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Access Area Switching and Signaling: Concepts, Issues, and Alternatives

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PREFACE

The study, whose results are presented in this report, was supported by the U.S. Army Communications Systems Agency (CSA), Ft. Monmouth, New Jersey, under project order no. 501-RD. Administration and technical monitoring of the program was performed for the agency by L.H. Wagner (U.S. Army, CSA). Technical and management supervision at the National Telecommunications and Information Administration/Institute for Telecommunication Sciences was provided by Dr. P. McManamon.

This report is part of a series prepared for CSA in support of the Access Area Digital Switching System (AADSS) program. Previous related reports have dealt with parametric cost alternatives for local digital distribution systems, as well as with preliminary switching hub evaluations, for the military base environment. This report covers two topics. It describes an example of a stored program controlled digital PABX switch suitable for the access area. It reviews signaling functions and methods that are currently in common use for the remote control of switches. Subsequent reports will address more recent, as well as more complex, signaling issues and their resolution. Such complex issues arise in the planned integrated - voice plus data - communications networks. They involve such advanced signaling techniques as the common channel interoffice signaling (CCIS), and others having foreseeable impact on military switching in access areas.

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ACCESS AREA SWITCHING AND SIGNALING: CONCEPTS, ISSUES, AND ALTERNATIVES

R.F. Linfield and M. Nesenbergs*

This report covers two key tasks of the Access Area Digital Switch (AADSS) program being conducted by NTIA/ITS for the U.S. Army Communications Systems Agency.

First, a brief introduction to digital electronic private automatic branch exchanges (PABX or EPABX) with stored program control is given, followed by some examples of system design. These examples offer a background, against which AADSS switching and signaling concepts, issues and alternatives can be reviewed. Furthermore, these systems provide integrated interfaces and digital switching to local access areas of the Defense Communications System (DCS). System functions and service features are discussed and initial cost projections given for installation sizes of interest.

Second, digital and analog signaling techniques of all existing types are reviewed. The main concepts in establishing and maintaining circuit connections and other message transactions are outlined in present day and near future technology. Interface issues during the foreseeable DCS transition from analog to digital integrated systems, as well as other signaling problems in the access area, are summarized.

1. DIGITAL PABX EXAMPLE

1.1. Introduction

This discussion deals with Private Automatic Branch Exchanges, otherwise known as PABX's. The field is further restricted not only to the electronic PABX (sometimes called EPABX), but also to digital connectivity which takes advantage of the time division switching technology. By definition, a PABX provides an exchange of calls among local users, and for calls to

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and from nearby central offices and the long-distance telephone networks. In DoD communications, the local user community is typically the military base, while the telephone networks are those of DCS and the U.S. common carriers. In many foreign countries one must deal with the appropriate postal telegraph and telephone agencies.

Figure 1 illustrates the basic concept of PABX deployment to access area hubs, both remote (local) and central (head end). The hubs shown provide access area local (turn-around) telecommunications services, plus interconnections to DCS and to the end offices of the telephone companies. As shown, the hub PABX's can be directly linked by trunks.

What exactly constitutes a hub or a PABX, either physically or functionally, may be an issue for deliberation. The physical main frame at the central location may be only part of the PABX installation. Substantial hardware parts may be remoted (see Fig. 2) by distances ranging from fractions of a mile to several miles. As will be discussed later, remoting of PABX modules into terminal clusters may offer economic advantages. The individual PABX may or may not reside at any one particular private domain. Because of variously ordered processing functions along the signal path, it is unclear where a line or trunk enters or exits the PABX. Perhaps a formal designation of a line card or an interface unit as the "boundary" would be acceptable.

In the user community the central hub PABX retains more than the majority of the end-office features. Thus, at certain locations and for certain users, the new PABX offers a host of additional services, such as call forwarding, camp-on, conferencing, etc. Most of the features and functions of the older manual switches are still provided and at a higher speed. Restrictions may affect toll dialing, individual billing, and priority preempts on the PABX. Broadly, new PABX's tend to offer more commercial user features and yet remain compatible with all older telephone office systems as well as with all existing handsets. The new PABX is also said to be cost effective. The

