APPLICATIONS OF DIGITAL VIDEO AND DATA COMMUNICATIONS TO THE REAL ESTATE MULTIPLE LISTING SERVICE

by

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1.0 INTRODUCTION

1.1 Background

In 1907 the real estate industry adopted the Multiple Listing Service (MLS). MLS has provided Realtors, and thereby buyers, with a printed listing of properties for sale in different locations by printing a picture of the property and a list of "vital statistics" that describe the homes in an MLS book. In 1972 the first automated MLS went on-line making MLS data available on computer by accessing a central mainframe computer through the local telephone lines, thereby creating a local area network (LAN). With the LAN connection, Realtors were provided the ability to query the database and print sorted information that could be used to help the buyer find an acceptable home to purchase.

1.2 System Inadequacies

There are numerous inadequacies with the current real estate system. These inadequacies include issues with regionalization, time, cost and additional services. Although currently about two thirds of the real estate boards in the country operate MLS systems, presently, none of these MLS systems are linked together. Also, each board currently governs a unique set of rules associated with

their MLS.

This regionalization has led to Realtor boards that charge expensive fees to become a member of the board and require this membership to use MLS. Additionally, different MLS systems use different application software, so Realtors who want to sell outside their region must pay membership fees to multiple boards as well as learn different software application programs. These limitations make it both difficult and expensive for Realtors to assist buyers who are moving outside a region.

Although the current MLS system does provide service, the process of selecting a new property is still time consuming and costly to the buyer, seller and Realtor. Buyers experience high stress and spend considerable time viewing homes. Long distance buyers face additional costs and inconveniences in traveling to a new location in order to house-hunt. Likewise, sellers face difficulties of currently having to list a property for a long period of time and face the excessive costs of Realtor commissions. Realtors are burdened with loss of additional income due to the current method's time consuming process which limits the number of buyers and sellers the Realtor can service.

1.3 Technical Advances

With today's technology, the current limitations with

the real estate system do not have to exist. There have been extraordinary advances in digital technology in the areas of component design, memory, communications, and, more recently, video. Many industries have moved with technology and have benefited from the rapid advances of the last decade or two. For example, the telephone industry started with analog, one call per line, direct connected service, then moved to digital, and currently uses digital multiplexing and fiber optic technologies to route thousands of calls over one line. Similarly, the motion picture industry has moved from black-and-white technology without sound, to high-resolution color with stereo sound. Likewise, motion picture platforms have progressed from the first home movie cameras to VCRs and are presently evolving into the digital video arena with High Definition Television (HDTV). And, computers have moved from a stand-alone machine using gears and tubes, to inter-networked computer systems with very high speed data rates and high speed memory access. However, regardless of these new advances in technology, the process of purchasing real estate has stayed relatively constant.

1.4 Proposed Solution

With the current technology available, the MLS system can go one step further in assisting buyers, sellers, and

Realtors to fill their individual needs. By using digital video technology and the current advances in data communications and memory technology, the MLS system can provide integrated data, video, and sound into the MLS system. An integrated Digital Video MLS (DVMLS) system could resolve many of the present frustrations and costs to buyers, sellers, and Realtors. While some "house-hunting" may still be necessary, the time, the number of homes reviewed, the number of house-hunting trips, and the cost associated with the "hunting" can be significantly reduced. A national MLS database and LAN network could provide real estate agents and, therefore, potential buyers with national information and up to the date video information of the properties currently on the market.

This enhanced MLS system would provide Realtors with the ability to query properties, as they currently do, but also to select potential properties nationwide that meet criteria of the home-shopper, and download the video, sound, and vital statistics data onto a Video Cassette Recorder (VCR) tape. Home-shoppers could then view the VCR tapes at their leisure, in the comfort of their own home and at their convenience, as opposed to fitting into the Realtor's schedule. This enhancement would save the home-shopper numerous house-hunting trips, and only those properties that appeared to have potential would need to be visited. This

would be of especially great value to home-shoppers moving long distances who currently have to schedule and pay for numerous trips to their eventual location.

1.5 Report Scope

To that end, this report will apply the systems engineering process and address many of the system design and development issues. Here, the conceptual system design issues will be discussed followed by a number of preliminary system design issues. Initially, a development of need will be discussed to establish that there is an actual identified need. Next, a number of feasible technology alternatives will be addressed. And although many of the feasibility study issues will be discussed, for the scope of this paper, it will be assumed that a rigorous feasibility study has already been performed based on the established needs. It will also be assumed that preliminary system operational requirements were evaluated against the feasible technical alternatives and that the DVMLS system resulted. For continuity of reading, the system concept for the DVMLS system will be discussed in Section 4. In Section 5, the operational requirements will be discussed that have evolved from an analysis of the need, combined with the feasibility of various technology applications.

Section 6 will discuss the maintenance concept that

provides a baseline for the establishment of supportability requirements and requirements for total logistic support. Moving into preliminary design, a system functional analysis will be covered in Section 7. The system functional analysis provides the basis for the identification of design requirements for each hierarchical level of the system. In Section 8, a preliminary system design configuration will be discussed and identified. Finally, in Section 9, a number of the important implementation issues of integrating digital video and sound into the function of the Multiple Listing Service that were not discussed in the preliminary system design configuration will be discussed.

1.6 Report Definitions

For clarification purposes, a number of terms that are used need to be defined. In this paper, "buyers" will include those parties who are looking to purchase a home and are dealing with a Realtor using the Multiple Listing Service (MLS) system. "Sellers" will include those parties who have decided to move and are working with a real estate professional who uses the MLS system to market the property for sale. A "user" is an individual, usually a Realtor, who will employ the proposed system as a tool for the selection of properties to show and market to potential home buyers. Also, the term "Realtor" will be used as is generally

understood by the public as a real estate professional or property salesman. While actually, use of the term Realtor "is limited to real estate practitioners who are members of the National Association of Realtors and have pledged to abide by the Association's Code of Ethics and Standards of Practice".[1]

2.0 IDENTIFICATION OF NEED

This section contains the impetus for the decision to proceed with the development of a new MLS system based on the identification of a number of existing deficiencies, and therefore, existing needs. The identification of these needs will initiate the top-down systems engineering approach that will continue through the systems operational requirements, system maintenance concept, preliminary system analysis, and onto preliminary system specification and design.

Although the Multiple Listing Service has been working effectively for nearly one hundred years and has been automated for nearly twenty years, there are numerous deficiencies with the current system that can be resolved or, at the very least, improved. The shortfalls include deficiencies of time, cost, convenience, and current MLS limitations to buyer, seller, and Realtor.

2.1 The Buying Process

The National Association of Realtors agrees that "looking for the right home can be a highly stressful period in an individual's life and is physically and emotionally draining as well".[2] Invariably, time and expense are contributors to this stress.

2.1.1 Local Buyer Issues: Time

In the buying process, there is excessive time spent by the house-hunter. In a study by the National Association of Realtors (NAR) in 1989, it was found that "on average, buyers [local and long distance] in the study took 14 weeks (3.5 months) to search for the right home".[3] The same study found that an average of 17 houses were examined. House-hunters currently have to spend days with many hours at a time reviewing properties that do not even meet their most basic criteria. Furthermore, this time to review properties with Realtors is not always flexible or desirable because of differences in the schedules of buyer and Realtor. Therefore, it is clear that the conditions contributing to the stress, such as wasted time, need to be changed.

2.1.2 Long Distance Buyer Issues: Time and Money

Next, long distance buyers are currently faced with even greater time requirements, as well as, incurring major expense in the buying and moving process. A long distance mover is defined, according to IRS tax rules, as buyers moving more than 35 miles away. In 1988, 20 % of movers purchased homes more than 100 miles away; but overall, 26 % of U.S. home buyers are long distance movers.[4] Although long distance movers take about half of the median time as

local home buyers to find their home (9 weeks average instead of 16 weeks for local movers), the number of houses examined is more (21 opposed to 16 homes for local movers).[5] This is largely due to the fact that long distance movers have less time to choose a new home, due to rapid company relocations and the fact that these movers are usually not already familiar with a particular area.

A 1991 study, found in the Directory of Professional Relocation Services, stated that the estimated cost of relocating a family of four (homeowner) in 1991 was $50,838.[6] This is a staggering sum of money. Expenses that can most effectively be decreased by improving the current real estate system are as follows: $2,950 for "Pre-Move Home Search Trips", $6,095 for temporary living expenses, and miscellaneous relocation expenses of $4,167. From these astounding statistics, it is obvious that changes are needed in the way long distance moves are currently handled in the buying process.

2.2 The Selling Process

As in the buying process, there is excessive cost, time, and frustration with the current real estate selling process. Excessive time is spent by both the seller and the Realtor. Exorbitant costs are incurred because of high commissions and drops in home prices, partially attributed

to long amounts of time that homes are on the market. With the current system, it is understandable why frustration is experienced by all.

2.2.1 Seller Time Issues

It is obvious that the current real estate system takes too long to sell a property. In a 1988-1989 survey by the National Association of Realtors, it was found that 6 in 10 sellers are in a hurry to sell[7]. Table 2-1 illustrates the level of urgency in selling a previous home among key home seller groups. The top two reasons are that the seller: 1) already moved out of the area, and 2) bought another home. This additional time on the market means that sellers must carry two mortgages, or pay rent until the home sells. Therefore, the additional time that a house is on the market needs to be decreased.

Likewise, outrageous amounts of time and frustration are encountered by sellers who are required to keep their homes open for show for long periods until the house eventually sells. From 1986 to 1989, the median time on market for all homes sold was eight weeks. However, it should be noted that the time on market varies greatly because of characteristics such as metro area, cost of home, and location. For the U.S., the length of time that homes were on the market were as follows: 35% at 1-4 weeks, 35% at 4-12

Table 2-1 Level of Urgency in Selling Previous Home Among Key Home Seller Groups (Percent Distributions)

	All Home Sellers	Local	Long Dist.
In no hurry to sell	38	43	37
In a hurry to sell because I had bought another home	24	35	7
In a hurry to sell because I was moving or had already moved out of the area	25	3	48
In a hurry to sell because of family reasons	4	7	3
Other	2	3	1
Base (N)	251	184	71

weeks, 15% at 13-24 weeks, and 15% at 24+ weeks.[8]

2.2.2 Seller Cost Issues

In the selling process, there are considerable costs associated with the inadequacies of the current MLS system. These costs are found both in actual cost and in unrealized profit. Figure 2-1 illustrates the impact of supply and demand on selling prices and shows that the longer the selling time, the greater the difference between the asking price and the selling price.[9] For example, the figure shows that homes that had been on the market fewer than four weeks sold for an average of 1.9 % less than the asking price. At the other end of the scale, homes that had been on the market for more than 24 weeks, on average, sold for almost 9 % less than the original asking price. Although this trend could be attributed to a house being overpriced and the market forcing the price to the purchased price, the trend also leads to the conclusion that if the houses spent less time on the market, the final price would have been closer to the asking price.

