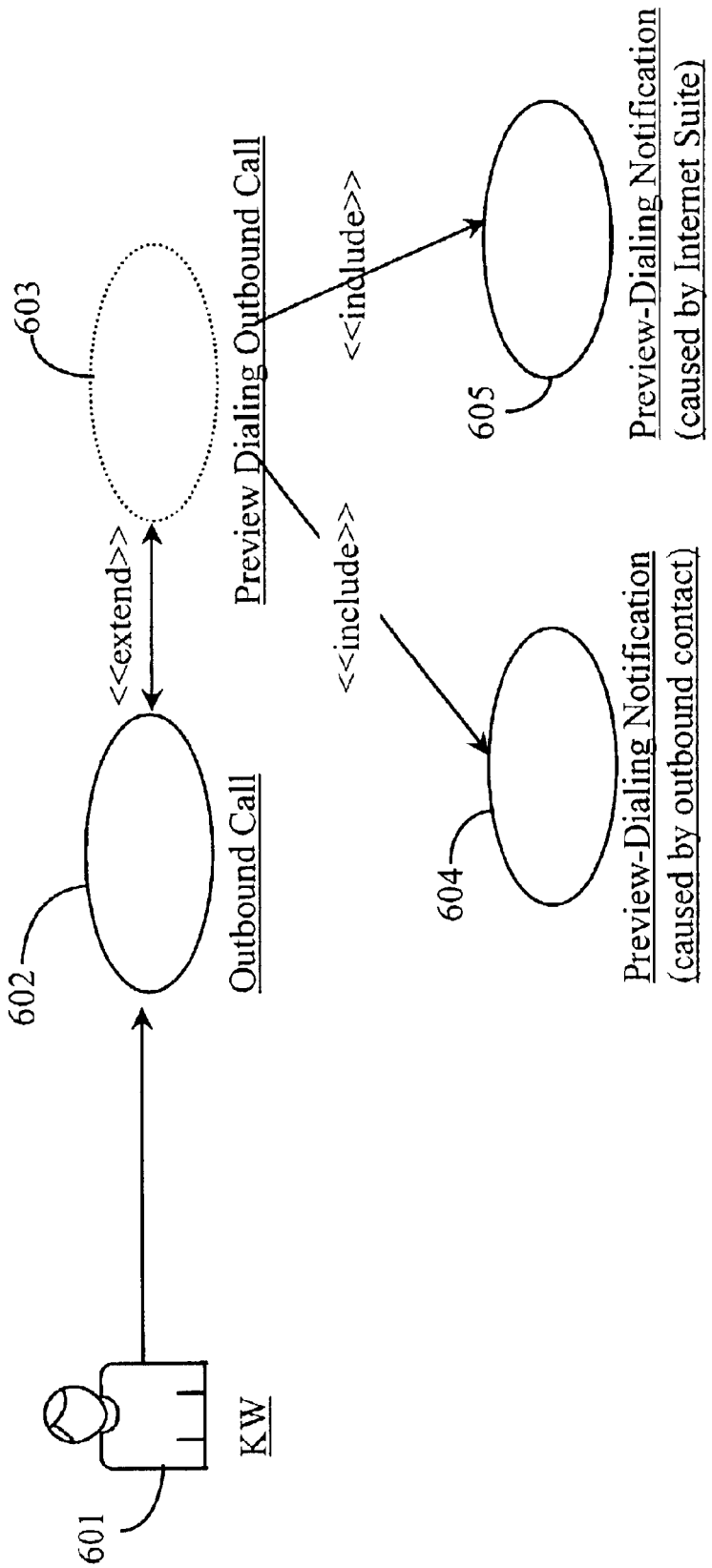
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Fig. 6

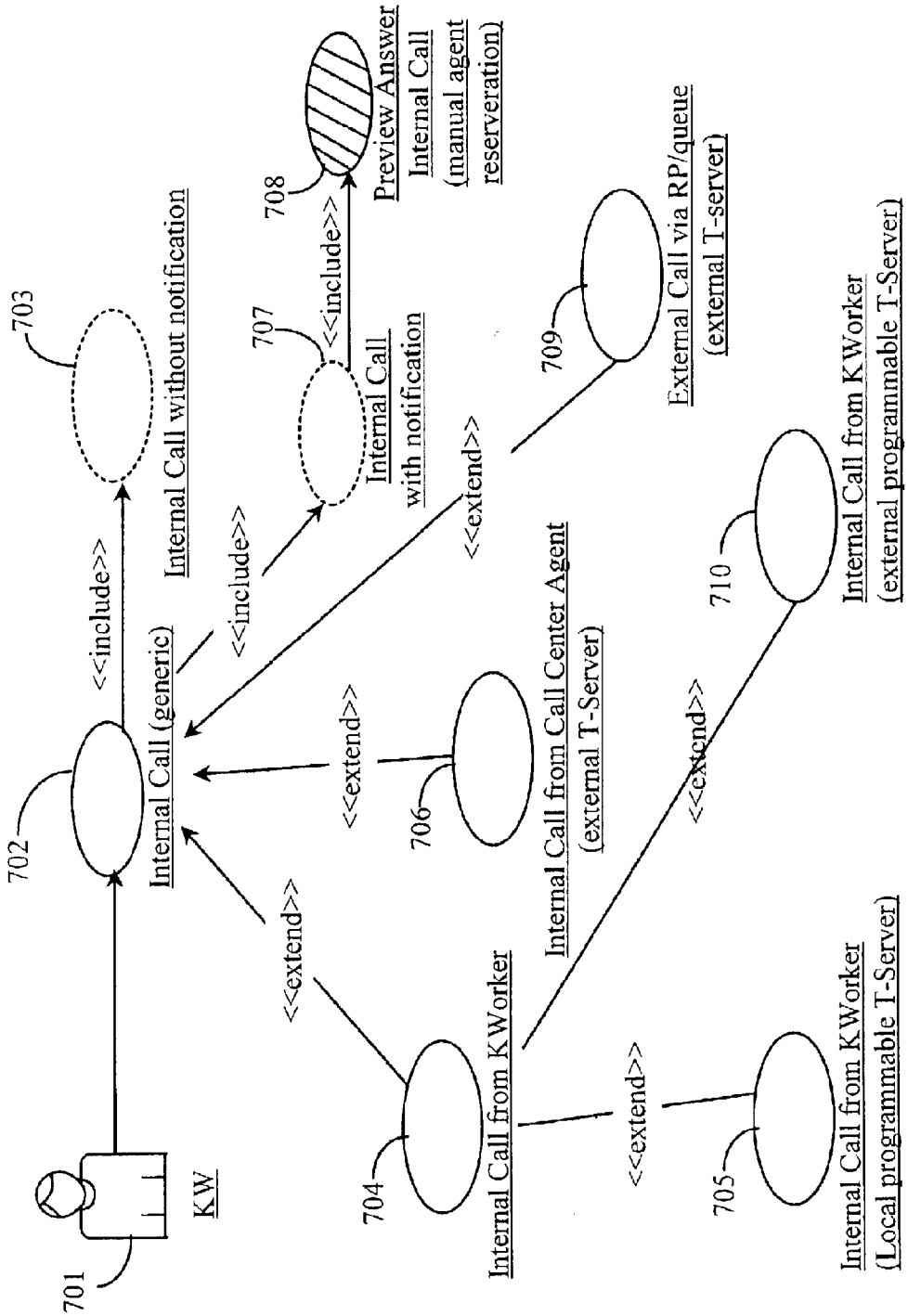
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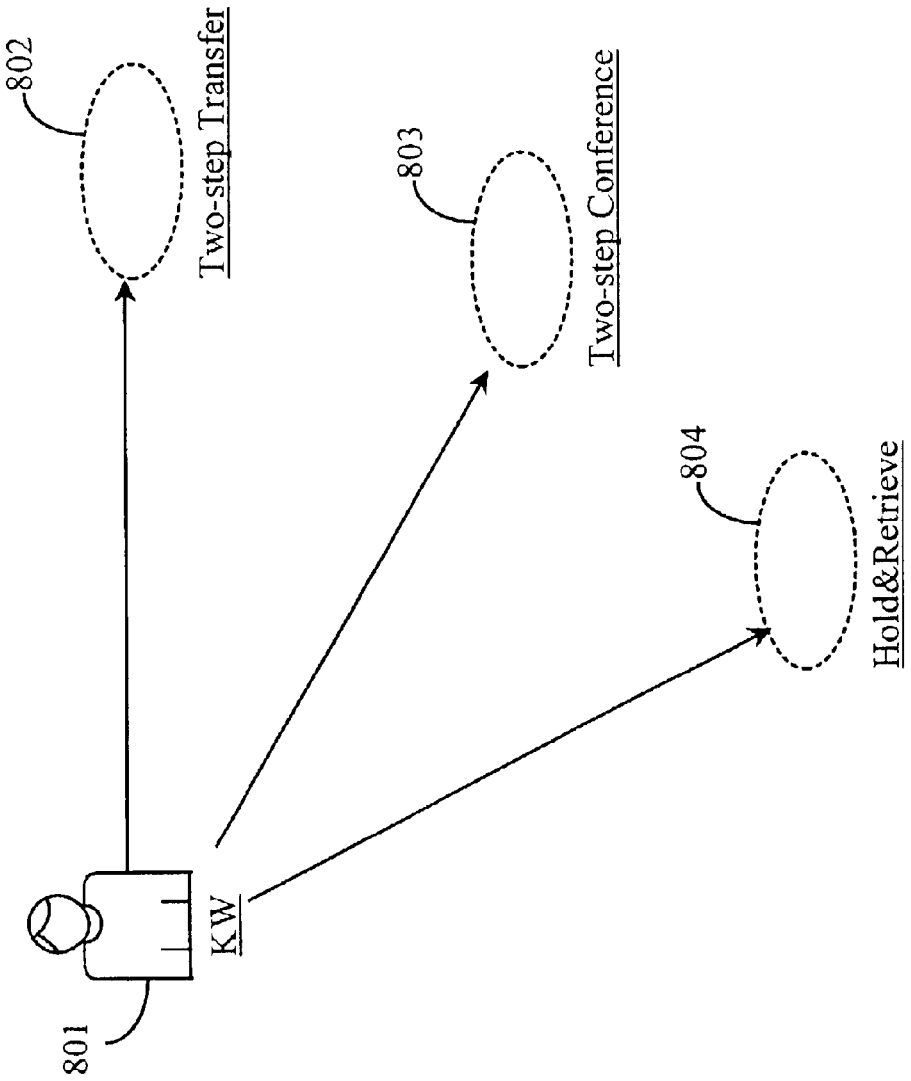
Fig. 7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KW
801

Fig. 8

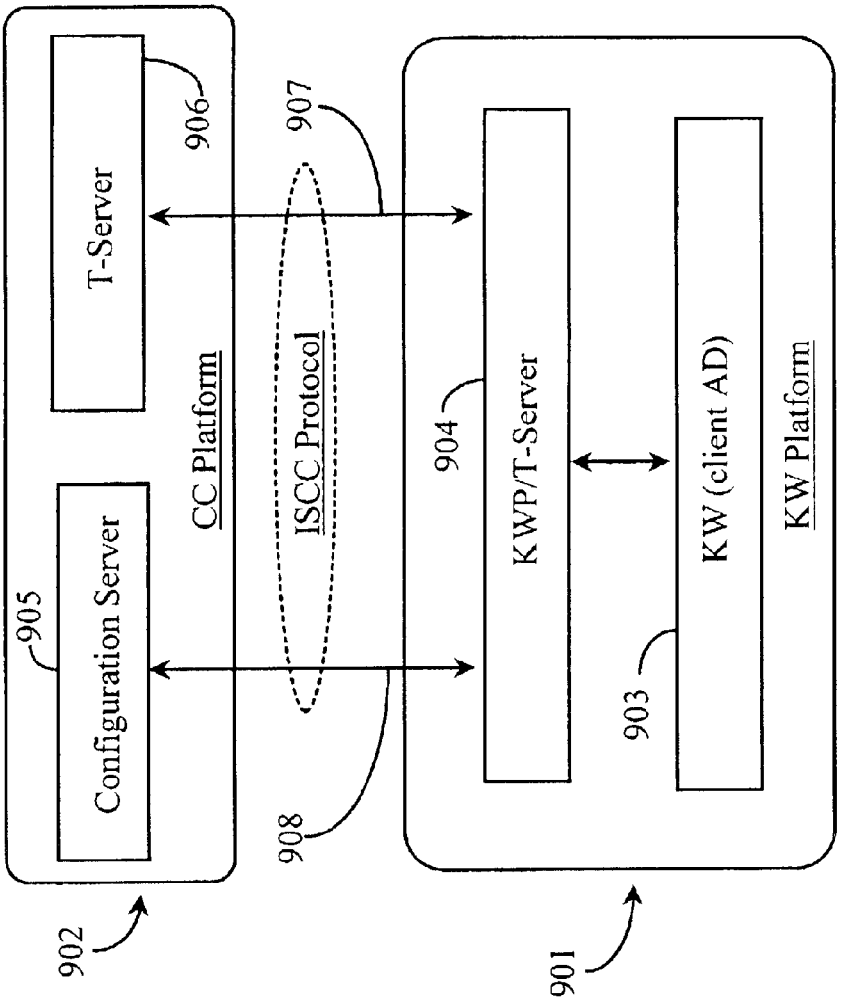
T-Server
906
907
CC Platform
ISCC Protocol
KWP/T-Server
904
KW (client AD)
KW Platform
Configuration Server
905
903
908
902
901

Fig. 9

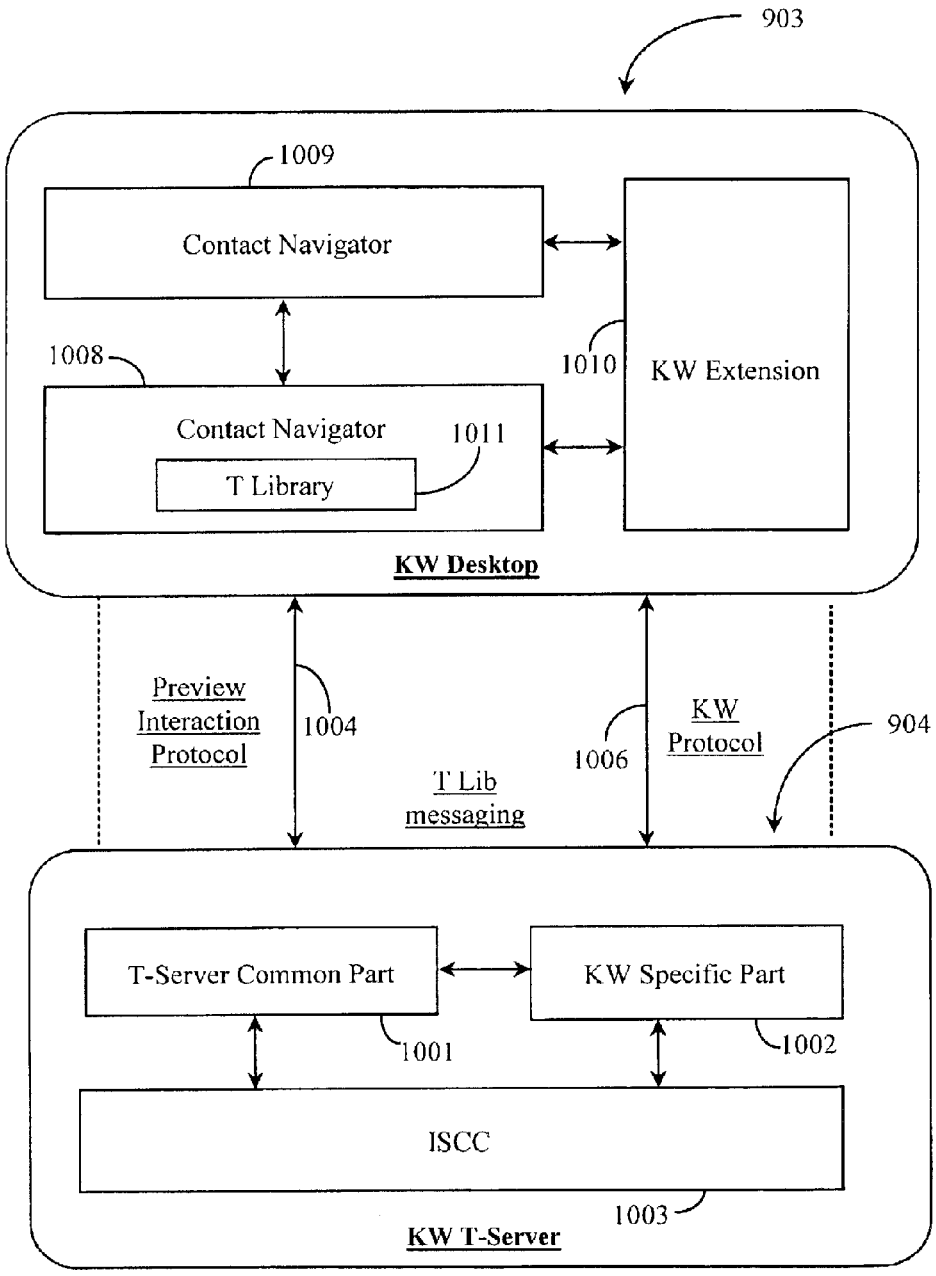
903
1009
Contact Navigator
1008
Contact Navigator
T Library
1011
1010
KW Extension
KW Desktop
Preview Interaction Protocol
1004
T Lib messaging
1006
KW Protocol
904
T-Server Common Part
1001
KW Specific Part
1002
ISCC
1003
KW T-Server

