INTERACTIVE ELECTRONIC HOME SHOPPING
AN UPDATE ON THE TELACTION APPROACH

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INTRODUCTION

Projections of CATV systems as the likely vehicle for the large scale introduction of interactivity to the TV viewing experience have been with us for about as long as CATV itself. The fact that most interactive endeavors, while meeting their technical objectives, have been eluded by economic success has not lessened that likelihood.

In fact, for the first time in the 20 odd years of interactive capability, the market, not the technology, is responsible for renewed interest. For this reason more than any other, the outlook for the economically successful inclusion of interactive service(s) to CATV program fare is brighter than at any previous time. An indication of this trend is in the nature of the interactive services themselves. While early efforts tried to provide as wide a range of uses as the technology would support, current fare has concentrated on specific services, i.e., home shopping, or pay per view or games, etc. A reactive rather than proactive position indicating a market need rather than responding to a market potential.

This paper will describe the current state of one such specific interactive service, "random access electronic home shopping".

One year ago, the J.C. Penney Company announced that it had formed a subsidiary - Telaction - to assess and develop a fully interactive electronic home shopping system (IEHS) for application to cable television.

At the time of announcement, the system was described in a paper entitled "Selective Electronic Home Shopping", by this author.

Over the ensuing 12 months, the system has been subjected to the rigors of both environmental and system assurance testing to determine reliability. It has further undergone consumer field trials in operational CATV systems to assess its suitability to the medium. The results of these tests, their implications, and a technical overview of IEHS architecture will be discussed.

CAPABILITY

Of the many and varied uses of interactive technology considered to date, none has the apparent potential for both revenue generation and subscriber satisfaction as that represented by electronic home shopping. However, if we are to exploit this potential to its fullest extent, an interactive electronic home shopping system must offer the user substantially improved functionality over systems previously available.

Shopping systems currently in use rely upon a stimulus-response relationship between viewer and presenter. Items are displayed in serial fashion, relying on the presenter's ability to hold viewer attention until an item of interest is displayed. At that time, the viewer interacts by operating whatever response mechanism is at his disposal, thus consummating the transaction.

The amount of time a purchaser must dedicate to a serial presentation varies over a wide range. To date, only limited progress has been made to refine the process by program segmentation. This, however, excludes the user looking for a cross section of products or services.

To that end, programmers are offering a degree of choice, such as five sizes of an apparel item or four pay per view movies, etc.

The limitation, however, remains that as choice and selectivity improve, so must the hardware complement at the user interface. Increases in intelligence and/or memory capacity at user stations necessary to provide a tangible increase in functionality remain substantial. Systems become costly and intrusive long before achieving a level of capability approaching random access.

Of the interactive system architectures available, those most frequently encountered fall into one of four control categories:

1. Polled-Real Time
2. Store and Forward
3. Hybrid Distributed
4. Contention Based

The selective use of a combination of these architectures with control and processing highly centralized has been shown to yield a very large increase in selectivity with adequate response times under most operating conditions. The system imposes no user interface hardware and operates in real time. Access to potentially 50,000 items is fully random-interactive.

A block diagram of the Telaction system is shown in Figure 1.

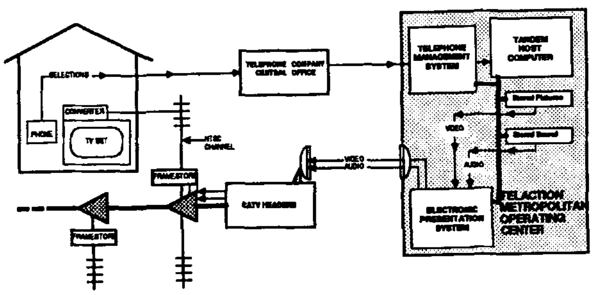

Figure 1

The intent is to provide, through the cable television interconnect, the electronic analogue of a shopping mall, with functionality approaching that of a brick and mortar mall, i.e., random access to a cross section of stores; the ability to enter those stores and examine a cross section of products again, through random access; and finally, to optionally purchase products, store products for future purchase or simply examine products at leisure without the necessity of visiting a conventional brick and mortar store, free of the intervention of a sales person. When and if human intervention is desired, the shopper has at his/her command a simple bridge to customer service representatives from any of the stores participating in the "electronic mall".

All of the capability described above is accessible through simple, touchtone strokes to cable subscribers at systems affiliated with Telaction. The system - a four year, sixty million dollar development effort, exists in hardware and is undergoing market introduction in the Chicago area.

