Convergence Between Public Switching and the Internet

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ABSTRACT In recent years the Internet has developed into a global data network that is highly accepted as a multimedia information platform which has the potential to develop into an alternative carrier network in the future. Telecom operators increasingly act as Internet service providers to maximize network utilization, to attract or retain customers, and to generate additional revenue. To leverage their installed base in the PSTN/ISDN the optimal strategy for telco ISPs is the integration of their point of presence into the central office: packetizing and grooming of IP traffic in the local office relieves load on the PSTN/ISDN trunk network, resolves existing bottlenecks due to Internet traffic upstream of the CO, and creates new opportunities for revenue-generating features for both telephony and Internet subscribers. This article intends to show that current telecommunication network elements can be upgraded with innovate cutting-edge technology to build a solid basis for a seamless multimedia network of tomorrow, thereby enabling telecom operators' and service providers' tremendous investment in existing network infrastructure to be fully utilized. An integrated Internet services platform is presented which turns the CO switch into an optimized link between the PSTN/ISDN and the Internet. Technically, it is proposed that the central office be expanded with an integrated Internet PoP (IPOP) configured from the following IP components: an internal high-speed data backbone (ATM or Ethernet); modem pools to terminate dial-in calls from analog modems using the PPP protocol; protocol handlers for UDP, TCP, IP, and lower-layer data protocols (X.25, frame relay, SMDS, etc.); access to data networks; IP router, RADIUS server, and name server database; a contents server (optionally), enabling telco ISPs to become content providers. This effectively turns the CO into an Internet access point that integrates smoothly into the existing telco OA&M/TMN. Investment in additional hardware is minimized, and the existing subscriber line and network infrastructure is completely reused. The IP functions integrated in the IPOP can interwork closely with PSTN/ISDN call processing. This is a prerequisite for the creation of new revenue-generating features such as supplementary PSTN/ISDN services for Internet calls, voice over IP, IP-activated dialing, and value-added Internet services (on-screen call-waiting indication, near-real-time bill viewing, etc.). As the demand for high-bandwidth subscriber access increases, existing line concentrators can be upgraded with wideband line cards. High-bandwidth IP traffic may be groomed in the concentrator and multiplexed directly on the high-speed (ATM, Ethernet) backbone network. The great benefit of an integrated approach is that the evolution from lower to higher bandwidth is smooth and as the market requires, thus guaranteeing the balance between necessary investment and revenue. This integrated approach is illustrated in this article by means of a concrete example using a state-of-the-art CO switch.

This article is organized into five sections as follows: In the introduction the impact of the Internet on the traditional public switched telephone network (PSTN)/integrated services digital network (ISDN) telecommunication networks is analyzed; resulting opportunities are identified from the market, network, and telecom operator perspective.

The second section presents the extension of the central office with an integrated Internet platform as an optimal strategy for telecom operators extending their business by acting as Internet service providers (telco ISP). This approach leverages the telco's existing telecommunication infrastructure and enables a convergence between public switching and the Internet. The technical concept is detailed, presenting the host central office (CO) architecture and the evolution strategy for wideband subscriber access using digital subscriber line (xDSL) and ISDN technology.

The third section demonstrates new revenue-generating features for both the PSTN/ISDN subscriber and the Internet user created on the basis of the integrated Internet platform.

The fourth section shows how the integrated Internet platform can add value with offering the service "voice over Internet" by a telco ISP.

The fifth section draws the conclusions from the presented approach.

Market Perspective: Converging the PSTN/ISDN and the Internet

In recent years the Internet has developed to become a global data network which attracts numerous users, especially with the variety of information and multimedia applications offered online. The growth of Internet/online users worldwide is illustrated in Fig. 1. Although still in its infancy with regard to reliability and guaranteed grade of service, the Internet is highly accepted as an information platform by users and information content providers alike. The high investments being made in the Internet by the computer industry, network carriers, and service providers may prove that the Internet will meet the expectations for exponential growth predicted by analysts and boosted performance claimed by the Internet industry.

Today the user's highway to the Internet is the PSTN/ISDN. The vast majority of Internet end users gain access to the medium of Internet from their PSTN/ ISDN subscriber lines, using either analog modems or ISDN cards to set up data calls. Internet services providers (ISPs) connect their modem pools to PSTN/ISDN subscriber lines. Marketing research shows that currently 97 percent of the 35 million Internet ports consist of analog modem (32 million) and ISDN (2 million) ports. These ports carry Internet traffic on narrowband switches. By the year 2000, according to our estimates, 83 percent of the then 133 million Internet ports still consist of analog modem (86 million) and ISDN technology (24 million). An additional 8 persent will consist of asynchronous DSL (ADSL) ports (10 million). Again, over 90 percent of Internet traffic will be carried by the PSTN/ISDN.

The PSTN/ISDN network is the largest telecommunication network worldwide, interconnecting about one-sixth of the world population by the year 2000. It represents an immense investment into infrastructure and carries all channel-switched

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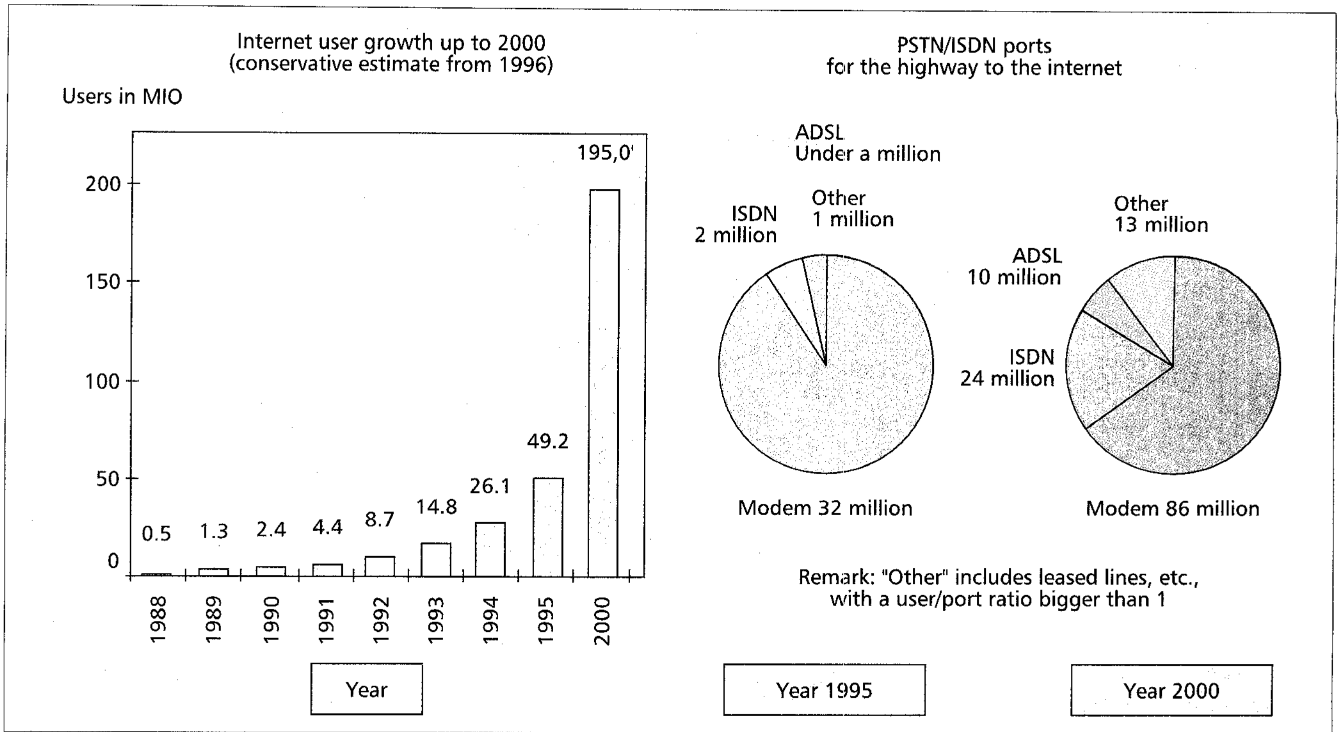


Figure 1. *Worldwide growth of Internet/online subscribers.*

public and substantial corporate voice and data traffic. With its nonstop processing network nodes PSTN/ISDN provides seamless intelligent services spanning the globe with extremely high reliability and grade of service.

