PC-Based Call Navigator

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الملخص

تصاحب مقاسم الهواتف الحديثة أنظمة لاستكشاف المكالمات، تقوم هذه الأنظمة بتسعير المكالمات و تحضير فاتورة لكل خط هاتف. و يهدف هذا العمل الى ايجاد نظام استكشاف مكالمات محوسب ليس قادرا على القيام بمهام المحاسبة العادية التي تقوم بها أنظمة استكشاف المكالمات الأخرى بنجاح فقـــط ، ولكنه بالإضافة الى ذلك يمكّن المستخدم العادي من الاطلاع على تفاصيل المكالمات التي يجريها عن طريق شبكة الانترنت ببساطة بدلاً من تكلف طلبها من شركة الاتصالات. كما يمكن ربط هذا النظام بقاعدة بيانات محلية بحيث يتم خصم تكلفة المكالمات مباشرة من رواتب الموظفين. النظام تم اختباره بنجاح على مقسم من نوع Panasonic في مختبر الاتصالات بالجامعة الإسلامية و من ثم على مقسم الجامعة و هو من نوع (Siemens Hicom 150 E Office Pro).

Abstract

Modern central office switches have combined call navigation systems. These systems price the calls and prepare a bill for each telephone extension. The aim of this work is to develop a PC-based call navigation system that is not only capable of performing classical call accounting tasks that other call accounting systems can accomplish successfully; but also enables ordinary users to view their call details any time they want simply by logging into the web, saving the trouble of having to ask for them from the telecommunications company. This system could also be tied to an intra company database and call bills could be discounted directly from employees' salaries. The system performance is tested on a Panasonic KX-TD1232 at the communications lab of the Islamic University of Gaza (IUG) and then on its PBX (Siemens Hicom 150 E Office Pro) and it showed outstanding results.

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1. Motivation

In 2001 the administration of the Islamic University of Gaza decided to replace its old PBX with a new modern one with larger capacity and which offers numerous features. The new telephone system, which is a small version of the phone company's larger central office switch, has a call accounting system. It is found that this system has severe problems. Hence, we decided to develop a powerful system that overcomes all these problems and that has more interesting features that ordinary call navigation systems do not usually provide.

2. Introduction

As mentioned above the proposed system was tested for performance on IUG PBX system. **PBX** stands for **P**rivate **B**ranch e**X**change. It is a small version of the phone company's larger central office switch used for routing voice and data. PBXs are located at the customer's location (hospital, hotel, university etc.) with an attendant console and are connected to the local telephone company by a common group of lines called *PBX trunk lines* [1].

The PBX acts like a telephone company switch, connecting outside callers with inside extension lines and extensions with each other as needed. It allows an organization to have fewer outside lines than extensions because it is safe to assume that not all extensions will be in use at once.

PBXs may be digital or analogue; more modern PBXs are consistently digital and can often handle digital terminals and telephones along with analogous telephones. PBXs come equipped with digital telephones that

offer dedicated function keys and ASCII display screens to access the numerous features offered by PBXs. Individual lines may have different features on them and different telephone sets attached to them.

PBXs provide switching and routing service with proprietary circuit cards located inside the PBX cabinet. Advanced PBX phone switches may include functions such as least cost routing for outside calls, call forwarding, conference calling and call accounting; they sometimes provide auto attendant, voice mail and ACD (automatic call distribution) services for the organization [2,3].

Most modern PBXs have an "SMDR port" (normally a serial port) as illustrated in Figure 1. SMDR stands for "Station Message Detail Reporting". It is the process by which a phone system logs its own operation.

SMDR creates a record of each call that originates within a system, and outputs this record through the SMDR port to the call accounting system, which can be co-located with the switch or remoted using modems. This type of systems usually consists of hardware and software. With the assumption that a PBX is already in place and working, the hardware then consists of a data capture system (a buffer box) which must be connected to the SMDR port of the PBX.

Call accounting software is a specialized database application, which records every call that is completed. Software called a call accounting package can price the calls and prepare a bill for each telephone extension.

Call detail records (CDR - the acronym for a single call record created by the SMDR process) must be output in real time because most PBXs don't

store the data. If it isn't captured when the record is created, it's gone forever.

