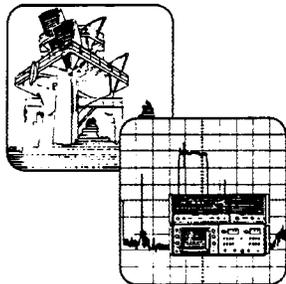


9-1-1 Technology

Management Briefing Number 4

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This short paper discusses the various 9-1-1 system technologies available. It is done as an aid to managers and others with limited technical knowledge of 9-1-1 systems. The use of some telephone jargon and terminology is unavoidable, but terms are explained as needed.

INTRODUCTION

9-1-1 has become the recognized standard as *the* national emergency number. Television shows such as "Rescue 9-1-1" have raised the awareness of 9-1-1 to the point that a large share of the population quickly identifies 9-1-1 as *the* emergency number. Such television programs also show the entire process of handling a 9-1-1 call. Citizens have come to think of 9-1-1 as the whole process from the call to the arrival of the emergency responder. This complicates the discussion of 9-1-1 technology because items such as computer aided dispatch (CAD), mobile data terminals (MDTs), and other high technology are not part of the 9-1-1 system even though they appear on television.

9-1-1 systems have evolved over the last two decades from relatively simple systems to very complex systems involving both telephone and computer technology. This note will discuss the three most common types of 9-1-1 systems: basic 9-1-1, 9-1-1 with automatic number identification (ANI), and enhanced 9-1-1. As with all technologies, 9-1-1 technology is rapidly progressing. What was not possible last year may actually be in the process of installation today. The exact technology chosen by an agency may vary a little but will likely be based on the systems described here.

As system complexity and capability goes up, so does the price. Basic 9-1-1 ((B)9-1-1) systems generally cost the least, 9-1-1 systems with ANI are the next most expensive, with Enhanced 9-1-1 ((E)9-1-1) being considerably more expensive than either alternative. Figure 1 shows the relative cost of the various types of systems.

SYSTEM ELEMENTS

Any 9-1-1 system is made up of two basic elements. The telephone network and the equipment located at the Public Safety Answering Point (PSAP). A PSAP is the point at which the 9-1-1 call is answered. The call may or may not be dispatched at the PSAP.

The telephone network is the heart of any 9-1-1 system. The telephone network connects the

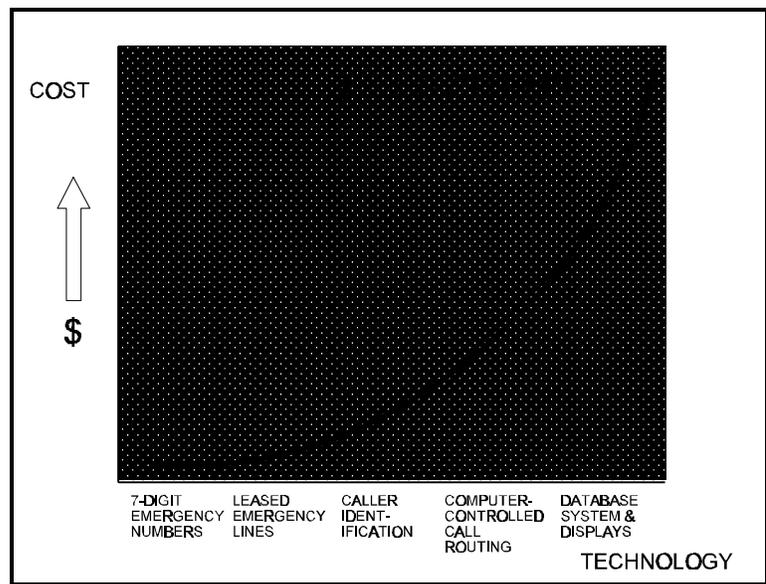


Figure 1 - Technology comes at a cost.

9-1-1 caller to the PSAP. This network can be very simple in a basic (B)9-1-1 system to quite complex in an enhanced (E)9-1-1 system. This portion of the system must be provided by the telephone company. It often requires special equipment or software at the telephone company central offices. A central office is the equipment that "reads" the digits dialed by a caller and determines where to send the call.

