

## E.R. – An Electronic Telephone Receptionist

Jerry Fitzpatrick

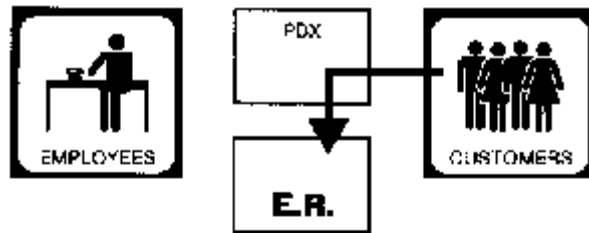
**E.R.** is an electronic telephone receptionist which enhances business communications by connecting callers to the appropriate person within a company. To achieve this, E.R. combines electronic voice and computer technologies to answer and process telephone calls coming into the company's PBX or CENTREX. By reducing switchboard blockages and missed calls, E.R. helps businesses provide a fast, professional response to their calls.

E.R. works best in specialized applications, such as customers calling into a field service department. By selecting a particular group of users, the system can be scaled to fit the application's needs instead of the much wider demands of the general public.

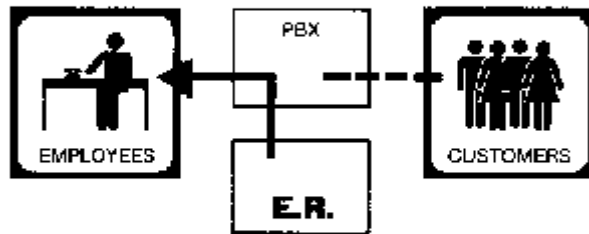
### What Does E.R. Do?

In its simplest mode of operation, the system transfers calls exactly like a switchboard operator (Fig. 1). Let's say you call E.R. to contact Bob Daley. E.R. answers with, "Hello. This is E.R. Who are you calling please?" Using your touch-tone phone, you enter the digit string B-D-A-L (2325), which is Bob's ID code. E.R. then politely asks you to wait and tries to call Bob. Before long, E.R. finds him, connects the two of you together, and drops out of the loop to wait for the next call.

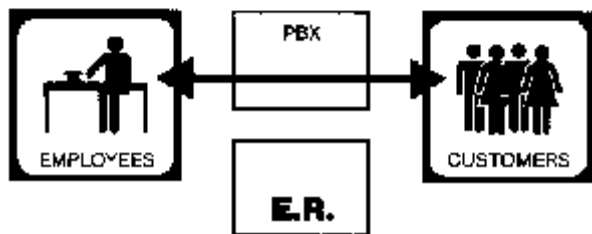
Fig 1 – E.R. transfers the customer to the employee



1. Customer calls E.R. and asks for employee.



2. E.R. puts the customer on hold and searches for employee.



The use of alphabetic ID codes has two advantages over extension numbers. First, it is easier to remember someone's name than their extension. Second, a person's name rarely changes, whereas extension numbers change frequently in a dynamic, growing organization.

Transferring a telephone call is a very useful function. The typical phone system, though, only lets you ring the phone on someone's desk. It's not surprising then that only 10-20 percent of all business calls get through to the receiver. E.R., however, enhances the phone system by trying *to locate the intended recipient of the call*. The key to E.R.'s call-completion success is its ability to use a programmable schedule to determine the most likely location of the person being called.

### Day After Day

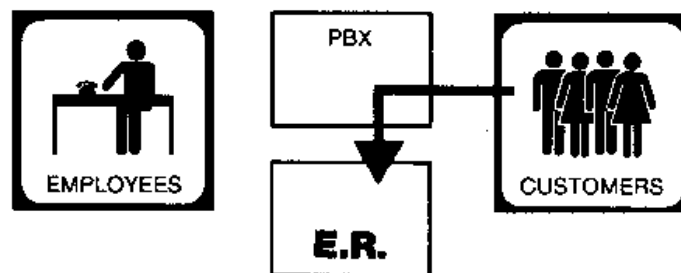
People really *are* creatures of habit. From 9:00 – 10:00 every Monday morning you're in a staff meeting and don't want to be interrupted. From 12:30 – 1:30 PM each day, you're usually eating a sandwich in the lunch room. The rest of the week you're in your office or, if not, you're probably in the drafting department. By recognizing these patterns and permanently scoring the information in E.R., you improve your chances of receiving important calls from friends, associates, and customers.

