PLANNED EVOLUTION OF RANGE TELEMETRY AND COMMUNICATIONS INTO THE PUBLIC DATA NETWORK

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ABSTRACT

The area of range telemetry and communications has been under budget constraints and interoperability enhancement requirements for some time. The near-term onslaught of multimedia communications offerings by telephony and communications companies is certain to cause range engineering personnel to conduct extensive research and possibly make numerous decisions on procurements and technologies before standards are finalized. This paper will address a low-risk migration path for range telemetry to the new multimedia communications for ranges based on current capabilities. This migration path has an end goal of positioning the ranges to take advantage of future multimedia communications as they become available, while leveraging off of current products and procurements, without a major investment.

KEYWORDS

Asynchronous Transfer Mode (ATM), Switched Multi-Megabit Data Service (SMDS), Multimedia, Public Network, Frame Relay, DS-3, Interoperability

INTRODUCTION

The communications industry is about to experience the biggest change and fastest growth of any technology area in the history of high-technology electronics. Commercial communications companies, public telephone companies, and the U.S. government are backing multimedia communications as the future communications medium, and Asynchronous Transfer Mode (ATM) as the multimedia standard. ATM lines of varying bandwidths will be available for every home and business in the near future. Computer companies, network companies, television manufacturers, phone manufacturers, and the like, will all be actively involved in providing multimedia communications trunks in their products and service offerings. Phone carriers and communications manufacturers will provide products and services for this new technology. Initially, the price will be high due to the low volume of customers for ATM. As the volume increases and the price drops, services and products will flourish.

The U.S. government will find the use of ATM irresistible due to the specific interconnectivity and interoperability features it will provide. All DoD and range facilities will eventually be connected through a public network similar to that shown in Figure 1. The problem facing many government facilities, and ranges in particular, is that while many interconnect and interoperability requirements need to be addressed now, ATM standards and products are still evolving. Due to the up-front cost of providing interoperability, the range communications groups could end up with equipment that is obsolete in 1-2 years. This paper will outline a roadmap and strategy for range communications personnel to follow when acquiring products to fulfill current interoperability requirements, that can be retained and utilized after the communications evolution begins.

TELEMETRY TRANSPORTS

The main goal of many of the current range interoperability requirements is to provide real-time data links between ranges. Voice, video, and non-real time data are needed today, but their transmission and reception is not currently feasible. A large move to multimedia now could be very risky due to changing standards, and expensive due to high service cost. The suggested method is to implement a current standard that has been designated as a supported trunk interface for future multimedia ATM services to meet current interoperability requirements. The DS-3, Frame Relay, and SMDS standards are three fairly safe choices. SMDS may not be offered by all carriers; some may go directly to ATM.

Currently, a data multiplexer/demultiplexer unit is available off the shelf equipped with a DS-3 interface link and telemetry I/O ports. The Loral 8245 has been available since 1992, and is field tested. DS-3 has been designated by the Forum and Standards Committee as a standard trunk interface to the newer ATM networks and products. Implementation of DS-3 mux/demux technology into an interface link now will allow the ranges to take advantage of this high-speed DS-3 technology, and will provide a ready-made trunk interface to future ATM switch technology.

Loral's DS-3 Data Mux/Demux units work on digital PCM technology. Although transfer of FM telemetry data throughout a range has always been necessary, no digital mux/demux unit is available that offers direct FM inputs and includes an interface to digital networks. In order to insert FM data into digital DS-3 links, the data must be digitized and put into a standard format accepted by the DS-3 units. The