Fig. 10

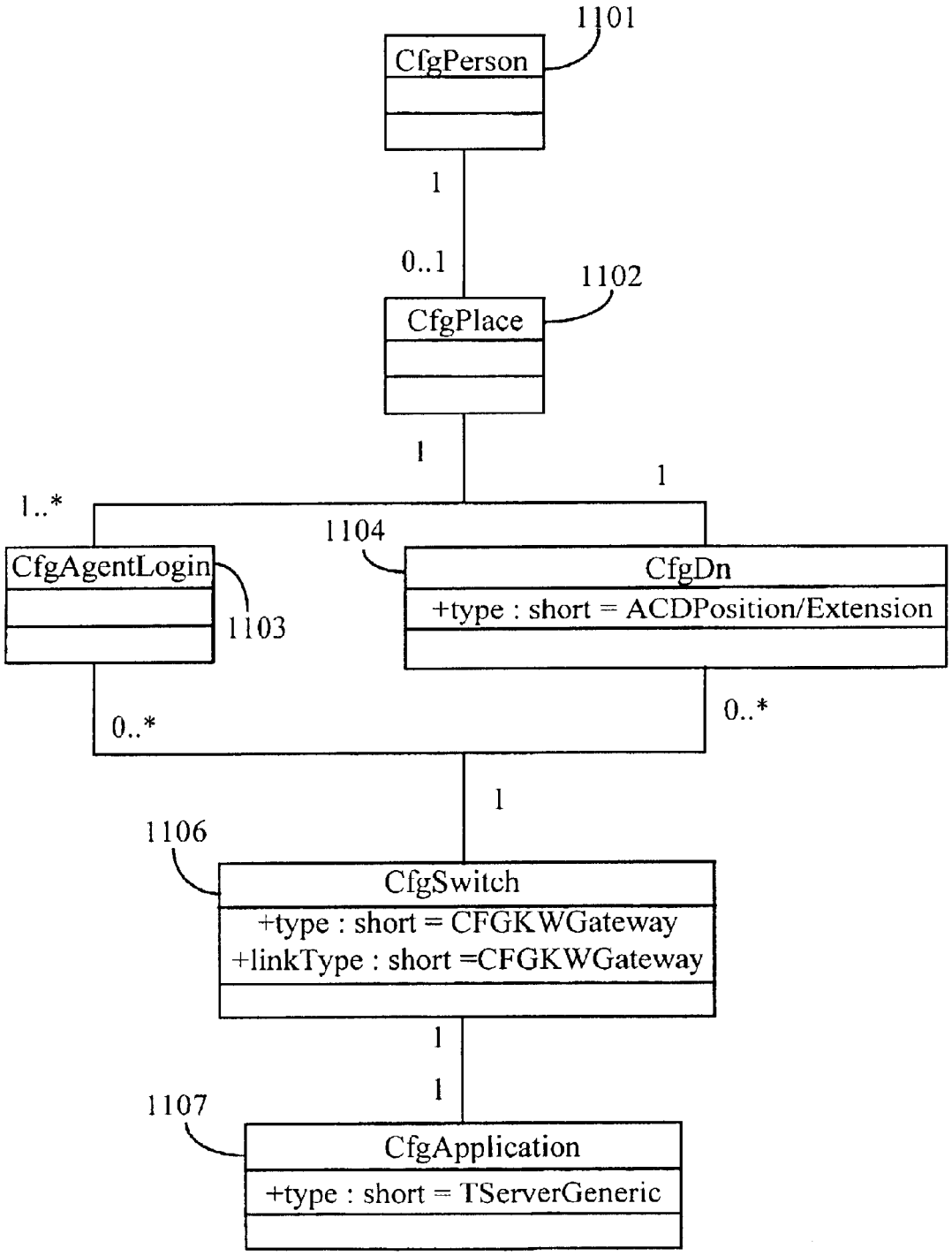
1101
CfgPerson
1
0..1
1102
CfgPlace
1
1
1..*
1104
CfgAgentLogin
1103
CfgDn
+type : short = ACDPosition/Extension
0..*
0..*
1
1106
CfgSwitch
+type : short = CFGKWGateway
+linkType : short =CFGKWGateway
1
1
1107
CfgApplication
+type : short = TServerGeneric

Fig. 11

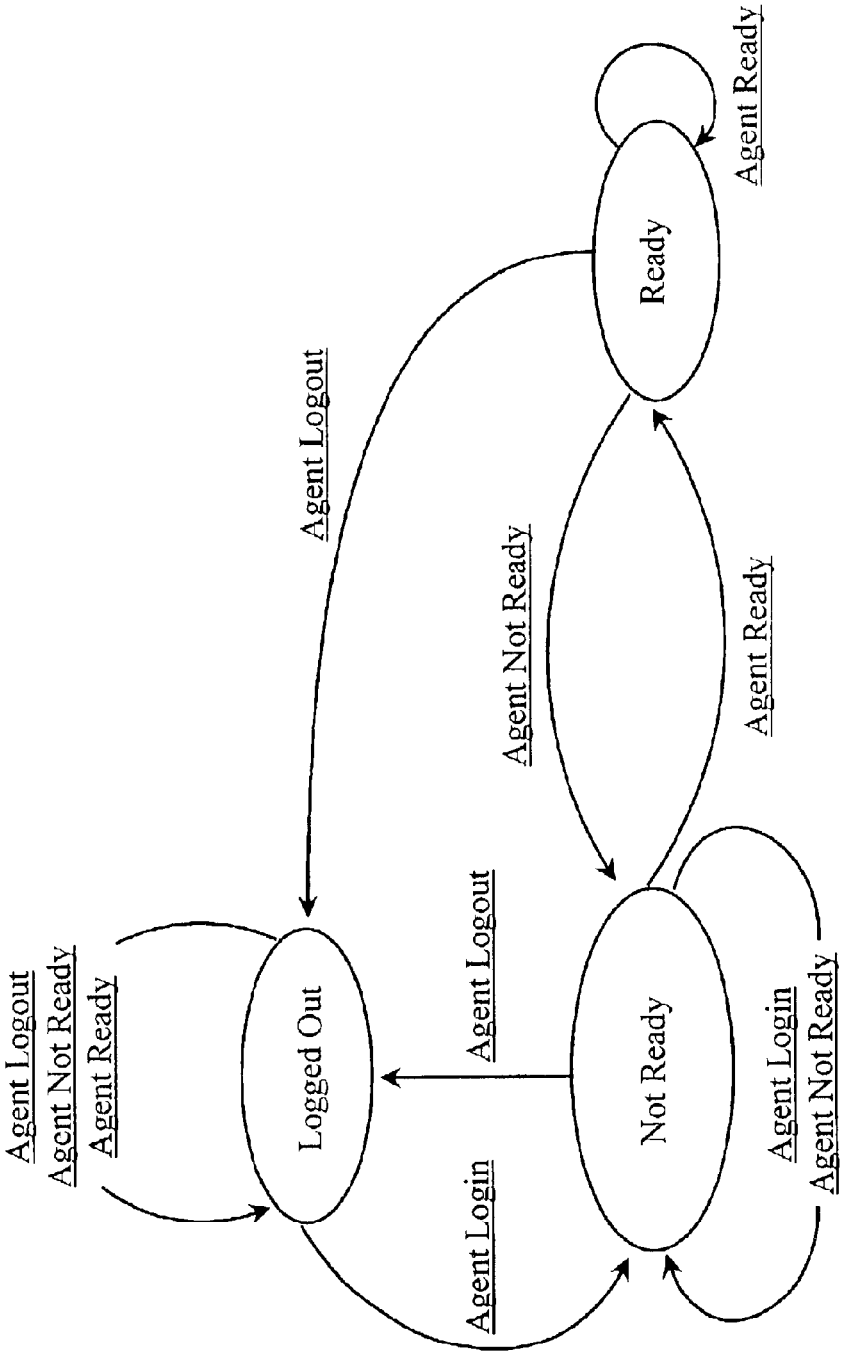
Agent Logout
Agent Not Ready
Agent Ready
Logged Out
Agent Logout
Agent Login
Agent Logout
Agent Not Ready
Ready
Agent Ready
Not Ready
Agent Ready
Agent Login
Agent Not Ready

Fig. 12

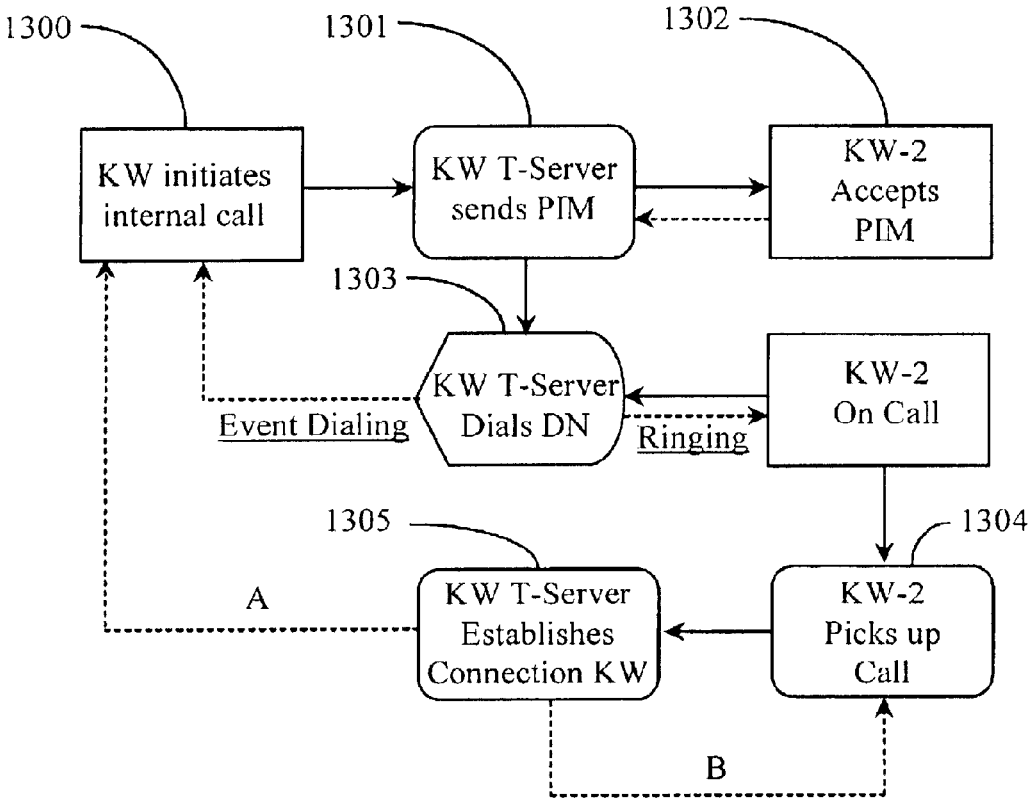
1300
1301
1302
KW initiates internal call
KW T-Server sends PIM
KW-2 Accepts PIM
1303
KW T-Server Dials DN
KW-2 On Call
Event Dialing
Ringing
1305
1304
A
KW T-Server Establishes Connection KW
KW-2 Picks up Call
B

Fig. 13

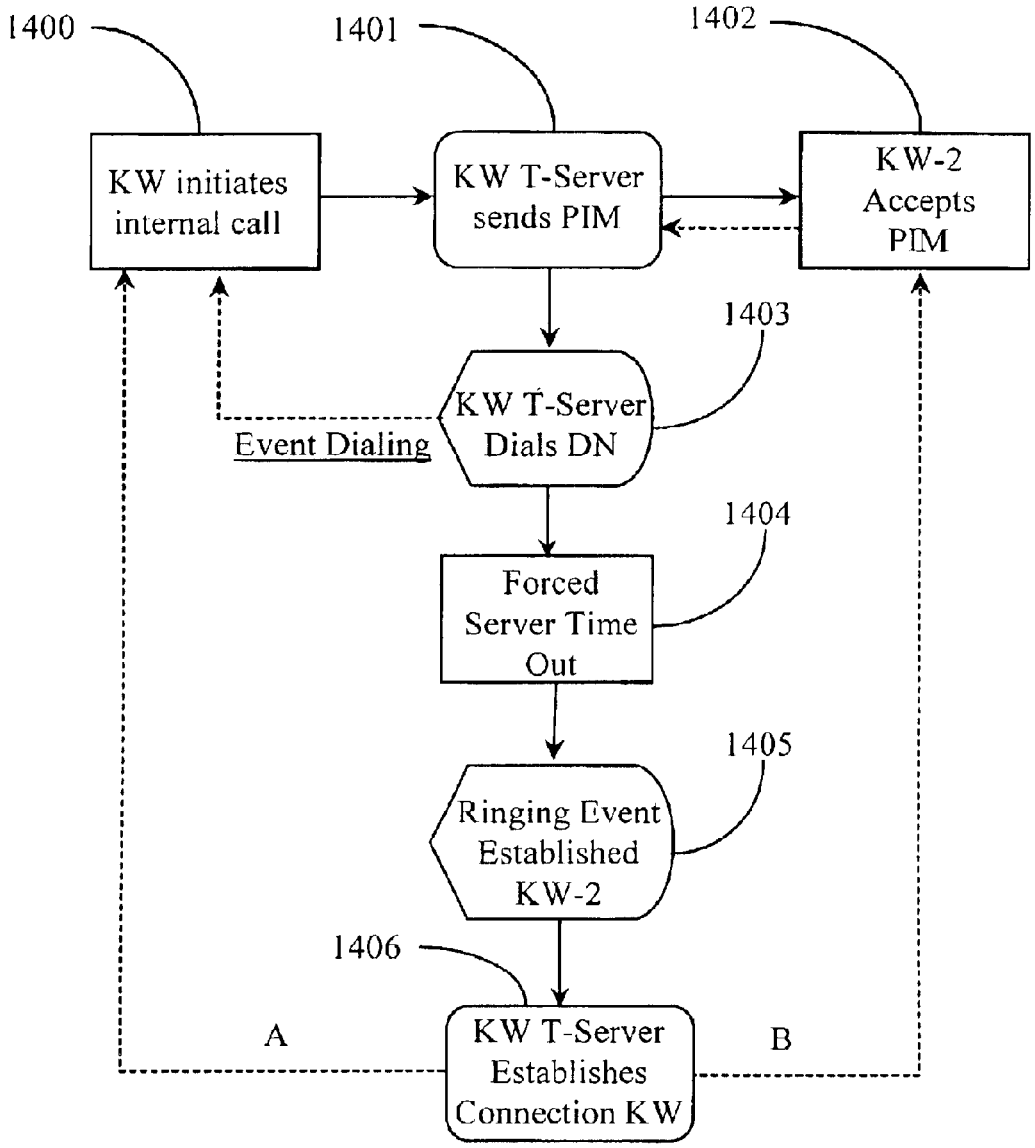
1400
1401
1402
KW initiates internal call
KW T-Server sends PIM
KW-2 Accepts PIM
1403
KW T-Server Dials DN
Event Dialing
1404
Forced Server Time Out
1405
Ringing Event Established KW-2
1406
A
KW T-Server Establishes Connection KW
B

Fig. 14

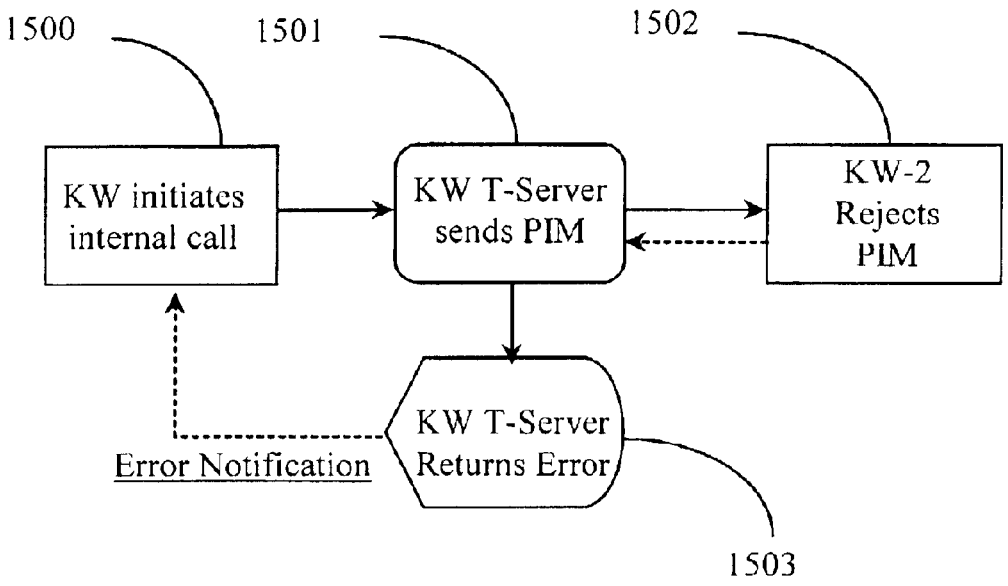
1500
1501
1502
KW initiates internal call
KW T-Server sends PIM
KW-2 Rejects PIM
KW T-Server Returns Error
Error Notification
1503

