STUDY PAPER
on
IP PABX
(IP based PRIVATE AUTOMATIC BRANCH EXCHANGE)

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1.0 Introduction

Private Automatic Branch exchange (PABX) is an in-house telephone switching system which makes connections among the internal telephones of a private organization (or an enterprise) and also connects them to the public telecom network via various interfaces. PABX can have various types of extensions such as analogue phone, digital Phone, IP Phone, etc. This system switches calls between users on local lines while allowing all users to share a certain number of external phone lines.

Originally, such systems called private branch exchanges (PBX), required the use of an operator. Presently, almost all private branch exchanges are automatic; the abbreviation "PBX" usually implies a "PABX." The main purpose of a PABX is to save the cost of requiring individual line for each user from PSTN telephone operators. Generally, the PABX is owned and operated by the enterprise rather than the telephone company. Initially, Private branch exchanges used analog technology. Today, PABX use digital technology or IP technology supporting IP terminals as well. Due to its IP in nature, the PABX industry are rapidly increasing and providing numerous features & facilities based on IP.

The aim of this study paper is to briefly explain the need & use of IP PABX, and requirement of a separate Standard document for pure IP based PABX.

2.0 History & Evolution of PABX

With the technology advancement in the field of Switching & Transmission, the different types of PABX were evolved. For better understanding, it may be categorized as:

- Manual Board PBX
- Automatic Strowger (SXS based Strowger PBX)
- Stored Program Control PABX
- Digital Switching based PABX
- IP based PABX

Figure 1 : Evolution of PABX

The term PBX was first applied when 'switchboard operators managed company' connected calls from switchboards manually using cord circuits. As automated electromechanical switches and later electronic switching systems replaced the manual systems, the terms private automatic branch exchange (PABX) and private manual branch exchange (PMBX) were used to differentiate them. Digital systems were sometimes referred to as electronic private automatic branch exchanges (EPABX). ISDN PABX systems also replaced some traditional PABXs in the 1990s, as ISDN offers features such as conference calling, call forwarding, and programmable caller ID. Today, the term PABX is applied to all types of in-house telephony switching systems.

The other options in PABX are key telephone system and central office exchange service (Centrex). The former is a scaled-down PABX, more suitable for smaller businesses with simpler needs and the later one i.e. Centrex has long been a staple of campus
environments that need PABX like capabilities, but at a lower cost in the form of a hosted system that is leased rather than owned.

Until a few years ago, all voice communications traffic was handled over the circuit switched network. Two significant developments took place during 1990s which led to innovation in PABX systems. One was the massive growth of data networks and second was increased public understanding of packet switching. Companies needed packet switched networks for data, but also explored the possibility of using them for telephone calls. Availability of the Internet (IP network) as a global delivery system made packet switched communications even more attractive. These factors led to the development of the voice over IP and thus IP PABX. In the case of VoIP, major traffic across the Internet still originates/terminates at a non-IP voice terminal connected to the PSTN or a customer premises communications system.

The other trend was the ‘idea of focusing on core competence’. PABX services had always been hard to arrange for smaller companies, and many companies realized that handling their own telephony was not their core competence. These considerations gave rise to the concept of hosted/virtual/cloud PABX. In a hosted setup, the PABX is located at and managed by the telephone service provider or any other company, and features and calls are delivered via the IP network. The customer just signs up for a service, rather than buying and maintaining expensive hardware. This essentially removes the branch from the private premises, moving it to a central location and evolved into VoIP centers that are hosted by the operators or even manufacturers.

With many features based on IP terminal such as Conference Bridging, Automated directory, Dial Name, Centralized messages, Application Share, Multi location Functionality, Customized Phone Profile, Instant messaging etc, IP now becoming the standard for telephony PABX has evolved into the IP PABX. IP-based systems are less capital-intensive and offer more flexibility in terms of adding new features and integrating VoIP with other communication modes.