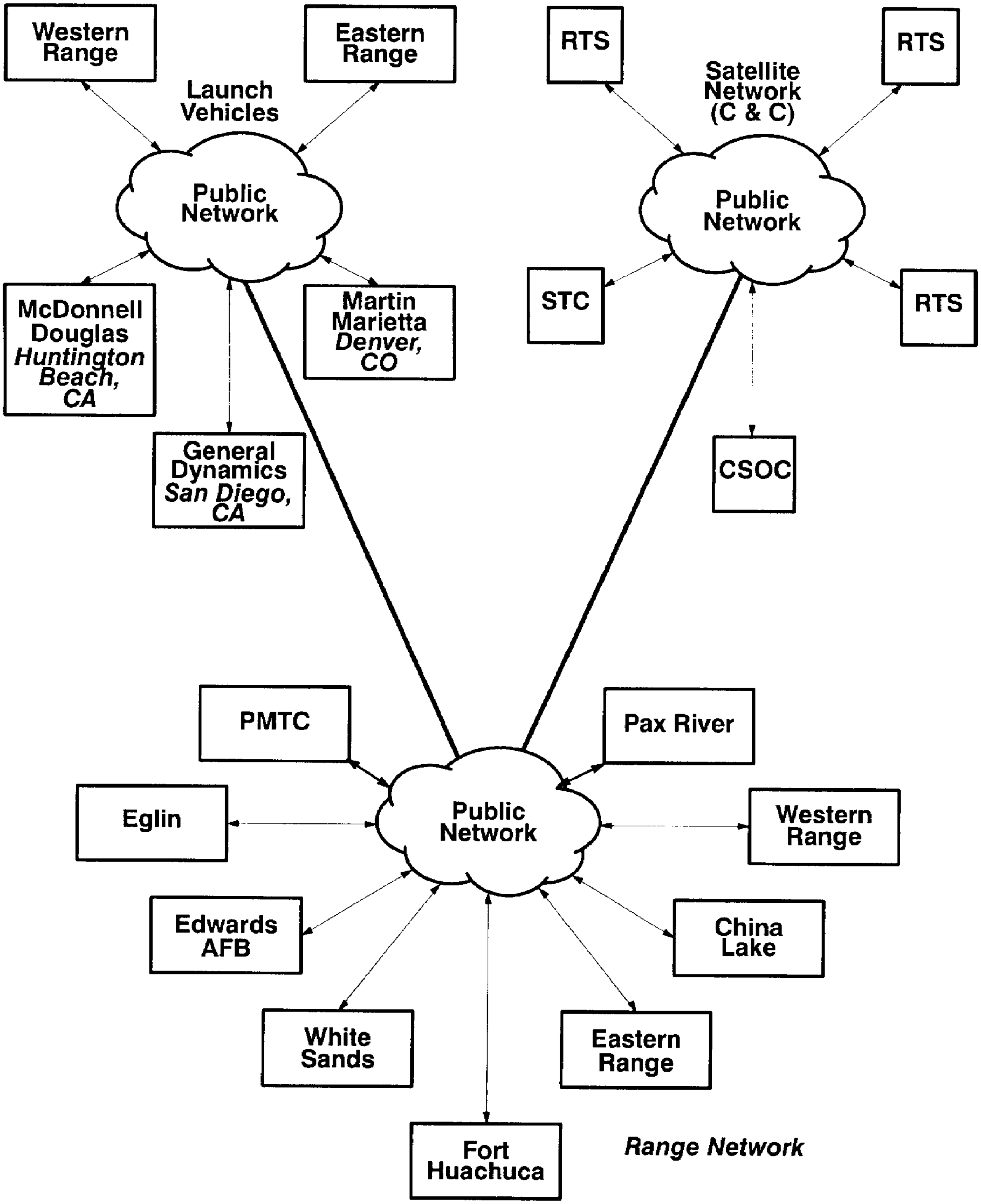

Figure 1. Future Range Network

Loral 8470 Digital Discriminator will serve as an FM front end to the 8245 DS-3 Mux/Demux. The 8470 will accept an FM multiplex as an input, digitize the multiplex, and provide a serial PCM output. This PCM output is IRIG standard and is used as a direct input to the 8245 DS-3 Multiplexer where multiple PCM streams are multiplexed together on a DS-3 format (see Figure 2). Voice can be input to the 8245 through the standard 8245 Analog Input/Output module. The module will accept up to 8 voice channels and digitize them for transmission over the DS-3 link.