Technology notwithstanding, the implications of so powerful a service are, of course, enormous.

Conceptually, the system operates as follows:

The cable subscriber, tuning to the Telaction channel, will observe a "welcome screen". The screen, a still frame graphic, will advise him in lower one-third (1/3) script ... "to begin shopping dial the phone number".

Following these instructions, the consumer removes the phone from its cradle, dials as instructed and within two seconds of closure a menu will appear on screen with its associated prompt. This menu will consist of product categories. Following the prompt, now reduced to touchtone keystrokes, the consumer may "navigate" the catalogue inventory of some 40 national and international stores, displayed in full NTSC video with aural accompaniment. This activity may now continue until such time as the consumer chooses to terminate the interaction by purchase, storage, customer service bridge, or simply hanging up the telephone.

Simply stated, the viewer need not be subjected to the rigors of computer operation or any sort of incremental hardware. Interaction is via telephone and television. Specifically, cable television.

ARCHITECTURE

Metropolitan Operating Center

This level of interactivity, albeit with a far narrower range of products and services, has been achieved to date only through use of home personal computer or point of purchase (mall) kiosk devices. In order to deliver such functionality while limiting user hardware requirements to CATV and phone, transaction processing and control must be accomplished externally. This is provided on a regional scale through a facility known as a Telaction Metropolitan Operating Center.

When an interactivity is initiated, i.e., a subscriber dials into the Telaction Network via the local toll, the call will be routed to the most local metropolitan operating center.

Placement of this center within the telephone network heirarchy is critical if acceptable levels of concurrent use are to be achieved.

Public switch convention at present

would preclude placing the sort of telephone management system (TMS) necessary to handle multiple-sequential-response interactivity at a cable system head end.

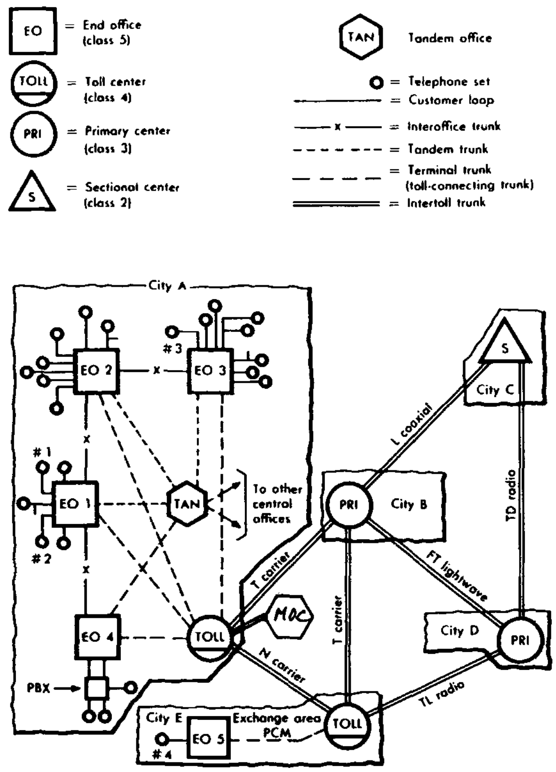

Figure 2
A simplified telephone system

A headend location would, in the vast majority of instances, be limited to end-office loop service to the subscribers it serves. The local loop would saturate far short of target levels for concurrent use. This sort of congestion has given rise to the widespread use of store and forward technology. A shopping system, however, must operate in real time. Consequently, MOC locations will be placed within access to toll grade service or greater. Traffic may then be diversified and concentrated on adequate trunk facilities.

1,800 incoming lines appear at the input of the Chicago MOC telephone management system. Incoming traffic will process via ATT conversant telephone management system (TMS). Voice grade circuits will direct incoming calls at the Chicago metropolitan operating center from the telephone management system, to a host computer system for data entry and control.

The host computer systems, in the interest of reliability, are Tandem Systems VLX multiple processor mainframes, characterized by full redundant hardware.

While essentially transaction process computers, the VLX systems are sufficiently fast to respond to the level of activity generated by electronic home shopping. A generally accepted measure of transaction processing power is the ET-1 Benchmark. The ET-1 is an amalgam of various commonly encountered processing tasks such as banking transactions, in an effort to quantify the operations of a transaction. It is an arbitrary unit representing the rough equivalent of some 1000 COBOL instructions. Relevant measures are cost and elapsed time.

Each four processor Tandem VLX in the Telaction system is capable of 32 ET-1 transactions per second.