Telecom operators (telcos) have a clear interest in leveraging this tremendous investment for the Internet. Consequently a solution is required that enables a seamless migration to the network of tomorrow and best fits the telecommunications market's requirements to evolve the present telecom network infrastructure. This future type of network will achieve true convergence by integrating the services offered by the "classical" network types, such as the PSTN/ISDN and public land mobile network (PLMN), with the Internet. Thus, it will be possible to benefit from the merits and innovations of all types of presently separated networks.

This article shows that by innovation with cutting-edge technology the present telecommunications network can build the solid basis for a seamless converged multimedia services network of tomorrow.

Network Perspective: Issues, Risks, and Opportunities

The principle structure of accessing the Internet from the PSTN/ISDN is shown in Fig. 2. PSTN/Internet gateways — points of presence (POPs) — are usually connected to selected narrowband switches by ISDN primary rate interfaces (PRIs) or by analog or ISDN basic access lines. The POP consists of dial-in modem pools and an IP router.

Due to high Erlang values of circuit-switched calls in the PSTN/ISDN network, three critical points in the transportation of packetized data traffic have been identified (Fig. 2):

- Connection of a POP over the concentration stage of the

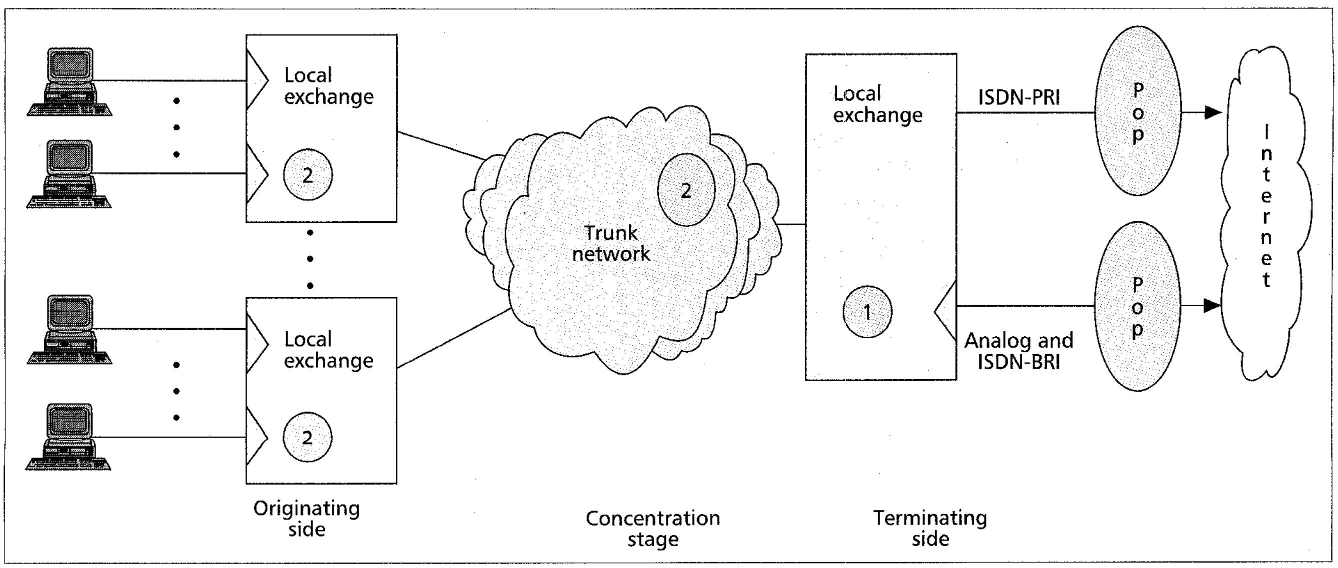
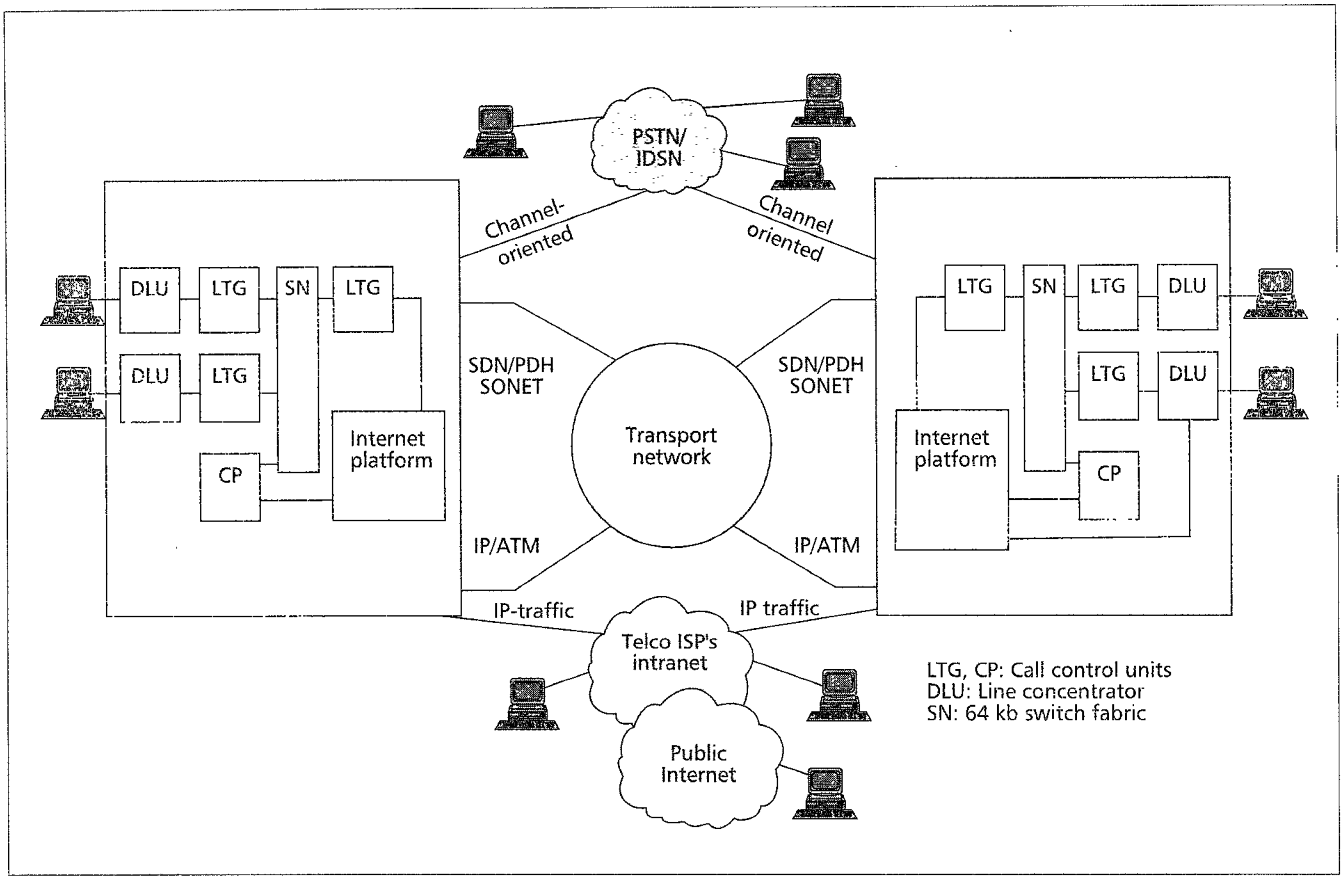
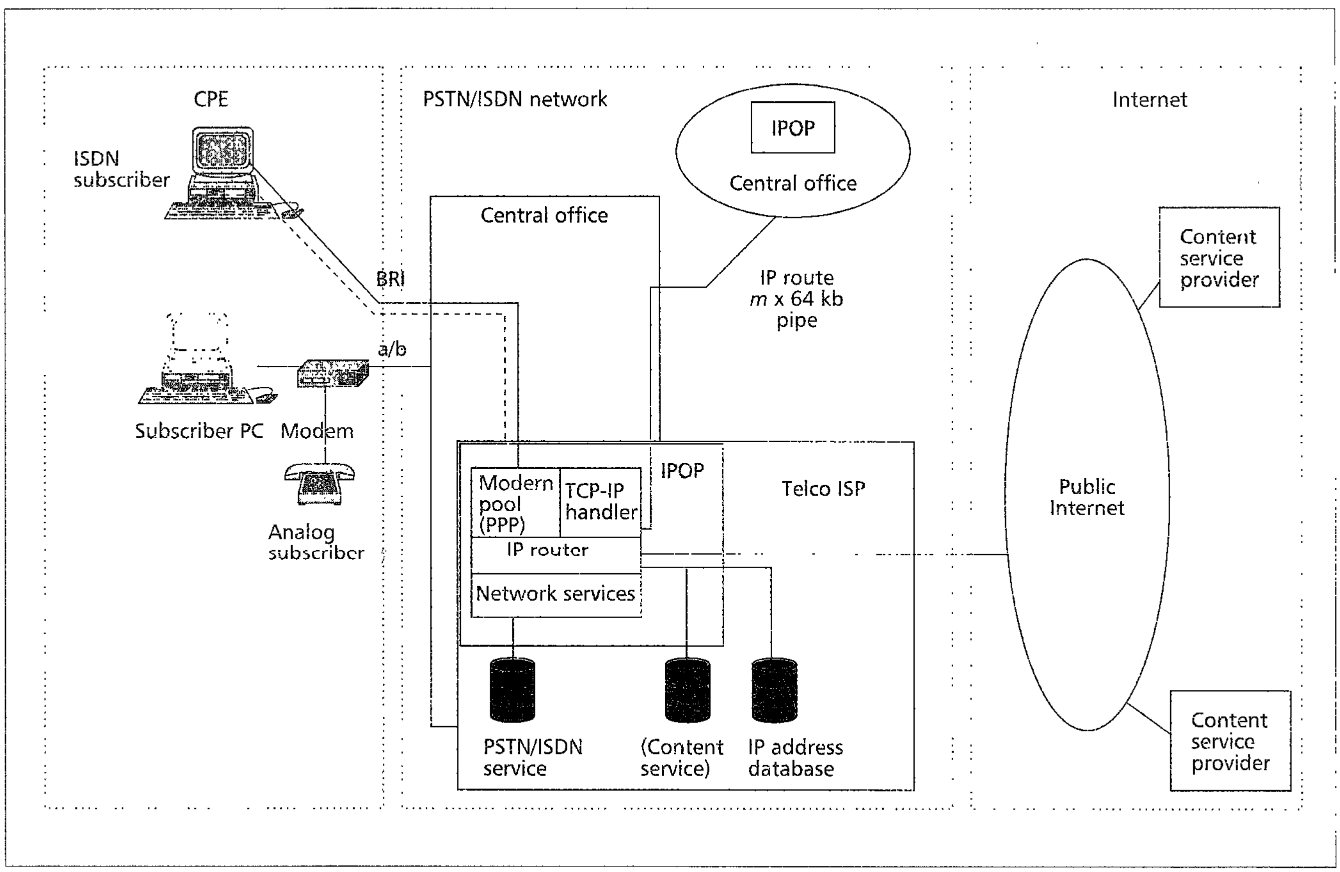