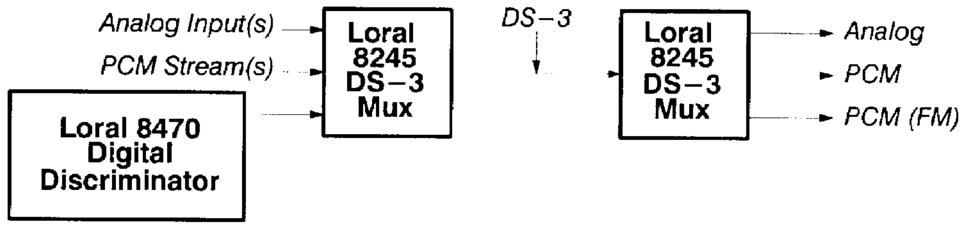

Figure 2. Current TLM Transport

There are two available options for future multimedia ATM networks that utilize the above configurations. First, several communications companies are in the process of designing switches/servers/routers with an ATM trunk interface to the planned open network through a DS-3 trunk line interface. After an initial installation of the configuration in Figure 2, the purchase of one of these new devices in the future can be done without obsoleting the previous equipment and without modifying the existing units. This is shown in Figure 3. Such an installation will allow an 8245 Mux/Demux that had previously been part of a dedicated link to be placed on an open multimedia network. The second option is to purchase an upgrade to the 8245 DS-3 unit to replace the DS-3 link interface with an ATM interface. The upgrade would require replacing one circuit card each in the multiplexer and demultiplexer as shown in Figure 4.