Fig. 15

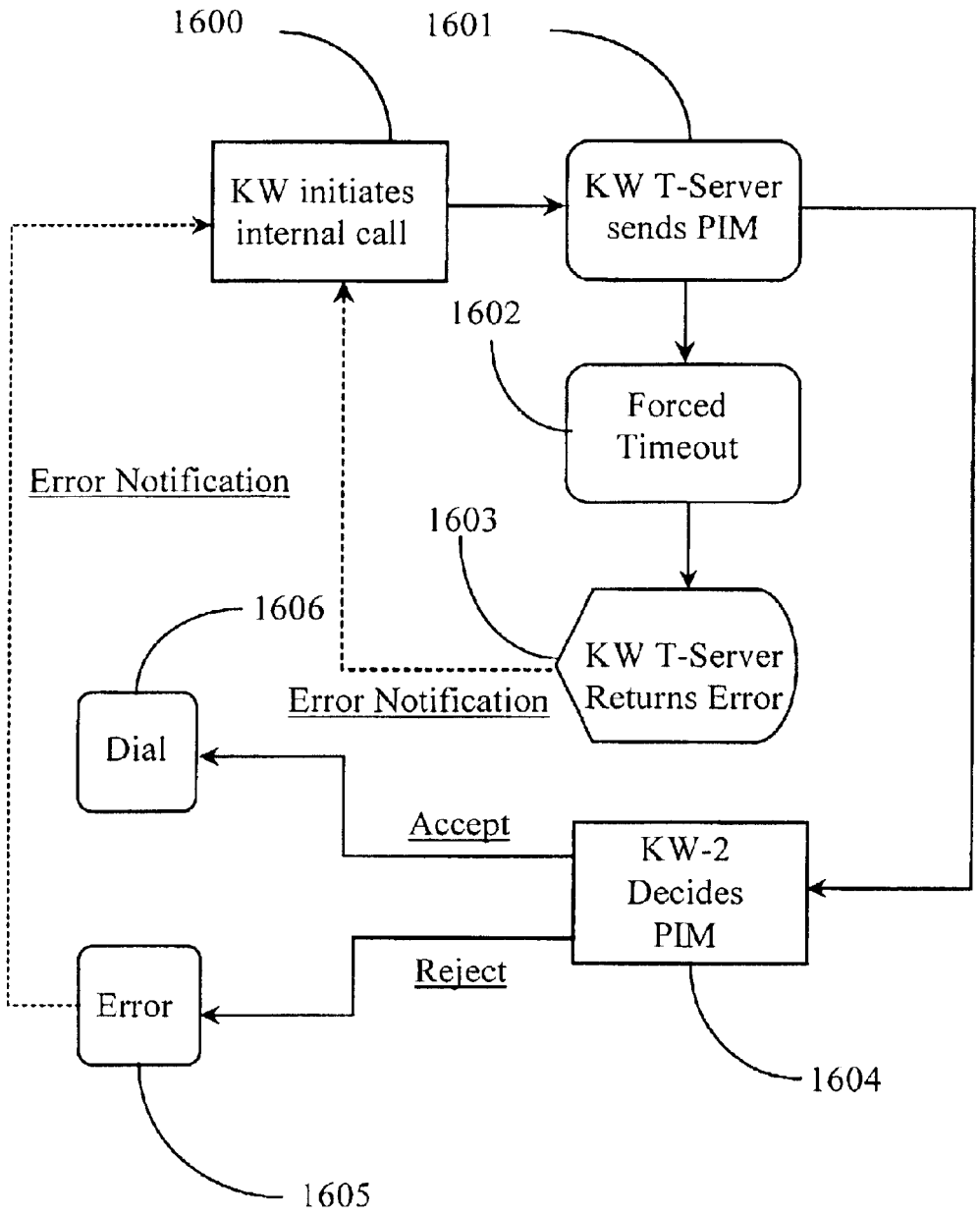
1600
1601
KW initiates internal call
KW T-Server sends PIM
1602
Forced Timeout
Error Notification
1603
1606
KW T-Server Returns Error
Error Notification
Dial
Accept
KW-2 Decides PIM
Reject
Error
1604
1605

Fig. 16

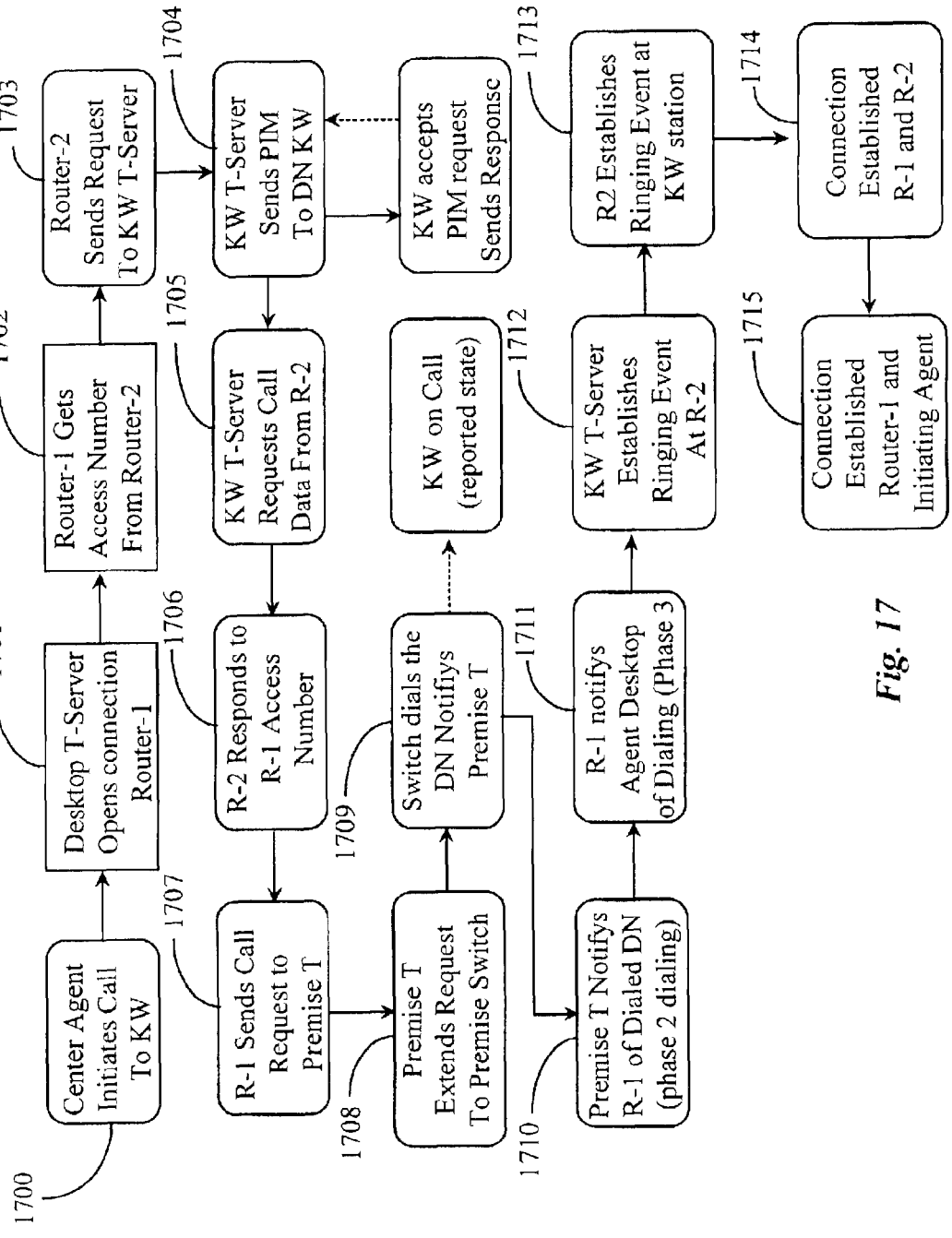
1700
Center Agent Initiates Call To KW
1701
Desktop T-Server Opens connection Router-1
1702
Router-1 Gets Access Number From Router-2
1703
Router-2 Sends Request To KW T-Server
1704
KW T-Server Sends PIM To DN KW
1705
KW T-Server Requests Call Data From R-2
1706
R-2 Responds to R-1 Access Number
1707
R-1 Sends Call Request to Premise T
1708
Premise T Extends Request To Premise Switch
1709
Switch dials the DN Notifys Premise T
1710
Premise T Notifys R-1 of Dialed DN (phase 2 dialing)
1711
R-1 notifys Agent Desktop of Dialing (Phase 3
1712
KW on Call (reported state)
1713
KW accepts PIM request Sends Response
1714
KW T-Server Establishes Ringing Event At R-2
1715
R2 Establishes Ringing Event at KW station
Connection Established Router-1 and Initiating Agent
Connection Established R-1 and R-2

Fig. 17

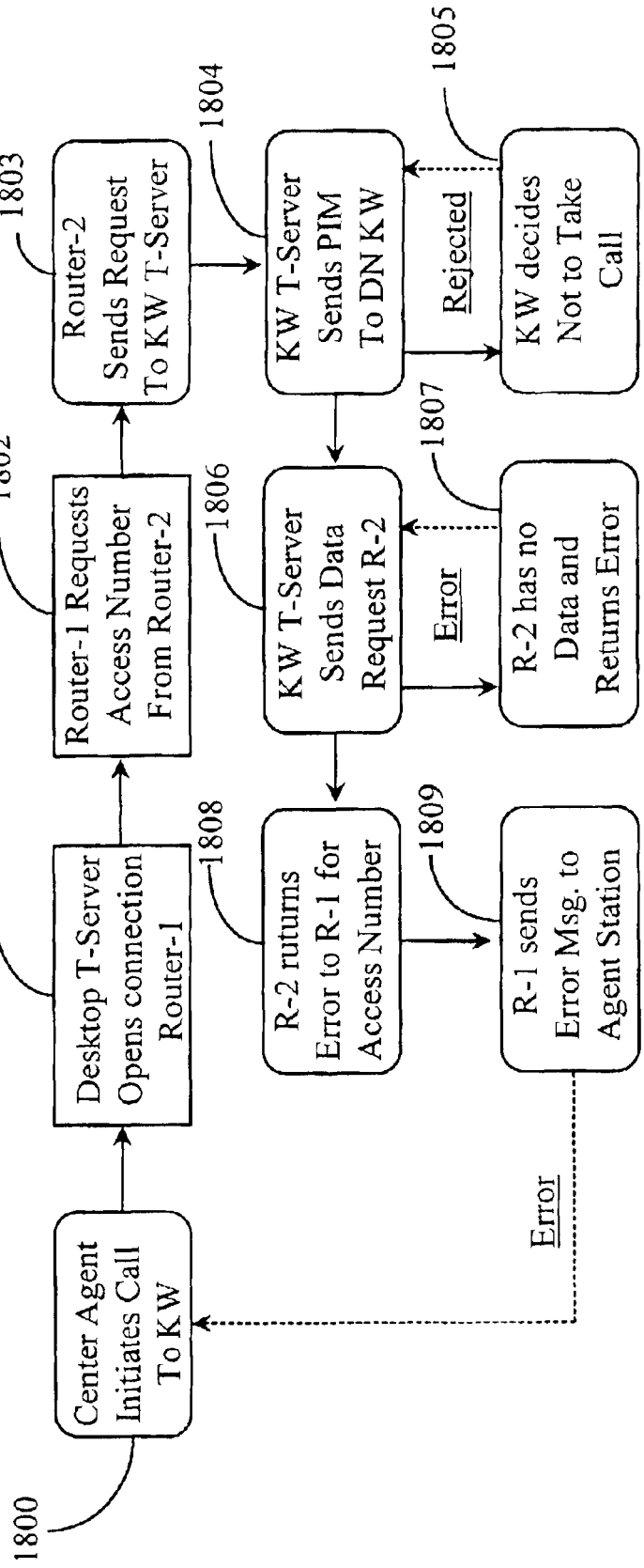
1800
Center Agent Initiates Call To KW
1801
Desktop T-Server Opens connection Router-1
1802
Router-1 Requests Access Number From Router-2
1803
Router-2 Sends Request To KW T-Server
1804
KW T-Server Sends PIM To DN KW
1805
KW decides Not to Take Call
Rejected
1806
KW T-Server Sends Data Request R-2
1807
R-2 has no Data and Returns Error
Error
1808
R-2 returns Error to R-1 for Access Number
1809
R-1 sends Error Msg. to Agent Station
Error

Fig. 18

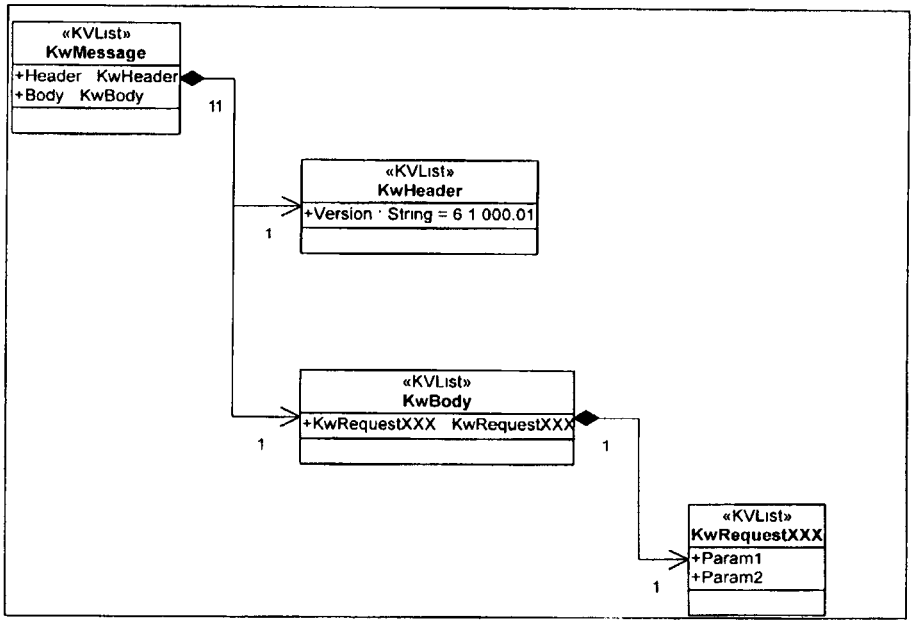
«KVList»
KwMessage
+Header KwHeader
+Body KwBody
11
«KVList»
KwHeader
+Version : String = 6 1 000.01
1
«KVList»
KwBody
+KwRequestXXX KwRequestXXX
1
1
«KVList»
KwRequestXXX
+Param1
+Param2
1

FIG. 19

METHOD AND APPARATUS FOR EXTENDED MANAGEMENT OF STATE AND INTERACTION OF A REMOTE KNOWLEDGE WORKER FROM A CONTACT CENTER

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED DOCUMENTS

The present [invention is a continuation in part (CIP) to a] *application is a reissue patent application of U.S. Pat. No. 6,985,943 filed on Oct. 10, 2002 as U.S. patent application Ser. No. 10/269,124. The content of* U.S. patent application Ser. No. 09/405,335 [entitled Method and apparatus for Method and Apparatus for Data-Linking a Mobile Knowledge Worker to Home Communication-Center Infrastructure], filed on Sep. 24, 1999, now U.S. Pat. No. 6,711,611, [which is a CIP to] *the content of* U.S. patent application Ser. No. 09/151,564, filed Sep. 11, 1998, now U.S. Pat. No. 6,108,711, [and these prior applications are incorporated by reference in their entirety. The present invention is also related to], *the content of* U.S. Pat. No. 5,960,073 [entitled Method and Apparatus for Providing an Interactive Home Agent with Access to Call Center Functionality and Resources], and [to a] *the content of* U.S. Pat. No. 5,802,163 [entitled Methods and Apparatus for Implementing an Outbound Network Call Center both of which], are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention pertains to telephony communications systems and has particular application to methods including software enabling extended management capabilities of state and interaction of a remote knowledge worker from a contact center.

BACKGROUND OF THE INVENTION

In the field of telephony communication, there have been many improvements in technology over the years that have contributed to more efficient use of telephone communication within hosted call-center environments. Most of these improvements involve integrating the telephones and switching systems in call centers with computer hardware and software adapted for better routing of telephone calls, faster delivery of telephone calls and associated information, and improved service with regard to client satisfaction. Such computer-enhanced telephony is known in the art as computer-telephony integration (CTI).

There are many ways that CTI enhancement may be done in the art, and the present inventors are knowledgeable in most of these. The present inventors are also knowledgeable about many special architectures and software enhancements that are not in the public domain. In the following background material only that material specifically designated as prior art should be taken to be acknowledged as prior art material by the inventors.

