



WHITE PAPER

ISDN Centrex

Prepared by Telcordia Technologies, Inc. for the
Council for Access Technologies (CAT)
www.CATcouncil.org

March 2001

ISDN Centrex

Table of Contents

1. INTRODUCTION.....	1
1.1 OVERVIEW	1
1.2 HISTORY AND BACKGROUND OF CENTREX	1
1.3 OBJECTIVES OF WHITE PAPER	2
1.4 TERMINOLOGY	2
1.5 ORGANIZATION	2
2. VOICE FEATURE ASSESSMENT	3
3. COMPARISON OF BENEFITS AND COST FACTORS FOR CENTREX AND PBX SOLUTIONS.....	4
3.1 CENTREX.....	4
3.2 PBXS.....	6
4. CUSTOMER INTERVIEWS.....	9
4.1 CENTREX CUSTOMER PERSPECTIVE	9
5. CONCLUSIONS	10
6. REFERENCES.....	11
7. ACRONYMS.....	12

1. Introduction

1.1 Overview

Centrex service was developed as a Central Office (CO) based alternative to Private Branch Exchanges (PBXs) for business voice solutions. Although originally targeted at very large businesses, Centrex is used today by many small and medium-sized businesses as well. With the addition of ISDN's BRI capabilities to Centrex, Centrex now offers a competitive set of advanced voice features. This White Paper compares the benefits of ISDN Centrex and PBX approaches and explores customer perceptions of Centrex service.

1.2 History and Background of Centrex

Centrex service evolved in response to changes in telecommunications regulatory policy. The Carterphone decision in 1968 allowed PBX and Key Telephone System (KTS) manufacturers to compete in the Customer Premises Equipment market (CPE). However, AT&T remained the dominant supplier of PBXs, and the Bell System did not aggressively market Centrex. After the Regional Bell Operating Companies (RBOCs) were separated from AT&T, the RBOCs had new motivation to emphasize Centrex—Centrex was their only service to compete with PBX solutions.

Centrex was originally conceived and tariffed as a premier networking solution for very large users. As the RBOCs evolved Centrex, new features were introduced to make it more competitive with feature-rich PBXs. Also, tariff changes made Centrex cost-effective for small- and medium-sized businesses.

One of the major advantages of PBXs were proprietary, multi-button telephone sets which allowed better control of voice features. Analog Centrex was limited in terms of the types of features that could be offered and how the end-user operated those features. When Basic Rate ISDN was introduced into Centrex, the gap between PBXs and Centrex narrowed significantly. ISDN Centrex allows easy access and control of a wide range of features via standard, multi-button, display telephone sets, similar to PBX telephones. Additional enhancements to ISDN via the National ISDN process made important voice features available to Centrex users.

In the past, a business's decision to use a PBX or Centrex solution was often driven by feature requirements. Although Centrex may have provided the customer with many operational advantages, these were secondary if a PBX provided a critical feature or capability not available in Centrex. Now that ISDN Centrex can satisfy most customers' feature requirements, the customer evaluation of competing approaches can focus on platform issues, rather than feature issues.

1.3 Objectives of White Paper

This White Paper explores the issues that a business encounters in determining whether to use ISDN Centrex or PBX for their voice solution. These issues include feature availability, operational support, price, and total cost of ownership.

For most corporate users, data *to the desktop* is satisfied with LAN connections to the Intranet/Internet. Such users typically would not utilize BRI's B-channel circuit-switched data or D-channel X.25 packet data. Consequently, BRI's data capabilities are not emphasized in this White Paper.

1.4 Terminology

For the remainder of this White Paper, the terms "Centrex" and "ISDN Centrex" are used interchangeably. Many of the benefits Centrex offers, such as LEC-responsibility for maintaining switch upgrades, apply equally to analog Centrex and ISDN Centrex. However, ISDN is a necessary part of a Centrex offering because it allows Centrex to have feature parity with PBXs. For years, despite the many operational advantages of the Centrex platform, analog Centrex was at a competitive disadvantage to PBXs because it lacked features later brought by ISDN. Consequently, it is meaningful to discuss the benefits of "Centrex" only after establishing that Centrex has the features that the customer requires. By assuming that ISDN is available in the Centrex group, we can be confident that the customer base whose feature needs are satisfied by Centrex is much larger than the customer base that could be satisfied with analog Centrex features alone.