Our source limited input traffic of 210 concurrent users each performing an average of one transaction every seven seconds yields a probable processor load of 30 ET-1/second. Of greatest importance, however, is the fundamental architecture of Tandem systems - complete hardware duplicity, each computer is a dual system, each running duplicate programs and interconnected in a failure deferral hierarchy.

Simply stated, should a host computer experience a catastrophic failure in hardware, the system will sense the failure, shift output to the operable duplicate and continue running valid data, virtually undistributed.

A system architecture characterized by its inherent ability to balance processor loading (Figure 3) is essential to orderly growth of the network. The Tandem system is capable of "bolt on" expansion to accommodate multiple processors.

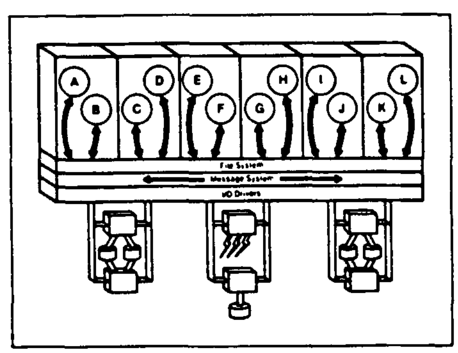

Figure 3

Video Display Subsystem

Following data base query as to the validity and identification of the incoming transaction, the host computer outputs a command to the video display subsystem.

The video display subsystem consists of a video display unit, (VDU), an audio distribution unit (ADU), intelligent controllers; VBI, address inserter, and a nxl matrix switch, interconnected via high speed LAN.

Video access is random read only as well as multiple write to accommodate dynamic data such as graphics or product change.

The entire EHS system is characterized by the output of the VDS.

The output, a series of television frames, are electronically conventional NTSC, 30 frames per second.

The frames, however, are concatenated, i.e., each is an individually fetched and addressed slide, bearing no apparent relationship to the previous or subsequent frame, but instead lifted from a laser disk in response to user commands and multiplexed serially.

This system of distribution allows for a very large transfer of information without stressing CATV system bandwidth or linearity.

Each information display requires only as much system time as is needed to fetch, replay and address a single 1/30 second NTSC frame.

Electromechanical limitations of playback equipment when used in random access fashion require that some thirty-six (36) video players be dedicated to the task of fetching single frames to achieve a 30 FPS rate reliably. The video display system controller (VDSC) will memorize each stylus location among the thirty-six (36) players. It may then assign that available device who's most recent frame location most nearly accords with the subsequent frame request thereby limiting stylus travel time. Further efficiencies can be realized through placement of frames. If those images most frequently requested are concentrated at disk center and distributed outward according to frequency of use and affinity, stylus exclusions can be further limited.

Some one-third (1/3) of all frames stored on disk for playback contain aural accompaniment. This can take the form of narration, music or product purchasing instructions. In all cases, audio is limited to less than forty (40) seconds of continuous output per frame of video.

To achieve the same level of playback efficiency realized in playback of video, a time compression technique is employed for audio storage and retrieval.

Audio is encoded and recorded onto individual video frames of the same laser disk used for video storage. The encoding technique used converts the analogue audio input to a format similar in waveform characteristics to NTSC video. Each such image is an analogue representation of audio sound, but is meaningless to view on a picture monitor. Instead, a digitally quantized sample of each ten (10) second audio segment is recorded during the active line period of the "video" frame, thus allowing a 300:1 time compression of aural information without significant compromise of linearity or fidelity.

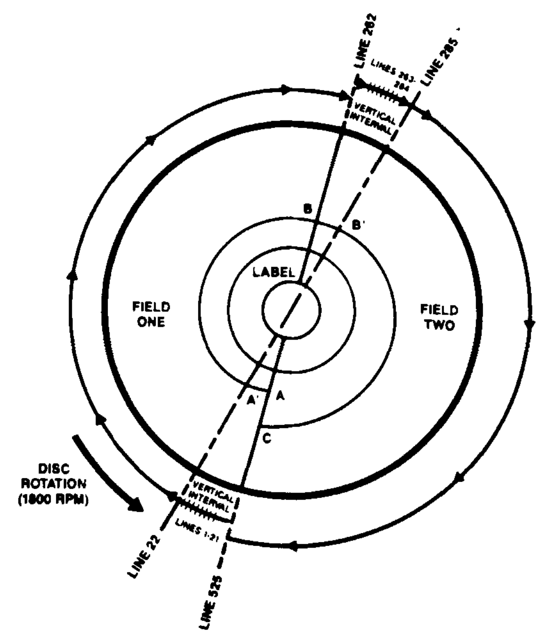

Figure 4
Laserdisk Format

Audio is stored on disk adjacent to its accompanying video frame in the interest of retrieval speed. (Fig. 4)

Audio Distribution Unit (ADU)

Following retrieval from disk, each audio "frame" is routed to the audio decoder. The audio decoder performs an analogue to digital conversion of the time compressed waveform. Digital to analogue conversion recovers the original 3.4 KHZ audio baseband signal for amplitude modulation upon a carrier in real-time. Carriers are selected according to availability from 210 discrete frequencies available.