Generally speaking, CTI implementations of various design and purpose are implemented both within individual call-centers and, in some cases, at the telephone network level. For example, processors running CTI software applications may be linked to telephone switches, service control points (SCPs), and network entry points within a public or private telephone network. At the call-center level, CTI processors are typically connected to telephone switches and, in some cases, to similar CTI hardware at the network level, often by a dedicated digital link. CTI processors and other hardware within a call-center are commonly referred to as customer premises equipment (CPE). It is the CTI processor and application software in such centers that provides computer software enhancement to a call center.

In a CTI-enhanced call center, telephones at agent stations are connected to a central telephony switching apparatus, such as an automatic call distributor (ACD) switch or a private branch exchange (PBX). The agent stations may also be equipped with computer terminals such as personal computer/video display unit's (PC/VDU's) so that agents using such stations may have access to stored data and enhanced services and tools as well as being linked to incoming callers by telephone equipment. Such stations may be, and usually are, interconnected through the PC/VDUs by a local area network (LAN). One or more data or transaction servers may also be connected to the LAN that interconnects agent stations. The LAN is, in turn, typically connected to the CTI processor, which is connected to the call switching apparatus of the call center in systems known to the present inventors.

When a call arrives at a call center, whether or not the call has been pre-processed at a service control point (SCP), typically at least the telephone number of the calling line is made available to the receiving switch at the call center by the network provider. This service is available by most networks as caller-ID information in one of several formats such as Automatic Number Identification (ANI). Typically the number called is also available through a service such as Dialed Number Identification Service (DNIS). If the call center is computer-enhanced (CTI), the phone number of the calling party may be used, in systems known to the present inventors, as a key to access additional information from a customer information system (CIS) database at a server on the network that connects the agent workstations. In this manner information pertinent to a call may be provided to an agent, often as a screen pop on the agent's PC/VDU.

In recent years, advances in computer technology, telephony equipment, and infrastructure have provided many opportunities for improving telephone service in public-switched and private telephone intelligent networks. Similarly, development of a separate information and data network known as the Internet, together with advances in computer hardware and software have led to a new multimedia telephone system known in the art by several names. In this new system telephone calls are simulated by multimedia computer equipment, and data, such as audio data, is transmitted over data networks as data packets. In this system the broad term used to describe such computer-simulated telephony is Data Network Telephony (DNT).

For purposes of nomenclature and definition, the inventors wish to distinguish clearly between what might be called conventional telephony, which is the telephone service enjoyed by nearly all citizens through local telephone companies and several long-distance telephone network providers, and what has been described herein as computer-simulated telephony or data-network telephony. The con-

ventional systems are referred to herein as Connection-Oriented Switched-Telephony (COST) systems, CTI enhanced or not.

The computer-simulated, or DNT systems are familiar to those who use and understand computers and data-network systems. Perhaps the best example of DNT is telephone service provided over the Internet, which will be referred to herein as Internet Protocol Network Telephony (IPNT), by far the most extensive, but still a subset of DNT.

Both systems use signals transmitted over network links. In fact, connection to data networks for DNT such as IPNT is typically accomplished over local telephone lines, used to reach points in the network such as an Internet Service Provider (ISP), which then connects the user to the Internet backbone. The definitive difference is that COST telephony may be considered to be connection-oriented telephony. In the COST system, calls are placed and connected by a specific dedicated path, and the connection path is maintained over the time of the call. Bandwidth is basically assured. Other calls and data do not share a connected channel path in a COST system. A DNT system, on the other hand, is not dedicated or connection-oriented. That is, data, including audio data, is prepared, sent, and received as data packets over a data-network. The data packets share network links and available bandwidth, and may travel by varied and variable paths.

Recent improvements to available technologies associated with the transmission and reception of data packets during real-time DNT communication have enabled companies to successfully add DNT, principally IPNT, capabilities to existing CTI call centers. Such improvements, as described herein and known to the inventor, include methods for guaranteeing available bandwidth or quality of service (QoS) for a transaction, improved mechanisms for organizing, coding, compressing, and carrying data more efficiently using less bandwidth, and methods and apparatus for intelligently replacing lost data via using voice supplementation methods and enhanced buffering capabilities.

In addition to Internet protocol (IPNT) calls, a DNT center may also share other forms of media with customers accessing the system through their computers. E-mails, Video mails, fax, file share, file transfer, video calls, and so forth are some of the other forms of media, which may be used. This capability of handling varied media leads to the term multimedia communications center. A multimedia communications center may be a combination CTI and DNT center, or may be a DNT center capable of receiving COST calls and converting them to a digital DNT format. The term communication center will replace the term call center hereinafter in this specification when referring to multimedia capabilities.

In typical communication centers, DNT is accomplished by Internet connection and IPNT calls. For this reason, IPNT and the Internet will be used in examples to follow. It should be understood, however, that this usage is exemplary, and not limiting.

In systems known to the inventors, incoming IPNT calls are processed and routed within an IPNT-capable communication center in much the same way as COST calls are routed in a CTI-enhanced call center, using similar or identical routing rules, waiting queues, and so on, aside from the fact that there are two separate networks involved. Communication centers having both CTI and IPNT capability utilize LAN-connected agent-stations with each station having a telephony-switch-connected headset or phone, and a PC connected, in most cases via LAN, to the network carrying the IPNT calls, or to a network-connected server on the LAN. Therefore, in most cases, IPNT calls are routed to the agent's PC while conventional telephony calls are routed to the agent's conventional telephone or headset. Typically separate lines and equipment are implemented for each type of call weather COST or IPNT.

Due in part to added costs associated with additional equipment, lines, and data ports that are needed to add IPNT capability to a CTI-enhanced call-center, developers are currently experimenting with various forms of integration between the older COST system and the newer IPNT system. For example, by enhancing data servers, interactive voice response units (IVR's), agent-connecting networks, and so on, with the capability of conforming to Internet protocol, call data arriving from either network may be integrated requiring less equipment and lines to facilitate processing, storage, and transfer of data. Some such equipment and services are known to the present inventors, which are not in the public domain.

With many new communication products supporting various media types available to businesses and customers, a communication center must add significant application software to accommodate the diversity. For example, e-mail programs typically have differing parameters than do IP applications. IP applications are different regarding protocol than COST calls, and so on. Separate routing systems and/or software components are needed for routing e-mails, IP calls, COST calls, file sharing, etc. Agents must then be trained in the use of a variety of applications supporting the different types of media.

Keeping contact histories, reporting statistics, creating routing rules and the like becomes more complex as newer types of media are added to communication center capability. Additional hardware implementations such as servers, processors, etc. are generally required to aid full multimedia communication and reporting. Therefore, it is desirable that interactions of all multimedia sorts be analyzed, recorded, and routed according to enterprise (business) rules in a manner that provides seamless integration between media types and application types, thereby allowing agents to respond intelligently and efficiently to customer queries and problems.

In a system known to the inventor, full multimedia functionality is supported wherein agents and customers may interact in a seamless manner. Likewise interaction histories of virtually any supported media may be automatically recorded and stored for latter access by agents and in some cases customers (clients) themselves. Such a system, termed a customer-interaction-network-operating system (CINOS) by the inventor, comprises a suite of software enhancements, implemented both at the communication center and at CPE sites, that are designed to provide automated and seamless interaction between customers, associates, and agents.

In order to successfully implement and administer the many aspects of a network operating system such as the CINOS system introduced above, a new agent called a knowledge worker has emerged. This is especially true in more state-of-the-art multimedia communication-centers. In a broad sense, a knowledge worker may be any individual that specializes, or is expert in a specific field or fields utilized within the communication center. Knowledge workers may be responsible for such tasks as creating automated scripts, building integrated software applications, tracking and parsing certain history paths in a database for automated reporting, and other relatively complicated functions. Knowledge workers may also be trained agents responsible for sales, service and technical assistance.

A knowledge worker, weather an agent or specialized technician, generally has all of the resource in the way of customer data, interaction data, product data, and multimedia support at his fingertips as long as he or she is operating from a designated PC/VDU or other supported station within the communication center. In some cases, a knowledge worker may have full data access and multimedia support if he is located off-site but is linked to the center by a suitable data-network connection such as from a home office or remote station.

Because a network operating system such as CINOS requires that certain customer or client CPE, including network equipment, be enhanced with software designed to facilitate seamless interaction with the communication center, it is often necessary that knowledge workers be dispatched into the field away from the communication center to aid in such as installation, set-up, and programming of software applications and tools. In some instances this can be a formidable enterprise.

A knowledge worker possesses the kind of skills that are largely indispensable and not shared by the average communication center worker. When a knowledge worker is away from a home-center such as on the road, or at a client location, he is generally limited in data access and interaction capability with his or her home communication-center data and tools. In some cases this may be a liability to the center. In many cases she/he will be limited to specific data that was carried along, or that may be downloaded from the center to such as a cellular telephone, a personal digital assistant (PDA) or a Laptop computer. Moreover, a mobile knowledge worker in the field may also be limited in providing service to the home-center by virtue of the same data-access limitations.

In some cases, a knowledge worker at a client site may, after some set-up, programming, and initialization, commandeer a suitable client PC so that she/he may establish free and unfettered access to home-center data and software services. However, such interaction, if not on the be-half of the client, may be deemed by the client as an intrusion at most and an inconvenience at least.

In typical contact centers, which may also include multimedia communication centers, the preponderance of incoming and outgoing interactions are processed by voice (DNT) or Web-based self service interfaces or by communication-center agents located within the domain of the center and managed through a communication center environment. However, many interactions cannot be successfully processed through client self-service interfaces or on-site agents often because of a high level of assistance required. Such interactions require the expertise of a knowledge worker, a knowledge worker being a call-center employee with a more detailed knowledge of the center structure and operations than the typical on-site agent.

Knowledge workers are not required for routine service assistance or other duties that are routinely performed within the domain of the center. As a result, they are typically located off site in a pool or remote to the extent of performing as a home-based or traveling workers. Therefore, standard communication center control systems and procedures cannot be applied to such knowledge workers. Often this problem is due to an absence of a CTI link established between the location of the knowledge worker and the communication center. Off-site knowledge workers are mobile and typically operate using a variety of communication equipment (non-CTI telephone, personal digital assistants [PDAs], wireless Web, etc.) and using applications that are not assimilated in standard or unified array throughout the communication environment. Therefore, it becomes increasingly difficult to provide management from the communication center in terms of state control and report accessibility. For example, which of a force of off-site knowledge workers are at any given time able to receive an interaction wherein they are also able to exchange interaction-related data with the center, client or both?

Remote knowledge workers are, from a control and management standpoint, invisible to standard CTI-enabled facilities. Not having the ability to manage these workers causes the ongoing costs associated with doing business from a communication center to rise.

The inventors are familiar with a system taught in U.S. Pat. No. 5,802,163 entitled Methods and Apparatus for Implementing an Outbound Network Call Center referenced in the Cross-Reference to Related Documents section of this specification. That system teaches a method and apparatus for integrating a remote home agent in a call center. In practice, the home agent or knowledge worker must dial a specific enabled telephony switch in the telephone network when an interaction to the agent is detected. This action terminates the incoming interaction to a first station-side port of the telephony switch. A connection is thus maintained between the home agent and the telephony switch until the agent disconnects. In this way, all events that are determined to be destined to the home agent are switched to the established connection. This action provides a continuing connection between the telephony switch and the home agent until the home agent disconnects. Events, such as incoming calls at the center selected to go to the home agent may then be switched to the established connection. The telephony switch functions as a login portal for the agent. However only the agent's media stream is controlled in t his case. Interaction-related data and agent status are not considered or addressed.

The inventors are also familiar with a call-center system taught in U.S. Pat. No. 5,960,073 entitled Method and Apparatus for Providing an Interactive Home Agent with Access to Call Center Functionality and Resources also listed in the Cross-Reference section of this specification above. This system supports remote agent stations through a network by establishing a data link between a computer platform at the remote agent station and a CTI-processor connected to a telephony switch at the call center. Events destined to the agent are switched from the call center to a telephone at the agent station while data pertaining to the calls is transferred over the data link to the computer platform at the remote agent station to be displayed. In this system data pertaining to or related to calls is retrieved from a database at the call center. The data can include scripts for an agent at the remote station.

Call center services are supported by cooperation between software at the CTI processor and the computer platform at the remote station. In one embodiment the data link, once established, is kept open while calls continue to be switched to the remote station. In another embodiment after an initial agent log in, dial up is done from the remote station upon detecting calls from the call center by a TAPI compliant device. A reduced log is performed at the CTI processor at the call center to save time. In yet another embodiment, the CTI processor establishes the data connection each time using a modem bank adapted for dialing. The modem bank switches the call from the call center to the remote station. A plurality of remote stations may be thus supported.

A drawback with this system is that it requires first-party control equipment established at the remote agent work-

place. The first-party control equipment controls the remote agent phone separately from the agent's computer platform.

The inventor is familiar with yet another system taught in U.S. patent application Ser. No. 2001/0023448 entitled Method and Apparatus for Data-Linking a Mobile Knowledge Worker to Home Communication-Center Infrastructure also listed in the cross-reference section of this specification. The system is a proxy system enabling a worker remote from a communication center to operate with full access to data and software at the communication center from a light computer device typically unable to operate as a workstation at the communication center. In this system, a proxy server, which may be a LAN-connected server at the communication center, has a two-way data link to the light computer device operated by the remote agent. The proxy executes software, which ascertains the hardware and software characteristics of the light device.

The proxy server accesses communication-center data at direction of the light device, operates communication center software tools, and provides results to the light device over the communication link in a form usable by the light device. This approach suggests a general method for management of remote knowledge workers from within a contact center (CC). In particular, it suggests using a proxy server as a mediator between a contact center environment and a remote agent device. However, it is still limited in terms of further enhancement that might enable more specific techniques and mechanisms. Part of this solution includes a remote option that requires special equipment to be provided and connected to the remote agent's telephone set, which in addition, must be a specially adapted telephone set to accept the equipment.

What is clearly needed is a method and apparatus that can provide full and unobstructed access to communication-center data and services for a mobile or otherwise remote knowledge worker. Such a method and apparatus would allow a communication center to freely dispatch mobile knowledge workers to client locations or other areas within the domain of a large communication campus or network of communication centers without compromising quality and response time of high-level technical services. Moreover, the method would not need to rely on client-associated resources.

SUMMARY OF THE INVENTION

In a preferred embodiment of the present invention a network system for managing remote agents of a communication center is provided, comprising a primary server connected to the network, the primary server controlling at least one routing point used by the communication center, one or more secondary servers distributed on the network and accessible to the agents, the secondary server or servers having data access to agent computing platforms and communication peripherals, and a software suite distributed in part to the secondary server or servers and in part to one or more agents computing platforms and peripherals, the software suite including protocol for reporting agent status data. The system is characterized in that the agent's computing platforms and peripherals are monitored for activity state by the one or more secondary servers whereupon the one or more secondary servers exchange control messaging and event related data using ISCC protocols with the primary server over the network, the primary server recognizing CTI protocol equivalents for the messaging for the purpose of intelligently routing events incoming to or otherwise communicatively involving the remote agents.

In some preferred embodiments the network is an Internet network and the routing point is one of or a combination of a telephony switch, a service control point, and an Internet Protocol Router. Also in some preferred embodiments the remote agents are grouped together in a central facility, while in some others the remote agents are distributed over a home network. In some cases the remote agents may be mobile and wirelessly connected to the one or more secondary servers.

In various embodiments the agent's computing platforms and peripherals are one of or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device. Also in various embodiments remote agents are specialized knowledge workers offering service not available within the communication center.

In some preferred embodiments software suite is an extension of a CTI software suite used in the communication center, the extended portion for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center. Also in some preferred embodiments control messaging and event related data exchanged between the primary server and the one or more secondary servers is formatted using Extensible Markup Language. In some cases Extensible Style sheet Language Transformation is used to transform the Extensible Markup Language files into formats useable on the computing platforms of the remote agents. The useable formats may include HTML, HDML, WAP, and WML.

In some embodiments a CTI-enhanced Interactive Voice Response system is used to exchange data with a remote agent receiving calls on an analog telephone in the event that the agent does not have access to a computing platform connected to the telephone and the one or more secondary servers. Also in some embodiments the remote agents establish one or more destination numbers for receiving events, the destination numbers to be set in the CTI environment for the period that the agent is logged into the system. The destination numbers may include one or a combination of telephone numbers, fax numbers, Internet Protocol addresses, e-mail addresses, universal resource locators (URLs), and pager numbers.

In another aspect of the invention a software suite for managing remote agents of a communication center is provided comprising a client portion including a contact navigation application, a contact extension application, and a code library, and a server application including a transaction management application, an agent specific application, and an ISCC application program interface. The suite is characterized in that the client portion specifies functionality and reports state information of the remote agent to the server application, whereupon the server application reports same under ISCC protocol to a communication-center suite for routing purposes and wherein the communication-center suite provides event-related data under ISCC protocol to the server application, which in turn transforms the data into data formats usable on various communication devices of the remote agent.