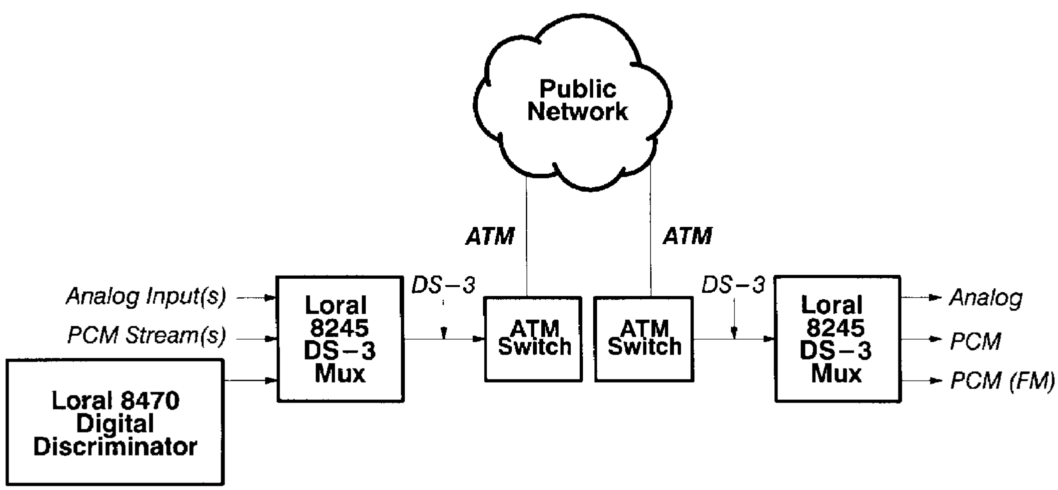

Figure 3. Near-Future TLM Transport

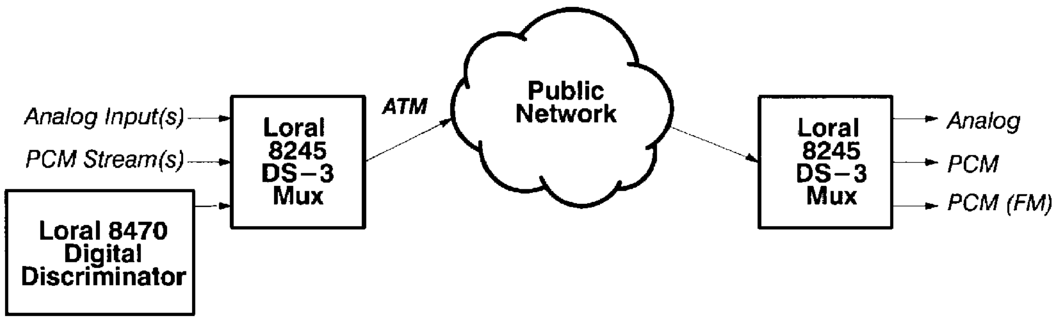

Figure 4. Future TLM Transport

PROCESSING SYSTEMS

Most current telemetry systems utilize Ethernet as the prime network interface and TCP/IP as the network protocol. This is shown in Figure 5. As ATM becomes more abundant, systems will transition to the new networks. On standard "open architecture" systems, most of the Ethernet interfacing is accomplished by a piggy-back or off-the-shelf interface card to a standard processor located in the telemetry front end, or as a workstation option. These cards are currently provided by computer manufacturers and communications companies. ATM network cards to replace or co-exist with Ethernet are currently available for most of the standard platforms.

The cost of modifying applications software is expected to be minimal for a future change to ATM. ATM products are currently expected to be delivered with a layered software network interface that will accept IP packets and encapsulate them within the ATM cells. At the receiving end, there is again no applications software impact. A layered ATM software interface is required.

Current telemetry systems utilize a proprietary parallel bus to transfer data between the system decommutators and the system front-end processors. As data rates increase in non-proprietary serial networks, these parallel buses could be replaced by ATM network nodes located within the system front end (see Figure 6). This would allow a distributed networked approach to processing data and give the telemetry equipment closer network access. In fact, as processing speeds increase, hardware decoms will probably be replaced by software decoms in many applications. The bit synchronizer will simply block the data into packets and transmit the packets over a network where all interested parties will decom and process the data. Where many users are involved, the obvious advantage to this is cost. One piece of hardware can deliver data to an open network where hundreds of users are monitoring a real-time test on different platforms using different decom, processing, and analysis software products.

The new ATM networks will initially be introduced as system upgrades on the back-end by replacing the existing Ethernet as shown in Figure 5 (future). However, in new products, these network nodes could eventually end up at the front end of a system, as at the decom or bit synchronizer shown in Figure 6. In the case of ranges, flight test facilities, and launch sites, real-time data that can be delivered in raw format over a secure public network is a desirable function. Tremendous costs are incurred during missions where government personnel, contractor personnel, and consultants must travel to the mission site to access real-time data.

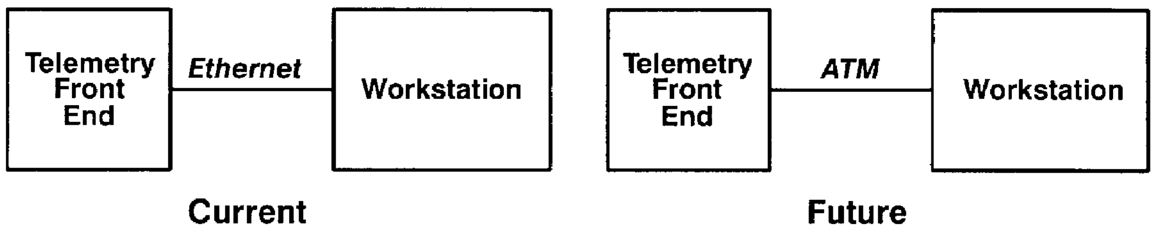

Figure 5. Network Processing System

To deliver real-time data to the network from front-end hardware, and keep the front end versatile enough to allow some latitude as standards solidify, industry-standard buses will initially be used for the front-end-to-network interface ports. The implementation of an industry standard bus to a bit sync or decom front-end card will allow the future purchase of an off-the-shelf ATM card for future network access.