A PSAP has equipment that is connected to the telephone lines to answer and handle the 9-1-1 calls. This equipment can range from fairly simple telephones for (B)9-1-1 to complex systems connected to computers for (E)9-1-1. There are very many choices available from equipment vendors for PSAP equipment, which may or may not be purchased from the telephone company. Many agencies prefer to purchase the equipment from the telephone company, so one vendor is responsible for the whole system. Each agency will have to determine what is the best approach for their own situation.

There is actually a third element, used only with (E)9-1-1 systems. That is a computer data base system that contains the addresses associated with the telephone numbers in the service area covered by the (E)9-1-1 system. Though considered by some to be part of the telephone network portion, it is really a distinct data processing function that can be operated either by the telephone company or by another organization. This computer system can be very large, with millions of addresses, or it can be a personal computer with only a few thousand addresses. The data base source is the telephone company that develops the information from their billing records and usually considers the data base proprietary to them. A single data base may serve several (E)9-1-1 systems.

TECHNOLOGY

The 9-1-1 call process starts with the citizen dialing "9-1-1" from a telephone. This telephone is connected to a telephone company switching center called a "central office." The central office (CO) determines where to send the call based on the number dialed. If the number dialed is 9-1-1, the central office will route the call as determined by the design of the system. The calls are routed differently depending on the type of 9-1-1 system installed. The caller is connected to a PSAP on special 9-1-1 lines. The PSAP call answering personnel know that the incoming call is a "9-1-1" call and that it is likely an emergency.

There are three basic types of 9-1-1 systems. They are:

Basic (B)9-1-1 - No telephone number or address display.

9-1-1 with Automatic Number Identification (ANI) - This system provides the call answerer with the telephone number of the calling party. This system is sometimes called (C)9-1-1. It may route calls in a manner similar to either (B)9-1-1 or (E)9-1-1 depending on the system design.

Enhanced (E)9-1-1 - This system provides the telephone number, address display, and automatic routing of the call by the caller's location. (This automatic routing is known as selective routing.)

Figure 2 shows how selective routing makes (E)9-1-1 much more effective in areas where there is more than one PSAP. With (B)9-1-1, all of the telephone lines associated with a particular central office must go to the same PSAP. As Figure 2 (top) shows, the lines in Jones City that are connected to the Smith County central office must go to the county sheriff's PSAP. An (E)9-1-1 system allows 9-1-1 calls to be routed to the correct dispatch center based on the callers address as shown in Figure 2 (bottom).

Figures 3 and 4 show the difference between (B)9-1-1 and (E)9-1-1 telephone networks. One of the major differences between (B)9-1-1 and (E)9-1-1 is that there is an intervening telephone company switching system between the central office used by the caller and the PSAP. This extra switching system is used to provide the automatic routing of calls based on the caller's telephone number, quick call transfer to agencies not dispatched by the PSAP, and trunk concentration. Trunk concentration allows many trunks from the remote central offices to be concentrated into fewer trunks that actually go to the PSAP. ANI can be used with 9-1-1 systems that are either direct trunked (most (B)9-1-1 systems) or that use the intervening switching office. (E)9-1-1 systems also have a large data base (ALI/DMS) that contain all of the address information.

Basic 9-1-1 systems may have the following features:

- Called party hold. This feature gives the PSAP the capability to maintain the connection after the calling party hangs up. This is especially helpful in tracing calls. Examples where this might be useful are false alarms or where a person in need of assistance hangs up before giving his or her address.
- Ring-back. This feature allows the PSAP to ring a hung-up telephone that has been placed on a "hold circuit." This feature is useful when the calling party has not provided all the information necessary for a proper response by a public safety agency before hanging up.