Audio carrier distribution is via 10.75 KHZ spaced frequency division multiple access (FDMA). Each carrier is synchronized with its associated video frame according to an addressing scheme described in a subsequent section of this paper.

Network Configuration

The Telaction system is characterized by an NTSC output of thirty (30) video frames per second transmitted in concatenated fashion for distributed storage. It is anticipated that each stored frame will be held by the viewer for an average of seven (7) seconds. This yields a need for real time audio accompaniment of 210 parallel audio channels. Additionally, addressing and variable text overlay information are consolidated into the composite video output.

Transmission to affiliated cable systems is via terrestrial microwave or suitable I-Net.

The recovered baseband signals are modulated on cable system trunk channels usually above viewable spectrum. Aural carriers distribution requires three (3) continuous megahertz of bandwidth. Signals are injected at -20 db video.

Since trunk distribution will route the signals through the CATV plant, selectivity and conversion to subscriber usable format must take place externally.

These functions are accomplished in an original engineering device known as the dual-node frame store unit (FSU).

FRAME STORE UNITS

While the system is designed to accommodate end user devices, such as dedicated set top frame store units, usage profiles encountered during field trials do not support this level of distribution.

For example, if 75 percent of all basic subscribers served by the 120 home feeder access the Telaction system twice monthly for a twenty minute shopping session, this would average one hour and twenty minutes of system access per feeder population per day distributed over a thirty day period. This is not considered an impediment to access.

This same level of activity, 75 percent of all basics, twice monthly, would require that each basic household have at least one dedicated FSU device installed. This would result in only two minutes of usage per device per day and is considered less than economically nominal hardware usage.

Therefore, frame store units are designed for installation at off premise aerial or underground locations generally co-located with similar population to existing bridger amplifiers. This level of distribution optimizes hardware use while limiting access costs.

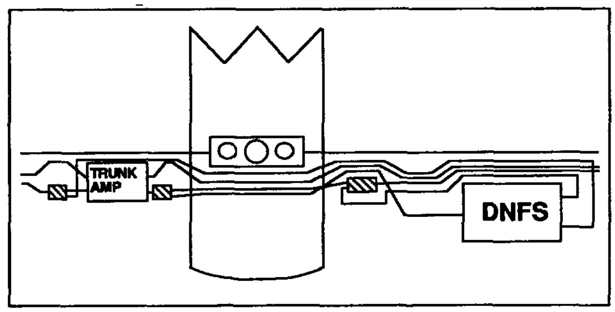

Figure 5

In its simplest form, the frame store system consists of a combination of circuit components that 1) recognizes a video frame addressed to it, stores that frame for subsequent transmission as a video signal to the subscriber addresses it serves, and 2) receives and transmits the audio signal related to the video image being transmitted.

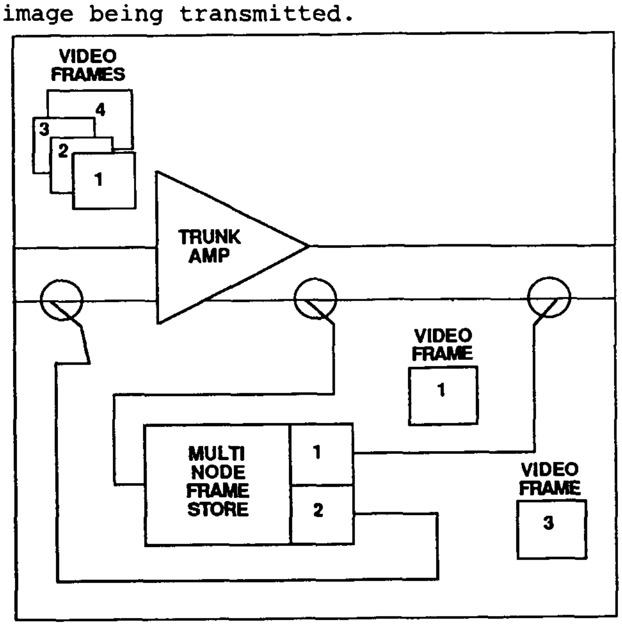

Figure 6

The external appearance is similar to that of a conventional CATV trunk amplifier and should exhibit similar environmental immunity and RF radiation properties consistent with a single channel device.