In some embodiments the remote agents are part of a communication center network, the server portion functioning as the network access and agent monitoring point for the remote agents. The communication network may include the Internet network and the public switched telephony network (PSTN). The remote agents may be grouped together in a central facility or distributed over a home network. In many cases the remote agents are mobile and wirelessly connected to the one or more secondary servers.

In some preferred embodiments the client portion resides on one or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device. Further the remote agents may be specialized knowledge workers offering service not available within the communication center.

In some embodiments the software suite is an extension of a CTI software suite used in the communication center, the extended portion for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center. The ISCC protocols may include Extensible Markup Language used to format messaging and event-related data. In some cases Extensible Style sheet Language Transformation may be used to transform the Extensible Markup Language files into formats useable on the computing platforms of the remote agents. The useable formats include HTML, HDML, WAP, and WML.

In some embodiments the remote agents establish one or more destination numbers for receiving events on the various communication devices, the destination numbers to be set in the CTI environment for the period that the agent is logged into the system providing the software. In some cases the destination numbers include one or a combination of telephone numbers, fax numbers, Internet Protocol addresses, e-mail addresses, universal resource locators, and pager numbers.

In yet another aspect of the invention a method for managing information about remote agents of a communication center for the purpose of intelligently routing events involving those agents is provided, comprising steps of (a) providing a software suite accessible to the agents for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center; (b) providing a network link between the software suite and CTI software of the communication center; and (c) routing communication events involving the remote agents according to state and other information about the agents provided by and through the software suite.

In preferred embodiments of the method, in step (a), the agents are accessible to the communication center through a combination of the Internet network and the public switched telephony network. Also in preferred embodiments, in step (a), the software suite comprises a server portion and a client portion. Also in some embodiments, in step (a), the agents are knowledge workers offering service not available from agents within the communication center. Further, in step (a), communication apparatus may include one or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device. Still further, in step (a), the software suite may be configured and updated from the communication center.

In some embodiments, in step (b), the network link supports ISCC protocol, which may include Extensible Markup Language and Extensible Style Sheet Transformation Language. In some cases the client portion resides on one or more of the communication apparatus and the server portion resides on a server accessible to the one or more communication apparatus via a network link.

In some embodiments, in step (c), state information includes ready, not ready, logged in, logged out, and on call. Also in step (c) other information may include skill level, registered destination numbers, and communication device type and platform.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

FIG. **1** is an exemplary overview of a multimedia-interaction storage system within a communication center according to an embodiment of the present invention.

FIG. **2** is a block diagram illustrating a connective relationship between a proxy server and a hand-held computer operated by a mobile knowledge worker according to a preferred embodiment of the present invention.

FIG. **3** is an architectural overview of a state and interaction management system according to an embodiment of the present invention.

FIG. **4** is a block diagram illustrating system connection hierarchy according to an embodiment of the invention.

FIGS. **5** through **8** are block diagrams illustrating call control use cases according to an embodiment of the present invention.

FIG. **9** is a block diagram illustrating components of the Knowledge Worker software and integration thereof to a communication center framework.

FIG. **10** is a block diagram illustrating components of the knowledge worker platform.

FIG. **11** is a configuration model for knowledge worker state information.

FIG. **12** is a data model for presenting an active knowledge worker state.

FIG. **13** is a process flow diagram illustrating the sequence of a successful internal call.

FIG. **14** is a process flow diagram illustrating a variation of the sequence of FIG. **13** with a forced answer.

FIG. **15** is a process flow diagram illustrating the sequence of a failed internal call.

FIG. **16** is a process flow diagram illustrating the sequence of an internal call with a forced timeout before PIM decision according to an embodiment of the invention.

FIG. **17** is a process flow diagram illustrating the sequence of a successful external call from agent to remote KW according to an embodiment of the present invention.

FIG. **18** is a process flow diagram showing the process of a failed external call according to an embodiment of the present invention.

FIG. 19 is a structure of messages in KWP.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **1** is an exemplary overview of a multimedia-interaction storage system within communication-center architecture **9** according to an embodiment of the present invention. Communication center **9** is illustrated solely for the purpose of illustrating just one of many possible system architectures in which the invention may be practiced. Center **9**, which in a preferred embodiment comprises both conventional and data-network telephony (DNT) apparatus, is exemplary of an architecture that could facilitate a network operating system such as CINOS (known to the inventor). Communication center **9** may be assumed to have all the internal components described in the background section such as agent workstations with LAN connected PC/VDUs, agent's COST telephones, and so on. Such a communication center operating an enhanced interaction network operating system such as CINOS would employ knowledge workers trained to interact with associates, clients, and in some cases internal systems that require programming, scripting, researching, and the like.

For the purposes of this specification, a knowledge worker (KW) is a highly skilled individual that is at least trained in systems programming and implementation using software tools. A KW is also typically trained in the use of all supported communication media and applications that may be used with a network operating system. In many instances, a KW may also handle high level sales and service while functioning as an agent for the communication center both inside the center and at a client's location. However, as described in the background section, a KW away from home (in the field) will not generally have full access to all communication center data and tools unless he/she carries a powerful computer station along, or commandeers a client's station having suitable connectivity and ability to perform all of the applications at the home station. Therefore, having many such highly skilled workers in the field and not in the communication center may be, at times, a considerable liability to the communication center, but unavoidable at times. It is to this aspect that the present invention mostly pertains.

Referring again to FIG. **1**, a multimedia data-storage system represented herein by a centralized grouping of connected and labeled text blocks is provided and adapted to facilitate rules-based storage of all communication-center interaction between agents and clients including co-workers and associates. Such a representation illustrates an important part of CINOS function.

At the heart of the storage system is a mass-storage repository **11** adapted to store multimedia interactions as well as text-based related files. Repository **11** may utilize any form of digital storage technology known in the art such as Raid-Array, Optical Storage, and so on. The storage capacity of repository **11** will depend directly on its implementation with regard to the size of communication center **9** and predicted amount of data that will be stored and kept by the system.

In this example, repository **11** is divided logically into two sections. One section, multimedia information system (MIS) **15**, is responsible for storing copies and records of all multimedia interactions, defined as media that is not text-based, such as audio, video, and graphics-based media. All multimedia interactions are stored in MIS **15** whether incoming, outgoing, or internal. A second section, herein referred to, as text section **13** is responsible for all text-based interactions as well as text versions and annotations related to non-text files.

Repository **11** is connected to a communication-center local area network (LAN) **45**. Repository **11** is accessible via LAN **45** to authorized personnel within a communication center such as agents, KWs, or the like using computerized workstations connected on the LAN, and may, in some instances, also be made available, in full or in part, to clients and associates communicating with the call center. A network router (RTN) **19** is shown connected to LAN **45** via network connection **41**. In this example, network router **19** is the first point within a communication center wherein data network telephony (DNT) media arrives. Network router **19** is exemplary of many types of routers that may be used to route data over LAN **45**. An Internet-protocol-network-telephony (IPNT) switch **35** is connected to network router **19** via a data link IPNT switch **35** further routes or distributes live IPNT calls that do not require routing to a live agent. IPNT calls that are routed to live agents are sent over connection **41** to LAN **45** where they reach agent PC/VDU's at agent and KW workstations connected to the LAN (PC/VDU is exemplary) or DNT-capable phones (not shown) as illustrated via directional arrows.

In the multimedia storage system represented herein, a KW such as one operating at a provided work station (PC/VDU **17**) typically has access to all multimedia interaction histories that are stored in repository **11**. CINOS applications (not shown) executable on workstations such as PC/VDU **17** empowers the KW to facilitate many tasks in the realm of communication center functionality. Such tasks include, but are not limited to, researching and creating virtually any type of system report regarding data held in repository **11**, updating and creating new management applications that may alter or enhance CINOS functionality, and other such system-administrator-type duties. LAN **45** is the network through which the "in-house" KW is empowered to access such as a CINOS MGR server **29**, repository **11**, and other connected data sources and systems (not shown) that may be present in a communication center such as center **9**.

By reviewing capabilities of the multimedia storage system of communication center **9**, a full appreciation of the necessity of various in-house skills possessed by a KW, such as the skill of operating at station **17**, may be acquired by one with skill in the art. Therefore, a detailed review of communication-center operation, particularly storing interactions follows.

Creating text-based versions of non-text multimedia transactions may, in some cases, be accomplished by an automated method. For example, a digital voice attendant **37** is provided and linked to IPNT switch **35**. Digital voice attendant **37** may be of the form of a DNT-capable IVR or other digital voice-response mechanism as may be known in the art. Such automated attendants may interact with a voice caller instead of requiring a live agent. A speech-to-text converter **39** is provided and linked to voice attendant **37**. As digital voice attendant **37** interacts with a caller, speech-to-text converter **39** converts the speech to text. Such text may then be stored automatically into text section **13** of repository **11** and related to the also-recorded audio data. Part of the purpose and rationale for the creation of text documents related to non-text files is that text can be more easily mined for content and meaning than non-text files.

It will be apparent to one with skill in the art that as speech recognition technologies are further improved over their current state, which is adequate for many implementations, reliable text versions of audio transactions are not only possible but also practical. Such speech-to-text conversions are used here only for the convenience of automation wherein no live attendant is needed to transcribe such audio data. The inventor is familiar with such converters as used in such as the CINOS system incorporated herein by reference. Such converters provide convenience in transaction recording but are not specifically required to achieve the interaction storage objectives of communication center **9**. A KW such as one operating from station **17** may be called upon to create and set-up the various rules-based applications that are required for routing and determining when digital voice attendant **37** will interface with a client or associate.

An automated services system **43** is provided and has a direct connection to section **13** of data repository **11**. System **43** is adapted to handle automated interaction and response for certain text-based interactions such as e-mails, facsimiles, and the like, wherein a complete text record of the interaction may be mirrored, or otherwise created and stored into text section **13**. For example, a fax may be sent and mirrored into section **13** or, perhaps recreated using an optical character recognition (OCR) technique and then entered. Physical text-documents such as legal papers and the like may be automatically scanned, processed by OCR

techniques, and then entered into text section **13** before they are sent to clients. There are many possible automated techniques for creating and entering text files into a database including methods for generating automated responses. A KW such as one operating at station **17** may be called upon to oversee the creation and operation of all automated services insuring such as prompt response time, queue management, accurate threading and organization into a database, updating or adding enhanced capability, and so on.

With respect to the dual telephony capability (COST/DNT) of communication center **9**, a central telephony switch **21** is provided to be a first destination for COST calls arriving from, for example, a PSTN network. Switch **21** may be a PBX, ACD, or another known type of telephony switch. Internal COST-wiring **31** connects telephony switch **21** to agent's individual telephones (not shown). Switch **21** is enhanced by a computer-telephony integration (CTI) processor **25** running an instance of a T-server CTI suite and an instance of a Stat-server, which are software enhancements known to the inventor. Such enhancements provide CTI applications, such as intelligent routing, statistical analysis routines, and so on. CINOS as previously described and disclosed in the co pending prior application incorporated herein is adapted to be integrated with such software when present in a CINOS-enhanced communication-center. A KW such as one operating station **17** may be called upon to compile and analyze results provided from statistical analysis routines executed at processor **25** for the purpose of creating new routing rules of routines that further enhance functionality.

An intelligent peripheral in the form of a COST IVR **23** is provided for the purpose of interacting with callers seeking information and the like who do not require connection to a live agent at the communication center. IVR technology may comprise voice response, touch tone interaction, or a combination of such known technologies. IVR **23** is linked to processor **25** and also to automated services **43**. An example of an IVR interaction may take the form of a presentation to a caller from the PSTN of options for using an automated service such as those described above, or perhaps waiting for a live agent. A KW such as a KW operating at station **17** may be called upon to create and install appropriate interaction scripts into IVR **23** for interaction with clients and associates calling in from the PSTN.

A CTI to DNT interface **27** is provided for the purpose of converting COST data to digital mode compatible with DNT so as to be adapted for digital storage and interaction according to CINOS functionality and enterprise business rules. Bi-directional arrows illustrated between interface **27** and IVR **23** represent the ability to route interactions in either direction. COST to DNT conversion may be accomplished in IVR **23** in addition to or in place of interface **27**. The connection architecture presented herein is exemplary only.

A speech-to-text converter **33** is provided for converting audio from the CTI side to text for entering into text section **13** as was taught with regard to converter **39** on the DNT side. Actual recorded media interactions are illustrated entering MIS **15** after text versions are rendered and entered into section **13** however this is not required. In some instances text versions of multimedia interactions may be rendered after the interaction is stored. There is no limitation regarding sequence. It is sufficient to say that converters **39** and **33** are capable of real-time conversion and entry.

Server **29** shown connected to LAN **45** is adapted to host a CINOS MGR (operating system) application, which provides control and organization with regard to various functions provided by the CINOS system as a whole. The storage architecture represented herein by the described text blocks, and all it encompasses in this embodiment, is meant only to be an example architecture as may be dedicated to the storage and organization of communication-center data according to enterprise rules.

It will be appreciated by one with skill in the art that a network operating system including a system for automatically storing and recording virtually all communication center transactions requires substantial skill in set-up, implementation, and administration both on the COST side and the DNT side within a communication center such as center **9**. Moreover, a substantial network operating system such as CINOS has client-side software applications that subscribers or associates must utilize in order to achieve full seamless interaction with agents and subsystems operating according to the system parameters. In some cases, the operating system may span several communication centers over a large technical campus connected by a WAN. This fact requires that system administrators and troubleshooters be available to assist in facilitating and preparing client and associate CPE for interacting with communication center equipment and software according to system parameters.

If a KW such as one operating at station **17** could be mobilized to operate effectively outside of communication center **9** such as at a client location, and still be able to service center **9** from the field, then an enterprise hosting center **9** and perhaps other like centers could save considerable resources associated with training and expenses incurred for maintaining a larger number of fixed KW's.

The inventor provides a method and apparatus whereby such a mobile KW could have full and unfettered access to virtually all data systems and sources housed within his home communication center without having to carry a powerful station or inconveniencing a client by commandeering client resources. This inventive method and apparatus is described below in enabling detail.

FIG. **2** is a block diagram illustrating a connective relationship between a proxy server **49** and a hand-held computer **47** operated by a mobile KW according to a preferred embodiment of the present invention.

Hand-held computer **47** has a CPU **63**, a memory **57**, a video adapter circuitry **55**, and a modem **65** all communicating on bus **59**. Video circuitry **55** drives a display **61**. Memory **57** may be any of a number of types, such as flash, random access (RAM), read-only (ROM) or similar type, or a combination of these. There may be other components as well, but these are not shown to facilitate description of the unique aspects of this embodiment of the invention. The hardware arrangement is intentionally shown as general, and is meant to represent a broad variety of architectures, which depend on the particular computing device used. Possibilities include many types of portable hand-held computers and also adapted cellular phones capable of receiving and sending video. A mobile KW would use such as device for communication and data access while in the field.

Proxy-Server **49** is a relatively sophisticated and powerful computer typical of computers used as WEB servers, although the use in this embodiment of Proxy-Server **49** is not the conventional or typical functions of a WEB server as known in the art. Proxy-Server **49** has a CPU **69**, a memory **71**, and a means of connecting to a data network such as the Internet. The network connecting means in this embodiment is a modem **67** communicating on a bus **73**. In other embodiments the network connecting means may be a network adapter or other.

Modem **67** in the embodiment shown is compatible with modem **65** in computer **47**. A communication link **66**, which may be facilitated by a telephone line or a wireless connection, facilitates communication between computer **47** and server **49**. The means of connection and communication can be any one of several sorts, such as a telephone dial-up, an Internet connection through an ISP, or a cell telephone connection, wireless IP networks or other wireless link, including private cell or wireless WAN or LAN. A communication port **75** connects to communication link **77** providing communication, in this case, through the Internet, to a suitable station or server in communication center **9** of FIG. **1**. In this example, the linked station is preferably the KW's own home-center workstation or PC/VDU **17** from FIG. **1**.

Port **75** and link **77** may also be any one of several types, or a combination of types. In some embodiments, server **49** and station **17** will be nodes on a local area network (LAN) covering a large technical campus, and the link between the two servers will be a serial network link with port **75** being a LAN card according to any of a number of well-known protocols. In other embodiments link **77** may be a telephone line, and port **75** will be a dial-up telephone modem. In still other embodiments, this link could be a parallel communication link This link could also be through the Internet or other wide area network.

Proxy-Server **49** exists in this embodiment of the invention to perform functions enabling hand-held computer **47** to operate as an apparently powerful web-browsing machine, even though the stand-alone capability of computer **47** will not even begin to support such functionality. As is well known in the art, for a computer to be a fully functional web-browsing system requires a high-performance CPU and execution of relatively sophisticated web-browsing and display applications. Such a computer typically has to operate, as described above, at or above a million instructions per second.

Proxy-Server **49** executes a program **53** the inventor terms an Inter-Browser. The Inter-Browser combines functionality of a conventional web browser with special functions for recognition of and communication with hand-held computer **47**. Commands from computer **47**, such as, for example, a command to access a WEB page on the World Wide Web, or a server or station such as station **17** within a home communication center such as center **9**, are received by Proxy-Server **49** operating the Inter-Browser program, and acted upon as though they are commands received from a conventional input device such as a keyboard.