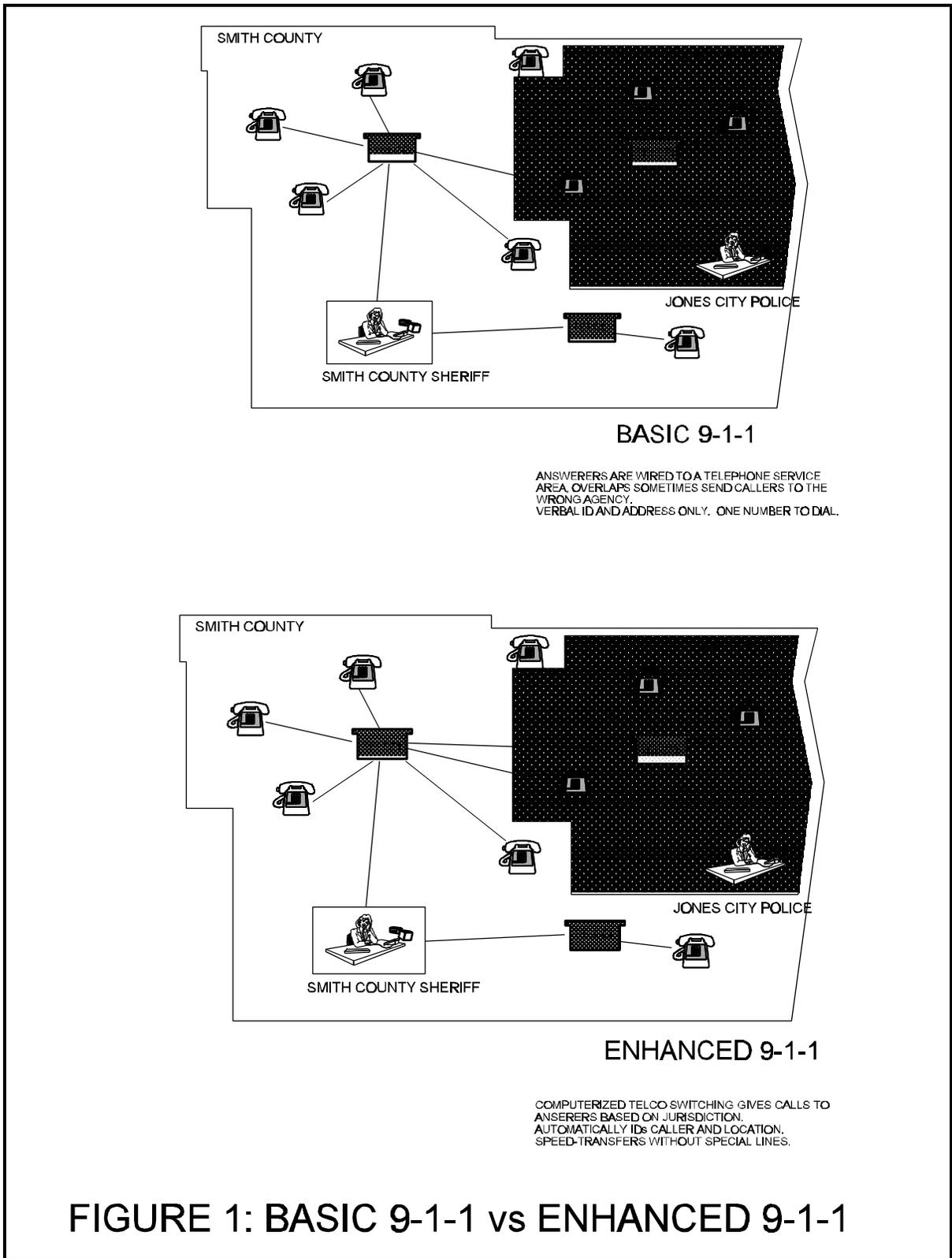


Figure 2

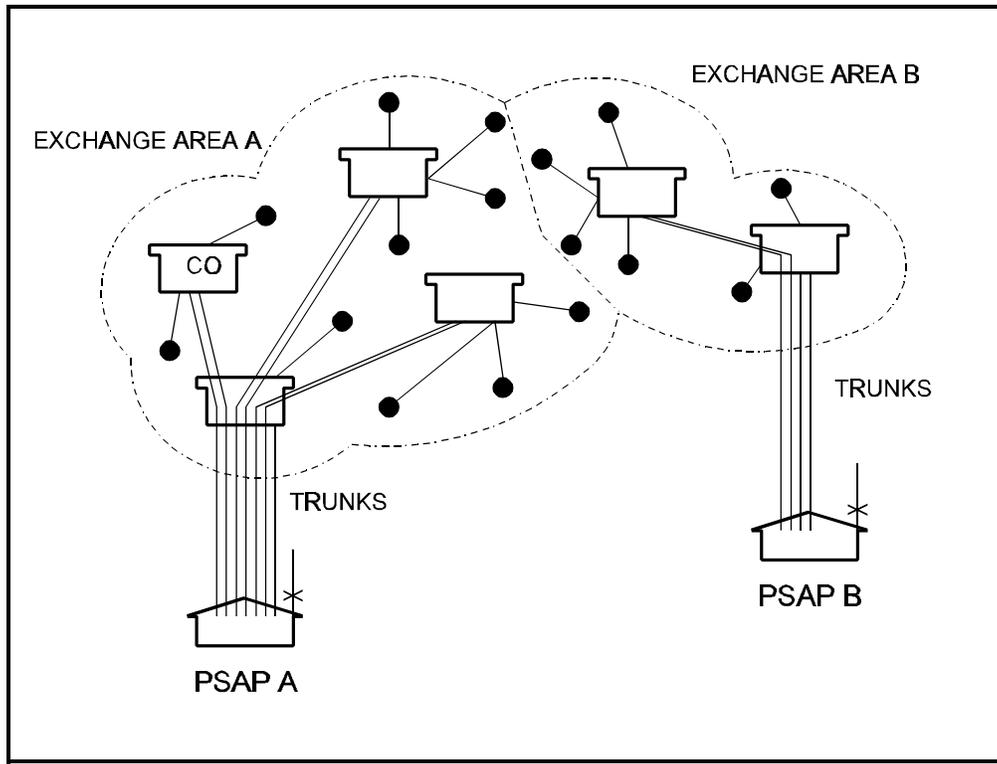


Figure 3 - Basic 9-1-1 trunks run from each central office to an associated PSAP