In today's environment, the KTS and PBX platforms are differentiated by the number of lines they serve—not on the functionality of the system. Due to the advent of low-cost digital technologies, small KTSs—sometimes referred to as hybrid systems—offer almost all the same features as larger PBXs. This was not always the case. According to historical definitions still used by the FCC, KTSs are not switches. They do not have the ability of PBXs to select trunks to route calls; a traditional KTS requires the user to press a button on a telephone set to select the outside line. Since the marketplace does not use these archaic definitions, and suppliers market very small, full-function PBXs as key systems, the term "PBX" will be used in this White Paper to refer to PBXs of all sizes including hybrid KTSs, unless otherwise indicated.

1.5 Organization

The remainder of this document is organized as follows:

- Section 2 discusses feature parity issues between ISDN Centrex and PBXs.
- Section 3 compares the benefits that are provided by Centrex and PBX platforms and explores the cost factors associated with each.
- Section 4 explores the views of a corporate telecom manager.
- Section 5 provides a summary of the key points of this White Paper.

2. Voice Feature Assessment

PBXs offer an extremely large set of features. There are a myriad of PBX suppliers in a highly competitive market; this drives them to constantly enhance their feature sets. In addition, it is less expensive for a PBX supplier to develop a new feature than for a CO switch supplier to develop a comparable Centrex feature. In order to access and control PBX features, the end-user employs a proprietary multi-button, display telephone set. Some of these phones are digital. Others are analog and use proprietary coding on 4 wire interfaces. Many PBXs support both PRI and BRI interfaces to the Public Switched Telephone Network (PSTN). In addition, some support limited functionality BRI interfaces to the desktop. Some PBXs support Computer Telephony Integration (CTI) for control of voice features from the desktop computer.

Although the Centrex feature set is smaller than the feature set available on PBXs (especially considering that a customer can select from many PBXs, each with a different set of features), ISDN Centrex offers most of the features that are important to business customers. Many, but not all, of the features unique to PBXs are either trivial features (such as the ability to use the telephone keypad as a calculator) or are critical for only niche applications.

Telcordia Technologies completed a full comparison of the ISDN Centrex feature set with that of two popular PBXs. Its main finding was that ISDN Centrex can offer almost all the features that are critical to common business applications. The most significant feature difference is that the ISDN feature suite does not include as many attendant services for inbound call management applications.

3. Comparison of Benefits and Cost Factors for Centrex and PBX Solutions

3.1 Centrex

The fundamental difference between Centrex and PBX solutions is that Centrex service is CO-based and operated by the LEC. All of the benefits unique to each platform are consequences of this difference. Some of the advantages of Centrex service are listed below.

- **Low initial investment:** The system acquisition cost for Centrex is much lower than a PBX. A Centrex customer needs only to obtain telephone sets, whereas the PBX customer must obtain an entire system. Although any firm can benefit from this aspect of Centrex, fast-growing companies with limited capital resources and limited personnel for non-core functions are particularly attracted to Centrex. Not only does Centrex allow such companies to focus on their core businesses, it also provides a cost-effective way for them to expand their phone systems as the companies grow.
- **Line expansion and ease of scalability:** CO switches are very large, serving many thousands of lines. A customer's Centrex service usually occupies only a small portion of a switch's capacity. When the customer needs additional lines, the LEC simply allocates them. The LEC has the responsibility to manage its hardware resources such that it has sufficient capacity to satisfy future demand. In order for a PBX customer to add a line, the customer (or outsourced support) must provision the new line on the PBX. In addition, the customer must maintain a sufficient inventory of line cards. Provisioning, installation, and inventory expenses increase the operating costs of PBXs.