Figure 2. *The general structure of Internet access today.*



■ **Figure 3.** *Converged PSTN/ISDN and Internet network.*



■ **Figure 4.** *Central office innovation with integrated Internet POP.*

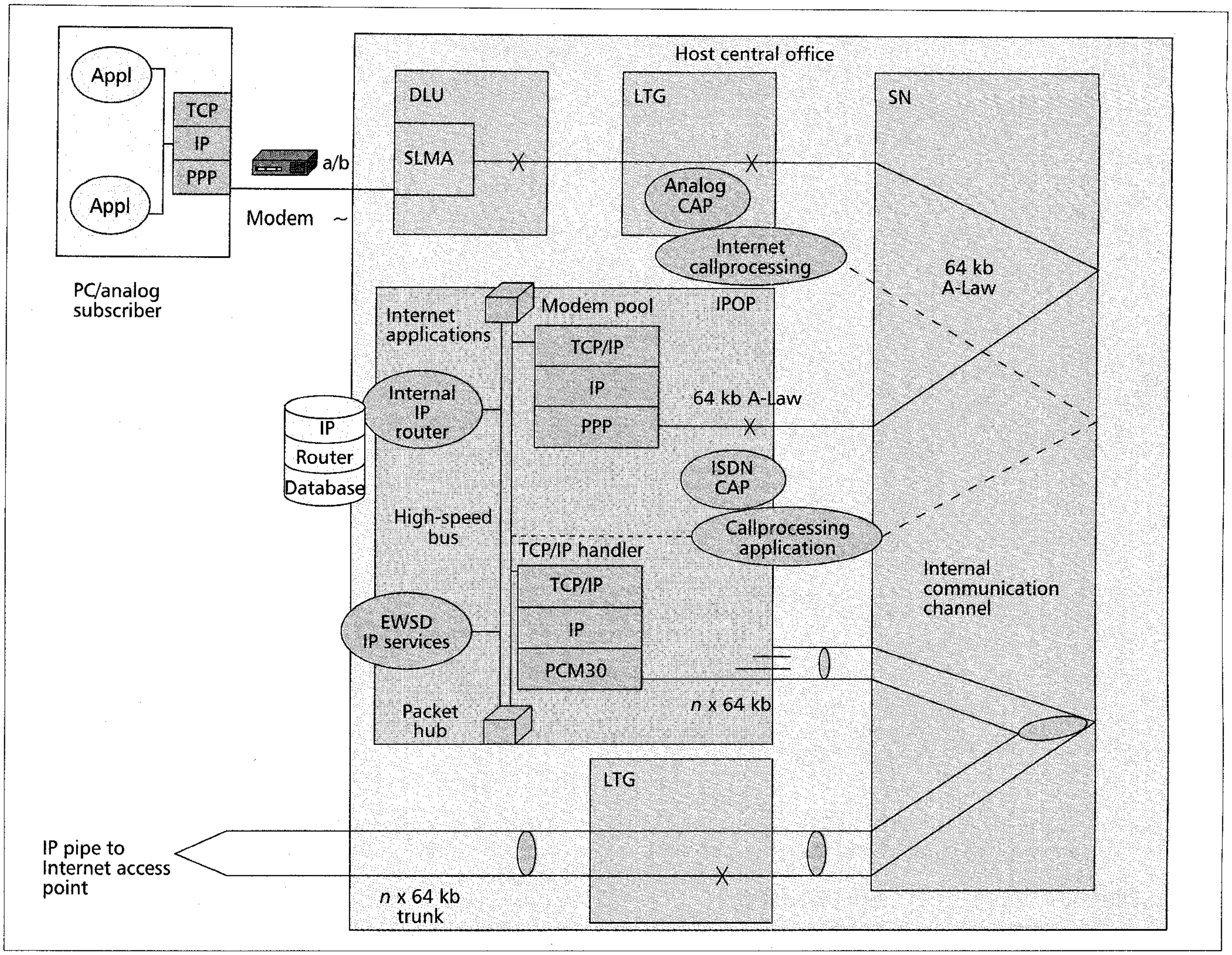


Figure 5. *CO: Internet POP (IPOP) — basic components.*

local exchange (LE): This method may lead to congestion in the concentration stage at the terminating side due to high-volume POP traffic.

- High penetration of Internet users at the concentration stage of the LE: A high penetration (> 15 percent) of Internet users on a fully loaded concentration stage may lead to congestion at the originating side.
- Performance degradation in the trunk network, due to long holding times of subscribers logged into the Internet (average 20 min compared to 3 min for normal calls) violate the classical rules for network dimensioning.