Additionally, in order to sell properties, seller assisted financing is sometimes required. Seller assistance includes taking a second mortgage, selling with a land contract, installment contract, contract for deed, or taking other measures. Even in the second half of 1988 when the

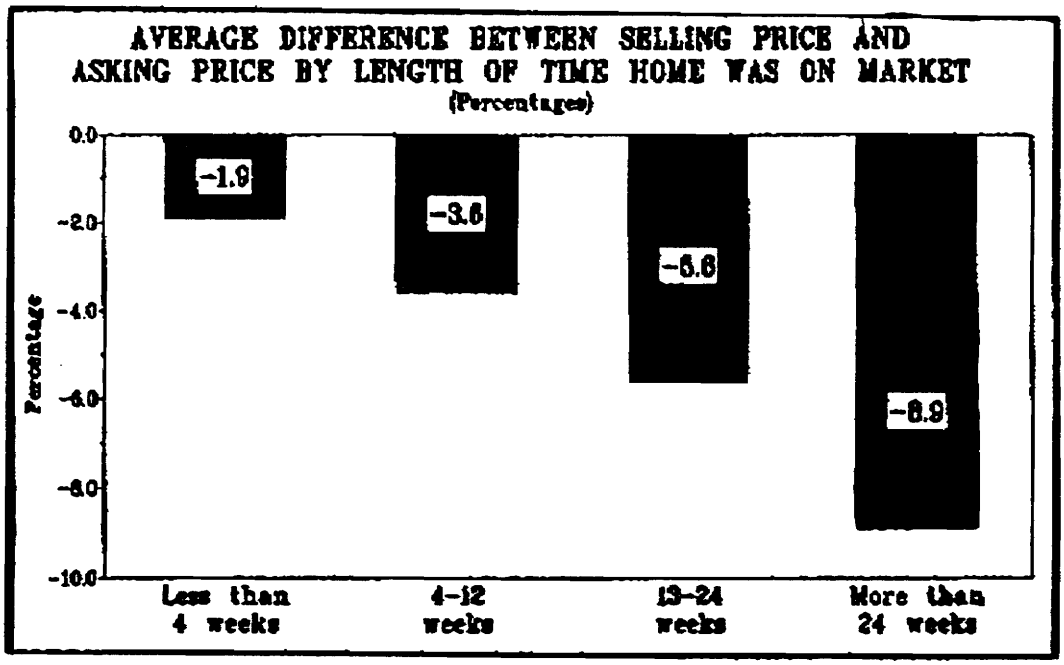


Figure 2-1 Unrealized Profit Due to Excessive Time on the Market

market was sufficiently robust that few sellers needed to help finance the sale, still there were 10 percent of the sellers that assisted buyers[10]. Seller assistance is an actual cost to the seller and establishes a need for a better real estate system that will provide sellers with better qualified buyers who do not need seller assistance. Housing Economics states that "one of the most important indicators in a local housing market is traffic", meaning the number of prospective buyers who look at new homes.[11] Henceforth, a more efficient and timely system would maintain the value of homes and increase the traffic for those homes utilizing DVMLS.

2.2.3 Realtor Time Issues

Time is one of a Realtor's most valuable resources, and currently a considerable amount of a Realtor's time is spent inefficiently. First, extensive time is spent by Realtors, both in researching properties, and in showing these properties to the house-hunter. From an interview with a number of Realtors at Century 21, showing properties currently constitutes up to half of the Realtor's time. Also, Consumer Reports in their 1989 Annual Questionnaire found that 28 percent of agent-assisted sellers considered being able to get access to the agent as the greatest determinant that influenced their decision to choose a

specific real estate agent. This same report stated that 21 percent chose a specific agent because the agent had access to MLS[12]. Therefore, Realtors clearly have a need for a more efficient process of selling homes, so that their level of customer service may be increased, while decreasing the time that they are required to spend with each buyer.

2.2.4 Realtor Cost Issues

Realtors also lose income because of the limited amount of time that they have to show properties. The National Association of Realtors states that "the longer the home has been on the market, the greater the likelihood that the seller will change agents -- typically the change occurs after 60 to 90 days which is typically the length of the listing agreement[13]. The NAR performed a study that defined the profile of agent usage and the results are shown in Figure 2-2. This figure shows that currently over 16 % of an agent's business is lost. Therefore, Realtors have a need to sell their properties more quickly so that they do not continue to lose a significant share of their customer base.

2.3 System Limitations

There are considerable system limitations with the current real estate system and more specifically the MLS

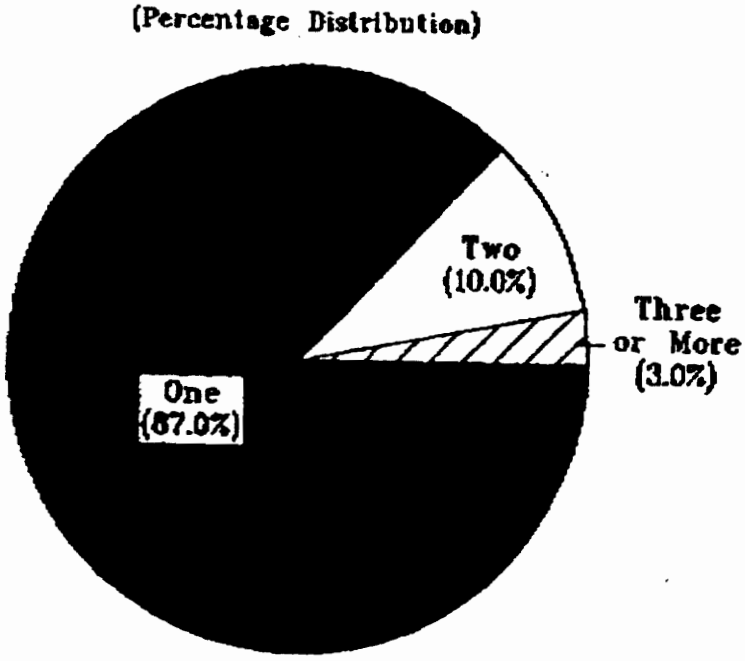


Figure 2-2 Number of Real Estate Firms with which the Home was Listed

system. Some of the most significant limitations are regional and service limitations.

2.3.1 Regional Limitations

Current real estate services are only regional and do not provide information on properties outside the specific region. Real Estate Today notes that, "particularly in large metropolitan areas that are served by several [real estate] boards, one of the biggest weaknesses of the MLS may be its inability to access an entire market. Gill Woods, of Edmund G. Woods Company in Holyoke, Massachusetts, said, 'If I were to put my finger on the one thing I think is a problem, it's that in some areas, a major company must join four or maybe even six MLS's to fully expose its properties to the market it serves.'"[14] Currently, for one to join different MLS boards there is considerable expense in membership dues, there is compliance with different sets of rules, and there are different computer languages to be learned.

An additional regional issue for Realtors is that a greater proportion of long distance buyers than local buyers found their homes with the assistance of real estate agents. The NAR found that 61 % of the long distance buyers used real estate agents while 46 % of local buyers found their homes through real estate agents[15]. Therefore,

a more effective system for providing service to long distance buyers is relatively important.

2.3.2 Service Limitations

There are many areas where additional service could be provided, but are not provided under the current system. These areas include local business marketing or providing community comparisons.

Current MLS systems do not provide any additional information on services to new home-buyers, a market clearly in need of additional information. There are many services such as household maintenance, moving, day care, schools, and churches that new home buyers need; and currently there is no means to market these services efficiently. Providing buyers with this information could decrease much of the time, cost and frustration currently associated with moving.

Communities also need to market their relative services and amenities to new citizens and currently do not have an effective means. Long distance movers are especially unfamiliar with the relative difference between communities. By having these differences exhibited to them, new buyers could become more educated on their potential city and the areas within that city that might interest them most. Therefore, time would not be wasted spent looking in locations that did not have the desired amenities of a

community such as schools, recreational areas, parks, libraries, fire and rescue.

2.4 Additional Needs

Previously in this section, the nature of the existing deficiencies has been defined in terms of inadequate performance, inadequate system support and excessive costs to individuals. It should be established that there is an actual identified need. There are however, additional needs that must be addressed which include important dates, resource limitations, and relative priorities.

The date by which the changes or the new system must be installed and operational will be set by the real estate boards who will be implementing the change. The aforementioned needs could all be satisfied more effectively by rapidly addressing the system changes outlined in this paper. Since the speed of implementation cannot be determined for the actual scenario, it will be assumed that sufficient time will be spent for a thorough systems analysis and feasibility of the many different systems considerations. Although this time should be limited to an established period of time for the purpose of analyzing current technology, the implementation of the system may involve years of system implementation based on region-by-region differences in economic and time

limitations. Therefore, the technical feasibility and trade-off results will need to be flexible and "living" so that new technology can be evaluated for potential application.

Likewise, the magnitude of resources for investing in the new system capability are difficult to quantify. For the purposes of this paper it is assumed that the necessary resources will be provided by additional fees to system users who are currently members of local real estate boards. The system feasibility and trade-off analyses must be performed with the cost-benefit in mind. It is assumed that the payback period will be amortized over multiple years.

The relative priority for the new system capability to be established can be derived from the multiple needs. From the facts that supported the needs, it is found that currently 74% of all of the home sales are to individuals who are moving locally (fewer than 35 miles) within a city or region.[16] Correspondingly, local movers make up the majority of all home sales and therefore must be the first priority for service. However, it is assumed that an increasing number of long distance home-buyers would use the service if it were available. This relative priority of service also leads to a graduated implementation where the less complex issues of increasing service to buyers and

sellers within an existing region can be performed first. Therefore, the more complex implementation issues of integrating all regional MLS systems can be performed at a later time.

2.5 Needs Summary

The deficiencies that have been outlined in this section are the basis for an actual identified need, which is paramount in the systems engineering process of preliminary system design. Because these needs are the basis for further development and they will be referred to repeatedly, and they are summarized here. For later requirements development and preliminary design, the needs have been grouped into four areas: regional, time, cost, and services. These needs are summarized as follows:

Regional Needs

- To serve a complete market.
- To provide national access.
- To standardize regional equipment and user interfaces.
- To standardize regional real estate regulations.

Time Needs

- To provide more buyer traffic

- To view more homes more time efficiently
- To decrease the time required to satisfy the needs of each Realtor's customers.

Cost Needs

- Decrease the cost associated with house-hunting by decreasing the number of trips or the length of house-hunting.
- Decrease the time a property stays on the market.
- Increase the number of customers that a Realtor can service.

Service Needs

- Provide buyers with community demographics and relative differences.
- Provide buyers with information on helpful local businesses and services.