Though VoIP is considered the future of telephony, the circuit switched network is still the core of communications, Legacy PABX systems still account for most of today's installed base, but the vast majority of new purchases and upgrades are in IP domain. In order to provide both features of TDM as well as IP, manufacturers have come out with a solution of “Hybrid” system. For making calls from IP network to the circuit switched network & vice versa, media gateways are being used.
A typical schematic of Hybrid type the PABX is given below, in which both traditional TDM & IP functionalities are included.

![Schematic of Hybrid PABX](image)

**Figure 2:** Basic Architecture of Hybrid PABX in N/W

### 3.0 Basic Architecture, its Functions & Interfaces

Generally, A PABX includes:

(a) Telephone Extensions (multiple phone) lines that terminate at the PABX

(b) A CPU card or server or a separate computer with memory that manages the switching of the calls within the PABX and in and out of it

(c) Trunk / Junction Lines connected to the Telephone Service Provider

(d) A console/PC for management functions

PABXs offer many calling features and capabilities, with different manufacturers providing different features (manufacturers may have a different name for same capability) in an effort to differentiate their products but the general PABX facilities include: Auto attendant, Auto dialing, Automated directory services, Automatic call distributor, Automatic ring back, Busy override, Call blocking, Call forwarding on busy or absence, Call logging, Call park, Call pick-up, Call transfer, Call waiting, Camp-on, Conference call, Custom greetings, Customized abbreviated dialing (Speed dialing), Direct inward dialing, Direct inward system access (DISA), Do not disturb (DND), Follow-me(also known as find-me), Interactive voice response, Music on hold, Night service, Public address voice paging, Shared message boxes (where a department can have a shared voicemail box), Voice mail, Voice message broadcasting, Welcome message and many more

**Different Interfaces in PABX Scenario**

(A) Interfaces for connecting PABXs to trunk lines (towards Public Network):

There may be various possibilities for PABX, by which it can be connected to TDM or IP based Public Telephone Network through different types of Interfaces as shown in Figure 2.
(a) 2-wire DELs for outgoing calls as well incoming calls. The junctions of PABX will be terminated on the analog subscriber line cards of the PSTN exchange.

(b) E1/MFR2 Interface i.e. 2048 Kbit/s using Indian R2 signaling.

(c) ISDN Basic Rate Access at S-Interface.

(d) ISDN Basic Rate Access at U-Interface.

(e) ISDN Primary rate access interfaces (PRI).

(f) V5.2 Interface.

(g) IP / Ethernet interface.

(B) Interfaces for connecting extensions to a PABX:

Various Extensions may as below;

(a) POTS (plain old telephone service) – the common two-wire interface used in most homes. This is cheap and effective, and allows almost any standard phone to be used as an extension.

(b) ISDN phones with NT devices

(c) DECT – a standard for connecting cordless phones.

(d) IP Phone based on H.323 and SIP protocols

(e) Most of Phone/extensions presently used in the PABX are Proprietary.

(C) Interfaces for connecting PABXs to other PABX for Networking purpose:

For making a large setup or networking purpose, PABX may be connected to each other with the following:

(a) Internet Protocol : H.323 and SIP are IP based protocols which can handle voice and multimedia (e.g., video) calls.

(b) ISDN PRI : based on E1 30 bearer channels + 1 signaling channel

(c) Proprietary protocols: Several manufacturers use proprietary protocols instead of standard protocols because it safeguards their business interest.

(d) QSIG : for connecting PABXs to each other, usually runs over E1 (E-carrier) physical circuits.

(D) Interfaces for collecting data from the PABX:

(a) File: the PABX generates a file containing the call records from the PABX.

(b) Network Port (listen mode) – where an external application connects to the TCP or UDP port. The PABX then starts streaming information down to the application.

(c) Network port (server mode) – the PABX connects to another application or buffer.

(d) Serial interface – historically used to print every call record to a serial printer. Now an application connects via serial cable to this port.

A data record from a PABX or other telecommunication system that provides the statistics for a telephone call is usually termed a call detail record (CDR) or a Station Messaging Detail Record (SMDR).