Following the example of a command communicated over link **66** from computer **47** for accessing station **17**, shown herein and in FIG. **1**, Proxy-Server **49** accesses the appropriate server (in this case station **17**) over link **77**, and transmits the appropriate data over link **77**. Proxy-Server **49** therefore has HTML and TCP/IP capability for accessing source data over the Internet. By hosting other routines that allow interface with data systems, data sources and such as station **17**, a KW may have full access to virtually any type of data or software tools that he could access from his station if he were operating from within center **9**.

Proxy-Server **49**, instead of displaying the downloaded data (or playing video and/or audio output, as the case may be, depending on the downloaded data), translates the data to a simpler communication protocol and sends the data in a TCP/IP protocol to computer **47** for output over link **66**. Link **66** becomes a dedicated TCP/IP pipe to and from Proxy-Server **49**. Proxy-Server **49** thus acts as a proxy for computer **47**, performing those functions of WEB browsing and data download that computer **47** cannot perform under its own computing power.

Computer **47**, through execution of a program the inventor terms a NanoBrowser **51** sends commands entered at computer **47** over link **66** to Proxy-Server **49** and accepts data from Proxy-Server **49** to be displayed on display **61**. Data is transferred in a protocol the inventor terms HT-Lite. The NanoBrowser also provides for interactive selection of links and entry into fields in displays, as is typical for WEB pages displayed on a computer screen. The NanoBrowser provides for accepting such entry, packaging data packets in TCP/IP form, and forwarding such data to Proxy-Server **49**, where much greater computer power provides for efficient processing.

One of the processing tasks that has to conventionally occur at the browser's computer is processing of received data into a format to be displayed on whatever display the user has. There are, as is well known in the art, many types of displays and many display modes. These range all the way from relatively crude LCD displays to high-resolution, multi-color displays. There are, in addition, a number of other functions that have to be performed conventionally at a user's computer to interact effectively with the WWW. For example, audio and video and some other functions typically require supplemental, or helper, applications to be installed on or downloaded to a field unit to process audio and video data and the like.

Most data transferred by WEB servers assumes relatively high-end displays, such as color SVGA displays as known in the art. Data accessed through the Internet from such as MIS database **15** of FIG. **1** would also assume a high-end display and large file size dependent on the type of media accessed. In PDAs, cellular video phones, and digital organizers, such as those anticipated for use in the present invention, the displays are relatively low resolution, and are typically LCD in nature. In the system described with the aid of FIGS. **1** and **2**, Inter-Browser program **53** at Proxy-Server **49** and the HT-Lite Nano-Browser **51** at hand-held unit **47** cooperate in another manner as well. When one connects to the Proxy-Server the hand-held unit, through the HT-Lite Nano-Browser program, provides a signature, which the Proxy-Server compares with logged signatures.

An ID match when connecting a hand-held unit to the Proxy-Server provides the Proxy-Server with information about the hand-held unit, such as CPU type and power, screen size, type and resolution, presence of a pointer device, and sound capability. The Proxy-Server then uses this specific information to translate HTML and other files from the Internet to a form readily usable without extensive additional processing by the hand-held unit. For a small monochrome LCD display a 60 k/70 k JPEG file becomes a 2 k/4 k bit map, for example. Also, multi-file pages are recombined into single file pages. This translation also minimizes bandwidth requirement for link **66**, and speeds transmission of data. In this way, a mobile KW may have access to all types of data sourced at his or her home communication center. Through proxy server **49**, a KW may also initiate and receive multimedia interactions including high-end transactions while operating unit **47**.

It is in this ability of the Proxy-Server to do the heavy computing, of which the translation of HTML files is a single example, that is responsible for a unique ability of hand-held devices in practicing embodiments of the present invention to accomplish functions that they could not otherwise accomplish, and to do so without inordinate usage of stored energy. In various embodiments of the present inven-

tion, hand-held devices with CPUs having an ability to run at from 0.001 to 0.05 MIPs can serve as WEB browsers, displaying WEB pages and allowing users to initiate on-screen links and to input data into input fields. Given the above example of MIPs requirement for WEB browsing, where currently available solutions may provide a 5× advantage, practicing the present invention can provide an advantage of up to 2000×, resulting in battery life approaching 2 weeks (given a 100 g battery weight), where expected battery life for similar functionality with a powerful CPU was calculated as 8 minutes.

As a given example of an instance wherein a mobile KW may provide full service to a home center, consider the following: Assume a mobile KW from center **9** of FIG. **1** is at a client premise installing network software and therefore not at center **9**. He opens his or her hand-held device **47** and plugs in to a nearby telephone jack for the purpose of establishing a connection to proxy server **49**, which in this case, may be implemented anywhere on the Internet. While he is configuring software on a client's computer, an important call from communication center **9** arrives through server **49** (hosted by the enterprise) to his hand-held **47**. The call is pre-processed at proxy server **49** by Inter-Browser **53** and transmitted over link **66** to device **47** where it is displayed according to device parameters and rules associated with Nanno-Browser **51**.

Suppose that the call requests that the KW rewrite a script used in such as digital voice attendant **37** because the current message has become corrupted or is not playing properly. The KW may then initiate a multimedia call to his resident workstation such as station **17** (FIG. **1**) through proxy **49** by way of link **77**. The call would arrive at router **19** and be routed directly over link **41** to station **17** based on identity thus by-passing normal DNT call handling routines. Part of the call includes a command to allow the KW to control the operation of station **17** by proxy. He may then use command keys to cause Inter-Browser **53** to browse a list of pre-prepared DNT scripts stored at station **17**. Such a list may appear as a text summary on such as display **61** of device **47**. The KW may then scroll through and select a script thus issuing a command to station **17** (by proxy) to access attendant **37** (FIG. **1**) and replace the message which is overwritten by the new one.

It will be apparent to one with skill in the art that there are a wide variety of interaction possibilities by virtue of the method and apparatus of the present invention. In the cited example, a DNT call was made to the KW's computing device **47**. Therefore, proxy **49** acts in one aspect as a call router. In another embodiment, a KW may accept a cellular call or a COST call and respond to the request-using device **47**.

In still another embodiment, a KW operating a portable device such as device **47** may temporarily plug in to any connected LAN network such as may be found connecting a large technical campus or the like. Upon plugging in, the KW may initiate an outbound-call to server **49** in the Internet and receive a temporary IP address and device authentication for communicating with such as center **9**.

To practice the invention, given an accessible WEB server configured as a Proxy-Server according to an embodiment of the present invention, one needs only to load HT-Lite NanoBrowser software on a computer and to provide Internet access for the computer, such as by a telephone modem. In many cases, candidate computers have built-in modems. In other cases, an external modem may be provided and connected. In the case of hand-held devices, such as PDAs and organizers, some have an ability to load software via a serial port, a PC card slot, through the modem extant or provided, or by other conventional means. In some cases, all operating code is embedded, that is, recorded in read-only memory. In some of these cases, adding HT-Lite routines may require a hardware replacement. In virtually all cases of hand-held devices, however, the necessary routines can be provided.

One of the components of the HT-Lite Nano-Browser software (**51**) is a minimum browser routine termed by the inventor a Nano-Browser. The Nano-Browser is capable of exerting a URL over the modem connection to access the Proxy-Server. Theoretically, one could exert a URL of a WEB site other than the Proxy-Server, but the result would be an unusable connection, as the small hand-held unit would not be able to handle the sophisticated data provided to be downloaded unless it were such as e-mail or other simple data.

Connection to the Proxy-Server provides the Proxy-Server with information as to the KW and the KW's equipment. These operations proceed in a manner well known in the art for such log-on and security transactions. Once access is extended to the KW, an interface is provided for the KW to browse in a manner very similar to well-known WEB interfaces. That is, the KW's display (**61**) provides an entry field for a URL which is asserted by an enter key or the like. There may also be an address book for often-visited sites, as is common with more powerful machines.

Similarly, there are no strict requirements for the location of Proxy-Server **49** or of accessible data sources or home stations in embodiments of the present invention. No restrictions are placed on such locations beyond restrictions on servers/nodes in general. In one embodiment, a corporation with multiple and perhaps international locations may have a local area network with one or more Proxy-Servers, and employees, particularly those employees whose job functions require travel, are provided with hand-held digital assistants according to an embodiment of the present invention. Multiple functions are then provided over Internet connection in Internet protocol, far beyond what could otherwise be provided with small and inexpensive units; and battery life for these units (device **47**) would be far beyond what would otherwise be expected. Furthermore, a company could reduce or streamline a force of KW's to a smaller number of mobile KW's with enhanced portable devices such as device **47**.

It will be apparent to one with skill in the art that the device-proxy method such as the one described above could be applied to a wide range of communication center architectures and network operating systems without departing from the spirit and scope of the present invention. A KW operating a device such as device **47** may operate while traveling to or from client locations as well as on-site at a client location. Types of devices used to communicate with proxy server **49** may vary without departing from the spirit and scope of the present invention. For example, PDAs, small notebook computers, some cellular telephones, CE type machines; all may be adapted for a proxy relationship.

Extended Management Control

According to another embodiment of the present invention an enhanced method and system is provided for enabling full and unobstructed access to contact center services and data for remote knowledge workers, including provision of full state and interaction management capabilities to the center managing the knowledge workers. The method and apparatus of the present invention is described in enabling detail below.

FIG. **3** is an architectural overview of a state and interaction management system implemented from a contact center **300** according to an embodiment of the present invention. Contact Center **300** can be employed in any mix of communication environment. For example, in a dually-capable COST/DNT multimedia environment, in a COST only environment, or in a DNT only environment. In the present example, a COST environment is illustrated. Likewise, one with skill in the art will recognize that there may be more and different types of known communication center equipment present and cooperative with the system of the invention other than what is illustrated in this example without departing from the spirit and scope of the present invention.

Center **300** utilizes a central office telephony switch **316**, which in this case, is a private branch exchange (PBX) switch. Switch **316** may also be an automated call distributor (ACD) or another known type or manufacture of telephony switch. Switch **316** is a relatively dumb switch, but is enhanced for intelligent routing and control by a CTI processor **317** running an instance of CTI transaction server (T-Server) software. CTI enhancement in this example is driven by T-Server software, which is an application that controls switch **316** and provides the intelligent computerized rules and executable routines for interaction management and state detection and management. A typical CTI link **315** connects processor **317** to PBX switch **316** in this example.

An agent workplace **319** is illustrated within the domain of center **300**. Workplace **319** is adapted minimally in this example with an agent desktop computer **320** and an agent telephone **321**. It will be apparent to one with skill in the art that there will, in actual practice, be typically many agent stations provided and adapted for normal communication center routine business and communication. The inventor illustrates only one station and deems the illustration sufficient for the purpose of teaching the features of the present invention in an enabling way.

In this case, agent telephone **321** is a COST telephone connected to PBX switch **316** by standard internal telephony wiring. Agent desktop **320** is connected to a communication center LAN illustrated by a LAN network **318** labeled T-Lib (for transaction library). A transaction library contains all of the business and routing rules applied to normal center interaction and operation. It may be assumed in this example, that other equipment (not shown) is connected to LAN **318** such as other agent stations, a customer information system, a product history database, and many other equipment types both client-oriented and service-oriented.

An agent illustrated herein as agent **322** uses telephone **321** and desktop computer **320** for the purpose of handling routine interactions such as purchase orders, order status reports, internal logging and reporting, and other tasks. In one embodiment, telephone **321** may be an IP-capable telephone and also may have a sound connection to desktop computer **320**.

A COST telephony network **303** is illustrated in this example as a preferred telephony network bridging customers to center **300** using COST technology. Network **303** is a public telephony switch notably most local to center **300**, Switch **332** is the last routing point in network **303** before making connection to switch **316** in a preferred embodiment. In one embodiment, switch **323** is CTI-enabled similarly to switch **316** within center **300** and communication center routines can be executed at switch **323** over a separate network connecting the CTI processors associated with both switches **316** and **323**.

A customer **301** and a customer **302** are illustrated in association with telephone network **303**, which is a public switched telephone network (PSTN) in this example. Customer **302** is illustrated as placing a call to center **300** through switch **323** and switch **316**. In normal practice, the call of customer **302** will be internally routed using CTI intelligence to an agent or automated interface within center **300**. In this case agent **322** receives the call on telephone **321**. Desktop **320** will display any pertinent customer information obtained from pre-interaction with customer **302** or from data sources internal to center **300**, or both.

A knowledge worker workplace **310** is illustrated in this example and is associated with communication center **300** by a network link **314** adapted for ISCC protocols. ISCC is an acronym for the well-known International Symposium on Computers and Communications. ISCC-developed protocols may be assumed to be practiced over network line **314** including a Flexible Interconnecting Protocol (FLIP).

It may be assumed then, in this example, that KW workplace **310** is located remotely from center **300** and outside of the physical domain of center **300**. Workplace **310** may be associated with other KW workplaces in a remote contact center. In another embodiment, workplace **310** may be a home-based workplace. In still another embodiment, workplace **310** may be in a state of mobility such as in a vehicle or at a remote customer worksite. KW workplace **310** has a desktop computer **311** (or equivalent) and a KW telephone **312**. A knowledge worker (KW) **313** receives calls from PSTN **303** that are directly placed from customers such as from customer **301**, or calls that are received to and then redirected from center **300**.

As described above, KW workplace **310** is not physically part of center **300** in terms of residing within a same building or physical structure. Rather, worker **313** is operating from a remote location. A major difference between the architecture of agent **322** and knowledge worker **313** is that worker **313** has no CTI link between a local switch and center **300**. In this example, a local switch **304** is illustrated and represents a local network switch (PSTN) presumably closest to KW **313**. In practice however, if workplace **310** is mobile, such as working while traveling, there may not be a specific permanent local switch from whence calls arrive to KW **313**.

It will be recognized by one with skill in the art that in the mobile sense, even in a wireless and semi-permanent networked environment, the fixtures illustrated within workplace **310** may vary widely. For example, telephone **312** may be a cellular telephone with Internet capability and desktop **311** may be a PDA or a laptop. In a fixed but remote location such as a remote knowledge worker contact center, individual knowledge workers may still be highly mobile but connected to communication to a LAN inside the center using a variety of communication devices.

To facilitate connection from center **300** to knowledge worker workspace **310**, a programmable T-server/Processor **305** is provided and distributed on a data packet network (DPN) such as, for example, the well-known Internet network. If workplace **310** is part of a permanent contact center operating remotely from center **300**, then switch **304** and processor **305** may be part of the equipment maintained in the contact center. However, for knowledge workers that are home agents or highly mobile, then switch **304** and processor **305** are network level systems, switch **304** in the PSTN and processor **305** in a private or public DPN.

The fact that there is no CTI link to center **300** means that under normal circumstance, the activities of KW **313** in workplace **310** cannot be managed. The system of the invention is enabled by a software platform known to the

inventor as a Knowledge Worker Platform (KWP) that functions in cooperation with hosting equipment, namely processor **305**, to alleviate the requirement for a hardwired CTI link or other complicated connection methods, system dependant CPE, or complex client software applications. KWP is a proxy agent that receives KW status information (e.g. ready or not ready) from a KW device such as from desktop **311** and sets the information within CC environment at center **300**. Status reporting is used for determining KW availability for routing determination. KWP also supplies the KW device with call-related information (e.g. customer/product information) when an event is routed.

Workplace **310** is connected to processor **305**, running an instance of programmable T-server, by a network link **308**. In this case, processor **305** is accessible from desktop computer **311**. In this particular embodiment, desktop **311** and telephone **312** are permanent fixtures and workplace **310** is part of an established physical center. In this case, link **308** may be a LAN network providing connectivity to other KW stations. Similarly, telephone **312** would be just one of many connected to switch **304** by internal telephone wiring. In this case, telephone **312** is also connected to desktop **311** by a cable so that desktop **311** may monitor call activity on telephone **312**. It will be appreciated that there are many other possible architectural scenarios both fixed and mobile using wireless technologies.

Desktop computer **311** has an instance of agent desktop (AD) application installed thereon similar to a traditional application expected for a traditional in-house desktop like desktop **320** manned by agent **322** within center **300**. However, the program on desktop **311** is modified to interact with KWP running on processor **305**. KWP (processor **305**) and AD (KW desktop **311**) exchange information including Transaction Library data (T-Lib), Knowledge Worker Protocol (KW Protocol), and Interaction Preview Data Protocol (IPDP). Data links **307** and **309** are logical only and all data shared between processor **305** and desktop **311** may travel over a single physical or wireless data connection.

The AD application running on desktop **311** may be adapted to run on virtually any network-capable device such as a cellular telephone with display, an IP telephone, a PDA, a paging device, and so on. The only modifications required for AD at workplace **310** are the application program interfaces required to work with data that is not in standard CTI format. In a preferred embodiment, KWP uses Extensible Markup Language (XML)-based protocol for device independent presentation and Extensible Style sheet Language Transformation (XSLT) scripts for transforming XML source data to, for example, HTML data or other data formats to accommodate device-dependent data presentation requirements. Basically XSLT is an XML processing language known in the art.