High penetrations of Internet access lines may also result in serious degradation of PSTN/ISDN user services and substantial loss of PSTN/ISDN operator revenue due to:

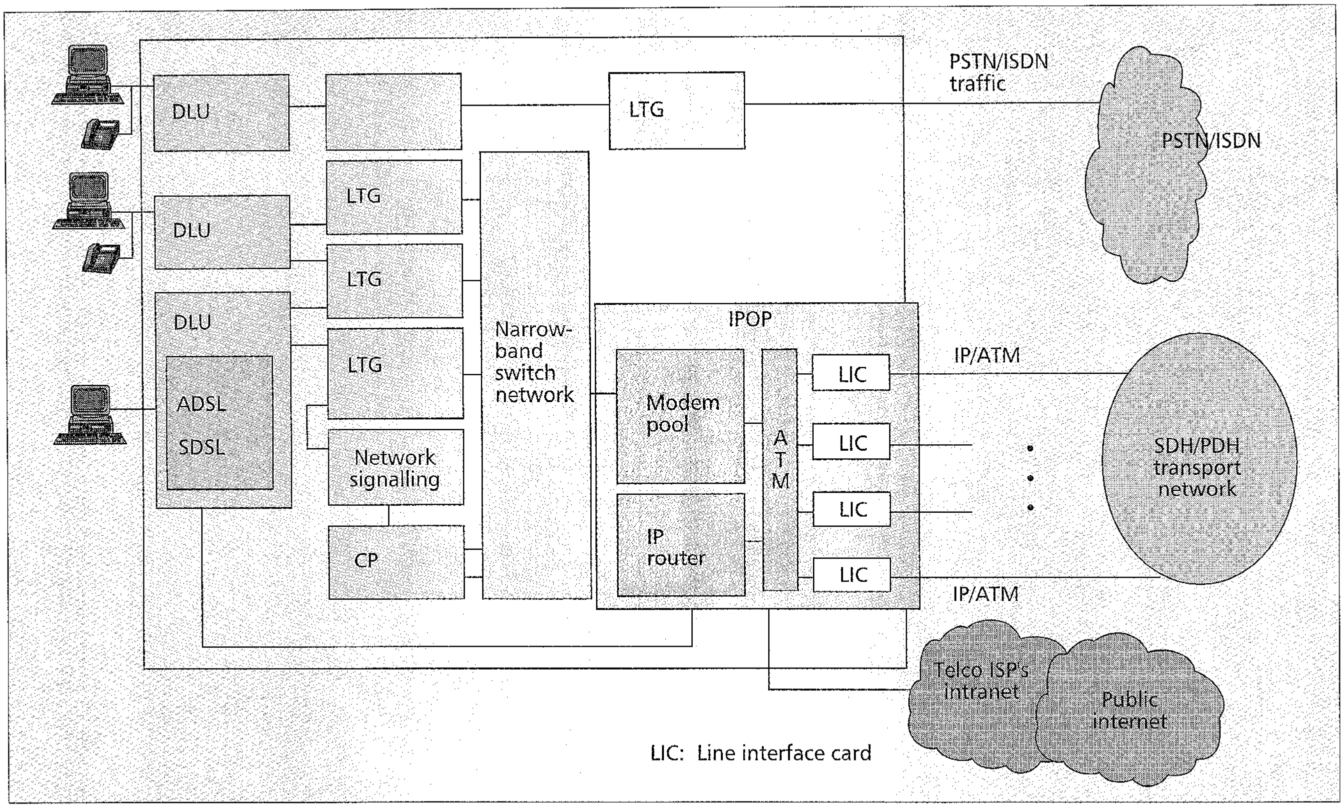
- Lost calls to subscribers who are busy due to Internet usage
- Long holding times at flat rate and cross-subsidized local tariffs
- Local calls pushing away profitable long distance and international calls
- Market demand for reduced tariffs for access to online services at nonflat rates, because PSTN/ISDN does not add value
- Migration of PSTN/ISDN services into the Internet, for example, fax replaced by e-mail and voice telephony potentially replaced by low-quality voice over IP
- Supplementary services provided by the CO being challenged by services in the intelligent terminal through computer telephony integration (CTI)

These impacts may become more pronounced in the future as the Internet matures to provide services with guaranteed grade of service, for example, voice and video over IP based on resource-reserving IP protocol enhancements (Resource Reservation Protocol, RSVP, and IPv6). This may eventually turn the Internet into an alternative carrier network, challenging today's PSTN/ISDN operators' business by diverting substantial high-revenue traffic away from the PSTN.

For the PSTN/ISDN operator there are two basic strategies to counteract these risks to his network and his business: either using external xDSL devices to divert the Internet traffic into a data network before it hits the PSTN/ISDN CO, or controlling Internet traffic in the CO as part of PSTN/ISDN traffic in an optimized manner.

Clearly the first option runs the risk of either installing an IP overlay network with all the consequences (new infrastructure; separate operations administration, and maintenance, OA&M; billing; etc.) or handing over direct control of the subscriber line to an Internet access provider (e.g., a cable network operator). As the Internet potentially develops into a full-service network, this may imply the complete loss of the subscriber, except possibly for low-revenue POTS service.

The second option, besides ensuring direct control of the subscriber line, enables the PSTN/ISDN operator to reuse and leverage his installed infrastructure to offer online services. This approach creates the opportunity for the PSTN/ISDN operator to become an ISP (telco ISP), so the operator can not only save and extend his existing customer base but gain additional



■ **Figure 6.** *Central office with integrated Internet platform.*

revenue from new value-adding subscriber services that can be created by interworking PSTN/ISDN and Internet technology.

OPERATOR PERSPECTIVE: TELCOS BECOMING INTERNET SERVICE PROVIDERS

The market trend clearly shows that telecom operators increasingly act as ISPs, taking advantage of the opportunities discussed above. Typically telco ISPs install their own IP-based Intranets that serve their installed PSTN/ISDN customers to access the Internet and build a basis on which telco ISPs progressively roll out online services.

The requirements of telco ISPs are expected to be oriented on a seamless integration of Internet infrastructure and services into their existing business with regard to system acquisition, operation and maintenance, and service deployment. To guarantee the level of grade of service and reliability that can differentiate the telco ISPs' Intranets from the competition on the ISP market, telco ISPs need proven technology. Therefore, an integrated approach of a public switch supplier may in particular satisfy this requirement. To meet the needs of the telco ISPs with respect to a demand-driven business rollout, flexible, scalable, and cost-effective solutions are required.

In response to these demanding requirements the integration of an IPOP in a central office switch is proposed. This CO internode fully implements the integrated services platform required by a telecom operator in order to establish his PoP right in the local exchange and to provide firsthand Internet services to his customers (see Fig. 3 for the proposed network configuration).

STRUCTURE OF THE INTEGRATED INTERNET PLATFORM

The integration of a POP into the CO is shown in Fig. 4. Integrating an Internet PoP into the CO technically means that the CO is extended by implementing the components required to handle IP traffic on the high-performance switch platform:

- An internal high-speed data backbone (asynchronous transfer mode, ATM, or Ethernet)
- Modem pools to terminate dial-in calls from analog modems using Point-to-Point Protocol (PPP)
- User Datagram Protocol (UDP), Transmission Control Protocol (TCP), IP handler, and lower-layer data protocol (X.25; frame relay; switched multimegabit data service, SMDS; ATM; etc.) access to the data network
- IP router and IP routing database
- RADIUS and accounting server functionality for remote access services (RAS)
- Contents server, if the telco ISP chooses to provide its own content

For the telco ISP the optimal strategy is to integrate the POP with the CO: packetizing and grooming of IP traffic in the local office offloads the PSTN/ISDN trunk network and resolves existing bottlenecks due to Internet traffic upstream from the CO. As an additional benefit, interworking of PSTN/ISDN supplementary services with Internet calls and Internet value-added services (e.g., on-screen call waiting indication, near-real-time bill viewing) can be implemented based on the installed POP equipment within the switch environment.

STRUCTURE OF A CO INTEGRATED INTERWORKING UNIT

The system configuration of a CO with an integrated IPOP may be seen in Fig. 5. To facilitate interworking between Internet and PSTN/ISDN calls, software subsystems are added to the CO call processing and IP processing in the IPOP communicating with the appropriate signaling interface.