A possible range configuration is shown in Figure 6. During a mission, the bit sync and processor provide real-time data locally for mission support, as well as nationally over a public network. The bit synchronizer takes the raw data, encapsulates it into ATM cells, and delivers this information to the network. The data is received at distribution sites where installed software decoms and analysis packages process the data. The platform and software used will be vendor-independent as long as there are standards defining encapsulation of raw telemetry data. The bit sync-to-ATM interface will provide a good payload/overhead ratio since the overhead information need not contain framing information, and the raw data number has not been expanded into a floating point number. However, the data is uncompressed and will include all data words.

Utilizing the more conventional processor to output data to the network will allow data compression and word deletion to be used to conserve bandwidth, although some of this savings is lost due to tagging of individual words. This approach will also require that all receiving nodes on the network install the same software package as the source, since the data, tag, and encapsulation techniques will more than likely be vendor-unique and database-dependent. In a system configuration, the user will be allowed a selection of any combination of the sources to distribute data.

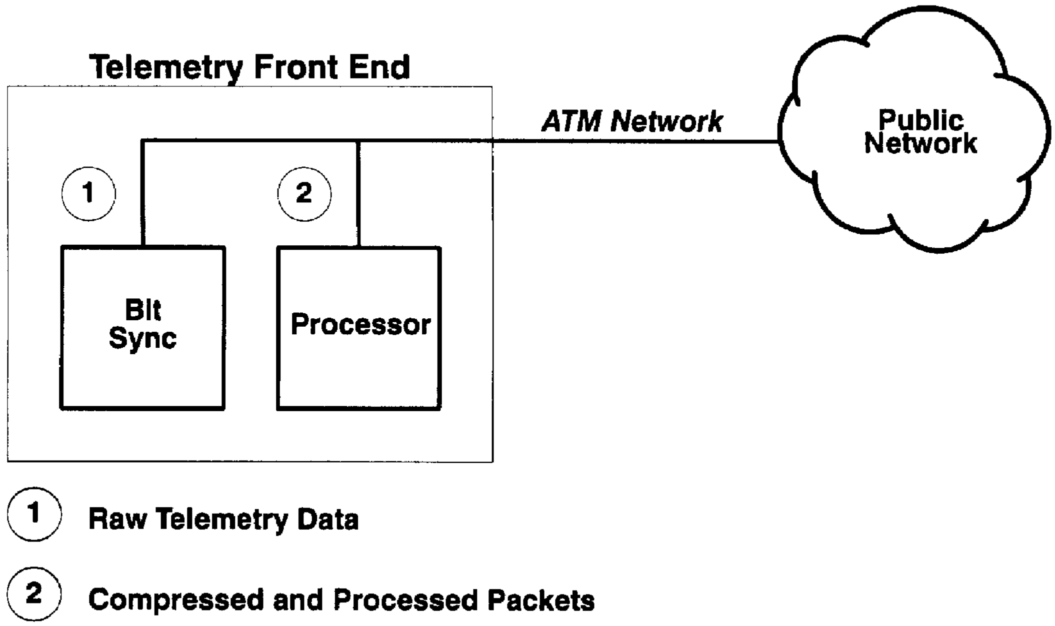

Figure 6. Future Network Processing System

A configuration for implementing a typical local area (remote area) network at a range is shown in Figure 7. This architecture is drawn with available products and integrates voice, video, data, and telemetry into a local area network. Expansion into the public network and trunk interface to other remote sites in a regional network is inherent in this system design.

Integration into the public network can be done locally if the ATM switch is capable of ATM circuit emulation. Public network access may be desirable in a central location (Central Office Switch) where an ATM switch provides public network service to all remote sites, and will prove less expensive.

CONCLUSION

Multimedia is about to invade every aspect of the electronics industry. Cars, computers, televisions, telephones, stereos, and telemetry will all be impacted by this technology. As such, we will have to deal with all of the changes it will bring—good and bad. Advanced planning for this technology is the only way to lessen its impact. All current procurements should be accomplished only after considering the cost impact involved in the architecture design for a transition to multimedia. Due to the tremendous advantages in standardizing telemetry data packaging on a multimedia network, and the severe costs if no standards are used, IRIG should be considering ways to standardize this open network telemetry.