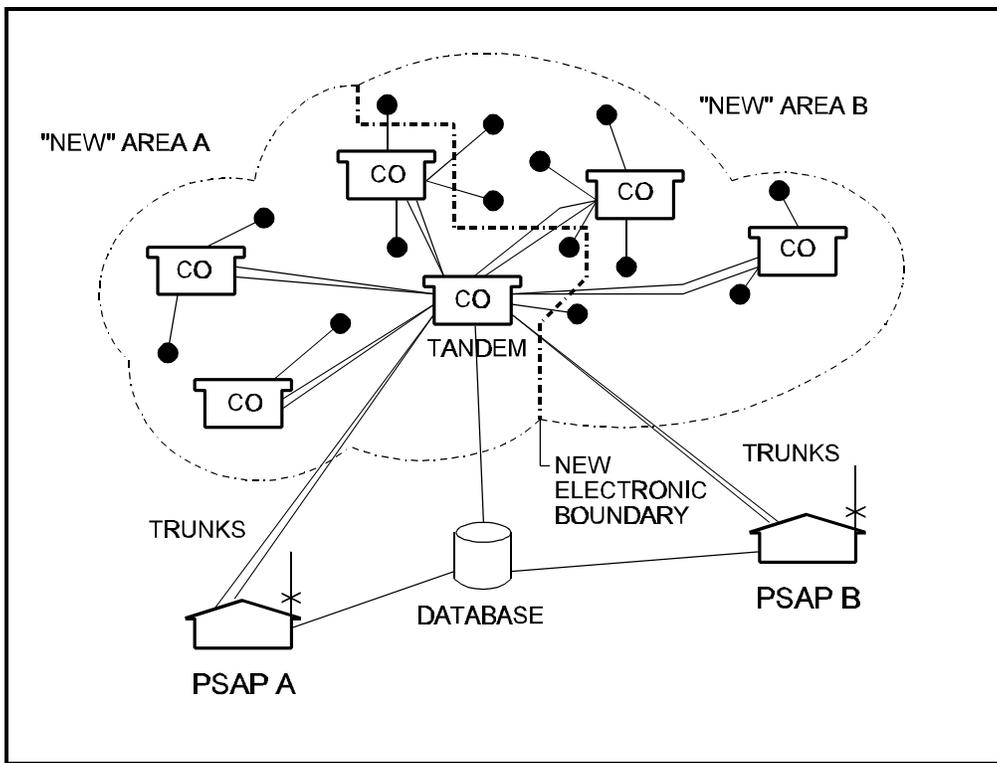


Figure 4 - Enhanced 9-1-1 trunks are gathered at a telco tandem switching center and concentrated calls delivered to the PSAP designated by political boundary