But what about those times you're waiting for an important phone call and have to leave for an unexpected meeting? Normally, if your PBX has call-forwarding feature you could forward your phone. Unfortunately, you have to know the phone number you can be reached at, and do the forwarding before leaving your desk. In contrast, E.R. lets you call from virtually anywhere (e.g. the meeting room you end up in) and make temporary changes to your default schedule. In fact, you can update this information as far as 24 hours in advance, telling E.R. where you will be, and how long you will be there.

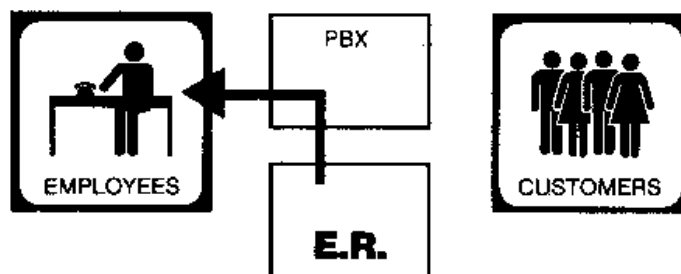
### The Best Laid Plans

What happens when E.R. can't find you? It takes a message just like a good secretary or receptionist would (Fig. 2). Whenever the system is unable to find you, it asks the caller if he wants to leave a message. If so, he can leave his telephone number and/or a voice recording.

Fig 2 – E.R. takes and automatically delivers messages



1. Customer calls E.R. and leaves a voice message for employee.



In voice mail systems, messages generally wait for someone to retrieve them. Unlike voice mail, E.R. knows that your time is valuable and that you have an important message waiting. Moreover, E.R. knows where you're likely to be, and *actively tries to deliver the message to you*. Thus you can retrieve your messages by calling E.R., or by it calling you.

### Who Should I Call?

There are, of course, times when a caller doesn't know precisely who he wants to talk to. For example, let's say you and your associates are experts on your company's High-Tech machine. Customers having a problem with their High-Tech can call your E.R. "hotline" and, by entering the group's ID code (e.g. HT for High-Tech), talk to a member of your group. The system will call each member of the group in turn until one of them becomes available, or until the caller can no longer wait. Groups can be arranged to distribute calls evenly between the members, or prioritize the members by calling them in a particular order.

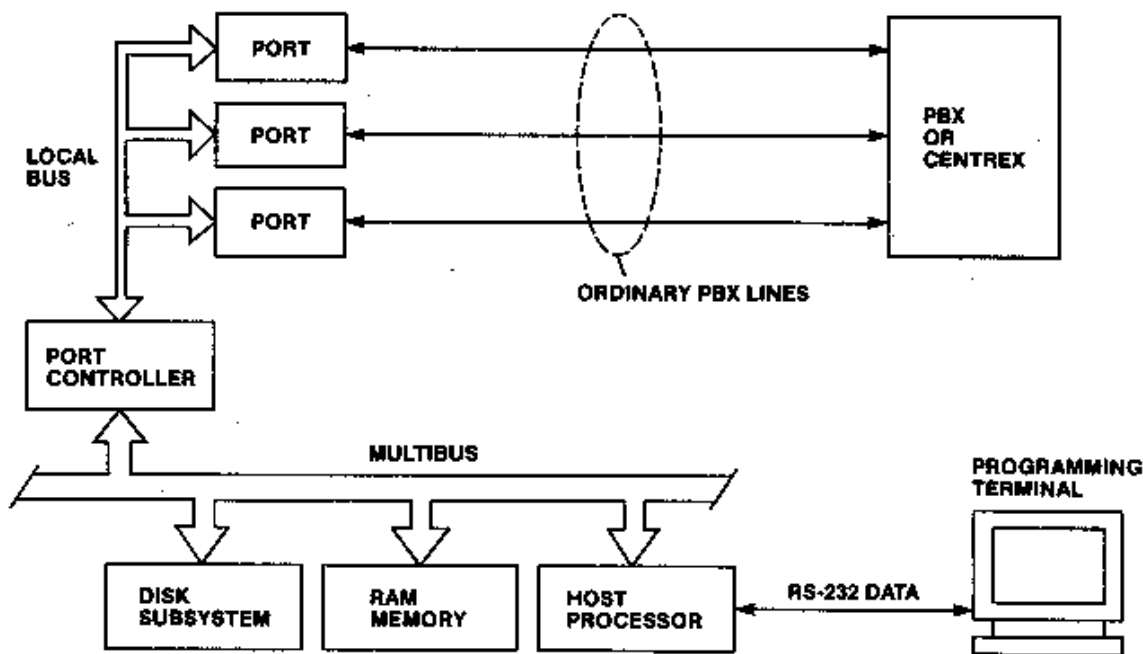
For maximum flexibility, E.R. is usually connected to a PBX rotary-hunt or ACD group, and is accessed via a direct-inward-dial or similar line. Thus you can call E.R. directly from inside or outside the PBX to make calls, leave messages, and change your schedule.