It is important to note herein that the models for KWP and AD are the standard T-Server and agent desktop models. Appropriate extensions are made to KWP and AD to enhance capability for dealing with KW protocol and added T-Lib entities. For example, the model for a knowledge worker is an extension of the model for a standard agent. Therefore, attributes of the KW model do not exist in the standard agent model. These attributes or object entities are added to the standard T-Lib for KW use. The extended attributes define the separation of remote KW characteristics and function constraints from those of a regular CTI agent.

In practice, CTI telephony capability is extended to KW **313** by way of link **314**, **308**, and the adapted applications KWP and AD. Switch **304** remains a dumb switch having no CTI control. For example, assume customer **301** has a direct number to telephone **312** and places a call to KW **313**. The call request is routed through switch **323** to switch **304** where notification of the call exemplifies a ringing event at telephone **312**. At this point, center **300** has no indication or idea that KW **13** has a call-event ringing notification. However, when agent **313** takes the call, AD software on desktop **311** detects the activity and sends pertinent state data to KWP in processor **305**, which in turn delivers the information to premise server **317**.

Once server **317** has the information, other calls destined to telephone **312** can be managed and queued according to KWP reporting data. During interaction with the caller on telephone **312**, KW **313** can use desktop **311** to obtain additional call and customer data, product data, history data and so on from center resources. Likewise, KW **313** may use terminal **311** to perform a call-related action such as hold, transfer, terminate, and other like commands. The command path in a preferred embodiment can be executed from server **317** and direct to a CTI-processor running an instance of T-Server (command path not shown) that intelligently enables switch **323** to terminate, interact or otherwise treat the event accordingly at switch **323**. An advantage is that management information is available from the time of call receipt. If a queue is used, the information may be used for queue management purposes so that the center can tell whether or not a particular knowledge worker is not available. The center can then route calls destined to KW **313** based on availability.

In one embodiment, customer **302** places a call to KW **313** the event routed through switch **323**, and switch **316**. By identifying the DN as that of KW **313** (telephone **312**) CTI messaging takes place between switch **316** and the Premise T-server application on processor **317**. Server **317** then communicates through ISCC link **314** to the Programmable T-Server application on processor **305** enhanced as KWP. KWP messages with AD at desktop **310** to determine availability of DN (telephone **312**). AD checks telephone activity by link **306** and if available responds along the reverse chain of links. Assuming availability then switch **323** can seamlessly re-direct the event to switch **304** by command from processor **317** and cause a ringing event at telephone **312**. This assumes that processor **317** is connected to a like processor at switch **323**. Otherwise, the call can be rerouted from switch **316** through switch **323** to switch **304**. Link **306** is virtual in the sense that telephone activity at telephone **312** can instead be monitored from switch **323** if it is CTI-enabled and has a link to processor **317**.

Outbound calls, inbound calls, and KW to KW remote calls can be monitored and reported in terms of state activity and availability. Assume, for example, that KW **313** places an outbound call from telephone **312** destined for telephone **321** in agent workplace **319**. AD running on desktop **311** detects the outbound DN and uploads pertinent data to processor **305** whereupon KWP sends appropriate request for availability to Premise T-Server **317** controlling switch **316**. Premise T-server **317** has information pertinent to the activity state and availability of agent **322** in his workplace **319** by way of LAN connection **318**. Returned data follows the reverse chain and may show up on desktop **311** before the ringing event has expired. A wealth of information can be propagated between KW **313** and center **300**.

Data about callers and contact center service tools and full database access is made available to KW **313** on desktop **311** using KWP and AD applications. If there is no monitoring capability between the device that KW **313** receives an event on and the computing platform of KW **313**, then KW **313** may have to manipulate AD on the computing platform in

order to access center **300** for data pertinent to the event. In other embodiments the computing platform and the device used to receive events are one in the same such as a network-capable cellular telephone for example.

KW **313** can register any number of DNs from AD on desktop **311** to receive events when he or she is leaving workplace **310** and will be away for a period. In the case of a short distance, a wireless peripheral can be used to access center data through desktop **311** and a wireless telephone can be set-up to receive the events. There are many equipment variations that are possible.

The nature of the connection between KWP and a KW device can be configured according to a number of criteria and supported platforms. For example, a one-way connection can be utilized for practicing only KW status notification to center **300**. A two-way connection can be practiced for call-related data propagation. In addition to dial-up techniques to facilitate the connection between KWP and a KW device, wireless and Internet Protocol (IP) connections can be implemented. It is also possible to practice the invention with a simple PSTN connection.

KWP architecture supports any existing media and platform. More specifically, KWP supports a traditional desktop with a data link (illustrated in this example), wireless linking for PDAs and wireless browser applications. KWP also supports conventional voice devices including but not limited to analog telephone, conventional IVR, and VoiceXML based IVR. Messaging protocols such as Simple Messaging System (SMS), Instant Messaging (IM), email. Internet markup languages such as traditional HTML-based languages are supported along with more recently introduced Wireless Application Protocol (WAP) and Wireless Markup Language (WML). More detail regarding the software platform of the invention and how it functions in telephony scenarios is presented below.

FIG. **4** is a block diagram illustrating system connection hierarchy according to an embodiment of the invention. In this simple example, KWP **402** resides between the communication center environment (**401**) and the remote KW or KWs. Therefore, KWP **402** is a proxy-serving platform that is integrated as an extension of the CTI telephony platform generally described as the T-Server platform. In this example, CC Environment **401** is analogous to the capabilities of center **300** described with reference to FIG. **3** including any extension of those capabilities into the PSTN network by way of separate data network connections and CTI processor distribution to network level components.

KWP **402** is analogous to KWP running on processor **303** described with reference to FIG. **3**. IP network **404** and PSTN network **403** illustrate exemplary communication networks used in communication. Other networks may also be substituted therfor or used in conjunction therewith. A plurality of KW devices is illustrated as examples of varying types of devices that may be used by a KW to practice the invention. A standard analog telephone **405**a can be used in a simple embodiment to communicate with KWP through PSTN **403**. IVR-based technology is used in this case to provide the KW with call and center-related data as well as for receiving routed events. A cellular telephone **405**b is illustrated and can be adapted to communicate with KWP **402** through a COST connection or through a DNT connection. WAP and WML are supported so that XML-based data from CC environment **401** can be displayed on device **405**b.

It is noted herein that AD, described with reference to FIG. **3**, normally requires approximately 30 megabytes of disk space in a robust version for desktops and the like. Therefore, an AD-Lite application would be downloaded to device **405**b according to storage availability. In another embodiment, AD may be combined with KWP at server side wherein AD is still personalized to the particular KW authorized to access it and operate it from device **405**b.

A PC **405**c is illustrated in this example and is analogous to desktop **311** described with reference to FIG. **3**. A PDA **405**d is illustrated in this example as a possible KW device that communicates to KWP through IP network **404**, or can also be operated with a wireless connection through PC **405**c as a host.

FIGS. **5** through **8** are block diagrams illustrating call control use cases according to an embodiment of the present invention. Referring now to FIG. **5**, the basic advantage of KWP in that KW agent **501** can accept inbound calls form customers (**502**) wherein availability status, skill level, and other criteria can be provided to the communication center environment for the purpose of routing call **502**. If the DN of KW **501** is not integrated with a KW computing platform, then KW **501** can still enter input from the KWP-connected computing platform when on call using an unregistered DN to retrieve data. At this point the communication center can track the activities and results based on KW data input. In another embodiment, the DN of the KWs receiving telephone can be set in the CC environment wherein a network level switch enhanced by CTI software can monitor state, determine best routing, and initiate data transfer of call-related and center-related data to the KW without first party input.

Referring now to FIG. **6**, KW **601** can initiate an outbound call (**602**). As an extension to traditional outbound dialing, a preview-dialing mode **603** is supported which includes preview dialing notification caused by outbound contact (**605**) and a preview-dialing mode supported by Internet suite (**605**) for IP mode.

Referring now to FIG. **7**, a KW (**701**) can place or receive internal calls (**702**) from other knowledge workers. This includes an internal call without notification (**703**), an internal call with notification (**707**). An internal call with notification includes an option (**708**) for preview answer of the internal call associated with a manual agent reservation. There are several extended options including an external call (**709**) via RP queue performed by an external T-Server, an internal call (**706**) from a center agent performed by the external T-Server, and an internal call (**704**) from another KW. Option **704** can be extended to an option of internal call (**710**) from a KW performed by an external programmable T-Server, or an option of internal call (**705**) from a KW performed by a local programmable T-Server.

Referring now to FIG. **8**, KW **801** can initiate more complicated interactions such as a two-step transfer (**802**), a two-step conference (**803**), and a hold and retrieve (**804**).

FIG. **9** is a block diagram illustrating components of the Knowledge Worker software and integration thereof to a communication center framework. The KWP **901** of the present invention includes a server application **904**, which is analogous to programmable T-Server and KWP software running on processor **305** described with reference to FIG. **3** above. A KW desktop or "client" application **903** is also part of KWP **901**. KW desktop **903** is analogous to AD running on desktop **311** described with reference to FIG. **3**.

KWP communicates with a communication center (CC) Platform **902** over a data link (**908**, **907**) that supports ISCC protocol. Link (**908**, **907**) is separated in terms of element number to show communication of two separate components in this example. However, the physical link is analogous to link **314** described with reference to FIG. **1**.

CC platform **902** includes a configuration server **905** and standard premise T-Server **906**. Configuration server **905** is a software implement that is used to configure and update KWP/programmable T-server **904**. In turn, KWP/T-Server programs KW desktop **903** if required. As was described further above, KWP **901** is an extension of CC framework. For example, T-server **906** serves as a basic model whereas KWP/T-Server is extended in functionality by additional attributes and capabilities.

Existing T-Library (T-Lib) protocol is used to build additional KW messaging between KWP/T-Server and client the application **903**. Standard agent desktop applications are extended to provide KW functionality.

FIG. **10** is a block diagram illustrating components of the knowledge worker platform **901** of FIG. **9**. As described with reference to FIG. **9** above, KWP **901** comprises a KW desktop application **903** and a KW T-Server application **904**. KW desktop application **903** comprises an agent desktop application known to the inventor as Contact Navigator given the element number **1009**. Contact Navigator **1009** utilizes a Transaction Library or T-Library **1008**, which contains all of the required business and routing rules and object entities needed to build useful communication between two physically disparate systems namely, the CC platform and the KWP. By themselves, navigator **1009** and library **1008** are identical to the desktop application contained within the physical contact center domain analogous to AD running on agent desktop **320** in center **300** described with reference to FIG. **3** above.

In this example, desktop **903** is enhanced with KW extension software **1010**. KW extension **1010** contains all of the attributes that facilitate the added capabilities of a KW desktop over a standard model desktop. T-Lib **1011** is thus enhanced with the appropriate components defined by the extension. It is noted herein that since KW desktop **903** is based on the standard desktop model (contact navigator) added capability can be remotely programmed thereto using the configuration server described with reference to the CC platform of FIG. **9**. The appropriate components are downloaded to KW extension **1010** for KW use.

KW desktop **903** has connection with KW T-Server **904** as described further above in this specification. KW T-Server **904** is partitioned into two parts, a T-Server common part **1001** and a KW specific part **1002**. KW T-Server **904** is also enhanced with ISCC communication capability via ISCC protocol **1003** for the purpose of economic communication with the contact-center platform.

One main goal of the invention is to maintain separation of KW specific part of T-Server functionality from the standard functionality of T-Server framework components at the host contact center. Such separation allows independent development and support for KWP **901** over contact center framework. Further, separation enables seamless integration of KWP with a variety of host customer-relation-management (CRM)-vendors.

KW protocol is provided instead of traditional CTI protocol. KW protocol, shown exchanged over logical link **1006** between the desktop and the T-Server provides CTI like messaging capability. This means that any KW desktop that registers a DN with KW T-Server **904** establishes telephony switch functionality at the contact center for servicing those registered DNs. KW protocol carries CTI like messages regarding real-time status of any registered DNs from KW desktop to KW T-Server. Various call-control messages are supported like TmakeCall, TanswerCall, TreleaseCall, THoldCall, and so on. These messages are treated as CTI messages that inform KW T-Server **904** of status of a particular interaction.

The KWP message is encoded in a KVList data type that enables future extension of KWP without breaking compatibility with older applications.

KVList structure

The following code exemplifies the structure of a KVList:

```
typedef enum {
    KVTypeString,
    KVTypeInt,
    KVTypeBinary,
    KVTypeList,
    KVTypeIncorrect = -1 /* used for error indication only */
} TKVType;
struct_kv_pair {
    TKVType type;
    char *key;
    int length;
    union {
        char * _string_value;
        int_int_value;
        unsigned char *_binary_value;
        struct kv_list * list_value;
    } _value;
#define string_value        _value._string_value
#define int_value           _value._int_value
#define binary_value        _value._binary_value
#define list_value          _value._list_value
    struct_kv_pair *kv_next;
    struct_kv_pair *kv_prey;
};
typedef struct _kv_pair TKVPair;
struct kv_list {
    struct _kv_pair *list;
    struct _kv_pair *current;
    struct _kv_pair *tail;
};
typedef struct kv_list TKVList;
```

TEvent Structure

The following code exemplifies the structure of a transaction event (Tevent):

```
typedef struct {
    enum TMessageType       Event;
    TServer                 Server;
    int                     ReferenceID;
    char                    *HomeLocation;
    char                    *CustomerID;
    TConnectionID           ConnID;
    TConnectionID           PreviousConnID;
    TCallID                 CallID;
    int                     NodeID;
    TCallID                 NetworkCallID;
    int                     NetworkNodeID;
    TCallHistoryInfo        CallHistory;
    TCallType               CallType;
    TCallState              CallState;
    TAgentID                AgentID;
    TAgentWorkMode          WorkMode;
    long                    ErrorCode;
    char                    *ErrorMessage;
    TFile                   FileHandle;
    char                    *CollectedDigits;
    char                    LastCollectedDigit;
    TDirectoryNumber        ThisDN;
    TDirectoryNumber        ThisQueue;
    unsigned long           ThisTrunk;
    TDNRole                 ThisDNRole;
    TDirectoryNumber        OtherDN;
    TDirectoryNumber        OtherQueue;
    unsigned long           OtherTrunk;
    TDNRole                 OtherDNRole;
    TDirectoryNumber        ThirdPartyDN;
    TDirectoryNumber        ThirdPartyQueue;
    unsigned long           ThirdPartyTrunk;
    TDNRole                 ThirdPartyDNRole;
```

-continued

```
    TDirectoryNumber        DNIS;
    TDirectoryNumber        ANI;
    char                    *CallingLineName;
    TDirectoryNumber        CUD;
    TAddressInfoType        InfoType;
    TAddressInfoStatus      InfoStatus;
    TTreatmentType          TreatmentType;
    TRouteType              RouteType;
    char                    *ServerVersion;
    TServerRole             ServerRole;
    TMask                       Capabilities;
    TKVList                 *UserData;
    TKVList                 *Reasons;
    TKVList                 *Extensions;
    TTimeStamp              Time;
    void                    *RawData;
    TDirectoryNumber        AccessNumber;
    TXRouteType                 XRouteType;
    TReferenceID                XReferenceID;
    TKVList                 *TreatmentParameters;
    char                *Place;
    int                 Timeout;
    TMediaType              MediaType; /* added 7/15/99 ER#9462 */
    TLocationInfoType       LocationInfo;
    TMonitorNextCallType        MonitorNextCallType;
    /*
     * Used in RequestPrivateService/EventPrivateInfo:
     */
    TPrivateMsgType         PrivateEvent;
} TEvent;
```

Another protocol provided for use in practice of the present invention is known as Preview-Interaction-Protocol (PIP) to the inventor. Preview interaction protocol is illustrated as being exchanged between KW T-Server **904** and KW desktop **901** over logical link **1004**. PIP provides an ability for a KW to preview incoming interactions before actually receiving them. In this way, a KW has the capability of accepting or rejecting an incoming interaction based on attached data such as user data attached with an incoming telephone call. This capability also allows the contact center platform to correctly process external call-control routines like external call, external transfer, external conference, and so on. All preview interaction messaging takes place between KW desktop **903** and KW T-Server **904**.

T-Library functions as a messaging transport layer in the software communication scheme. In other words, particular T-Lib messages are used to carry KW protocol and PIP messages.

FIG. **11** is a configuration model **1100** for knowledge worker state information according to an embodiment of the present invention. Configuration-Management-Entities (CME) are configured into the system for active state and call control. CME configuration model **1100** is a typical CME configuration routine for configuring remote knowledge workers to practice the present invention. First a KW is configured with CfgPerson **1101**. Secondly, the place or places of operation are configured with CfgPlace **1102**. The relationship between person and place typically includes one place where a KW will receive interactions. However in some embodiments a KW may be live at one place and have automated services set up in another place. Therefore, the relationship between person and place in this CME model can be one to many.

Place **1102** has two basic attributes that must be configured. These are agent login (CfgAgentLogin) **1103** and DN (CfgDn) **1104**. Agent login includes any pre-designed procedure deemed appropriate for a KW to login to the system of the invention. In some cases login may not be required in terms of passwords and so on. Simply opening a connection between the KW computing platform and the KW T-Server may be sufficient for login purposes. In some embodiments, KW platforms associated with automated systems may remain connected and, therefore logged in 24/7. In other cases, automated connection establishment and login may be pre-programmed so that the KW platform will login whether the agent is actually there or not.