Depending on the switch, call detail information is provided either as a single record containing all the information at the end of the call, or as a series of records which are produced as phases of the call occur. In the latter case the switch assigns a unique sequence number to each call all the records pertaining to the call contain the sequence number. The call management system then must use the sequence number to locate and accumulate all the records for each call.

There are no official or de facto standards established for call detail record formats or the data contents. The current record is typically a common set of information elements with additional elements provided depending on the switch. The common set includes: the date and time the call was placed, the call duration, the called number, the extension placing the call, and the outbound circuit used. Additional elements include: an accounting or billing code, attendant or directly dialed indicator identification of any shared switch hardware that was used, a reason why the call was attempted but not completed and indicators that transmission of data occurred. If inbound calls are also recorded, then additional elements include: inbound circuit caller identification by ANI and ISDN information.

The add on call accounting systems compete for customers by offering a wide range of reports, formats, data selection methods and display outputs. The standard list of report choices include: call by call detail by time, by extension and trunk circuit, busy hour, plus summaries by extension, department, account code, trunk circuit, and trunk group. These same reports are offered in a weekly, bimonthly, monthly and

yearly version. Bar, pie and line graphic charts, and histograms are common alternative formats to the standard analytical printed reports.

Call cost information may be included in the reports with the cost calculated from a current tariff database. The report may be used directly for billing or for comparison of used facilities versus the alternative tariff facility.

Exception reports, if available can provide very beneficial information. Exception reports can list those calls with call durations longer than a specific length or greater than a specified cost. Exceptions can also show those extensions where more calls than a specified amount were made plus the total calls made to specified numbers. The reports can be used to detect misuse, high or low volume traffic pattern to areas that may require network reconfiguration and facility changes. Exception reports can also indicate switching hardware and trunk circuit problems. Trunk circuits which consistently carry many calls with very short durations or very few calls but very long durations when compared to other circuits in the graph are indications of problems in switch hardware or trunk circuit.

3. The Call Explorer

The Call Explorer is the telephone call management system of IUG PBX system [4]. It should analyze information about telephone calls made through the system and collect Call Detail Records (CDR) generated by telephone calls. Data collected by the Explorer is stored in a Database in a PC and is used for producing analysis reports and graphs on all telephone activity. This information is used by the system administrator to obtain management reports and graphics and help him ensure the available telephone resources are used efficiently while maintaining a high quality of service.

When PBX detects a call, it sends the data of the call to the Call Information Server (CIS). Normally the scheduler of Explorer [4] connects to CIS once a day, downloading all the new calls in it. The Explorer connects to the CIS directly or via a modem. CIS is communicating directly with the PBX. When a call arrives into the PBX it sends notification to the CIS which stores the call data into its battery secured memory. So, the CIS is actually a call buffer between a PBX and a PC. The amount of calls the CIS can buffer depend on how much memory is installed into it.

The call database is the part of Explorer which holds all the call data which is imported from the CIS. When producing reports, the data for them is fetched from the database.

In most cases one doesn't want to see all the data from the call database in reports, but to analyze specific call information. For example, calls during certain hours in a day, just outgoing calls, calls that cost more than a specific value, etc. Filters are used to provide that function. When generating reports, all calls will go through a filter accepting only calls that match the filter parameters.

The call management system that came with PBX "the call explorer" program doesn't work in a proper way concerning the following points:

The system is not user friendly i.e. you cannot use it easily on any PC. Each PC has a computer ID and a corresponding license key that should be ordered from its company in order to access its full options. Without it, it works in a demo mode. So each time one formats his own PC or installs the program on a new PC has to order a new license key.

It should connect to the CIS automatically once a day downloading all new calls. Unfortunately when it is scheduled to do so; it is corrupted and an error message appears. So the data is collected manually every two weeks and this obviously is an annoying process. This may be due to the heavy traffic imposed on a system like the university's. The system may prove to be efficient on a smaller scale system.

The program should be able to price calls according to a pricing file prepared with the current prices from the telecommunication company. Unfortunately the prices, which are correct when tested, do not apply accurately to actual calls.