Based on the integration of an IPOP in the switch, interworking between the CO call control and a PC/analog subscriber (characterized by his IP address) can be realized: for subscribers communicating via IP with an Internet access point, the main tasks of the IPOP are to terminate the modem protocol of an analog subscriber, and perform user authentifi-

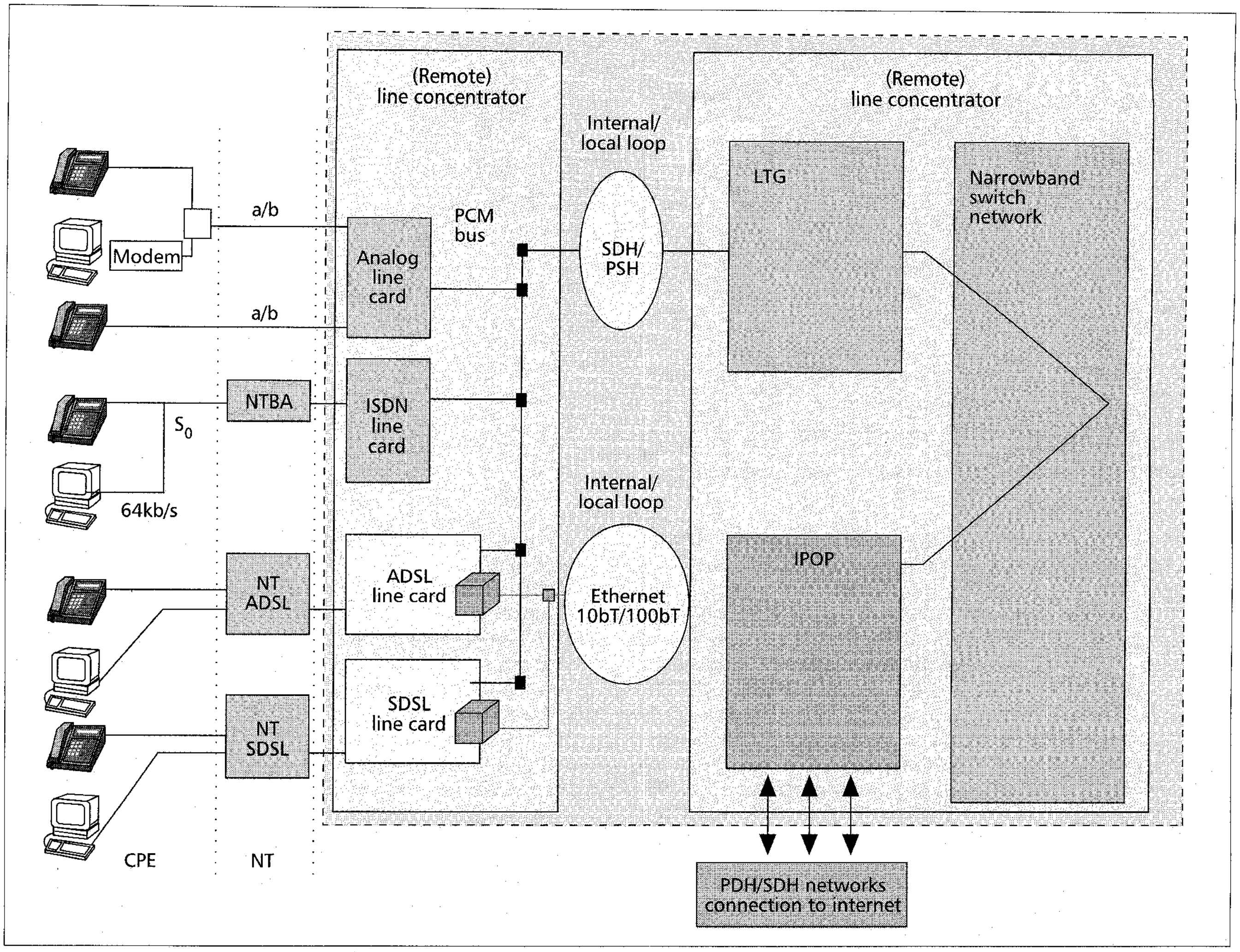


Figure 7. *Integrated broadband access — system architecture.*

cation and IP edge routing. The IPOP includes call processing application software that is able to send and receive IP packets from the internal router. On the other hand, this application communicates with a core-switch Internet call processing application via an internal communication protocol.

For the communication between the switch and the analog Internet subscriber, the IP address assigned to the subscriber during Internet logon is stored within the switch, related to the E.164 number. This address reference is the basis on which all PSTN/ISDN and Internet interworking features can be built: when a message to the subscriber has to be sent, it is transported via the internal communication channel to the IPOP, translated into an IP packet, and routed to the IP address of the appropriate subscriber (using the UDP or TCP/IP/PPP stack).

The same messaging mechanism is used in the other direction, to send information from an Internet subscriber or Internet server to the CO switch.

To avoid overloading or blocking in the CO due to long holding times and high traffic volume, it is first a prerequisite that the concentrator stage itself does not strongly concentrate high-volume traffic, and second that the switching network of the host CO is able to switch high traffic volumes, therefore requiring larger switch fabrics.

The data connection to the external Internet is done by TCP/IP reusing bandwidth in the PSTN/ISDN transport network. As an example this can be either frame relay over PCM30, which is transported via n x 64kb/s nailed-up connections to a concentrating Internet access point, or direct access to a broadband backbone network such as synchronous optical network/synchronous digital hierarchy (SONET/SDH)) carrying high-bit-rate IP data traffic over ATM.

As a potential evolution strategy the IPOP components can be distributed on the CO core system platform (Fig. 6):

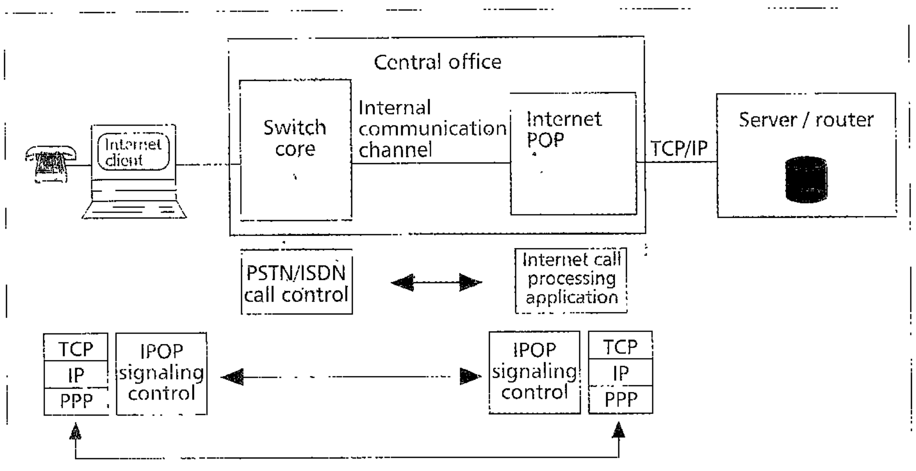
- The analog modem moves to a new type of Internet line card.
- The IP name server moves to an exchange database processor platform.
- The IP protocol handler and router move to the protocol handler platform.
- The Internet interface moves to a high-bandwidth switch fabric (ATM transport layer).

The benefits of integrating the IPOP into the CO are significant:

- Integration of POP facilitates network management through existing CO OA&M.
- Bottlenecks on the network and ISP access levels are resolved.
- The modem pool can be integrated into a remote concentrator (based on a remote switching unit). This also enables the provisioning of wideband subscriber line cards (see the next subsection).

PSTN/ISDN operators can provide new subscriber features based on Internet technology and offer ISP-based features supporting Internet access (see the third section); offering voice service over Internet is facilitated (see fourth section).

Telco ISP requirements for PSTN/ISDN subscriber access to the Internet will be market-driven: for the mass market



■ **Figure 8.** *Communications between the switch and an Internet client.*

low-cost products with bandwidth up to 128 kb/s will be adequate, while for the high-end market where new services demand for connectivity (holding times) and higher-bandwidth new technologies (e.g., ADSL/xDSL) are required.

As demand for high-bandwidth subscriber access arises, this need is addressed by the development of a high-bandwidth Internet line card taking into account ADSL technology, multistandard fast modems (MSFMs) (Eureka study MEDEA), and ISDN enhancements for higher bandwidth. High-bandwidth IP traffic will be groomed in the (remote) line concentrator and multiplexed on the high-speed (ATM, Ethernet) CO backbone. Figure 7 shows details of the (remote) line concentrator in a CO switch with wideband access to the integrated Internet platform.