3.0 FEASIBLE TECHNICAL ALTERNATIVES

From Section 2 it is clear that an identified need exists, so next, the evaluation of various technical approaches can be studied. The scope of this paper is not to address an entire feasibility study, but rather to go through the preliminary design process. As mentioned in the introduction, it will be assumed that a rigorous feasibility study has been performed based on the established system needs identified in Section 2. Here, in Section 3, many of the feasibility study issues will be discussed to provide a transition from the need, to the preliminary design of an established system concept.

As alternatives are studied, it should always be kept in mind that the option to do nothing and keep the current system as it is may prove to be a more cost effective solution for the limited resources. With as many unfilled needs as were discussed in Section 2, this alternative does not appear to be a prudent decision. Regardless, the alternative of doing nothing is always real, and should not be discounted in performing trade-off analyses.

3.1 Regional Issues

The technical and administrative issues of regionalizing the MLS system into a nationwide system are complex.

Organizationally, the MLS board will have to come to agreement on regional locations, agree on common regulations nationwide, reorganize governing bodies, adjust user fee structures, and address implementation costs and time lines. Technically, at first approach, the task of operating the MLS system on a nationwide basis appears easily achievable. After all, nationwide communications is not a new industry and the telephone system is nationwide and already in place.

3.1.1 National Hub with 1-800 Call In

Thus, the first alternative that was studied was a central MLS center or hub that could be accessed nationwide via a 1-800 or 1-900 telephone number. This implementation has many strengths. First, the implementation would be less difficult as well as being cost effective to implement from the user point of view. Implementation for the user would only consist of changing the telephone number that the current modems use to access the MLS system. This change is relatively cost free. Second, training would be minimized since only the telephone number that the modem dials would change and possibly some menu options on the current software to select different regions. Even if the software interface for all users did change, the training on the new software should not be too difficult or costly. And third, users would not be required to purchase additional equipment

to satisfy the new implementation. Since computers and modems are already required and used by MLS users, there would be relatively little or no user equipment costs.

Although this national center or hub using a 1-800 telephone line has many strengths, there are also weaknesses. Foremost, the quantity of calls that would need to be satisfied for all MLS users nation wide would be enormous. Likewise, the amount of equipment necessary to store and process data for all regions in the country is also prohibitive. Additionally, there would be limited to no reuse of the current MLS equipment that is in place for data storage and handling. All of the money that went into the current equipment configuration would be wasted. Therefore, for these reasons, this alternative was not chosen to be the best, or most feasible, solution.

3.1.2 State-by-State Service with Nationwide Links

An additional alternative that was studied was to organize the MLS system on a state-by-state basis with communications links to other states. This alternative would increase the size of the regions and standardize the real estate MLS practices on a state wide basis. However, the market boundaries do not always fall within state boarders so it may still be difficult to access an entire market that spans multiple states. For example, the

Washington D.C. metropolitan area includes Virginia, Maryland and possibly West Virginia and Pennsylvania.

3.1.3 Merge Existing MLS into Regions and Link Nationwide

This alternative would involve using the existing MLS systems that are established in many large metropolitan areas and link these systems together. Therefore, the current MLS systems will be expanded as needed to serve a complete market while equipment reuse is maximized for cost effectiveness. The existing telephone lines could be used for inter-regional communications as is currently done, while other existing telephone services could be used to provide national access by linking regions. The task of standardizing regional equipment and user interfaces as well as real estate regulations would still need to be addressed as in all implementations. For these benefits as compared to the other feasible options, this alternative is recommended.

3.2 Time Issues

There have been numerous attempts at servicing the time issues of buyer, seller, and Realtor. Some of the alternative for providing more buyer traffic, viewing more homes more time efficiently, and decreasing the time required to satisfy the needs of each Realtor's customers

are already being attempted.

3.2.1 Continuous Broadcast Radio

The first alternative uses the concept of continuous broadcast radio as a means of providing more information to the buyer. This implementation would be relatively inexpensive and easy to set up since there are many existing radio stations. The concern with this alternative is the effectiveness of radio broadcasts for the purpose of providing information to buyers. Buyers would either have to schedule their listening time or tape the broadcasts which is not effective for long-distance movers who are located outside the broadcast area. Also, listeners would not be able to visualize their home which is an important factor in home buying.

3.2.2 TV Home Buying Network

This alternative uses the concept of broadcasting television spots on different homes located within selected areas. This alternative is currently being used is a few of the larger metropolitan areas on Cable Vision. On the cable channel, homes will be described with their relative advantages and important statistics such as cost, footage, and number of rooms. This alternative appears to be successful for buyers who are looking for some additional

information or who do not already have a real estate agent to work with and can choose one from the homes that are interesting. Again, buyers would either have to schedule their viewing time or tape the broadcasts and this is still not effective for long-distance movers who are located outside the broadcast area. Although there can be pictures or videos of the properties that will help the buyers visualize the properties, there is no way to sort or query these viewings so that only the specific location of price range is viewed.

3.2.3 Integrated Video

Another alternative uses the concept of video spots that can walk buyers through a property while integrating audio descriptions and text information into the videos. This alternative could involve collection of audio and video data that would be combined into a standard tape length that could be viewed by prospective buyers at their leisure. Also, if Realtors had query capabilities, they could pre-select homes that could be viewed thereby providing more buyer traffic, viewing more homes more time efficiently, and decreasing the time required to satisfy the needs of each Realtor's customers.

The technology required for this implementation is relatively simple for buyer and Realtor, however, it is

somewhat complex, but not prohibitive, for data storage and handling. The equipment required by the buyer would just be a home video cassette recorder (VCR). The Realtors could use their existing equipment to select which properties through an MLS query that is done currently. The data production and handling does, however, have some difficult technical considerations. One of the difficulties is that video information currently uses the analog technology which is difficult to store and transmit. Otherwise, when video information is digitized and stored in digital form, it requires large amounts of data and some resolution is lost. Therefore, a trade-off between the resolution quality of the video signal versus the amount of data that is required to represent the video which is based on the sample rate.

There have been a number of advancements in technology in the last few months and years which address these issues. First, video compression technology has evolved so that digital video data can be compressed into more manageable quantities. For example, Intel's RTV (real-time video) compression allows for compression rates of up to 150 to 1[17]. Second, there have been quantum leaps in memory technology in both chip and disk media in the last few years. More memory is now readily available for the home PC than was economically feasible for most mainframe computers just five years ago. Third, computer processing speed has

experienced similar advances in the ability to process large quantities of data quickly, which would be required for this alternative. The technology for this alternative does exist and is becoming more mature as time goes on. Therefore, the alternative of integrated video is an alternative that is both technically feasible and also satisfies the needs.

3.3 Cost Issues

Many of the cost issues can be addressed similar to the time issues. Decreasing the cost associated with house-hunting by decreasing the number of trips or the length of house-hunting, as well as decreasing the time a property stays on the market can be addressed by providing potential buyers with more information at an inexpensive price. Likewise, if customers are provided with more information, Realtors do not have to verbally provide this information so that Realtors can free up time to increase the number of customers that a Realtor can service. The alternatives for providing this information are discussed below.

3.3.1 Self Service/Free Reign

One alternative that is currently attempted is that of self service, or providing large quantities of information,

usually in text form, to the public. This is done by the information found in The Home Book and others that show current listings, a picture, text data and a point of contact. This is a feasible alternative which has been widely implemented, however it has deficiencies in service to long distance movers, currency of data, limited information or visualization, and not being able to query or sort the relevant data from the irrelevant.

3.3.2 Tape Record Radio or Television Broadcasts

Tape recording radio or television broadcasts of real estate properties could provide more information to buyers and would be cost effective. However, all of the limitations discussed in Section 3.2 still apply. Although the broadcasts could be sorted and consolidated for the buyer by the Realtor, the visualization aspects are lost for radio broadcasts.

3.3.3 Integrated Video

As discussed earlier, integrated video could provide the visualization aspects that are lost in radio broadcasts but also be placed in a manageable form so that queries and sorts can be performed. The aspect of queries and sorts separates integrated video from taping television broadcasts. It may be possible to use the preparation that

is done for the television broadcasts and use this in the integrated video. Because of the sort and query aspects of integrated video, this alternative was determined to best satisfy the cost issues.

3.4 Service Issues

The service issues of providing buyers with community demographics and relative differences as well as providing buyers with information on helpful local businesses and services is also an information issue. These services are generally advertized or provided by research (ie. the Chamber of Commerce or Yellow Pages), word of mouth through friends or relatives, or direct advertising through flyers or direct mail. In addition to these conventional methods, the audio tapes and video tapes television and integrated video also satisfy these needs.

4.0 SYSTEM CONCEPT

From a rigorous feasibility study that was discussed in section 2, it is proposed to develop the national Digital Video Multiple Listing Service (DVMLS). Before the system operational requirements are derived from these needs and the application of available technologies, the overall DVMLS system concept will be discussed to provide the reader with a better understanding of how the DVMLS should operate. Conceptually,, DVMLS involves the integration of real estate data consisting of video, sound, and text data that is converted into digital format and networked nationwide. DVMLS can be described by four primary segments. These four segments are 1) data and video collection, 2) communications and handling, 3) users, and 4) production and distribution. To speed implementation and decrease cost, as much of the existing MLS system will be used as is possible. A figure of the DVMLS system architecture is shown in Figure 4-1.

4.1. Data and Video Collection

Data and video collection would be responsible for the collection and integration of all text data, video, and sound information.