Some calls are recorded by mistake to accounts that are not currently present. For example, not a small quantity of calls was recorded to account 00000000 which is not a valid account.

The system logs all calls made through the system including internal and external calls. A thing that imposes constrains and heavy traffic on the system as there's no need to log internal calls. Only external calls should be logged for billing purposes.

4. Description of the proposed system.

The PBXs handled in this work provide call detail information records in ASCII format. A PC connected to the RS232 port can be used to capture the records by means of a program. Any programming language may be used to design the capture software. However, we adopted Visual Basic as it is a popular language that has a simple syntax. Moreover, it provides an efficient support for accessing databases and it comes with a powerful development environment with several user-friendly debugging facilities.

In Visual Basic, the **MSComm** control provides serial communications for applications by allowing the transmission and reception of data through a serial port [5]. Selecting "Comm1" to be the name of this control, the following code may be used to open and initialize the serial port COM1 to be compatible with the Siemens PBX:

```
Comm1.CommPort = 1
Comm1.Settings = "9600, n, 8, 1"
Comm1.PortOpen = True
```

The MSComm control's OnComm event is used to trap and handle the CDRs. To store all received CDRs in an Access database table "TblOnline" which has a text field named "CDR" the following code may be used:

```
Private Sub Comm1_OnComm ()
Set R0 = DB.OpenRecordset ("TblOnline")
    R0.AddNew
    R0!CDR = Comm1.Input
    R0.Update
End Function
```

One may add code to split the CDR fields and store them in a database table (Tbl) as shown in Figure 2. Sophisticated reports may be produced depending on the organization needs.

5. Call monitoring using the web

Once the call detail information is captured on a database, it is easy to let customers monitor their reports using the web. While there are many techniques available to accomplish this task, we adopted the Active Server Pages (ASP). It is a server-side design environment that can be used to create engaging, real-world Web applications. An ASP page is an HTML page that contains server-side scripts that are processed by the Web server before being sent to the user's browser. Unlike conventional

Common Gateway Interface (CGI) applications which are difficult to create [6], ASP is designed to greatly simplify the process of developing Web applications. With just of few lines of script one can add database connectivity or advanced customization features to your Web pages. With ASP ordinary Web scripting languages such as Microsoft Jscript [7,8], Microsoft Visual Basic (VBScript) [9,10], or any COM compliant scripting language can be used.

A common use of intranet and Internet server applications is to process a form submitted by a browser. With ASP, scripts written in VBScript can be embedded directly into an HTML file to process the form. ASP processes the script commands and returns the results to the browser. For example, the following HTML code creates a simple form to request user phone information:

```
<font size="4" face="Arial, Helvetica">
     <b>The Islamic University of Gaza</b></font><br>
     <b>Projects and Research Lab</b>
     <hr size="1" color="#000000">
<form action="info.asp" method="get">
<p>Code: <input name="Code" size="20"><input
type="submit"></p>
</form>
```

When browsed it looks as shown in Figure 3. Like all HTML forms, this one sends the data to the Web server as pairs of variables and values. For example, the number the user types in the Code text box is assigned to the variable named Code. ASP provides built-in objects that can be used to access the variable names and values submitted by a form. The info.asp file which manipulates the user request and displays the required phone calls information is written below.

```
<%@ LANGUAGE = VBScript %>
<HTML>
 Code: <% = Request.QueryString("Code")%> <BR>
 <% Dim oConn : Dim oRs : Dim filePath : Dim Index : Dim Code
 Code = Request.QueryString("Code")
 filePath = Server.MapPath("data.mdb")
 Set oConn = Server.CreateObject("ADODB.Connection")
 oConn.Open "Provider=Microsoft.Jet.OLEDB.4.0;Data Source=" &
filePath
 Set oRs = oConn.Execute _
 ("SELECT Date,Time,Ext,Duration,Des From Tbl where Code='"&Code&"'")
 %> <TABLE border = 1>
    <tr><TD bgcolor="#FFFF99">Date</TD><TD
bgcolor="#FFFF99">Time</TD>
    <TD bgcolor="#FFFF99">Ext</TD><TD bgcolor="#FFFF99">Duration</TD>
    <TD bgcolor="#FFFF99">Dest</TD></tr>
    <% Do while (Not oRs.eof) %>
    <tr><% For Index=0 to (oRs.fields.count-1) %>
    <TD VAlign=top><% = oRs(Index)%> </TD><% Next %></tr>
    <% oRs.MoveNext : Loop %>
    </TABLE>
 <% oRs.Close : oConn.Close %></BODY>
</HTML>
```

Figure 4 shows the generated report for the calls issued by the user whose code is 6598.