Circuit-switched telephony connections are still routed via the line concentrator and the narrowband switch fabric. The split IP traffic from the analog/ISDN line cards and from the new ADSL/xDSL Internet line card (SLMI) is transported on a wideband Ethernet or ATM backbone network within the CO. Line status handling, call handling, and charging are fully integrated into the CO call control processing. The SLMI has the following features:

- Provides an interface for >1 Mb/s, extendible for a distance of at least 4000 m
- Handles both channelized and packetized traffic
- Plugs into the existing (remote) subscriber line concentrator in the CO; can be mixed with traditional analog and ISDN line cards
- Is integrated into the CO OA&M concept (control of bandwidth)
- Is integrated into the CO line test concept

For advanced ISDN markets, seamless migration to higher-bandwidth technologies, with greater than 128 kb/s, should be based on ISDN since there already exists a quite large installed base of ISDN private branch exchanges (PBXs) and ISDN telephone sets. The early pioneers of ISDN, SOHOs and business customers, are in particular expected to demand more bandwidth at first.

The large benefit of an integrated approach is that the evolution from lower to higher bandwidth can be done smoothly and in increments proportional to the revenue required to balance the necessary investment. Depending on the customer's demand for bandwidth, line cards can be upgraded from analog to ISDN or xDSL, all with the existing and proven telecommunications management network (TMN) facilities for subscriber management.

As the penetration of Internet users increases and a certain density is reached, the next step might be that the respective content provision and electronic commerce platforms move to the access node in the CO in order to facilitate distribution and access to local content. This gives the telco ISP the opportunity to act as "proxy server" for other Internet service(s) and content providers.

New Subscriber Features for Using the Internet

The critical factors for the success of the telco ISPs in competition with traditional ISPs are the following:

- To keep telephony and Internet traffic in their network
- To increase the number of successful call attempts (telephony)
- To differentiate from other ISPs by providing new value-adding features
- To increase revenue by providing new features

Telephone network providers that do provide Internet services by combining technologies based on telephony and the Internet gain a clear competitive advantage through the host of new applications and features/services which become available from this integration of technologies.

The dial-up Internet subscriber profits by new features based on the interworking of telephony and the Internet. The main benefits for subscribers are:

- Easy access to the Internet (lightweight but secure authentification procedure)
- Automatic information from the ISP (about new received e-mails, new service offers, etc.)
- Awareness of incoming calls and the ability to answer these calls during an Internet session, using the PC as a phone via Voice over Internet Protocol (VoIP)
- Set up a call from an Internet session (e.g., to a service representative)
- Easy use of complex PSTN/ISDN features (subscriber control input, etc.)

Together with the facilitated VoIP services, this effectively turns the PC into a telephone and brings CTI applications a big step forward!

To provide these features based on PSTN/ISDN and Internet interworking, a logical communication channel is introduced between the CO with the IPOP to which the Internet subscriber is connected and the Internet application running on the subscriber's PC. Figure 8 shows the communication between the CO switch and Internet client. The call processing application in the IPOP and the CO call control realize the interworking between "traditional" telephony protocols (PSTN/ISDN D-channel) and the IP application.

In the illustrated example an analog subscriber is logged into an Internet session, communicating via a 64 kb/s channel with the IPOP. PPP is terminated on both sides (over a modem protocol). To communicate with the Internet client on the subscriber's PC, the switch uses the IPOP as a transfer point, which translates internal communication channel messages into IP packets and vice versa. Based on this communication, new features become possible.

As an application of the unique PSTN/ISDN and Internet interworking capabilities in the CO with IPOP, some subscriber features are illustrated in the following sections that create benefits for both network providers and subscribers.

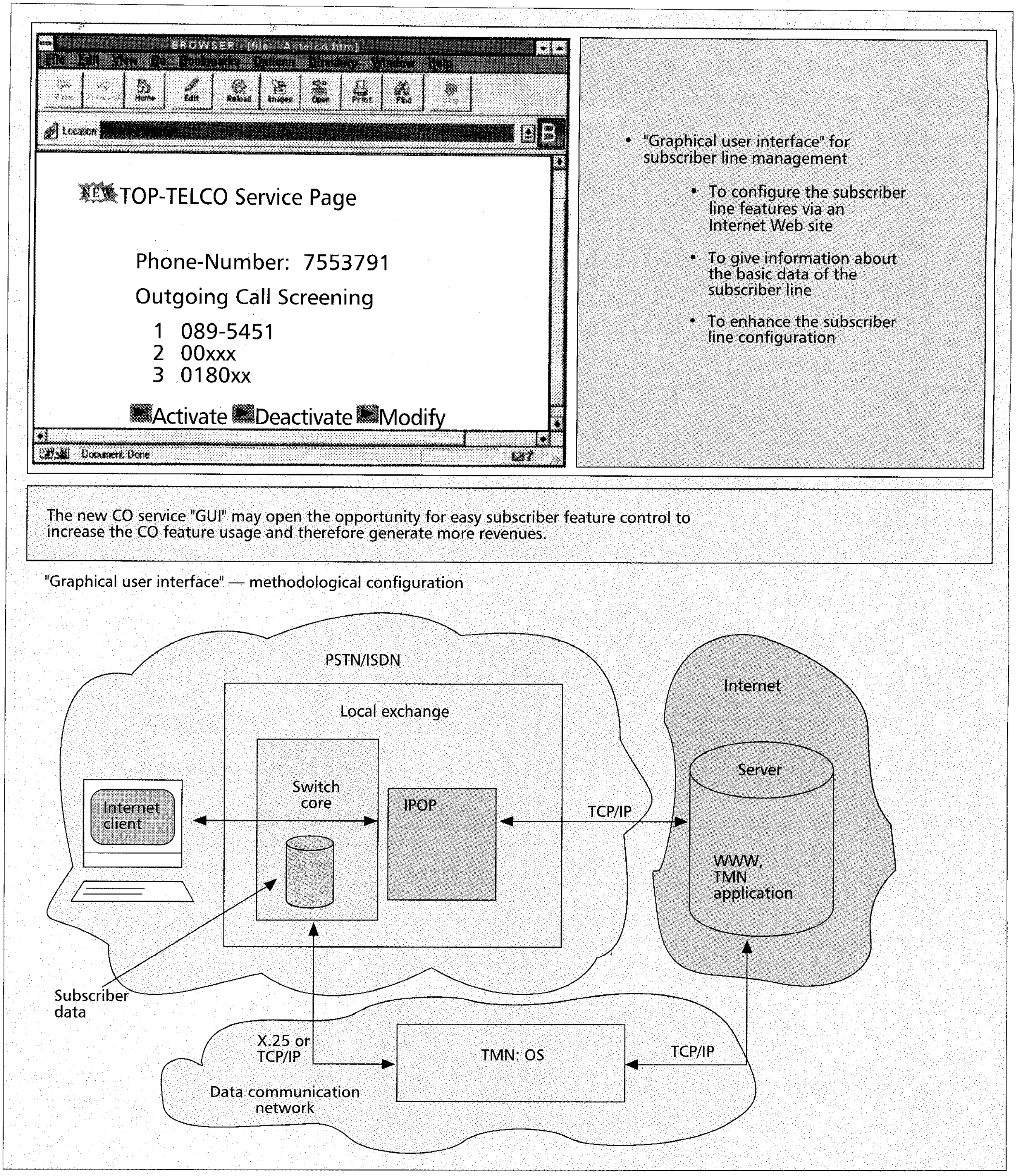


Figure 9. *Subscriber-controlled input via Internet — graphical user interface (GUI).*

SUBSCRIBER-CONTROLLED INPUT VIA INTERNET

This feature enables the subscriber to configure supplementary services for his PSTN/ISDN line through a graphical user interface by starting Web applications. The subscriber is able to get specific online information about his line (e.g., online viewing of the telephone bill).

The network provider can distribute additional information to his subscribers by putting it on the Web page. The main opportunity for the network provider is to enable new or support existing SCI features which are too complicated to be used by normal keypad telephones.