4.1.1 Text Data Collection

Text data would consist of all of the vital statistics

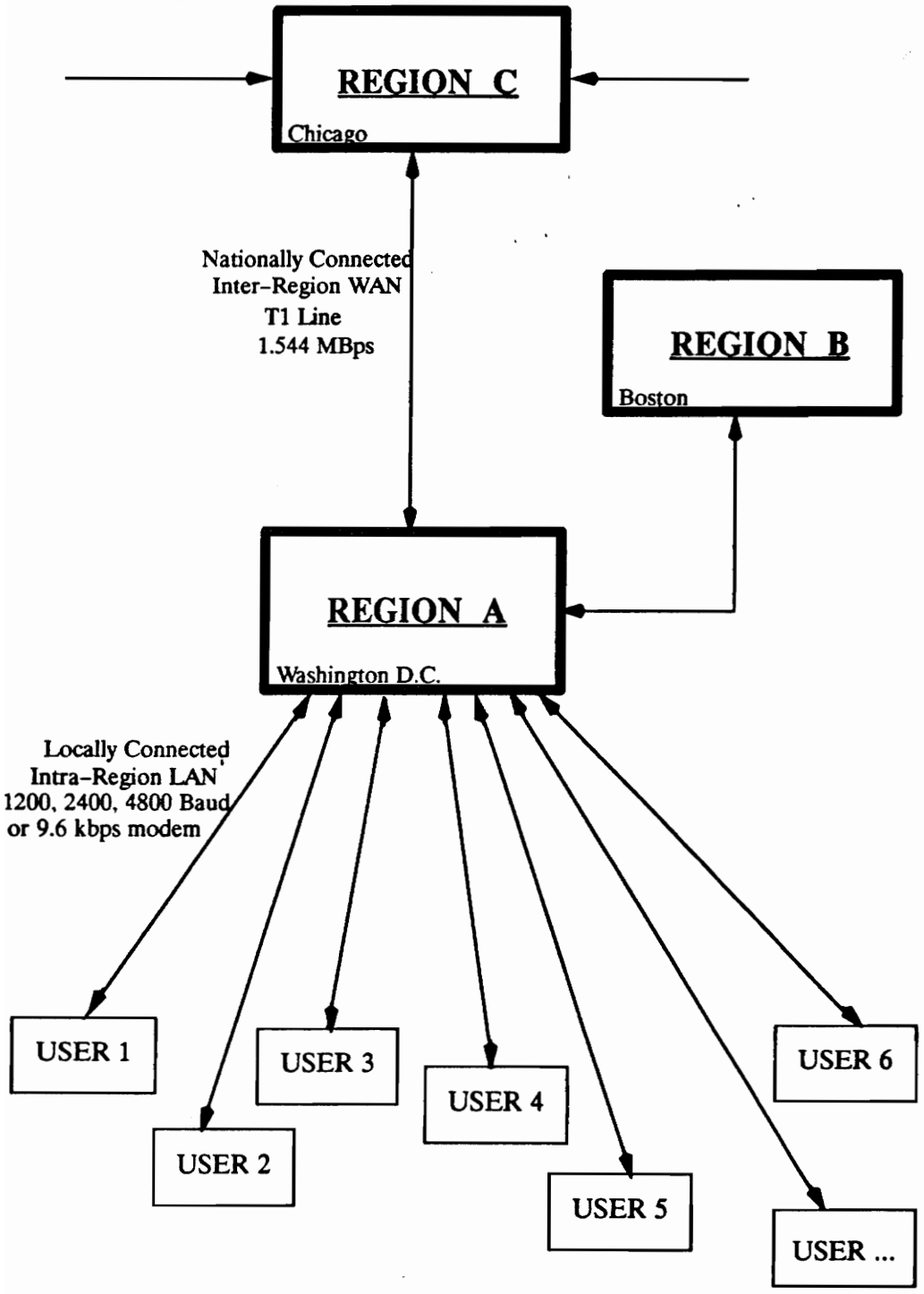


Figure 4-1 The DVMLS System Architecture

of the property (such as price, size, location, and number of rooms) currently utilized by MLS. The current MLS text data categories and maximum field sizes are shown in Figure 4-2. Additional fields would be added to capture video information and linked with names of digital video files.

4.1.2 Video Collection

Video and sound data would be collected and produced privately as a new commercial service. A commercial firm would "video tape" a home using digital video recorders and then later integrate sound in the production process. The data and video collection segment would output the digital information that then would be put on the DVMLS LAN and database(s).

4.2 Communications and Handling

The communications and handling segment would be responsible for all the information handling and storage. This segment would consist of a Local Area Network (LAN) communications system to access a regional database via telephone lines and modems. The regional database would be queried by users, and selected data would be output. Regional databases would be set up nationwide and linked together in a Wide Area Network (WAN).

RESIDENTIAL FORM

ST 20 # 6 $ 7 Date 8 L# 5 Map 5
Cty 27 Co 5 Subd 20 Bus 3
Dir 56 Poss 8
Const 11 Style 8 Apx SF 5 + - Zip 9 Ed 8
1st Fl Rms 2 Brs 2 Bths 4 Flr 7 Cl 1 Basement 3 Mortg 6
2nd Fl Rms 2 Brs 2 Bths 4 Flr 7 Cl 1 Fin 4 Assm 1 $ 5
3rd Fl Rms 2 Brs 2 Bths 4 Flr 7 Cl 1 Unf 4 Pay To 10
Total Rms 2 Brs 2 Bths 4 Typin 3 5 % Mo Pmt 11
Gar 1 Carpt 1 Cars 1 Apx Age 3 + - Laundry 9 Pl 1 T 1 I 1
Elec 5 220 3 Cen Air 6 Land Sz 9 + -Ln # 14
Gas 16 A/C Unt 6 Type St 10 CtyTx 1 Rt 8
Heat/Fuel 3 Typ 3 E/I Kit 6 Roof 10 St/CoTx 1 Rt 6
W/H/Fuel 3 Gal 2 Sep D/R 6 Foundtn 10 DB 4 PG 4
Water 14 Firepic 6 FR/Den 10 BLK 4 Lot 4
StmWnd 13 Vacant 6 Sewer 10
Schl: Elem 10 Mid 10 High 10 Paroc 10
Rmk: 71
76
76
Listed by 30 Agt # 5 Agt Ph 17
Owner 50 Comm. SA 3
Lst Realtor 44 # 4 Ph 8

THE NUMBER INDICATED IS THE MAXIMUM NUMBER OF CHARACTERS (LETTER, NUMBERS OF SPACES) THAT CAN BE USED FOR EACH CATEGORY.

ANY COPY BEYOND THE MAXIMUM NUMBER OF CHARACTERS INDICATED WILL NOT APPEAR ON THE LISTING.

Figure 4-2 Current MLS Data Categories and Field Sizes

4.3 DVMLS User

The user segment consists of the individual Realtors who use the DVMLS system. Initially most users will be Realtors, but may include increasing numbers of non-Realtors. These users would access the information through LAN/WAN and query the database. Users would query and sort, as they presently do, by price, location, size, or any multiple of the available vital statistics used as data fields. When the users find a set of properties that are potentially match a buyer's criteria, a set of instructions would be produced for the production and distribution.

4.4 Production and Distribution

The production and distribution segment would be responsible for producing a VCR tape of the selected properties' information and distributing the tapes to the home-shoppers. The production process would involve downloading the selected information from the DVMLS database and transferring this digital data into analog VHS VCR tapes, which are then shipped to the home-shoppers through mail or package delivery. Home-shoppers would view this VCR tape and select from the tape the properties that they wanted to explore further.

A second generation system could combine satellite communications to make the system available on a worldwide

basis. This would be especially useful for large commercial holdings of international corporations that buy property internationally.

4.5 Service Applications

Local DVMLS service would be provided using much of the existing MLS LAN. The existing MLS LAN is centrally based within a region and uses the telephone lines to connect Realtor users. DVMLS would use this same local network to tap into regional, national, and international networks. All communications between a user and the DVMLS system would be contained on these local lines. Services to national and international databases would then be communicated via DVMLS communications systems of T1 lines and possibly satellite communications in the future.

4.6 Service Priorities

As determined in section 2.4, local movers make up the majority of all home sales and therefore must be the first priority for service. However, it is assumed that an increasing number of long distance home-buyers would use the service if it were available.

5.0 OPERATIONAL REQUIREMENTS

From the analysis of the need and the feasibility of various technology applications, the technical parameters can now be established here in the operational requirements. To limit the scope of this report, various requirements and assumptions were adapted as ground rules. Requirements and assumptions have been based on the system concept as well as information and estimates available in current literature and are outlined in the following sections.

5.1 General Technical Requirements

General technical requirements have been summarized to include the implementation, capacity and growth, and system coverage.

5.1.1 Implementation Requirements

Implementation of DVMLS will not decrease the functionality of the current MLS system. Enhancements will not affect any users so that current MLS use is not disrupted. Once established, service must be continuous and undisturbed. The information will be phased in by developing regional DVMLS first, then linking the regional DVMLS mainframes into a national network; and, potentially, the final system will be international in coverage and

usage.

5.1.2 Capacity and Growth Requirements

The DVMLS system will support the current level of 2.7 million homes available for sale per year.[18] Table 5-1 shows a United States summary of home sales from 1986 to 1991. Also, the DVMLS system will support a capacity growth of 6 % per year.[19]

5.1.3 System Coverage Requirements

Initially DVMLS shall provide service on a regional basis, using the current MLS system and making minor regional changes. Next, the regional mainframes will be linked together, creating nationwide coverage. Finally, plans will be made to use satellite technology so that international coverage can be achieved.

In order to facilitate smooth transition from one phase of coverage to the next, all communications equipment will be able to accommodate interfaces for multi-region and international coverage.

5.2 Segment Requirements

5.2.1 Data and Video Collection

All of the text data fields currently provided in the

Table 5-1 U.S. Summary of Home Sales from 1986-1991

United States Summary

Year		Single-Family Home Sales (Seasonally Adjusted Annual Rates)		Number of Homes Available for Sale (End of Period)		Months' Supply of Homes on the Market		Median Sales Price of Single-Family Homes	
		Existing	New	Existing	New	Existing	New	Existing	New
1986		3,565,000	750,000	1,970,000	361,000	*	*	$ 80,300	$ 92,000
1987		3,526,000	671,000	2,160,000	370,000	*	*	85,600	104,500
1988		3,594,000	676,000	2,160,000	371,000	*	*	89,300	112,500
1989		3,440,000	650,000	1,870,000	385,000	*	*	93,100	120,000
1990		3,296,000	534,000	2,100,000	321,000	*	*	95,500	122,700
1991p		3,287,000	504,000	2,160,000	285,000	*	*	99,900	120,000
1990	Dec	3,130,000	464,000	2,100,000	318,000	7.9	8.4	$ 91,700	$127,000
1991	Jan	2,880,000	414,000	2,340,000	315,000	9.7	9.3	$ 96,800	$117,900
	Feb	3,160,000	488,000	2,580,000	313,000	9.8	8.0	94,000	119,800
	Mar	3,220,000	495,000	2,630,000	308,000	9.8	7.5	96,200	122,500
	Apr	3,310,000	506,000	2,670,000	303,000	9.7	7.3	100,300	121,000
	May	3,540,000	507,000	2,690,000	299,000	9.1	7.2	101,100	116,000
	Jun	3,590,000	518,000	2,530,000	295,000	8.4	7.0	102,000	119,000
	Jul	3,320,000	507,000	2,500,000	296,000	9.0	7.2	103,600	120,000
	Aug	3,250,000	522,000	2,660,000	291,000	9.8	6.9	102,200	120,800
	Sep r	3,120,000	496,000	2,530,000	291,000	9.7	7.2	99,700	120,000
	Oct r	3,160,000	518,000	2,620,000	287,000	9.9	6.7	99,200	123,500
	Nov r	3,310,000	559,000	2,550,000	264,000	9.2	6.4	97,900	117,300
	Dec p	3,340,000	522,000	2,160,000	283,000	7.8	6.6	100,000	123,800

r Revised p Preliminary * not applicable

Source: New home sales data from Census Bureau, U.S. Department of Commerce

MLS system will be provided in DVMLS. Additionally, audio data will be interleaved into video data and delivered to DVMLS in digitally compressed files using the DVMLS standard compression algorithm. The additional information that the DVMLS system will contain includes test fields for digital video file availability, the corresponding digital video file name, and the digital video file size.