6. Comments, conclusions and suggestions for future work

In this work we studied IUG PBX call management system and discovered its limitations and problems. We then developed an alternative PC based call management system that overcomes obstacles which encountered the previous system and that offers new features for the convenience of employees. The system is not suited only for PBXs, but it is also applicable to central office switches.

The bases used for developing the capture software are almost common for all switching offices. However, the developed software is system dependent as it is designed for a specific CDR format. The source code of the software may easily be modified to be compatible with various switching offices.

In a future work we plan to study tying this system to a bank database so that ordinary users may benefit and call bills discounted directly from their accounts.

References

[1] Fraidoon Mazda, switching systems and applications, MPhil DFH CEng FIEE, 1996.

[2] http://raventechnologies.virtualave.net/telecomm/pbx/1.htm.

[3] http://www.itl.nist.gov/lab/bulletns/bltnaug00.htm.

[4] Siemens Inc., "Call Explorer user manual", 02/99.

[5] http://www.physics.brandeis.edu/phys32b_2002/MSComm.doc.

[6] http://www.drbob42.com/books/cgi.htm.

[7] http://cobdev.isu.edu/psb/jscript/jstutor.htm.

[8] http://www.iei.uiuc.edu/JS4LL/resources.htm.

[9] http://www-scf.usc.edu/~csci571/Special/vb_examples.html.

[10] http://csu.colstate.edu/webdevelop/vbscript/index.htm.

PBX
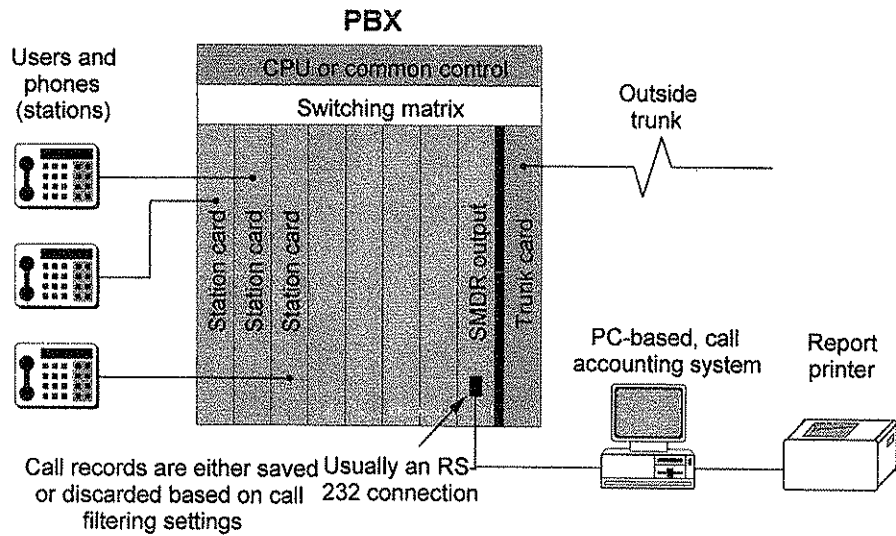
Figure (1) Connection between the call accounting system and the PBX.