This feature is based on a Web application running on the PSTN/ISDN server owned by the telco ISP. Hypertext Markup Language (HTML) documents are provided on this server which start a communication process to the telco's TMN platform, sending or receiving specific data of the specified subscriber line and converting to/from TMN commands (Fig. 9).

E-Mail Waiting Indication

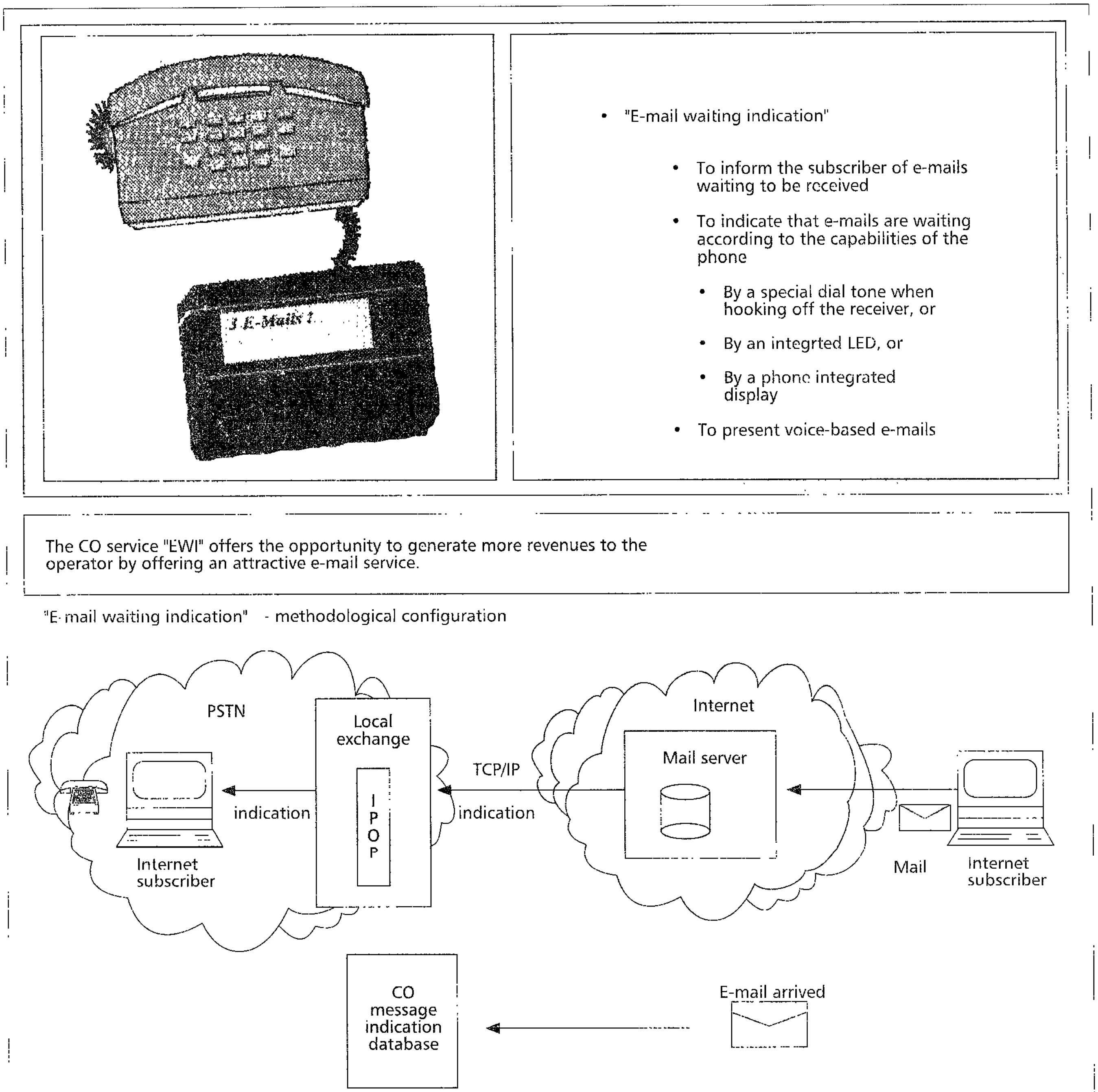
A subscriber with the e-mail waiting indication feature is informed when an e-mail has been received by his electronic mailbox. This feature supports the use of e-mail. It is not necessary that the subscriber log onto the network — the necessary information is sent to his customer premises equipment (CPE) and indicated by the CO, for example, by a terminal display, a light-emitting diode (LED) on the telephone, or a special dial tone.

The functionality is based on information sent by the mail server in the Internet to the IPOP in the local exchange via TCP/IP. The local exchange keeps a database with this information and sends it to the appropriate CPE (Fig. 10).

Call Completion on Internet-Busy

With the call completion on Internet busy feature, a subscriber can receive incoming calls while in an Internet session by using VoIP technology. The advantage for the subscriber is to be aware of incoming calls and to be able to answer these calls when he is busy in an Internet session. From the network provider's point of view, the number of unsuccessful call attempts is minimized.

If an Internet busy subscriber receives an incoming voice call, the CO core internally forwards the call to the IPOP, which converts the analog voice into VoIP packets, initiating a VoIP call to the subscriber via H.323 protocol. The interworking software function is required to associate the subscriber E.164 number with the (transient) IP address in the



■ **Figure 10.** *E-mail waiting indication (EWI) — network configuration.*

IPOP. The subscriber receives a notification with the telephone number of the ringing party. The subscriber can choose how to handle the call (answer, deflect, or drop). During the whole process, the Internet session is not interrupted, even if the subscriber answers the call. For a functional overview see Fig. 11.

CALL WAITING INTERNET

Using this feature a subscriber, logged onto an Internet session and unable to receive VoIP calls, is informed by a popup window on his screen when another party tries to call him. The telephone number of the ringing party is displayed. The subscriber can choose between answering the call or continu-