5.2.2 Communications and Handling

The DVMLS system will accommodate varying traffic demand of user requests as is found with current MLS usage. Different data rates to include 2400 baud, 4800 baud, and 9.6 kbps will be accommodated. File format will be standard and limited to a DVMLS standard number of bytes. Video and sound information will be stored as compressed sub-files of the data file. A standard communications protocol will be used for DVMLS to control the text and compressed video data. Error correction and re-transmit capabilities will be included. Batch requests for video information will satisfied to the user without noticeable delay to the user interface. This will be done by a background process that utilizes the untasked data processing capability of the full data rate. Interrupted batch processing will resume on next login unless otherwise requested.

5.2.3 Users

Users will be provided with the ability to select properties for batch processing and distribution of video tapes using their current equipment of computer and modem. The additional data fields for video will not affect the access times that users currently experience when accessing data and performing sorts and queries.

In order to view the video information during selection or to download video information for production and distribution, users shall have the minimum standard multimedia PC requirements which include the following equipment:[20]

- IBM PC with a 386SX processor running at 10 MHz
- 2 MB of RAM
- a 30 MB hard drive
- a 1.44 MB high-density floppy disk drive
- a 16 color VGA display.

Although the minimum standard Multimedia PC (MPC) requirements will allow users to access digital video and utilize the DVMLS system, Microsoft and a consortium of hardware manufacturers that developed the MPC standard recommend the following equipment to provide faster processing with better quality graphics. The recommended equipment includes:

- IBM PC with a 386DX processor running at 25 MHz

- 6 MB of RAM
- at least a 120 MB hard drive
- a 256 color VGA display with a super VGA adapter.

Other peripherals required are:

- printer, modem, and compression boards.

Other peripherals recommended include:

- VCR adapter, VHS recorder.

Maintenance for user equipment will be available by mobile service units that are on-call 24 hours/day and will have a maximum downtime of 4 hours. If equipment cannot be repaired within the 4 hours, a temporary replacement of like quality or better will be provided.

5.2.4 Production and Distribution

DVMLS will produce VHS tapes that are compatible with the VHS standard and playable on a standard VHS VCR machine. The VHS tapes that are produced must include monophonic sound. Stereo sound is not a requirement as many televisions and VCRs do not have stereo outputs. Also, the VHS tapes that are produced must be recorded at the Standard Play (SP) speed so that a standard is set throughout DVMLS. DVMLS VHS tapes of requested query results will be produced and placed into distribution channels within one day.

Distribution will rely on external distribution channels such as the US mail, Federal Express, or UPS. Different

distribution fees and schedules will be selectable for rush or normal delivery.

The production and distribution shall have a turnaround time of no greater than 24 hours from time of batch process request. This time includes time for preventive or corrective maintenance.

6.0 SYSTEM MAINTENANCE CONCEPT

Section 6 describes the system maintenance concept for the DVMLS system and the overall support environment in which the DVMLS system operates. As aforementioned, the DVMLS system is comprised of four segments: 1) data and video collection, 2) communications and handling, 3) user query and analysis, and 4) production and distribution. The maintenance concept describes the responsibilities of and levels of support for each of the segments in terms of preventive and corrective maintenance of the DVMLS system. Figure 6-1 shows the system operation and support flow. Figure 6-2 shows in pictorial form the responsibilities for maintenance of the DVMLS system. Figure 6-3 provides an overall maintenance concept flow for the entire DVMLS system to include unscheduled (corrective) and scheduled (preventive) maintenances as well as support factors.

6.1 Data and Video Collection

As described in the system concept, data and video collection are separate functions. Data collection is handled by the user, while video collection is handled by an outside service. Since the video collection is handled by an outside service, to include editing, preparation, and delivery to DVMLS, the maintenance responsibilities will not be handled here. Also, the data collection will be handled

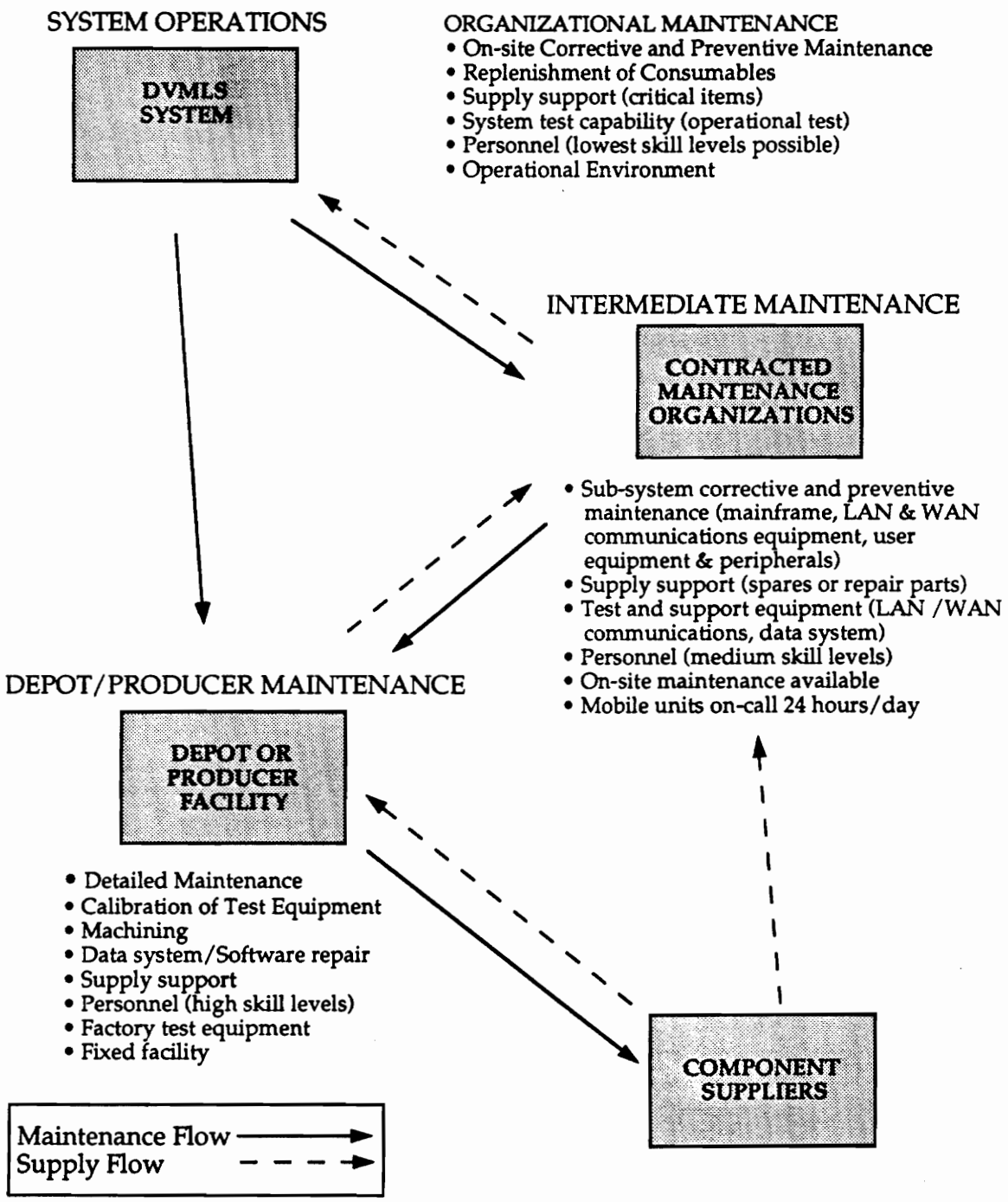


Figure 6-1 System Operation and Support Flow

CRITERIA	ORGANIZATIONAL MAINTENANCE	INTERMEDIATE MAINTENANCE	DEPOT/PRODUCER MAINTENANCE
Done where?	• At DVMLS operational communications facilities	• Mobile or semi-mobile maintenance units • Truck, van, portable shop, or equivalent	• Depot or producer facility • Specialized repair site, or producer's manufacturing plant
Done by whom?	• DVMLS system equipment operating personnel (low to intermediate maintenance skills)	• Contracted personnel assigned to mobile or semi-mobile units (intermediate maintenance skills)	• Depot or facility personnel, or producer's production personnel (mix of intermediate fabrication skills and high maintenance skills)
On whose equipment?	• DVMLS equipment and/or tools	• Equipment and/or owned, leased, or acquired for use by maintenance organization	
Type of work accomplished?	• Visual inspection • Operational checkout • Minor servicing of communications & memory equipment • External adjustments • Removal and replacement of some components • Minor calibration of communications equipment	• Detailed inspection and system checkout • Major servicing • Major equipment repair and modifications • Complicated adjustments • Limited calibration • Overload from organizational level of maintenance • Complex repairs, modifications, and upgrades • Detailed calibration	• Overhaul and rebuild • Supply support • Overload from intermediate level of maintenance