4.0 IP PABX

IP PABX is based on IP core and calls may be sent over the IP (VoIP) network. IP PABX systems frequently result in cost savings when compared to traditional PABX systems. A typical IP PABX (Hybrid IP PABX) can also switch calls between a VoIP user and a traditional
telephone user, or between two traditional telephone users in the same way that a traditional PABX does.

In the traditional PABX, two separate networks are required (one for voice and one for data). Instead of two separate networks, only one network is required if voice is packetized (Voice over IP) and sent over the IP network. An IP PABX is a combination of a switch/router and a call server/card that handles VoIP.

The voice over IP PABX may be a software based solution that ensures linear scalability, ease of administration and management, resiliency and reliability, Voice mail, direct inward dialing, call forwarding, Web based configuration and wide speed dialing are few features that describes the advanced system. IP based PABX system provides communication solutions for wide network organizations.

**Architecture:**

An IP PABX can have extensions as IP phones and/or soft phones (software application on PCs that also converts voice to packets and vice versa). Existing phones along with adapters that packetize voice, and standard phones connected to PCs (PCs acts as the adapters) can also be used as extensions. IP PABX may be deployed with different architecture like server based or Hosted/cloud based architecture.

With the consideration of future network, all IP concepts will exist predominantly. Accordingly, there is a requirement of PURE IP PABX in which only IP Terminals, IP core Switching and IP connectivity towards public Network will exist. This may be known as Next Generation PABX. It will be on IP based powerful communication platform that operates on open standards based protocols on a general purpose server/communication server (like PC), with IP at its ‘Core’ switching and SIP Trunk/IP Connectivity with Public Network.

![Figure 3: IP PABX with IP connectivity to Public Network](image)

**Hosted/Virtual/Cloud PABX**

Hosted PABX has many advantages compared to traditional systems; with hosted PABX system the advanced functionalities of a hardware PABX system are provided to the user through a hosted server. Since the user is free from the hassles of maintaining the equipments, the system is also called virtual phone PABX system. These systems deliver PABX functionality as a service, available over the service provider’s core network or the
Internet. Hosted PABXs are typically provided by a telephone company or service provider, using equipment located in the premises of a telephone exchange or the provider’s data center. This means the customer does not need to buy or install PABX equipment. Generally the service is provided by a lease agreement and the provider can, in some configurations, use the same switching equipment to service multiple hosted PABX customers.

It is possible to get hosted PABX services that include feature sets from minimal functionality to advanced feature combinations. Hosted PABX is also known as Cloud PABX.

In addition to the features available from premises-based PABX systems, hosted-PABX allows a single number for the entire company, despite it being geographically distributed. A company could even choose to have no premises, with workers connected from home using their domestic telephones but receiving the same features as any PABX user. It allows multimodal access, where employees access the network via a variety of telecommunications systems, including POTS, ISDN, cellular phones, and VOIP. This allows one extension to ring in multiple locations (either concurrently or sequentially). It also allows scalability; in case company’s employee base grows more lines can be demanded and at the same time if it reduces the lines can be withdrawn. Thus, allowing company to avoid expenditure on PABX which would otherwise become wasteful if the number of employees is reduced.

5.0 Benefits of IP PABX over Traditional PABX

There are many benefits /advantages with the using of IP based PABX.
(a) IP PABX handles both voice and data.  
(b) It is cheaper since it requires only one network to install and maintain instead of two, and also much easier to install & configuration.  
(c) It reduces equipment costs (only IP based products; no voice products needed).  
(d) It supports services such as unified messaging.  
(e) It is more flexible & scalable.  
(f) It makes it easier to provide new services, such as data and video collaboration.  
(g) It allows remote configuration (over the Web), and supports modular software upgrades, new technologies (new CPUs, etc.) are easy to incorporate.  
(h) If IP PABXs are based on the open SIP standard, any SIP hardware or software phone may be used with any SIP-based IP PABX. In contrast, a proprietary phone system often requires proprietary phones to use advanced features, and proprietary extension modules to add features.  
(i) With an IP PABX, it can be deliver better customer service and better productivity.