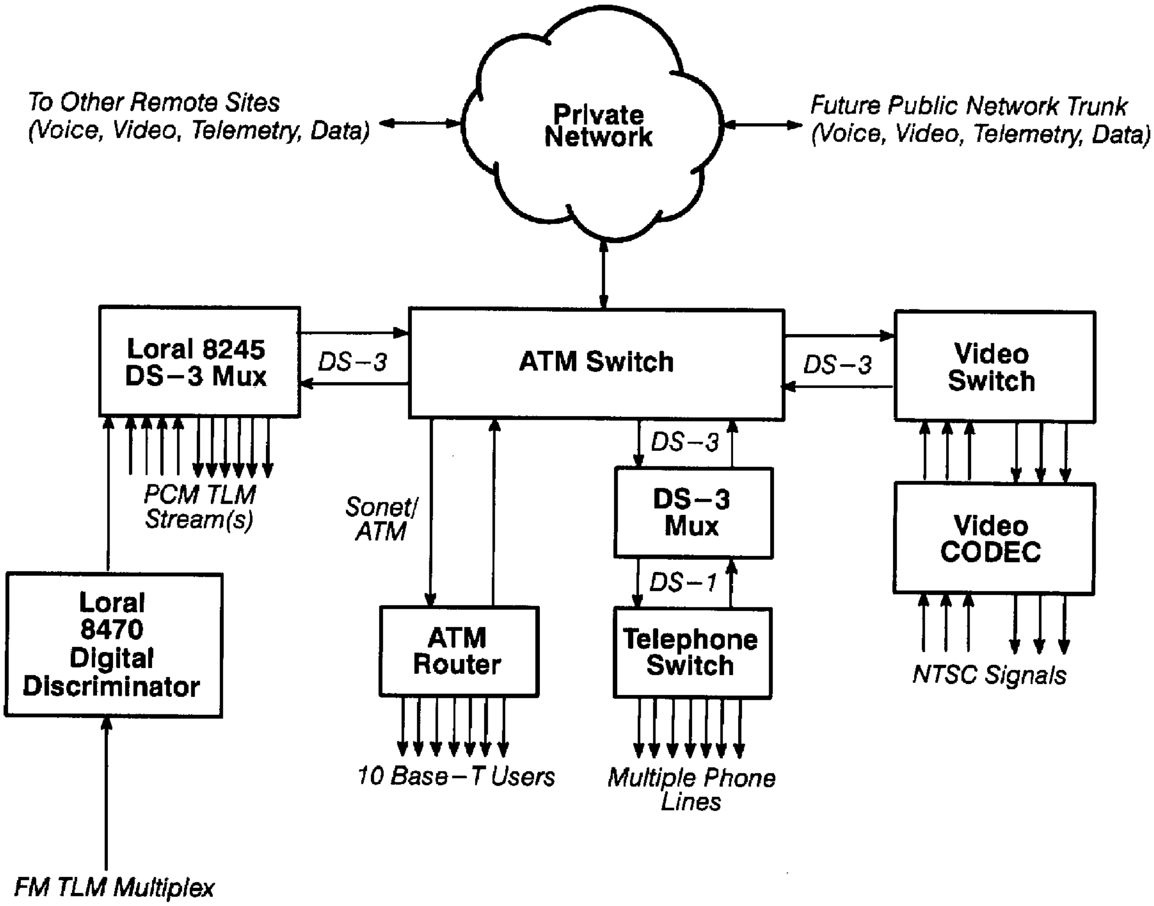

Figure 7. Remote Site (local area network)

This paper is not intended to sanction or promote any aspect of multimedia. Multimedia itself has such momentum that no one company or approach will have a great impact upon the final outcome. The multimedia infrastructure will be established with eventual guidelines for use. Users will enjoy tremendous benefits, but will be required to operate within established guidelines. The ideas presented in this paper are meant to establish a framework of standards, practices, and off-the-shelf products to provide a less painful and better planned migration to the open network for range telemetry.

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