### Inside The System

E.R. is a compact 16" x 11" x 25". There are external connections for AC power, modular jacks for the PBX lines, and an RS-232 port for the programming terminal. Fig. 3 illustrates the system's architecture.

The system's hardware comprises a *host processor* which controls the overall system. Using an 8086 microprocessor, it provides Multibus access, interrupt control, programmable timers, a real-time clock, and the RS-232 port.

Fig 3 – E.R. architecture



The interface to each PBX line is provided by a *port*. Each port provides switchhook control, call progress tone detection, DTMF generation and reception, and codec circuitry. The coded uses CVSD modulation to digitize speech at 24,000 bits per second, providing storage and reproduction of very high quality voice messages and system vocabulary.

The *port controller* handles the flow of control signals and digitized speech to and from the ports. It uses an 8088 microprocessor to manipulate data, perform calculations, and communicate with each port via the local bus.

A 640K byte RAM memory is used for temporarily storing running programs, program variables, and digitized speech.

The disk subsystem consists of a hard disk driver, a floppy disk drive, and a disk controller. The 5¼" floppy disk driver is used for program backup and updates. The 5¼" hard (Winchester) disk stores all of the system's programs. It also stores user schedules, system vocabulary, and voice messages. It is interesting to note that the disk storage capacity can be considerably less than voice mail systems because E.R. is good at finding people and delivering their messages.

As regards software, all programs in E.R. run under control of the MP/M-86 operating system (the multi-tasking version of CP/M). All of the programs were written in C-language, except for a few time-critical routines in the port controller.

The software consists of two main parts: the Virtual Operating System (VOS) and the E.R. application task. The VOS provides a convenient and powerful structure for controlling voice processing and telephone lines. Communications between the VOS and application programs takes place via small queues or "mailboxes". The E.R. application program provides the personality of the system. By putting "letters" into the appropriate VOS queues, it is able to speak, answer the phone, and perform other receptionist functions.

### **Applications**

E.R. can be effectively used by almost any organization wanting efficient, high-quality call coverage. For example, a company needing to expand its customer service availability could provide 24-hour phone coverage by having E.R. transfer calls or problem reports to the service agent, regardless of his or her location. Other organizations could use the system to handle sales orders, or to direct customer inquiries to the best person to handle the question. Communications between field-based dealers or salesmen, or between plant and branch offices can also be improved, particularly when they are situated in different time zones. The number of direct-inward-dial trunks can also be reduced because E.R. gives callers access to people inside the plant.

### **E.R. In Action**

For about fifteen months now, Teradyne has been using a three-port E.R. to fully understand and refine its operation. For the past eight months this system has been recording details about call-ins, messaging, and system operation.

Traffic analysis shows that this E.R. can support approximately forty calls per hour with a blocking probability of P0.01. Our test group of 100 users have created this level of traffic less than 3% of the time.

To date, E.R. has logged over 6000 call-ins. About 33% of the callers got through to their party, in contrast with the 20% normally ascribed to telephone usage. Another 36% did not get through, but left a message for their party. The remaining 31% also failed to get through, but apparently decided that a message wasn't necessary. For unknown reasons, this one-third split has proved remarkably consistent – even over a week's time!

The statistics also show that messages remain in the system an average of only 120 minutes, due mainly to E.R.'s active delivery feature. This suggests that there are a few messages being held by the system at any given time. Although we cannot directly monitor instantaneous disk usage, we have never exceeded five megabytes (about fifty average messages). This is quite impressive considering that well over 2000 messages have passed through the system!

Photo of E.R.system