6.0 DOT Guideline

(a) As per latest UL license, condition 2 of Chapter IX on internet service, The Licensee may provide Internet Telephony through Public Internet by the use of Personal Computers (PC) or IP based Customer Premises Equipment (CPE) connecting only the following:

(i) PC to PC; within or outside India  
(ii) PC / a device / Adapter conforming to TEC or International Standard in India to PSTN/PLMN abroad.  
(iii) Any device / Adapter conforming to TEC or International Standard connected to ISP node with static IP address to similar device / Adapter; within or outside India.  

(b) In case of ISP, There should be no termination with PSTN/PLMN.
(c) Specific Guideline has been issued by Department of Telecom, if PABXs are being used in the category of OSP (Other Service Provider). There should be no bypass of NLD/ILD while making PSTN/PLMN calls. All national or international calls from any PABX extension shall be routed through the PSTN/PLMN lines terminated in PABX. [i.e. Any extension in city 'A' shall use PSTN/PLMN connectivity only of the Licensed Service Area (LSA) encompassing the city 'A' and not any other LSA for making or receiving calls to/from PSTN/PLMN. Calls to other LSA shall be routed through NLD/ILD].

**Challenge in current scenario:**

(a) As per prevailing licensing condition, calls through ISP can not be terminated on PSTN/PLMN number within the country. However, technology does provide this facility but to some extent encouraged as it bypasses toll also. How to restrict this grey area is a challenge in today's scenario.

(b) With distributed architecture, it would be rather more difficult to monitor PABX traffic by investigating agencies, if they so desire.

![Figure 4: Typical deployment of Hybrid IP PABX in current scenario](image)

7.0 TRAI Recommendation

TRAI released its recommendation issue related to Internet Telephony dated 18 Aug 2008. Which states as below:

(a) Para 1.10.12

"The regulatory restrictions on ISPs to provide unrestricted Internet telephony and lack of interest of access providers to offer similar services are encouraging development of grey markets to provide Internet telephony."

(b) Para 3.10.16

Internet telephony may be permitted to ISPs with permission to provide Internet telephony calls to PSTN/PLMN and vice-versa within the country. Necessary amendments may be made in the license provisions."
8.0 Conclusion

(a). In Present scenario, having different types of PABX as discussed above, it is clearly accepted that PABX's demands & deployments are increasing day by day. PABX vendor/manufacturers are coming out with many different models of PABX with new features as compared to others.
Small or large traditional type PABX based on the requirement are still being used by many organizations. With introduction of IP facility & IP phones as extensions, hybrid PABX are used in which both TDM and IP facilities are included. A next generation IP-PABX system brings together a truly converged communication.

(b) Before formation of BSNL in the year 2000, DoT was the only operator for providing telecom services. It is understood that use of PABX was governed by Indian Telegraph Rules (ITRs) and also by instructions/orders issued by DoT from time to time. It is also understood that BSNL follow those rules/instructions. They might have worked out new guidelines too.

With the use of IP technology in PABX, the potential of toll bypass has increased. As per the current guidelines, ISPs are not allowed to have interface with PSTN/PLMN for providing voice communication.

Thus it appears appropriate to review the existing rules and instructions including those followed by BSNL, with a view to examine whether these are in line with license regime. Issue of consolidated instructions will be useful for proper implementation of license regime.

References:

(a) http://www.dot.gov.in/carrier-services/other-services-providersincluding-bpo.
(b) TRAI consultation paper on “Encouraging Telecom Equipment Manufacturing in India” and feedbacks from different stakeholders.
(c) TRAI Consultation Paper on “Allocation of Spectrum Resources for Residential and Enterprise Intra telecommunication Requirements/ cordless telecommunications system (CTS)”.
(d) DGS & D, New Delhi document regarding “Technical Particulars of EPABX”.
(e) Technical documents of various stakeholders (i.e. M/s Coraltelecom, M/s VNL)