Configuring Geographically Distributed Videotex Databases: Model and Solution Procedure

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Videotex refers to computer-based interactive systems that are capable of electronically delivering screen text, numbers and graphics via telephone or two-way cable for display on television sets or video monitors. This technology allows computer-naive users to easily access general interest or highly specialized information stored in on-line databases in the amount and sequence (s)he desires. Over the past decade, there has been considerable interest in videotex systems, and a number of them have already been implemented in different countries. With the proposed implementation of Integrated Services Digital Networks, the interest in videotex systems is expected to grow even further.

This paper provides a brief overview of commercial videotex systems in various countries, and discusses possible organizational usage of these systems. In addition, we formulate a 0/1 integer programming model for allocating videotex files in a geographically distributed videotex system. A Lagrangian relaxation based solution procedure is developed for solving the videotex file allocation problem. Results of extensive numerical experiments performed using the proposed heuristic solution procedure are reported.

Videotex refers to computer-based interactive systems that are capable of electronically delivering screen text, numbers and graphics via telephone or two-way cable for display on television sets or video monitors (Augmente, 1987). Using retrofitted personal computers or special videotex terminals, subscribers (users) can access general interest or highly specialized information stored in on-line, videotex databases. These databases consist of a network of ‘pages’ or ‘frames’ that the user can navigate using simple commands, such as menu selection, keyword searches and form filling (Gescei, 1985). Usually, the subscriber is charged for connect time, and the number of pages referenced. Videotex provides the user with a simple interface to access large amounts of data quickly, in the amount and sequence (s)he desires.

First generation videotex systems (VS) were essentially low cost public information retrieval services. However, over the past decade, the emphasis has shifted to using videotex as a communication medium rather than a simple information retrieval system. Currently, VS are being used for accessing multiple independent databases, messaging, and electronic mail. These systems have also been used extensively for conducting interactive, transactional services such as home banking and tele-shopping.

Over the past few decades, tele-communication networks have been designed and implemented to support a wide variety of services, including the integration of a customer’s voice, data and video communication requirements. Rapid advances in VLSI technology, coupled with declining costs of fiber-based transmission systems, have resulted in high speed, broadband digital networks capable of transporting hundreds of megabits per second. The most attractive of all recent trends is the expected deployment of Integrated Services Digital Network (ISDN). Growing from the need to eliminate different access methods and equipments for each kind of service (e.g. voice, data, video) desired by a customer, the primary objectives of ISDN are (i) to provide integrated access via a single set of wires, (ii) to establish an internationally standardized protocol, and (iii) provide digital end-to-end connectivity. Due to the proposed

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implementation of ISDN and the consequent availability of digital, high speed communication links, interest in VS will continue to increase in the immediate future.

In addition to information retrieval and transactional services on centralized databases, most currently implemented videotex systems provide facilities that allow transparent gateways to other databases and services. The user-friendly, interactive nature of VS, coupled with the ability to access multiple databases easily from a single desktop computer system, has important implications for the organizational use of these systems. Videotex has the potential of presenting easily updatable and timely information to computer-naive users. Thus, from an organizational standpoint, VS provides the advantages of a wider information base, both internal and external. Currently, organizations must spend significant amount of time and effort to train end users on how to use the information system. Due to the inherent simplicity of videotex systems, this training time (and associated costs) can be reduced considerably.

**Components of a Videotex System**

In general, subscribers access on-line videotex information via special user terminals. These terminals are connected to a communications medium, usually telephone lines or two way cable. A keypad is attached for selecting options that appear on the screen. Currently, however, the trend is towards the use of personal computers with ‘videotex cards’ instead of specialized user terminals. The information in the databases are maintained and updated by a set of suppliers known as Information Providers (IP).

Users and information providers are connected to the Information Services System (ISS). The ISS can be partitioned into:

- Information Retrieval System (IRS),
- Information Update Server (IUS), and
- Gateway Service Provider (GSP).

Subscribers (users) interact directly with the IRS. Based on the user’s request, the IRS retrieves the appropriate data from the videotex database. When the required data is not available at the local IRS, the request can be transferred through the GSP to a geographically distant information retrieval system. Usage accounting is handled by the IRS.

Data from information providers are received by the IUS. If the data is already in videotex format, the IUS forwards the data to the associated IRS. Otherwise, before distributing the data, the IUS reformats the data to an appropriate form. Electronic mail, file transfer, and access to remote locations (databases) are handled by the GSP. The inter-connections between various components of a videotex system are shown in Figure 1.

**Objectives of this Paper**

The objectives of this paper are two fold. First, it is our intention to provide an outline of existing, commercial videotex systems and discuss the organizational uses of this technology. Available literature on videotex systems are dominated by discussions on protocol standards, hardware design, and various marketing, psychological, and social aspects of these systems. There is, surprisingly, a scarcity of literature concerning analytic foundations for designing these systems. Accordingly, our second goal is to provide an analytic tool for allocating videotex files in a geographically distributed videotex system, henceforth referred to as a videotex network (VN). There are marked similarities between a VN and distributed databases, and hence models developed for the latter can be utilized for designing VN. However, due to some special properties of videotex, considerably simpler solution procedures can be developed. We propose a Lagrangian relaxation based solution procedure for solving the videotex file allocation problem.

The remainder of this paper is organized as follows: Section 2 provides an overview of commercial videotex implementations in different countries, and discusses possible organizational uses of these systems. The subsequent section details a 0/1 integer programming model for allocating videotex files. Section 4 presents the proposed solution procedure and results of computational experiments. Section 5 points out the limitations of this research, provides directions for future work, and concludes this paper.

**Commercial Videotex Systems**

Development of videotex in European countries and the U.S. have followed different patterns. In Europe, nationwide videotex networks, subsidized heavily by the national government, have been established. Consequently, due to governmental regulations, there has been a high degree of standardization in conventions and protocols, thus aiding further development of VS. Additionally, governmental involvement and subsidies have helped defray some of the initial setup costs, thereby reducing the financial commitment required from the eventual users. This has resulted in large subscriber bases. In United States, on the other hand, videotex has been in the hands of the private industry, each attempting to provide a novel (and often incompatible) service. To a large extent, this has contributed to lack of standards and small subscriber bases for each videotex provider, thus hampering the development of these systems (Gescei, 1985). To start with, this section provides an overview of commercial videotex implementations in U.S.A. and other countries.
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