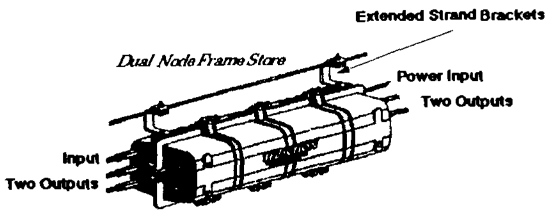

Figure 7

The circuit components include a dual audio receiver, a video demodulator, an analogue/digital converter, a digital frame store, a digital/analogue converter, a channel modulator, and a controller which reads and interprets the addressing information in the incoming vertical blanking interval and activates the other components as required.

In its dual-node configuration, the FSU system (Figure 5), will accept an input signal, comprised of NTSC video and frequency divided multiple access (FDMA) audio.

By virtue of address, the system will detect, A/D convert, discriminate, store, D/A convert, remodulate and amplify two specific video and associated audio "frames". Stored signals will appear simultaneously at two parallel feeder maker outputs of the FSU.

Output video levels are continuously variable over a 20 db range, up to a maximum of +65 dbmv continuous.

When a subscriber initiates a transaction call to the M.O.C., the requested frames are routed to and through the CATV trunk system. All frames appear at the input ports of all FSU's, and are selected by address for display by the FSU associated with the initiating subscriber.

Audio is routed via frequency division multiple access technique throughout the trunk system as well. The appropriate carriers are selected for feeder distribution by address and modulated on subcarrier 4.5 MHZ above video by the targeted FSU.

Simply stated, in the CATV trunk line a channel of concatenated frames, as well as narrow channel of FDMA audio, are routed. At the feeder level, those frames (A&V) requested by homes served by each feeder are selected by the FSU and routed only to that feeder.

Each interaction taken by the subscriber results in an additional VDS subsystem output. Each will be discriminated by that subscriber's FSU for display. Telaction's design target for response time is two (2) seconds, from key stroke to video display at the drop.

Since all frames distributed to and through each cable system will appear at the inputs of all frame store units in that system, the dual-node FSU will recognize, discriminate and redirect user specific frames determined by three message types appearing at its input.

Message Type 00

When an FSU is initially activated (or following a power outage), it will tune its input to a pre-selected default channel. It will detect a pre-determined vertical blanking interval (VBI) line in that channel. This control data will communicate and enable the FSU to retune its input to that channel allocated as the channel of interest and containing the concatenated video frames.

Additionally, this address identifies the input audio band of interest and enables the FSU aural input to tune accordingly.

Message Type 01

Once tuned to the video channel of interest, a series of FSU specific VBI messages will appear at its input. When the FSU detects and decodes an address match, it will capture the subsequent video frame and tune its audio input to the appropriate 10.75 KHZ FDMA audio carrier within the audio band of interest associated with that video frame. This message will also indicate which output modulator will receive the captured audio and video information for distribution to subscribers and that modulator's frequency.

Message Type 11

Under certain operating conditions, it may be necessary to change an FSU's channel configuration. In this instance, a type 11 message containing operational data will be acted upon only after being detected three times in succession. This capability is intended to provide improved subscriber access in instances of unusually heavy use.

All messages employ 16 bit cyclic

redundancy (CRC-16) error detection.

The frame store output carrier frequency is phase locked to its input and variable over a 20 db range.

Spurious emissions at the FSU output will be at least 60 db below output levels in any 10 KHZ band from 5 to 550 MHZ.

Output carrier frequencies can be any 12.5 KHZ increment between 5 and 550 MHZ according to any commonly used protocol (HRC, IRC, STD).

CONCLUSION

The Telaction system is intended to provide an eminently practical interactive system offering broad selectivity. It is compatible with all commonly encountered CATV system architectures and imposes no user intrusive incremental equipment.

A contention basis was selected as an economically feasible method of providing this level of interactivity to all of a system's basic subscribers.

Actual contention has been minimally encountered in feeder populations of between 60 and 240 households during field trials and is not considered an impediment to system use. Telaction's design target remains 86% availability during the peak traffic periods (busy hour) on a system basis.