Centrex service provides an amount of scalability that cannot be matched by PBXs. *Scalability* refers to the relationship between capacity and costs. In a scalable system, costs increase or decrease in a proportionate relationship to capacity. In a system with low scalability, costs can increase significantly in response to minor increases in capacity. Since Centrex service is billed per line, the customer's cost for Centrex service increases as they add lines and decreases as they remove lines. After the high acquisition cost for a PBX is incurred, the cost to add a line may be nominal until certain breakpoints are reached (e.g., the need to add a new cabinet and processor), at which point a substantial expense may be incurred to add just one additional line.[†] In addition, PBXs do not have scalability as line requirements decrease; instead, the investment in PBX capacity is distributed over fewer lines, increasing the price per line. Firms engaged in highly

[†] Note that the LEC encounters similar scalability issues with the CO switch that a PBX user encounters with a PBX. However, there are greater economies of scale for a CO switch than for a PBX. Consequently, the LEC is able to manage CO switch scalability issues more cost effectively than a PBX user can manage PBX scalability.

seasonal businesses tend to favor Centrex service because it offers scalability for both increasing and decreasing line requirements.

- **Reliability and Repairs:** System maintenance for Centrex is provided by the LEC; there is no extra charge to the customer for maintaining the switch. The LEC provides 24 x 7 monitoring of the switch and often resolves switching problems before customer service is affected. PBX troubles usually affect users before the problems are detected. In addition to the operating expenses for PBX maintenance personnel (or outsourced support), the PBX customer must make a capital outlay for spare parts.
- **Upgrades:** The LEC is responsible for hardware and software upgrades on the CO switch. The PBX customer assumes these responsibilities for the PBX; in addition, the PBX customer has the additional burden of replacing the PBX at the end of its lifetime. Consequently, Centrex services removes both capital and personnel expenses from the customer.
- **Day-to-day operation of the switch:** All switch provisioning is done by the LEC for Centrex service. This includes daily functions like provisioning lines for Moves, Adds, and Changes (MAC). It also includes common but less frequent functions like updating routing tables for area code splits or new exchanges. For PBXs, in-house (or outsourced) personnel with the appropriate expertise must be available to perform these functions.
- **Multilocation Centrex:** If a customer has multiple facilities served by a single CO, the customer can easily include all the facilities in single Centrex group. If that same customer used a PBX solution, separate hardware must be deployed in each facility, dramatically increasing both the capital and support expenses. In addition, if the PBX customer wanted to include all the locations in a single dialing plan, extra expenses would be incurred to network the PBXs together.
- **Security:** Centrex service is more secure from hackers and fraud than PBXs. PBXs offer Direct Inward System Access (DISA) trunks and remote maintenance ports that hackers can use to vandalize the system or to make long-distance calls that are billed back to the PBX. Although it is possible to disable insecure access ports, many PBXs continue to operate with their ports accessible to hackers. In contrast, LECs have implemented reliable security measures to protect the PSTN from hackers.
- **Environment:** There are a number of mundane issues (and associated costs) that affect PBX customers but not Centrex users. For example, floor space must be allocated for a PBX; the room must have appropriate air conditioning, ventilation, and backup power. In addition, the PBX should be protected against disaster (e.g., specialized fire suppression systems). CO construction addresses all of these issues.† Centrex customers are not only

† Note that even though the CO provides backup power to the switch for Centrex service, the ISDN Centrex customer must still provide backup power to ISDN CPE in order for the BRI to operate when local power fails.

freed from these responsibilities, but they can be confident that the issues are being addressed by competent professionals.

- **Complete Solution:** Centrex service is a complete solution that provides for the business customers' internal and external voice traffic. PBXs require LEC-provided trunks to the PSTN in order to support external traffic; consequently, a PBX customer needs to work with more service and product providers than a Centrex customer.

Perhaps one of the biggest advantages of Centrex is that the customer does not face the same amount of risk that a PBX user does when selecting a PBX. When choosing a PBX, the customer must evaluate all of the above factors to determine which PBX offers the best price and performance for that customer's current and future needs. This requires the customer to accurately predict the lifetime of the PBX and the customer's growth in terms of stations, call volumes, and feature requirements. An error in this evaluation can make any particular PBX solution much more costly than anticipated. Not only does Centrex remove these risks, it also offers predictability of costs (based on terms stated in the Centrex contract). Although PBX acquisition and installation expenses can be predicted accurately, PBX upgrades and enhancements are subject to higher markups and can increase at unpredictable rates. Also, as mentioned above, the lack of proportionate scalability of PBX costs makes the total cost of PBX ownership difficult for a customer to predict.