Figure 6-2 Maintenance Concept: Major Levels of Maintenance

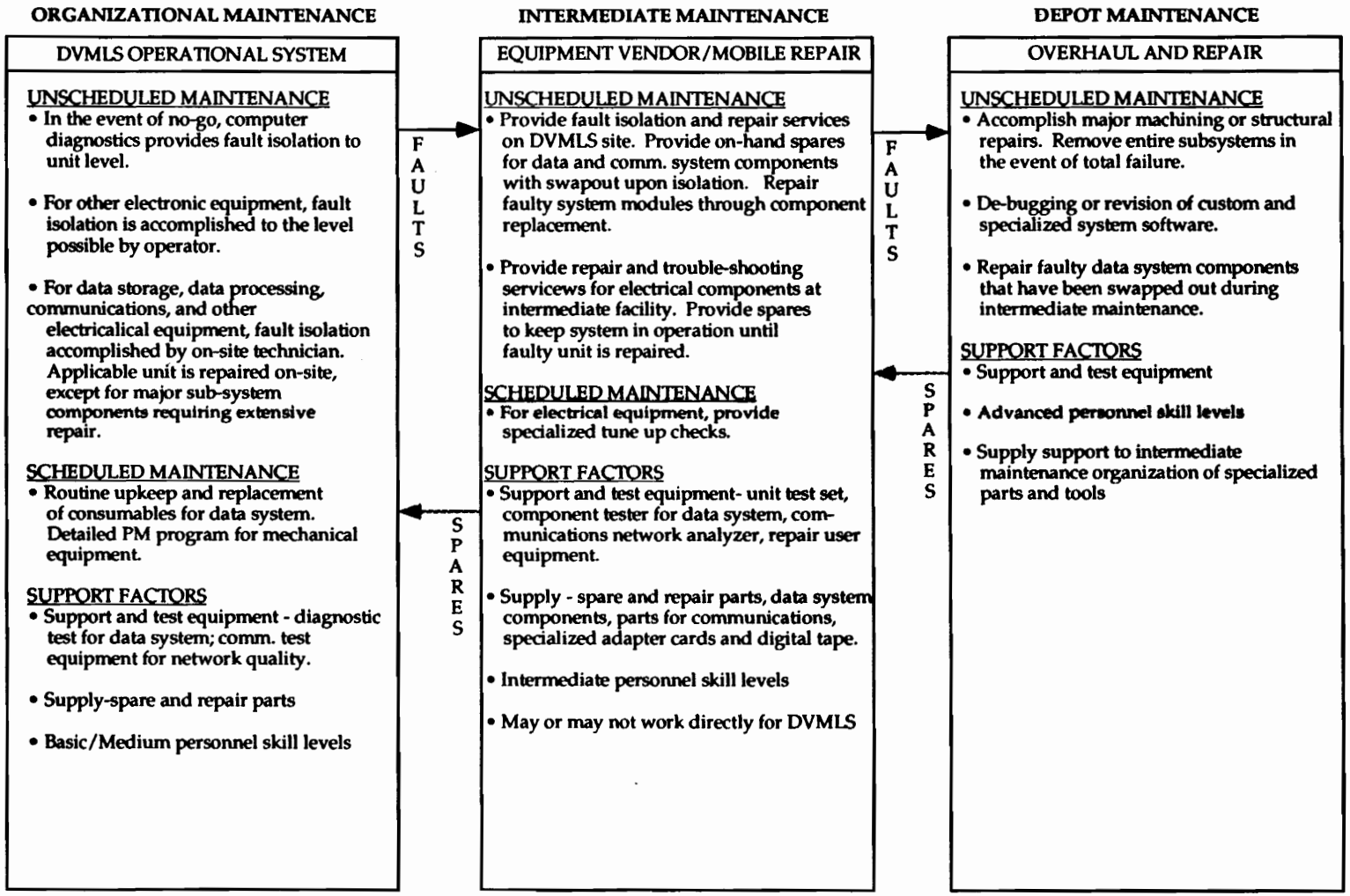


Figure 6-3 DVMLS Maintenance Concept Flow

by the DVMLS user, and the maintenance concept for the user equipment will be handled in Section 6.3 User Query and Analysis.

6.2 Communications and Handling

The communications and handling segment is the most complex and involves most of the hardware and software associated with the DVMLS system. The communications equipment will involve modems, modem switches, and high speed LAN (HSLAN) equipment. The data handling equipment will involve mainframe computers, large memory storage, digital compression interfaces, and custom software. The communications and handling section will have components that operate within strictly maintained environmental conditions, but do not inhibit maintenance on components residing within the controlled environment.

6.2.1 Preventive Maintenance

6.2.1.1 Organizational Preventive Maintenance

Since the communications and handling section is highly complex, the operational personnel are not expected to be able to repair all devices. Sparing will be sufficient for most components that are more prone to failure will be spared. The operational personnel will be expected to

perform basic troubleshooting, remove equipment and replace with a spare. They will also be expected to perform regular memory backups so that any loss of data can be minimized. Likewise, system analysis tests to evaluate operational performance will be performed.

6.2.1.2 Intermediate Preventive Maintenance

Computer systems and communication electronics do not require a lot of preventive maintenance, but intermediate preventive maintenance is probably the most important. The intermediate maintenance facility provides the following preventive maintenance support:

- -loading new or upgraded operating system, application, or custom software,
- -loading a new or upgraded database,
- -installing a new or replacing existing hardware that is either obsolete or will fail soon,
- -cleaning the read/write heads on all magnetic media, storage devices,
- -periodically optimizing disk storage,
- -ensuring that the environmental control devices are operating properly, and
- -periodically backing up the entire system (in addition to the automatic backups).

6.2.1.3 Depot/Producer Preventive Maintenance

With the exception of complex hardware upgrades, depot maintenance is not responsible for any preventive maintenance measures on the order processing subsystem.

6.2.2 Corrective Maintenance

6.2.2.1 Organizational Corrective Maintenance

The operational personnel will be expected to perform limited troubleshooting and repair for the hardware. As far as software, if the software should fail to operate properly for any reason, the operational personnel will be expected to perform an Initial Program Load (IPL) to restore the system to operational status. If the IPL does not fully correct the problem, the operators will notify the intermediate maintenance technician. The operators will be asked to try to isolate the component (software, disk drive, communication equipment) responsible for the error, but are not ultimately responsible for fault isolation.

6.2.2.2 Intermediate Corrective Maintenance

The intermediate maintenance technicians are responsible for the following corrective measures:

-isolation of fault to either software or hardware,

-isolation of fault to the component level (i.e., H/W:

CPU, disk drive, monitor, etc.; S/W: application, custom, operating system, etc.)

-resolution of all problems by either fixing the faulty component or swapping the faulty component out for a spare component, and

-determination of whether a swapped component may be repaired at the intermediate site or must be sent to the main depot.

6.2.2.3 Depot/Producer Corrective Maintenance

Depot maintenance is responsible for correcting components sent to it from the intermediate maintenance department. Depot maintenance is responsible for making the determination whether to repair or discard faulty components. The depot makes the most cost effective choice, which in turn is most cost effective to DVMLS. If the problem is isolated to the software and sent to the depot maintenance, the depot maintenance department is responsible for ensuring that a temporary fix is secured within one day and a permanent fix is secured within one week. These are reasonable limits to deal with an operational system of this type where the software is complex.

6.3 User Query and Analysis

The user section consists of hundreds of DVMLS users

that have basically the same equipment. The equipment also has different uses depending on the office environment. For example, user equipment may be used for office automation, as well as for DVMLS query and analysis.

6.3.1 Preventive Maintenance

Although the equipment is very sophisticated, all of the components are highly reliable and nearly maintenance free. It is even likely that many components such as computer displays or computer interface boards will become functionally obsolete before they require maintenance. Therefore, the preventive maintenance is limited to cleaning the display screen and keyboard and using a VCR head cleaner if a VCR interface is made. All of this preventive maintenance will be performed by the user, and there will not be any other additional preventive maintenance by intermediate or depot services.

6.3.2 Corrective Maintenance

The equipment support for users will be performed by a computer maintenance service that will be on call 24 hours a day. These technicians will service the user equipment by performing fault isolation and repair. If there are components that can not be repaired, these technicians will replace the faulty unit and send the unit to depot

maintenance for repair.

6.4 Production and Distribution

The production equipment is based at either the communications and handling organization or the user organization. Therefore, this maintenance will fall under these two sections.

7.0 FUNCTIONAL ANALYSIS

Section 7 provides a functional analysis of the DVMLS system for the primary purpose of structuring system requirements into functional terms. Operational functional flow diagrams are shown in Figures 7-1 and 7-2. Figure 7-1 represents the first level of operational functional flow. The second level of operational functional flow is shown in Figures 7-1 and 7-2 to represent an expansion of the first level. The DVMLS system is broken down into five distinct functional areas. These are 1) data and video collection, 2) communications and handling, 3) users query and analysis, 4) production and distribution, and 5) buyer view and selection. Although some of the video collection details are not covered in this paper since the service will be contracted out, it will be covered here to show how the video collection integrates into the DVMLS system.

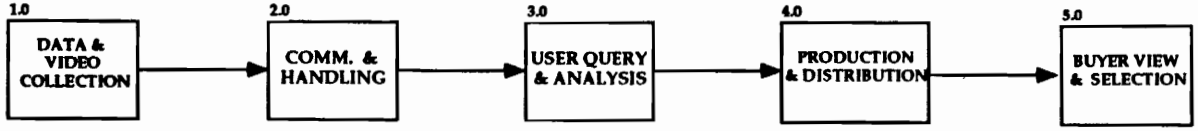
7.1 Data and Video Collection

7.1.1 Sales Contract and Video Collection Order

7.1.1.1 Sales Contract

The sales contract would initiate the inclusion of property into the DVMLS system. Sellers would select a Realtor and then agree on a sales contract. Ideally, in the

First Level:



Second Level:

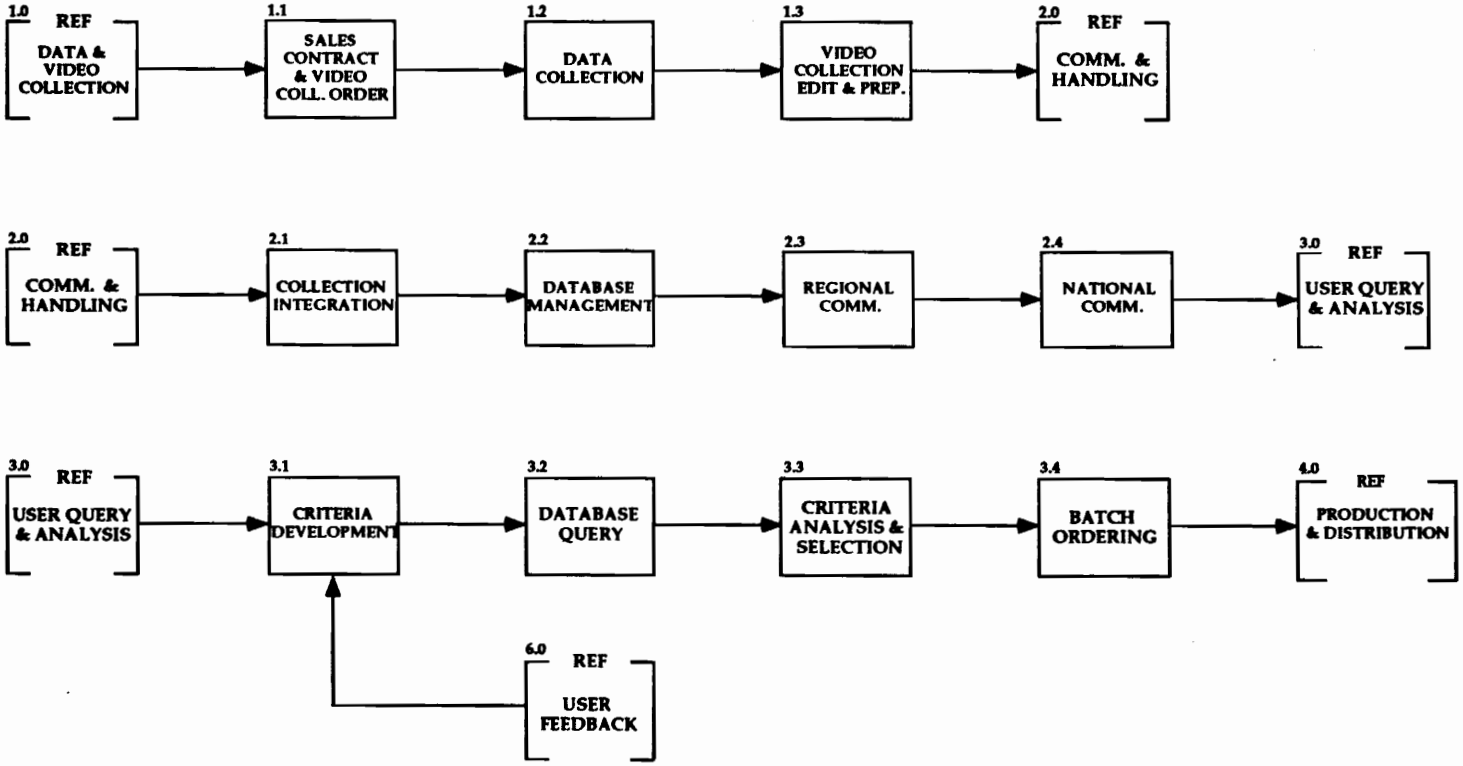


Figure 7-1 1st and 2nd Level Operational Functional Flow

Second Level Continued:

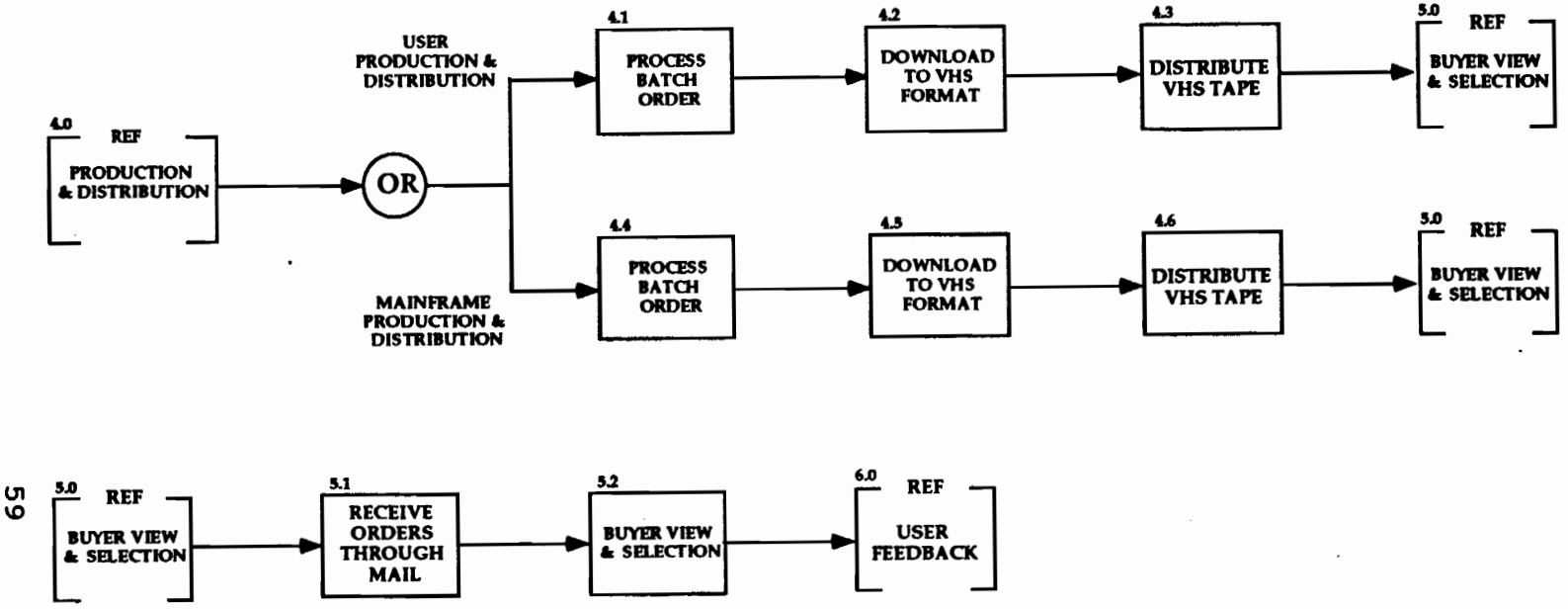


Figure 7-2 2nd Level Operational Functional Flow Cont'd

future, it will be possible for individuals selling their property to work directly with the DVMLS system.

7.1.1.2 Video Collection Order

A video collection order is made as soon as possible after completion of the sales contract. This order will request that a commercial video group take the necessary measures needed to develop integrated digital audio and video data.

7.1.2 Data Collection

Data collection with the DVMLS system would not change significantly from the current MLS system. As currently performed, Realtors would collect the relevant data, or "vital statistics", on a property to make up the current MLS fact sheet. This data would then be entered into the regional database via user LAN connect.

7.1.3 Video Collection, Edit and Preparation

7.1.3.1 Video Collection

Video collection would be the process of a video crew physically going to a new property and producing a draft video tape for later editing.

7.1.3.2 Video Edit

The video data that would be collected at the sellers' property would then be edited for the most effective use in the DVMLS system. In the editing, sales practices should be incorporated as well as limiting the total file size and video playback time limits set by the DVMLS system.

7.1.3.3 Audio Production

After the video portion has been completed, audio would be developed and integrated into the video. The audio content should be of a somewhat standard format, detailing the location, amenities, and relative advantages of the property.

7.1.3.4 Digital Preparation

The audio and video data will be taken and reformatted into the required digital format that the DVMLS system can accept and process. Much of the audio and video editing can be done entirely in the digital medium. Regardless, the end product of the data and video collection must be compressed into digital format so that the computers can store the large quantities of digital data. The compressed digital information will then be delivered via magnetic tape or disk or via direct communications lines to the DVMLS communications and handling center.

7.2 Communications and Handling

7.2.1 Collection Integration

The compressed digital information will be delivered from the audio and video studio and then linked with the text data provided by the Realtor. The text data will remain in an open database so that queries can be made on this data. The text data will include additional fields that will reference the compressed digital file which stores the digital video and audio data.

7.2.2 Database Management

The DVMLS database will perform all the functions that are currently performed in the MLS system and will also include considerations for linking text data to the compressed digital files. A mainframe computer will handle all database queries, reports, data transfer requests, and batch processing. Regional mainframes will interface with other regional mainframes to include data that is requested but not available in individual regional databases.

7.2.3 Regional Communications

For a more rapid and cost-effective implementation, regional communications will use much of the current MLS data handling system to interface between the regional main

frame computer and individual DVMLS users via the phone lines. As DVMLS demand increases, modem speeds and message formats will be modified to accommodate future DVMLS enhancements.

7.2.4 National Communications

To ensure that DVMLS does not fall into the same regional limitations currently found in MLS, national communications lines will be established to connect all regional databases. Regional mainframes will be linked together so that databases can be accessed to provide requested information on properties outside the home region. Along with the dedicated regional support, each regional mainframe will either satisfy the request of another region's information needs, or pass-through the request to another database that can provide the information.

7.3 User Query and Analysis

7.3.1 Criteria Development

To limit the enormous amount of information available, the DVMLS users must develop important criteria of the desired property to limit the amount of data, or properties, that would be selected. Criteria will include items such as

location, price, property type, and size. After viewing a tape, buyers will often modify their criteria selection. Therefore, the process of criteria development will often be iterative and require numerous queries.

7.3.2 Database Query

The buyer criteria described in Section 7.3.1 is translated into database queries in order to focus the scope of requests on the enormous quantities of nationwide properties. Query commands will be sent to regional mainframe computers to search the databases for properties that match the selected criteria. Thus, the user will receive information on properties that meet the entered criteria, which should provide a list of potential properties to purchase.

7.3.3 Criteria Analysis and Selection

The database query information is used by DVMLS users to analyze the merits of prospective property matched within the initially entered criteria. The results of a query will often have constraints placed upon them to limit the number of properties to review. When a potential match is thought to meet many or all of the buyer's criteria, the database record will be flagged. When a number of properties have been pre-screened and their records flagged, all of these

records will be processed together by batch ordering.

7.3.4 Batch Ordering

Batch ordering will consolidate the selected records that meet the buyer's criteria into a single order for the database to handle. There are two ways to process batch ordering: first, directly, by the user, or second, by using the mainframe. Using the direct batch ordering, the DVMLS user may have all files downloaded from the mainframe to the user's individual computer. The DVMLS user will then perform the functions of production and distribution to allow a user to either view the videos with the buyer in the users office, or for review and shipment to the buyer. Otherwise, a batch order can be processed by the mainframe to handle the production and distribution functions.

7.4 Production and Distribution

7.4.1 User Production

The process of user production will involve downloading selected files from the mainframe and transferring this digital data into VHS video format for later viewing on a home VCR. A user must have necessary equipment for file decompression and conversion as well as video equipment to record the video information.

7.4.2 Mainframe Production

Mainframe production will accept a batch request from a user and download the requested DVMLS information onto a VHS VCR tape for home display. The mainframe will control the decompression of data and file conversion into analog VHS format. The end product will be a VCR tape that is then passed on to distribution.

7.4.3 Distribution

Distribution to the buyer can be performed by direct handling or via mail or courier. User production is more likely to utilize direct handling which will include physically presenting the tape to the buyers. Mainframe production will procedurally utilize mail or other courier options to deliver DVMLS tapes to buyers.

7.5 Buyer View and Selection

7.5.1 Receive Orders Through Mail

This step is obvious, as packages are received from distribution.

7.5.2 Buyer View and Selection

The process of reviewing the DVMLS tape is the objective of the DVMLS system. The speed and difficulty in which this

process takes place is a valuable indicator of how well the DVMLS system is functioning. After viewing the DVMLS tape at their leisure, feedback is given to the user who performed the query and ordering functions.

8.0 PROPOSED PRELIMINARY SYSTEM DESIGN CONFIGURATION

In this report, a top-down approach to overall system development has been utilized by identifying the need, analyzing feasible technical alternatives, developing a system concept, establishing requirements, applying a maintenance concept, and plotting the functional flow. As mentioned in the technical feasibility section, there are numerous trade-off analyses that need to take place before this project can move forward, but from the analysis that has been performed, the following is a proposed preliminary system design configuration. Other implementation issues will be discussed in the conclusions section.