Date	Time	Ext	Duration	Des	Code
07.09.02	09:40:22	2800	00:01:59	2860747	2894
07.09.02	09:40:53	2212	00:03:59	2847896	2335
07.09.02	09:42:45	2914	00:02:35	059787833	6598
07.09.02	09:44:54	2625	00:01:42	2052628	7956
07.09.02	09:45:26	2624	00:03:18	2554282	9213
07.09.02	09:45:27	2918	00:01:19	059714770	3235
01.02.00	19:56:52	1114	00:02:45	2130140	7895
01.02.00	20:00:38	1122	00:02:13	2067566	4589
01.02.00	20:04:39	1407	00:08:28	2538381	6598
08.09.02	12:46:40	2380	00:02:59	2862123	6598
08.09.02	12:47:04	2890	00:01:47	059732983	9812
01.02.00	20:59:01	1480	00:03:37	2879261	3289
01.02.00	20:59:46	1243	00:02:09	2457497	2156
08.09.02	12:48:11	2617	00:05:53	2871826	3267
08.09.02	12:48:13	2551	00:02:23	022826588	6598
01.02.00	21:00:13	1460	00:02:55	2457379	8722
08.09.02	12:49:06	2380	00:01:07	2050923	2366

Record: 18 of 18

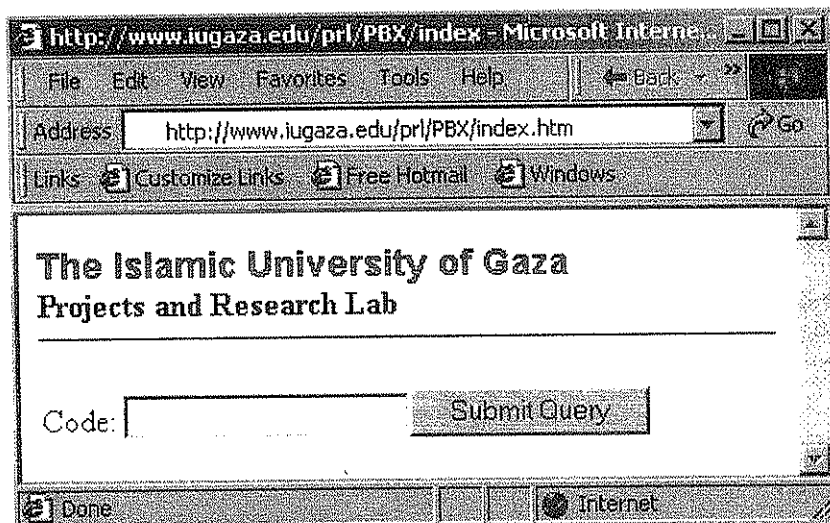Figure (2) Call details records are stored in a database table

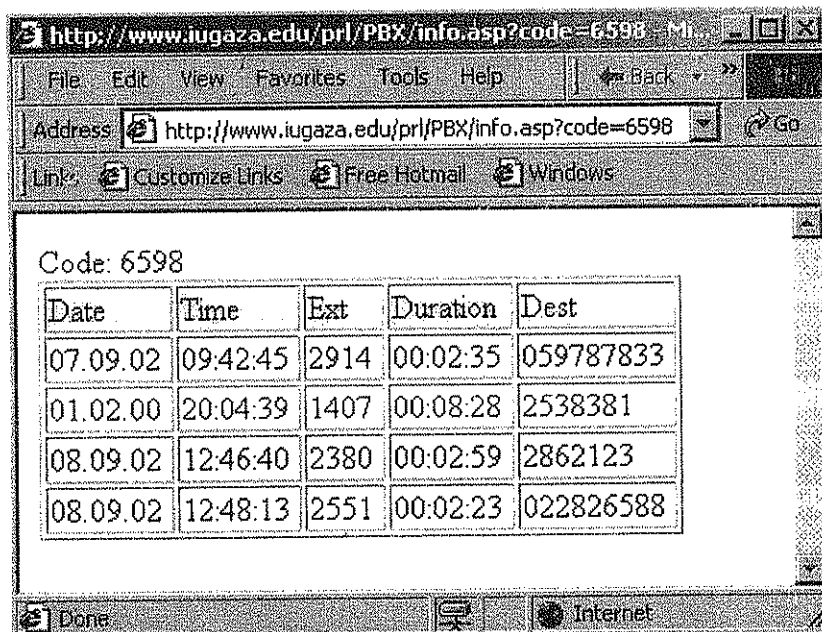Figure (3) The phone information query Web page.

Figure (4) A Sample showing the generated response for the user code 6598