In addition to the general advantages of Centrex that apply to most customers, Centrex offers other benefits that attract users with niche applications. For example, firms with trunk-intensive, incoming applications, like large call centers, may find that Centrex reduces the number of trunks that may have been required by PBX solutions. In Centrex, traffic is queued and held in the CO switch when there is no available line. On the other hand, PBXs hold traffic at the customer premises; one PBX trunk is needed for each call on hold. Consequently, a call center in which large call volumes wait on hold would require fewer Centrex lines than PBX trunks.

3.2 PBXs

More business lines are served by PBXs than by Centrex. The main reasons that customers often select PBX solutions over Centrex are listed below.

- **Features and functionality:** PBXs offer more features than Centrex. While many of these features are not needed by the majority of users, an impressive list of features may make the decision maker evaluating a PBX more confident that the PBX will satisfy all the customer's future feature requirements. In addition, PBXs provide some popular features, like certain advanced attendant services, that may be critical to some businesses and are not yet available on ISDN Centrex.

Telecom managers also may not be familiar with all the capabilities of ISDN Centrex. A telecom manager who has only been exposed to analog Centrex may not think of Centrex in terms of ISDN's multi-button, display speakerphones when comparing the ease of control of PBX features to Centrex features. Media coverage of ISDN often describes the difficulty of ordering ISDN and does little to encourage the telecom manager to explore the option.

- **Costs:** PBX systems are generally perceived as having a lower long-run cost than Centrex. Although Centrex may have a lower initial cost than a PBX acquisition, the PBX can be amortized over its lifetime[§] whereas the Centrex costs recur each month. In some cases, this belief is correct; but in many cases, it is a misconception.

The average industry price of a PBX (excluding hybrid KTSSs) is \$600 to \$750 per station.^{[1][2]} For hybrid KTSSs, the average price per station drops to \$250 to \$400.^[2] Although the total cost of ownership for lower-priced hybrid KTSSs may be lower than the costs for ISDN Centrex, ISDN Centrex can be more cost effective than larger PBXs when all cost factors are considered.

One of the major cost factors after PBX acquisition is maintenance and support for the system. If a firm wishes to outsource this function, the typical annual cost for support is 15% of the purchase price of the PBX.^[2] This type of support includes coverage between 8 AM and 5 PM; however, service level agreements indicate how long the contractor can take to complete certain functions. For example, typical response times are two days for MAC functions that can be completed remotely, five days for on-site MAC functions, and three hours for an on-site response to a major failure.^[3] (The cost to complete the same functions with in-house personnel will vary widely by company.)

When all costs are factored, including the PBX's trunks to the PSTN, the floor space the PBX occupies, and the cost of hardware and software upgrades, PBXs are much more expensive than many customers originally anticipate. The costs are certainly higher than PBX sales material and even objective trade journal articles suggest. However, depending on how a firm allocates expenses (such as whether in-house staff supports the PBX alone or PBX support is performed by the IT support group, and whether floor space costs are allocated to the PBX or the expense of the PBX floor space is treated as an overhead expense distribute to other offices), the firm may never quantify the real cost of the PBX.

Telecom managers also may have perceptions that Centrex is more expensive than it actually is. For example, the cost of providing multiple POTS lines to a single multi-line analog telephone set is eliminated by ISDN Centrex, where a single BRI can provide two users with equivalent functionality. In addition, ISDN CPE prices have dropped tremendously in recent years.

Since the prices for various PBXs vary widely and ISDN Centrex prices depend on local tariffs, it is impossible to make a definitive statement as to which approach is cheaper. However, Telcordia Technologies compared the cost of one LEC's ISDN Centrex service (including ISDN CPE purchase) to comparable solutions for three different PBX arrangements. In all three cases, the Centrex service provided the customer with lower short-term and long-term expenses.