CfgDn **1104** is used to register one or more KW DNs with the contact center environment, typically a CTI telephony switch. A KW may configure more than one DN with attached data as to what types of interactions should be routed to which DN. A DN may include one or more telephone numbers, cell phone numbers, an e-mail address, a virtual number for an automated system, an IP address and still other location identifications. One to many relationships between place **1102** and agent login **1103** are possible. Similarly, one to many relationships between agent login **1103** and CfgDn **1104** are possible.

CfgSwitch **1106** configures the acting telephony switch or switches practicing the present invention. This process uses a special KW gateway. CFGKWGateway enables the switch to differentiate KW telephony traffic from regular contact-center and other normal traffic. Switches with or without CTI links are configured if they are involved in KW interaction routing. CfgApplication **1107** is used to configure KWP software at the remote location. This configuration process includes configuring KW T-Server and KW desktop software. CME provides data sync methods for data synchronization, data transformation between customer main and central storage facilities and data transfer between directories by LDAP or preferably through XML and XSLT import/export mechanisms.

FIG. **12** is a data model for presenting an active knowledge worker state. The model of this example presents the various agent states that are implemented by KW T-Server **904** described with reference to FIG. **10** above. The basic reportable states are Agent Login, Agent Logout, Agent Ready, and Agent Not Ready. This model is the basic agent model for standard CTI- T-Server implementation as would be the case inside contact center **300** described with reference to FIG. **3**. Hence the term agent can be replaced with the more appropriate term knowledge worker for remote implementation. The arrows represent all possible associations in the model. One with skill in the art will recognize that this is a basic example and that other reportable knowledge worker states may also be represented in this model. Similarly, this model may be applied to different types of interaction media including telephone interaction without departing from the spirit and scope of the invention.

FIG. **13** is a process flow diagram illustrating the sequence of a successful internal call. At step **1300** a KW initiates an internal call to another KW. This action can occur from a KW telephone or from a KW computing platform analogous to telephone **312** and desktop **311** of station **310** described with reference to FIG. **3**. At step **1301**, a KW T-Server analogous to processor **305** described with reference to FIG. **3** receives notification of the initiated call and sends a preview interaction message (PIM) to the destination KW. The PIM is forwarded before the call is dialed and gives the second KW a chance to decide whether or not he will accept the call based on the PIM data.

At step **1302**, KW-**2** receives and, in this case accepts the PIM from the KW T-Server. A dotted return arrow illustrates an acceptance response forwarded back to the T-Server. At step **1303**, the T-Server dials the DN specified in the call initiation event. A notification of a dialing event (broken return arrow labeled Event Dialing) displays on the caller's

computer platform or is activated on the caller's telephone with respect to KW of step **1300**. There are many indication possibilities for a dialing event. A ringing event is also established by the T-Server at the computer platform or telephone of KW-**2** as illustrated by the broken arrow labeled Ringing. At this particular moment it happens that KW-**2** is on a current call. A pre-defined time period may be established for the ringing event so that KW-**2** may, during that time, terminate the previous call and pick up.

At step **1304**, KW-**2** picks up the call. Detecting the pick up at step **1305**, the KW T-Server establishes the connection between the KW of step **1300** and KW-**2** of step **1304** as indicated by broken arrows. It will be apparent to one with skill in the art that there may be variations in this process for a successful internal call between 2 KWs without departing from the spirit and scope of the invention. Variations in the flow are dependant on actual events. For example, in the case that KW-**2** could not terminate the previous call to pick up the initiated event before a sever timeout has occurred, a notification of not ready could be returned to the initiating KW. Similarly, KW-**2** could opt to reject the call before it is made by rejection the PIM request.

FIG. **14** is a process flow diagram illustrating a variation of the sequence of FIG. **13** with a forced answer. In this example, steps **1400**-**1403** are identical to steps **1300**-**1303** described with reference to FIG. **13** above. Therefore, the same description given in the example above applies to steps **1400**-**1403** of this example as well.

At step **1404**, there is a forced server time out indicating a forced answer mode. At step **1405**, a ringing event is established at the station of KW-**2** audible over telephone or audible and perhaps visible on the computing platform of KW-**2**. At step **1406** then, KW T-Server establishes connection for the dialed event. It is noted herein that event connection first connects the initiating party and then the receiving party as indicated by broken arrows A and B.

FIG. **15** is a process flow diagram illustrating the sequence of a failed internal call. At step **1500** a KW initiates a call to another KW as described with reference to the previous 2 examples. At step **1501**, the KW T-Server sends a PIM request to the second KW (KW-**2**). However, upon reviewing the request, KW-**2** decides not to accept the call and rejects the PIM in step **1502** as illustrated by a broken return arrow. The result of this action is that in step **1503**, the KW T-Server returns an error message or notification to the initiating KW. It is noted herein that notification messages can take the form of a wide variety of media such as Voice over Internet Protocol (VoIP), IVR response, e-mail response, and son dependant upon media type and equipment.

FIG. **16** is a process flow diagram illustrating the sequence of an internal call with a forced timeout before PIM decision according to an embodiment of the invention. Steps **1600** and **1601** are identical to the first 2 steps of the previous examples. However, at step **1602** a forced server timeout occurs before KW-**2** responds to the PIM request sent in step **1601**.

At step **1603** the KW T-Server sends a timeout error notice to the initiating KW. In the meantime, the PIM request sent to KW-**2** is still alive and pending. At step **1604** after the timeout occurs, KW-**2** receives the PIM request and determines whether to accept or reject the call. If in step **1604** KW-**2** accepts the request, then at step **1606** KW T-Server dials the DN number and subsequent steps for dial notification, ringing event notification and connection establishment occur as with a successful internal call. However, if KW-**2** rejects the call event at step **1604**, then at step **1605** KW T-Server sends an error notification back to the initiating KW as indicated by the broken return arrow.

FIG. **17** is a process flow diagram illustrating the sequence of a successful external call according to an embodiment of the invention. At step **1700** a center agent initiates a call to a remote KW. Initiation of the call can take place from the agent telephone or from the agent desktop analogous to telephone **321** and desktop **320** in workplace **319** of center **300** described with reference to FIG. **3**. At step **1701** the desktop T Server opens a connection to a first local router or router **1**. It is noted herein that the T-server implement may be in the agent desktop itself or it may be in a premise T Server processor accessible to the agent.

At step **1702** the first router local to the agent sends a request to a second router local to the KW to get an access number or DN. At step **1703** the second router forwards the request to the KW T-Server hosting the agent. It is assumed in this example that the KW in question is logged in. Otherwise, an error message (KW not available) would be returned to the initiating agent.

At step **1704** the KW T-Server sends a PIM to the KW having the requested access number or DN. The KW is now aware of the impending incoming call and can decide whether to accept or reject the call. In this case, the KW that will receive the call accepts the PIM request as indicated by the associated block below block **1704**. At step **1705** KW T-Server requests call data from the second router. In the meantime, at step **1706** the second router gives the access number to the first router local to the agent.

At step **1707** the first router sends a call request to the premise T-Server. At step **1708** the premise T-Server extends the call request to the premise switch. At step **1709** the switch dials the associated DN and notifies the premise T Server in the first phase of dialing. At step **1710** the premise T-Server notifies the first router of the DN in phase 2 of dialing. At step **1711** the first router notifies the agent desktop of the dialing (phase 3). This manifestation may occur on the agent telephone, desktop or both.

At step **1712** the KW T-Server establishes a ringing event at the second router local to the KW in a first phase of ring notification. At step **1713** the second router establishes the ringing event at the KW station, for example, on the telephone or desktop or both. At step **1714** the connection is established between router **1** and router **2**. A t step **1715**, the connection is extended from router **1** to the calling agent. It is assumed in this example that the connection is a COST connection, however DNT interactions are similarly routed according to CTI rules.

It will be apparent to one with skill in the art that the steps described in this example may vary in number and order without departing from the spirit and scope of the present invention. For example, it may be that there are more than 2 routers involved in the connection path of the call. Similarly, server timeouts, agent availability, queuing requirements, and so on can change the nature and order of the described steps. The inventor intends that the presented example illustrate just one example of an external incoming call sourced from a center agent and destined to a remote knowledge worker according to a preferred embodiment.

FIG. **18** is a process flow diagram of a failed external call according to an embodiment of the present invention. Steps **1800** through **1804** are identical to steps **1700** through **1704** described with reference to FIG. **17** above for a successful external call from a center agent to a remote KW.

At step **1805** however, the KW decides not to accept the pending call and return a rejection response. At step **1806** the KW T-Server sends a data request to R-**2** for call data. At

step **1807** R-**2** sends an error message to KW T-Server because of absence of call data due to KW rejection of PIM request. At step **1808** R-**2** returns an error message to R-**1** local to the agent regarding the earlier request for access number at step **1802**. At step **1809** R-**1** sends an error message to the agent station as indicated by a broken arrow. The error message may be that at this time KW John in not available due to current load or duties. The fact that KW decided not to take the incoming call from the agent can be expressed in a variety of syntax. Perhaps the agent could elect to receive a call back from the KW at a more advantageous time or perhaps the agent can be prompted to place the call again at a latter time period.

It will be apparent to one with skill in the art that remote call control is possible and practical using the method of the present invention without a functioning CTI link provided between the center and the local switch closest to the KW center or other remote KWs. Incoming calls can be routed to any remote KW with a connection to the KW T-Server according to availability, skill level, and so on. In a preferred embodiment intelligent routing of events to remote KWs can be made at the premise of the communication center or at network level. In the case of network level routing, a network T Server must be provided to enhance the involved network level switch or switches.

If all KWs are, for some reason, unavailable at the time of a call attempt, then IVR functionality can be utilized to prompt the caller to leave a number for a return call. In this embodiment, premise T-Server function enables outbound dialing and connection when it is determined that a KW becomes available to take calls. In one embodiment ISCC protocol enables a center agent engaged in a call to transfer the connection to a remote KW with data attached to the event. XML-based data and XSLT transformation capability renders the attached data into the desired format for dissemination at the KWs end device whether it is a voice only device or a display-capable/voice capable device, or even a display only device.

In another embodiment, the service-provider infrastructure (center) can partially monitor independent interactions through network signaling such as D-channel pinging, OSIG, or call progress detection mechanisms.

The method and apparatus of the present invention should be afforded the broadest scope in view of the many possible applications, many of which have been detailed above. The spirit and scope of the present invention is limited only by the claims that follow.

What is claimed is:

1. A network system for managing remote agents of a communication center comprising:

a primary server connected to the network, the primary server controlling at least one routing point used by the communication center;

one or more secondary servers distributed on the network and accessible to the agents, the secondary server or servers having data access to agent computing platforms and communication peripherals; and

a software suite distributed in part to the secondary server or servers and in part to one or more agents computing platforms and peripherals, the software suite including protocol for reporting agent status data;

characterized in that the agent's computing platforms and peripherals are monitored for activity state by the one or more secondary servers whereupon the one or more secondary servers exchange control messaging and event related data using **[**ISCC**]** protocols with the primary server over the network, the primary server recognizing **[**CTI**]** *computer-telephony integrated* (*CTI*) protocol equivalents for the messaging for the purpose of intelligently routing events incoming to or otherwise communicatively involving the remote agents.

2. The system of claim **1** wherein the network is an Internet network and the routing point is one of or a combination of a telephony switch, a service control point, and an Internet Protocol Router.

3. The system of claim **1** wherein the remote agents are grouped together in a central facility.

4. The system of claim **1** wherein the remote agents are distributed over a home network.

5. The system of claim **1** wherein the remote agents are mobile and wirelessly connected to the one or more secondary servers.

6. The system of claim **1** wherein the agent's computing platforms and peripherals are one of or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device.

7. The system of claim **1** wherein the remote agents are specialized knowledge workers offering service not available within the communication center.

8. The system of claim **1** wherein the software suite is an extension of a CTI software suite used in the communication center, the extended portion for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center, *wherein the parameterizing includes formatting messaging and event-related data into a format useable on the agent computing platforms*.

9. The system of claim **1** wherein control messaging and event related data exchanged between the primary server and the one or more secondary servers is formatted using Extensible Markup Language.

10. The system of claim **9** wherein Extensible Style sheet Language Transformation is used to transform the Extensible Markup Language files into formats useable on the computing platforms of the remote agents.

11. The system of claim **10** wherein the useable formats include HTML, HDML, WAP, and WML.

12. The system of claim **1** wherein a CTI-enhanced Interactive Voice Response system is used to exchange data with a remote agent receiving calls on an analog telephone in the event that the agent does not have access to a computing platform connected to the telephone and the one or more secondary servers.

13. The system of claim **1** wherein the remote agents establish one or more destination numbers for receiving events, the destination numbers to be set in the CTI environment for the period that the agent is logged into the system.

14. The system of claim **13** wherein the destination numbers include one or a combination of telephone numbers, fax numbers, Internet Protocol addresses, e-mail addresses, universal resource locators, and pager numbers.

15. A *system comprising:*

a plurality of computer devices hosting a software suite for managing remote agents of a communication center, *the software suite* comprising:

a client portion including a contact navigation application, a contact extension application, and a code library; and

a server application including a transaction management application, an agent specific application, and an **[**ISCC**]** application program interface;

characterized in that the client portion specifies functionality and reports state information of the remote agent to the server application, whereupon the server application reports same under [ISCC] *a* protocol to a communication-center suite for routing purposes and wherein the communication-center suite provides event-related data under [ISCC] *the* protocol to the server application, which in turn transforms the data into data formats usable on various communication devices of the remote agent.

16. The software suite of claim **15** wherein the remote agents are part of a communication center network, the server portion functioning as the network access and agent monitoring point for the remote agents.

17. The software suite of claim **15** wherein the communication network includes the Internet network and the public switched telephony network.

18. The software suite of claim **15** wherein the remote agents are grouped together in a central facility.

19. The software suite of claim **15** wherein the remote agents are distributed over a home network.

20. The software suite of claim **15** wherein the remote agents are mobile and wirelessly connected to the one or more secondary servers.

21. The software suite of claim **15** wherein the client portion resides on one or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device.

22. The software suite of claim **15** wherein the remote agents are specialized knowledge workers offering service not available within the communication center.

23. The software suite of claim **15** wherein the software suite is an extension of a CTI software suite used in the communication center, the extended portion for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center, *wherein the parameterizing includes formatting messaging and event-related data to and from the software suite into a format useable on the agent computing platforms*.

24. The software suite of claim **15** wherein the [ISCC] protocols include Extensible Markup Language used to format messaging and event-related data.

25. The software suite of claim **24** wherein Extensible Style sheet Language Transformation is used to transform the Extensible Markup Language files into formats useable on the computing platforms of the remote agents.

26. The software suite of claim **25** wherein the useable formats include HTML, HDML, WAP, and WML.

27. The software suite of claim **15** wherein the remote agents establish one or more destination numbers for receiving events on the various communication devices, the destination numbers to be set in the CTI environment for the period that the agent is logged into the system providing the software.

28. The software suite of claim **27** wherein the destination numbers include one or a combination of telephone numbers, fax numbers, Internet Protocol addresses, e-mail addresses, universal resource locators, and pager numbers.

29. A method for managing information about remote agents of a communication center for the purpose of intelligently routing events involving those agents comprising steps of:

(a) providing a software suite accessible to the agents for parameterizing and enabling additional services and communication apparatus generic to the remote agents but not available within the center[:], *wherein the parameterizing includes formatting messaging and event-related data into a format useable on the computing platforms of the remote agents, wherein the additional services are services provided by the remote agents, and wherein the enabling of the addition services includes:*

(b) providing a network link between the software suite and [CTI] *computer-telephony integrated* (*CTI*) software of the communication center; and

(c) routing communication events involving the remote agents according to state and other information about the agents provided by and through the software suite.

30. The method of claim **29** wherein in step (a) the agents are accessible to the communication center through a combination of the Internet network and the public switched telephony network.

31. The method of claim **29** wherein in step (a) the software suite comprises a server portion and a client portion.

32. The method of claim **29** wherein in step (a) the agents are knowledge workers offering service not available from agents within the communication center.

33. The method of claim **29** wherein in step (a) communication apparatus includes one or a combination of a desktop computer, a lap top computer, a personal digital assistant, a cellular telephone, an Internet Protocol telephone and a paging device.

34. The method of claim **29** wherein in step (a) the software suite may be configured and updated from the communication center.

35. The method of claim **29** wherein in step (b) the network link supports [ISCC] *a flexible interconnecting* protocol.

36. The method of claim **35** wherein the [ISCC] protocol includes Extensible Markup Language and Extensible Style Sheet Transformation Language.

37. The method of claim **29** wherein the client portion resides on one or more of the communication apparatus and the server portion resides on a server accessible to the one or more communication apparatus via a network link.

38. The method of claim **29** wherein in step (c) state information includes ready, not ready, logged in, logged out, and on call.

39. The method of claim **29** wherein in step (c) other information includes skill level, registered destination numbers, and communication device type and platform.

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