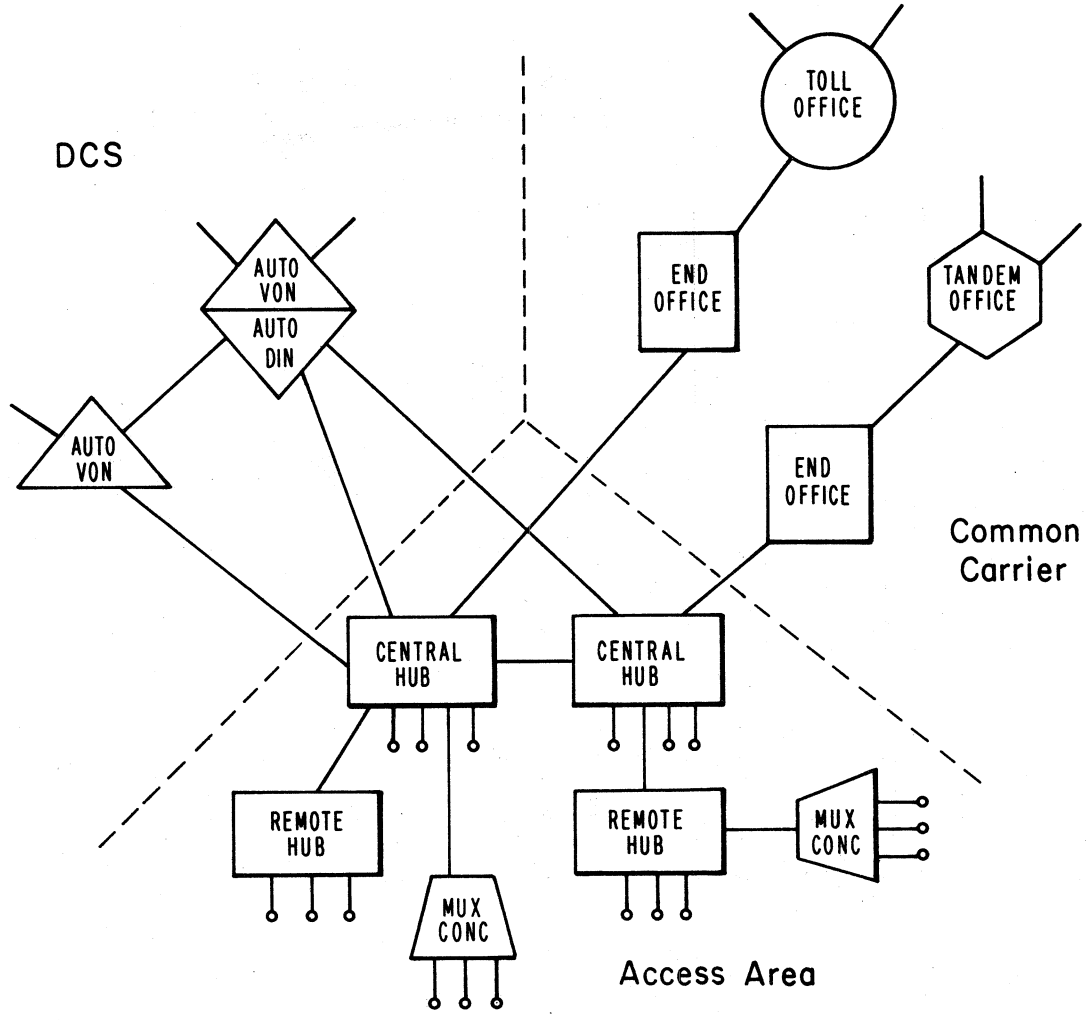

Figure 1. Basic deployment concept of access area hubs and PABX's with DCS and common carrier networks.