[§] For accounting purposes, the life expectancy of a traditional PBX is estimated to be between 8 and 10 years. However, many companies continue to utilize their PBXs until the systems are 12 to 14 years old.^[1]

- **Control and flexibility:** Some firms believe in identifying their own needs and controlling their own systems. These firms are willing to assume the responsibility of managing a PBX in order to gain the benefits of controlling their telecom environment. The PBX provides them with the flexibility to configure the environment exactly to their preference without relying on agreement or negotiation with the LEC.
- **Telecom manager and independent consultant prejudice:** Sometimes the decision whether to use a PBX or Centrex approach is not objective. Often, the decision maker may have personal interests that influence the evaluation. Many telecom managers require a PBX to justify their jobs. When a PBX reaches the end of its lifetime, they are likely to replace it with another PBX rather than giving Centrex serious consideration. This is because Centrex does not contribute to their departmental budgets, staffing, or span of control, and hence may interfere with their personal career and salary goals. When the decision maker is someone higher in the company than the telecom manager (and presumably not subject to the same conflict of interest), the decision maker usually is not a telecom expert and hence relies on the recommendations of the telecom manager.

Even when a company does not have the internal expertise or available resources to evaluate its telecom needs, Centrex is often slighted. Independent consultants are reluctant to recommend Centrex. The solution of ordering Centrex from the LEC may appear to the client as being too simple to justify a high-priced consultant.

Considering the merits of each solution, many businesses currently using PBXs could be better served by ISDN Centrex service today. It would be prudent for firms to reconsider Centrex when it is time to replace their existing PBXs.

4. Customer Interviews

In researching this White Paper, corporate telecom managers were interviewed. The subsequent section explores the views of one of these telecom managers.

4.1 Centrex Customer Perspective

This telecom manager is responsible for a set of Centrex groups. Each group is served by a different CO. One of the COs serves a multilocation Centrex group. The Centrex groups use AIN and Virtual Private Network facilities for traffic between the groups. The combined size of the groups is between 10,000 and 12,000 lines. Twenty percent of the lines are ISDN.

This telecom manager indicated that the following benefits are the main advantages his firm receives from Centrex:

- Avoids floor space requirements for PBX.
- Avoids need for support appliances for PBX (air conditioning and ventilation, backup power, etc.).
- Reduces personnel requirements by 1 to 1.5 headcount (by avoiding need for maintenance and MAC on PBX).
- LEC assumes responsibility for routing table updates.
- LEC assumes responsibility for software upgrades on the switch and provides an up-to-date set of features.
- LEC provides a highly reliable service.
- Because one of the Centrex groups is multilocal, a PBX approach would require additional hardware and support expenses for additional PBXs and trunking facilities between them.
- Centrex integrates well with the company's voice mail system.

In general, this manager was enthusiastic about the benefits his company received from Centrex.

5. Conclusions

Over the last several decades, Centrex service has evolved to meet the changing needs of businesses. Originally conceived for very large enterprises, Centrex now serves businesses of all sizes. The addition of ISDN capabilities to Centrex allows the service provider to offer advanced call management capabilities and features while continuing to provide Centrex's traditional operational and cost advantages.

6. References

1. Datapro Information Services, *PBX Systems: Technology Overview*, Rich Costello, 1999.
2. GartnerGroup, *Voice Equipment Budgets for 2000: Hype vs. Reality*, Strategic Planning SPA-08-7699, A. Schoeller, July 19, 1999.
3. GartnerGroup, *Standard PBX Maintenance Contracts Are Not Acceptable*, Decision Framework DF-05-6989, K. Volpe, September 15, 1998.

7. Acronyms

ACRS	Accelerated Capital Recovery System
BRI	Basic Rate Interface
CLEC	Competitive Local Exchange Carrier
CO	Central Office
CPE	Customer Premises Equipment
CTI	Computer Telephony Integration
DISA	Direct Inward System Access
GUI	Graphical User Interface
ILEC	Incumbent Local Exchange Carrier
ISDN	Integrated Services Digital Network
KTS	Key Telephone System
LAN	Local Area Network
LEC	Local Exchange Carrier
MAC	Moves, Adds, and Changes
PBX	Private Branch Exchange
POTS	Plain Old Telephone Service
PRI	Primary Rate Interface
PSTN	Public Switched Telephone Network
RBOC	Regional Bell Operating Company
WAN	Wide Area Network