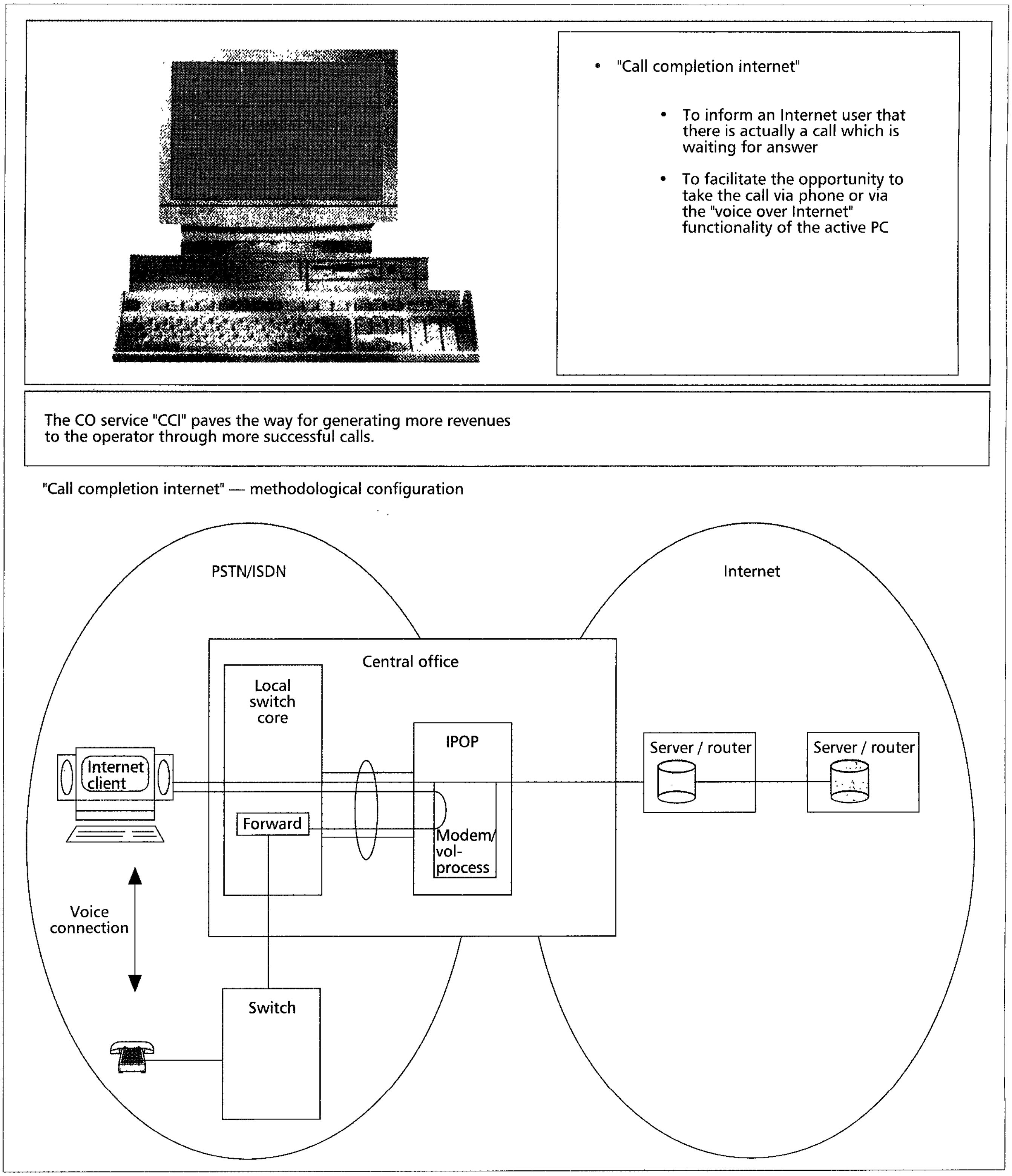


Figure 11. *Call forwarding to an Internet session — call completion Internet (CCI).*

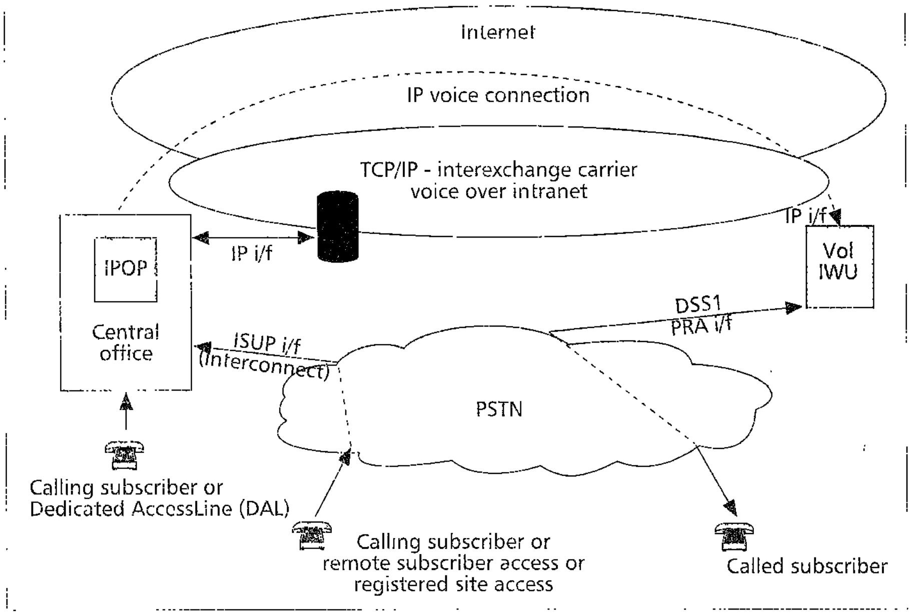


Figure 12. *Voice over Internet structure.*

ing his Internet session. The current Internet session is not affected until the subscriber decides to accept the call.

The main difference from call forwarding Internet is that after accepting the call, the Internet session is terminated and the incoming call answered via telephone.

Call Setup from an Internet Session

The call setup from an Internet session feature allows a content provider to include an E.164 telephone number on his Web page. When this is selected, a telephone call to the PSTN/ISDN B party is established. The first "leg" of the call is set up to the IPOP using VoIP, speech is (de)packetized in the IPOP, and the second leg from the IPOP to the B subscriber in the PSTN/ISDN is circuit-switched.

This feature provides a seamless transition between Internet-based help desk or call center applications providing general information on Web pages and personal customer contact by talking to a representative, or ordering special information.

Voice over Internet

Today, PSTN and ISDN deliver high-quality and reliable voice services to subscribers all over the world. The main reasons for the introduction of voice over Internet are:

- There is demand for long distance calls at low cost/low quality, driven by a new form of the classical reseller business over Intranets with TCP/IP technology.
- Local exchange carriers (city networks) can provide long distance services without investment in expensive backbone infrastructure.
- Packet structure of the Internet reduces transmission network costs through voice compression.
- Usage of low-cost Internet resources (today).
- The PC becomes a true multimedia network terminal.

More and more PCs on the market are equipped with a sound card, speakers, and a microphone or headset, sufficient for most voice over Internet applications. Thus, a widespread basis for this new kind of communication already exists. It is expected that this type of network computer is likely to evolve to become the next-generation telephony terminal.

Voice over Internet service is not restricted to Internet subscribers. It is also possible to reach telephone subscribers (PSTN/ISDN) everywhere in the world. Today, due to incomplete standards, an interworking over "open interfaces" between several ISPs is not yet possible. However, the recent work of standardization bodies of the Internet Engineering Task Force (IETF), International Telecommunication Union (ITU), and European Telecommunications Standards Institute (ETSI) (TIPHON) will improve interoperability of VoIP implementations in the near future.

The major challenge of voice over Internet today is to guarantee quality of service. The IP-based transport results in delay, variation of delay, and loss of transmitted data information. Improvements will be achieved with the advanced IPv6 protocol by optimizing data buffering, usage of RSVP, or simply providing more bandwidth.

The voice over Internet network structure is shown in Fig. 12. This concept consists of the following functional entities:

The voice over IP interworking unit (VoIP-IWU) is responsible for voice coding/decoding according to ITU recommendations (e.g. G.723), provision of the necessary Internet protocols (e.g., H.323 plus proprietary extensions), and provision of the ISDN based internal communication protocol to communicate with the traditional CO call controls.

The voice over Internet server is responsible for conversion of the B side subscriber's E.164 number to the permanent IP address of the B side VoIP-IWU (i.e., the IWU closest to the B subscriber), as well as gathering information for charging and so on. In the proposed IPOP these functions are integrated with the corresponding CO call control functions for subscriber authentication, number translation, and routing.

The voice over Internet subscriber needs off-the-shelf PC software (and for certain audio coding protocols requiring high performance, special modem hardware) to provide voice coding/decoding, Internet protocols (e.g., H.323 plus), and the login procedure to voice over Internet (Internet session) included in most standard PC software.

The advantages for a telco ISP to provide voice over Internet are as follows:

- In combination with the existing switching facilities, an advanced VoIP service can be provided (e.g., simplified access authentication, charging methods of the local exchange).
- Due to this cooperation, the subscriber has a number of benefits concerning subscription, authentication, call setup (fewer digits, more speed), and charging (e.g., advice of charges is possible).
- The telco ISP can keep the (compressed) voice traffic in its own network.
- New low-cost services attract new customers.

Conclusion

In this article an integrated Internet services platform has been presented that turns the CO into the optimized gateway between PSTN/ISDN and the Internet. The key component is an Internet POP constructed from cutting-edge IP technology that integrates smoothly into the state-of-the-art CO and allows for interworking between PSTN/ISDN call processing and Internet services.

Through the presented concept, the CO of today evolves into an optimized Internet access point that fully supports the telecom operators' strategy to reuse their investment in the PSTN/ISDN infrastructure as they position to become ISPs: the CO with integrated Internet service platform optimizes PSTN/ISDN network performance by grooming Internet traffic and creates the basis for new subscriber services based on Internet technology.

The presented approach enables evolutionary extensions for broadband subscriber access starting from the installed narrowband infrastructure in the PSTN/ISDN balancing user demand for Internet services with telco investments. This way, the approach contributes to a convergence of PSTN/ISDN and the Internet toward a seamless multimedia network of the future.

BIOGRAPHIES

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