- Forced Disconnect. This feature allows the PSAP to disconnect a call to avoid jamming the incoming phone lines. It is especially helpful when a person has had to leave the phone before hanging up—in prank calls or with malfunctioning automatic dialers (alarms).

Enhanced 9-1-1 systems have the following features:

- Automatic Number Identification(ANI). This feature displays the telephone number of the caller as it is known to the telephone company. In general, the telephone number is displayed for all single-party telephones, business main numbers, single-line businesses, and many Centrex/Centron/CentraNet numbers. The system generally will not identify numbers from multiparty lines and from individual telephones behind a PBX.
- Automatic Location Identification(ALI). This feature displays the address associated with the telephone number displayed by the ANI display. If the ANI display is not present or is incorrect, the ALI will be correspondingly displayed or be incorrect. The ALI information is generally taken from the telephone company records and, therefore, may not be 100 percent accurate.
- Selective Routing. This feature allows a call to be routed to a particular PSAP depending on the address in the ALI data base. This allows calls to be routed by political jurisdiction not just by central office boundaries.

PSAP EQUIPMENT

At the PSAP, equipment is required to answer the incoming 9-1-1 calls. This equipment can be fairly simple for a (B)9-1-1 system and very complex for an (E)9-1-1 system in a large PSAP.

Figure 5 shows the basic equipment configuration for (B)9-1-1. The telephone lines are terminated on a telephone set that can answer standard telephone lines. This can be a simple pushbutton key system to a large PBX with many features. In addition to a telephone set, most PSAPs also have a logging recorder to provide record tapes of each telephone call, an instant-recall recorder to provide immediate playback of a garbled telephone message, and a TDD for communicating with hearing impaired callers. A TDD is now required by the Americans with Disabilities Act (ADA).

Figure 6 shows the basic equipment configuration for an (E)9-1-1 system. In most cases, special enhanced 9-1-1 equipment (known as an ANI controller) is installed between the telephone lines and the PSAP telephone system. This equipment receives the ANI signals from the central office.