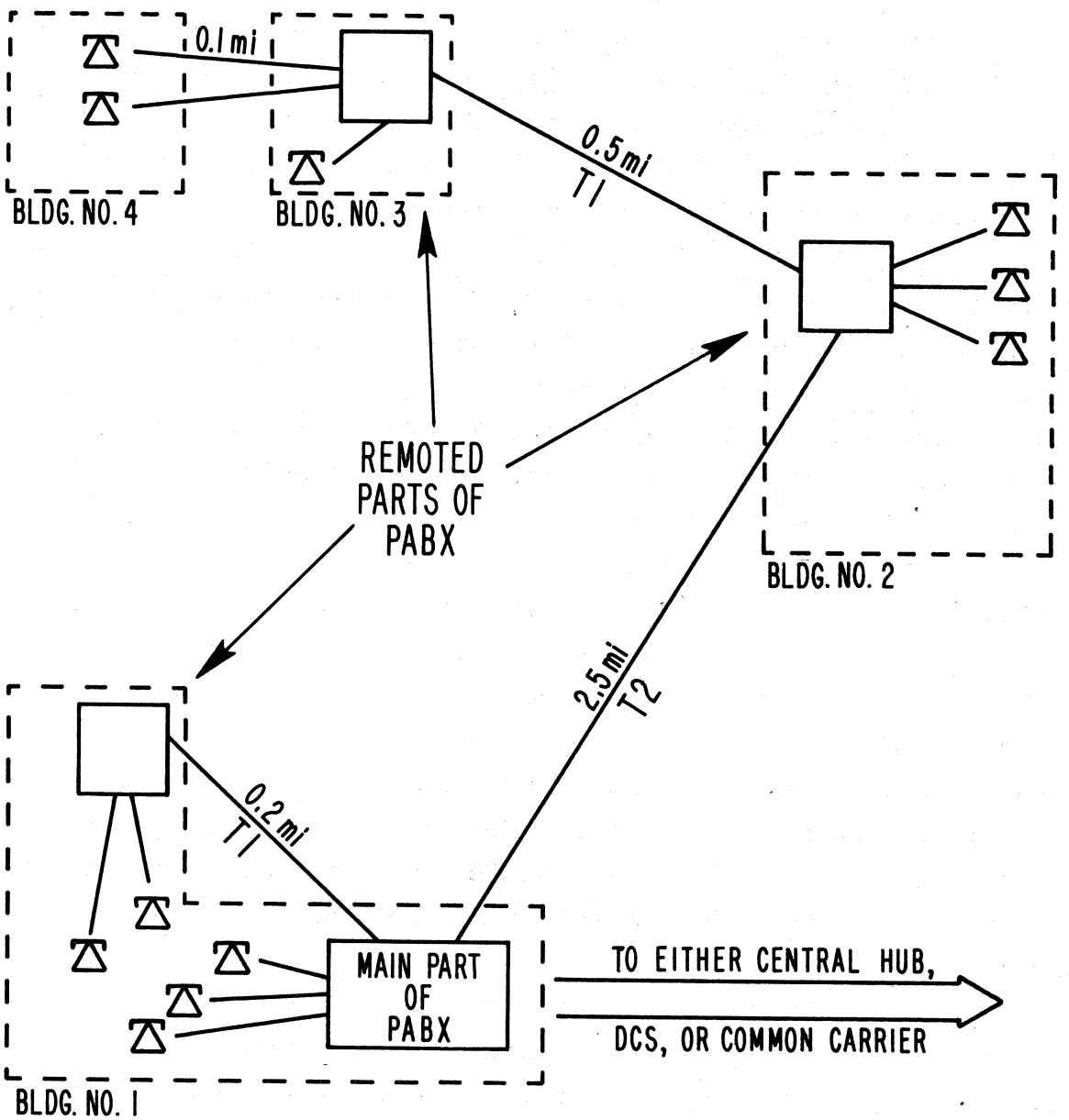

Figure 2. Dispersal of the physical PABX plant at hub level.

basis for this fortunate trend is the claimed application of more powerful and sophisticated software to the state-of-the-art LSI hardware.

Although it appears that digital technology will, in the future, permit reductions in space, in power, and eventually in the cost of integrated voice and data telecommunications equipment, it is incorrect to infer that all the technical and non-technical problems have been solved. One of the objectives of this report is to raise issues, indicate alternatives, and recommend areas where future work might be beneficially concentrated. This is done in Section 3. The issues and recommendations summarized in Section 3 relate primarily to the switching and signaling aspects of the system.

Switching issues which impact PABX design invoke questions like: What traffic and blocking assumptions should be used? Where should the analog-to-digital conversion points be located? What are the service requirements? How are the roles of hardware and software separated in the control processing units?

Signaling strategies involve the total network design and the interface structure. Signaling issues raise questions like: Should a common channel be used or should signaling be accomplished on a per-channel basis? What protocol, procedure, and mode of operation should be used? What routing strategy enhances reliability and survivability? Should network fault monitoring and controls be both centralized? Should routing and address information be secure?

In addition, there are other issues which are not directly related to switching or signaling and as such are not emphasized in this report. These issues include: transmission problems (e.g., loss, crosstalk, echoing, etc.); equipment protection problems (e.g., lightning, power line, electromagnetic transients, etc.); survivability problems (e.g., routing strategy, network topology, etc.) catastropic failure problems (e.g., hardware, software, clocking, etc.) and the network management and maintenance problems.