8.1 Data and Video Collection

The design configuration of the data and video collection segment are especially important since the collection process is the "front-end" of the DVMLS system. The recommendation is to out-source the video and audio collection and production activities to private companies. By outsourcing the collection and editing jobs, there can be a number of different companies that can fill this need. With the competition between a number of different companies, the most efficient and cost effective companies will survive. This competition will also increase the

level of service and quality that would normally be provided by a single-source supplier. Additionally, since the data and video collection will be out-sourced, many of the implementation issues will be left to the service provider.

8.1.1 Information Types

The data that will be managed in the DVMLS system will include video, sound, and text information. All of this information will be represented in digital format. The digital video and sound will be interleaved so that the information can be directly converted into analog VHS VCR cassette tapes as end products. The text data that is currently being used in MLS will be separate from the video and sound data so that the text portion of the data file can be sorted and queried when used in a database.

8.1.2 Data Compression and File Size

Data compression and file size really cannot be separated since they directly affect one another. When the video images are collected, it is recommended that digital video cassette recorders be used. By using a digital recorder, there are no losses due to sampling in converting an analog video to digital format. However, because these recorders are just coming into the market, this technology

advance will not be addressed, but rather strengthen the assumptions make here. For this paper, it will be assumed that an analog VCR camera will be used to collect video information.

The variable bit rates and transmission economy offered by the DVMLS system relies on various bit compression techniques. By using bit compression techniques to process video and audio signals, a maximum file size of 1 Megabyte can be transmitted at in 1.39 seconds over a standard 4800 baud modem instead of 208 seconds that would be required if no bit compression were used.

Audio signals are handled as video information with respect to the bit compression. This was done so that the audio signals and video signals could be interleaved and treated as one set, while still being separate from text data. The DVMLS system uses a combination of motion compensated interframe and intraframe coding techniques. Through the use of these combined compression techniques, the DVMLS system can operate efficiently at a number of transmission speeds while maintaining excellent picture quality.

The intraframe coding technique compares elements within each frame (sent every 1/30th of a second) for similarities such as a large area of color in a background. The similarities are then encoded and transmitted as a few bits

of information instead of thousands of bits of redundant information. The interframe technique compressed the signals by comparing one from with the previous frame and sending only changed information. By sending only those changed information bits, redundant transmission of information common to each frame is eliminated.

Several compression techniques that use intraframe and interframe have been proposed, but only two are currently in use, which are Intel's Digital Video Interactive (DVI) compression algorithm and the Joint Photographic Experts Group (JPEG). It is recommended that Intel's DVI compression technique be used since this compression allows for compression rated of up to 150 to 1 while JPEG only offers a maximum compression ratio of 20 to 1[21]. To store 60 minutes of full-screen DVI video still requires about 550MB of disk space. This correlates to a one second pan of 30 frames per second to equal roughly 152.8 kbytes. Therefore, if a 1 Megabyte file limitation were set, this would allow for over 6.5 seconds of video footage at 30 frames per second.

There are a number of reasons this file size is chosen. A one Megabyte file size is small enough so that a fairly basic computer can load the file and present the information. Also, one Meg is a convenient size since each file can be stored on an individual disk in its entirety.

From the production point of view, this is still enough storage to present a large amount of images. For example, the TV Home Shopping network has 25 second spots with usually only 1 or 2 photographs of poor quality. With 1 Meg of memory, production could produce a one minute presentation of a home with as many as 200 still images or up to 6.5 seconds of full motion video. As a standard, the time limit of each video should be set to one minute. One minute is enough time for a buyer to be presented with all of the text fields of statistics and should be able to view every piece of the property.

8.2 Data Communications and Handling

8.2.1 Error Correction

The DVMLS system will contain a forward error correction scheme in order to protect against bit errors caused in the line. DVMLS will use the BCH (255,239) double error correction algorithm. It can correct up to two isolated errors within a block.

8.2.2 Data Communications

There are two types of data communications used in the DVMLS system. These are the Intra-region LAN and the Inter-region WAN.

8.2.2.1 Inner-region LAN

The inner-region LAN provides communication between the user/Realtor and the regional database. Users/Realtors will access the Inner-region LAN by logging into the DVMLS network via modem. The current MLS inter-region LAN will be used as much as possible to limit the transition cost, time, and technical deviations. A modem hook up will be provided for every user. Modem speeds that the current MLS system supports is 1200, 2400 and 4800 baud. Due to the increase in available data, a 9.6 kbps communication line will also be available.

8.2.5.2 Inter-region WAN

The inter-region WAN provides communication between two regional databases within the same continental region. Communications networks may be categorized on the architecture and techniques used to transfer data. The following types of networks are in common use:

Switched Communications Networks

- Circuit-Switched
- Message-Switched
- Packet-Switched

Broadcast Communications Networks

- Packet Radio Network
- Satellite Network

Local Network.

A switched communication network consists of an interconnected collection of nodes in which data are transmitted from source to destination by being routed through the network of nodes. With broadcast communications network, there are no intermediate switching nodes. A transmission from any noted can be broadcast to and be received by all other stations.

The switched communications network is more suited for the requirements of the DVMLS system because of cost complexity and distance requirements. Since there will be a large number of network centers (possibly in every major metropolitan area) a direct broadcast connection between all network centers would be extremely costly because the communications would have to be duplicated for each network center. Likewise, the distance requirements of a national DVMLS would not allow for cost effective communications since satellite technology would probably be used. Therefore, switched communications should be used.

There are three types of switched communications networks: 1)circuit switched, 2) message switched, and 3) packet switched. The telephone network is designed to receive, switch and transmit analog signals into the voice-frequency range of about 300 to 3400 Hz. Modems (modulator-demodulators) convert digital data to analog

signals, and vice versa. There are three basic encoding or modulation techniques for transmitting digital data into analog signals. These are Amplitude-Shift keying (ASK), Frequency-Shift Keying (FSK), and Phase-Shift Keying (PSK). PSK is recommended to be used for modems to maximize the data rate by using multiple phase angles and more than one amplitude.

Amplitude-shift keying (ASK) is susceptible to sudden gain changes and is rather inefficient, generally used up to 1200 bps on voice-grade lines. FSK is less susceptible to errors than ASK, but still is typically used up to 1200 bps. In PSK, the advantages of both are utilized. Therefore, for the inter-region LAN, a switched communications network using multiple PSK modulation should be used. T1 designated communications lines should be used to allow for a standard 1.544 Mbps to be utilized. Using a T1 line, 24 channels can be multiplexed at rates of 64 kbps each.

8.3 User

The user sector also has a number of preliminary design configuration involving hardware. Some of the hardware issues with equipment selection are: interfaces to DVMLS LAN, user equipment requirements and standardization, maintenance contracts for user equipment. Software issues

that have been addressed are the compression and decompression algorithms, and levels of error correction and how error correction is handled by the hardware.

8.4 Production and Distribution

Production and distribution has preliminary design configuration issues that involve the type of production and type of distribution. It is recommended that the production be available in both VHS and Beta VCR format and be selectable by the DVMLS user. Distribution will be serviced by standard distribution channels such as the U.S. postal service, Federal Express, or DHL, and will be based on lowest cost for services.

9.0 CONCLUSIONS

In this report, the definition of need, system concept, technical feasibility, requirements, maintenance concept, and functional flow were discussed. These aspects to an engineering process or solution are important and necessary for the successful completion of a major undertaking such as implementing the DVMLS system. As mentioned in the technical feasibility section, there are numerous trade-off analyses that need to take place before this project can move forward. The implementation issues, to include trade-off analysis issues, will be identified. An exhaustive analysis of the implementation issues can not be performed, but many of the important issues of implementation will be covered.

9.1 Data and Video Collection

The implementation issues that need to be addressed in the data and video collection segment are especially important since the collection process is the "front-end" of the DVMLS system. However, since the video and audio collection and production will be out-sourced, many of the implementation issues will be left to the service provider. The specification of the interfacing hardware and formats do have to be established.

9.2 Communications and Handling

The communications and handling section contains much of the hardware and software that is the basis for the DVMLS system. Because of this, there will be considerable trade-off analyses needed to evaluate the different hardware and software architectures, and the different hardware devices that can fill the requirements. With equipment trade-offs, the cost, functionality, maintenance, and ease of use must all be factored into the equipment trade-off. Other implementation issues that are important in the communications and handling sector are: database structure, data storage architectures and devices, high capacity phone switches and handling, WAN communication architectures and corresponding protocols, and the potential implementation of satellite communications. For all of these trade-offs, the flexibility of the equipment must be analyzed to allow for later enhancements, reconfiguration, or changes in requirements.

9.3 User

The user sector also has a number of implementation issues involving hardware, but also in administrative or policy decisions. Concerning technical trade-offs, there are both hardware and software issues. Some of the hardware

issues with equipment selection are: interfaces to DVMLS LAN, user equipment requirements and standardization, maintenance contracts for user equipment, and user training. Software implementation issues include the selection of user software, the compression and decompression algorithms, and levels of error correction and how error correction is handled by the hardware.

Unlike the other segments, the user sector has a number of policy or administrative decisions to make. Some of these decisions involve the procurement, integration, and education schedules. The schedules are driven by the liquidity of funds to pay for the advancement and the cost to users. Regulations will also be needed for the DVMLS system.

9.4 Production and Distribution

Production and distribution has implementation issues that involve the type of production and type of distribution. The production can be either VHS or Beta VCR format, or both. While distribution will select the type of distribution channels between the U.S. postal service, Federal Express, DHL, and others.

As should be apparent, the implementation analysis issues are many. The speed, cost efficiency, and effectiveness of these many trade-offs could make the

difference between the success and failure of integrating a new system such as DVMLS. The system need, requirements, functional breakdown, and maintenance issues have been addressed. Although this is the necessary beginning of a systems project, here, it is also the end.

NOTES

[1]National Association of Realtors, "Home Buying and Selling Process: 1989", Real Estate Business Series, (National Association of Realtors, 1990), 31.

[2]Ibid., 31.

[3]Ibid., 11.

[4]Ibid., 32.

[5]Ibid., 32.

[6]"The Estimated Cost Of Relocating A Family In 1991", Directory of Professional Relocation Services, 1991, 41.

[7]National Association of Realtors, 65.

[8]Ibid., 64.

[9]Ibid., 65.

[10]Ibid., 67.

[11]Henry E. Martinson, "Prospective Buyer Traffic Versus Sales", Housing Economics, (September, 1991), 6.

[12]National Association of Realtors, 69.

[13]Ibid., 70.

[14]Stacey A. Waldron, "The MLS Withstands the Test of Time", Real Estate Today, (August, 1989), 26.

[15]National Association of Realtors, 34.

[16]Ibid., 13.

[17]Michael J. Miller, "Multimedia", PC Magazine, Volume 11 Number 6, (March 31, 1992), 132.

[18]National Association of Realtors, "United States Summary", Home Sales, (January, 1992), 9.

[19]Ibid., 9.

[20]PC Magazine, 127.

[21]Ibid., 132.

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