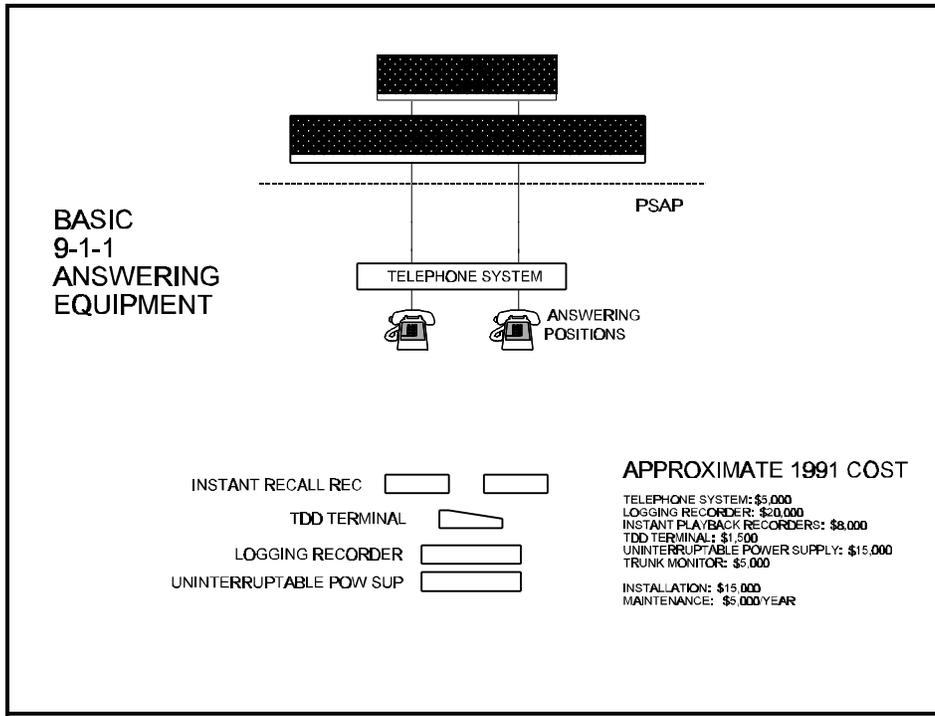


Figure 5 - Answering Basic 9-1-1 calls requires simple, reliable equipment

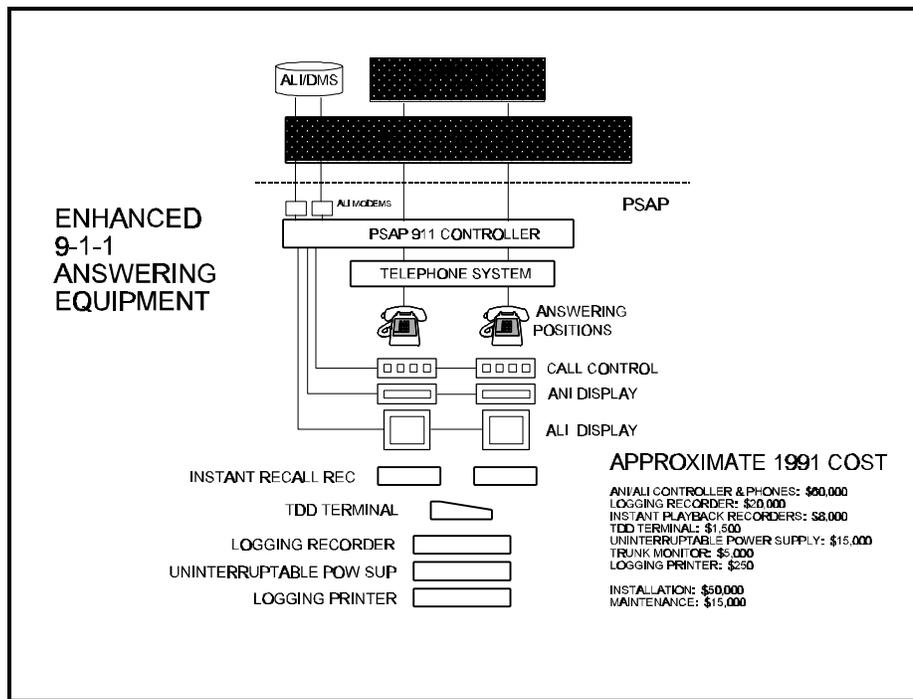


Figure 6 - Enhanced 9-1-1 answering points require additional equipment for gathering and displaying caller data

This equipment then determines which operator position actually answered the call and sends the ANI data to that position's ANI display. At the same time, the ALI controller sends a request to the ALI data base for the name and address associated with the telephone number shown on the ANI display. When this information is received by the ALI controller from the ALI data base, the ALI controller routes it to the proper answering position. Some newer telephone systems have the ANI controller incorporated into them.

The support equipment (e.g., logging recorders, etc.) for an (E)9-1-1 PSAP is generally the same as for a (B)9-1-1 PSAP except that logging printers are usually part of the (E)9-1-1 ANI and ALI controllers.

(C)9-1-1 (9-1-1 with ANI) often uses the same ANI controller as is used with (E)9-1-1. One might ask why only install (C)9-1-1 when (E)9-1-1 is so much better. The answer is that to implement (E)9-1-1 requires a unique address for each location in an area served by (E)9-1-1. Using postal rural routes, post office boxes, and other nonunique methods of identifying a location will not work. In many areas, this requires completely addressing the county and cities. In many cases, citizens may need to have their addresses changed to avoid conflicting and duplicate addresses. This can be a very political process and usually requires 1 to 2 years. (C)9-1-1 is often used as an interim solution until the addressing and data base can be put into place.