VIDACOM™ SYSTEM FIELD TRIAL OBJECTIVES AND RESULTS

Michel Dufresne

VIDEOTRON COMMUNICATIONS LTEE

The VIDACOM™ system developed by Vidéotron Communications Ltée has been introduced in early 1983 as a field trial in selected areas of the Vidéotron cable network in Montreal. This system presently supports 375,000 subscribers. This paper summarizes the major objectives of this field trial as derived from the test plan. Three major aspects are the subject of particular attention in the context of the field trial: Technology, services and network architecture.

Firstly, the field trial includes a large scale verification of the technology used in the VIDACOM™ system, although all new technologies were already tested through laboratory prototypes. The system is based on OSI packet data transmission at high speed of 4MB/sec. within a frequency bandwith of 6MHz (equivalent to a TV channel). The system achieves high quality transmission with 10^{-8} bit error rate or better. The protocol used permits both selective and interactive services.

Secondly, the field trial is used to collect precious actual information about the subscriber's behaviour with respect to new services; (text, video games, home computer, pay TV, addressability, captioning, hybrid video/data).

Thirdly, the field trial is the first "test bed" for the network architecture, based on the "open system" concept whereby the external world of information and service providers and user's peripherals equipment can be connected to the VIDACOM™ system using standard telecommunications protocols.

I. BACKGROUND

Vidéotron Group is one of the tenth largest MSO in North America with a total base of more than 650,000 subscribers geographically distributed across the province of Québec, CANADA. Four PTV services are being offered since February 1st, 1983 with a penetration rate rapidly approaching 10%. Since 1975, Vidéotron has been offering a group of various type of services such as:

- TV on request (arts, sports, children, etc.)
- France's programming channel
- Videogames
- Video classified ads
- Telidon information channel
- Specialized TV channels (consumer, ethnic)

With the arrival and definition of new services, Vidéotron has established a research and development program to develop an integrated data communication system named VIDACOM™ . One of the main objectives of such a development was to define a system that will eliminate the use of parallel and non-compatible approach now used for each different service. The use of a unique protocol will reduce the total cost of offering these services, will reduce the complexity of utilisation by the user and will rationally use the bandwith capacity of CATV networks.

II. INTRODUCTION

The system is based on a broadband digital communications approach with 1-way and 2-way capabilities in a sub-split subscriber area network or entertainment CATV network. The VIDACOM™ system is designed around data processing concepts as used in packet transmission system and is structured based on the OSI model of ISO. (International Standard Organization).

Its design makes VIDACOM™ fully transparent to the network architecture (star, tree, loop, bus) in addition of being transparent to the medium itself (satellite, microwaves, coaxial cable and eventually fiber optics). The broad definition of its communication protocol structure offers the capabilities of supporting a diversity of services such as Video control and addressability, Information services based on selective and interactive videotex and transactions, Data transmission such as software downloading of home computers software, and finally Audio options such as stereo or bilingual multisound features.

Special other services are also provided by VIDACOM™ using multiple types of signals and their integration to produce specialized services such as captioning, user's guide, video/data programs, user's programming options and many others.

This paper will cover the description of a field trial being conducted in Montreal based on 450 interface units. A summary of the objectives and results of the experiment will be presented for the following aspects:

- The technology used:
  OSI protocol, packet transmission, packet

format, energy spectrum, performances (BER), selective-interactive services, signal transparency, full addressability.

- The network architecture:
  no needs of networks modifications, selection of any 6 MHz bandwith for data channel, AML compatibility, one-way and two-way capabilities and compatibility, IP and user gateways.
- The services:
  Tiering with 256 classes, multi-magazines of information-database, response time, user's guide and content's guide, high security PTV based on public key, reprogrammable keypad (converter, information and games), captioning and data overlay services, software downloading for personal computer and video games.

Results will be presented on each of these subjects in relation with the field trial objectives that were addressing the following elements.

- technology
- user/system interrelation
- service market studies/research

III. TECHNOLOGY DEFINITION

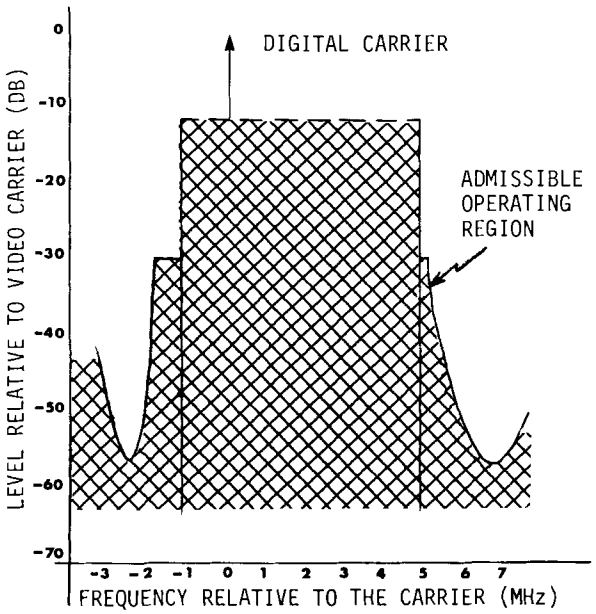
The technical objectives were to demonstrate the feasability and reliability of high speed data transmission on a subscriber's cable network concurrently with the offering of standard television services.

The definition of digital receiver, of low cost, handling high data rate transmission of more than 4Mb/sec. and providing performances of bit error rate of less than 10^{-8} was the main initial concern. In addition it was necessary to demonstrate that such a signal can be transmitted via any 6MHz TV channel without interference with other adjacent television channels (triple beats, sound buzz etc.). All these demonstration and tests were conducted with satisfactory results approved by DOC even when using a data carrier level equivalent to adjacent video channel carriers.

Figure III-A shows a template of energy level measured in a 6MHz video channel. The digital signal, for different transmission sequences met this maximum energy level. Many tests, both suggestive and technical, were made with the conclusions that no impacts or interferences are created by the data channel defined.

FIG.: III.A

TEMPLATE SHOWING LEVEL CONSTRAINTS FOR A DIGITAL DATA CHANNEL



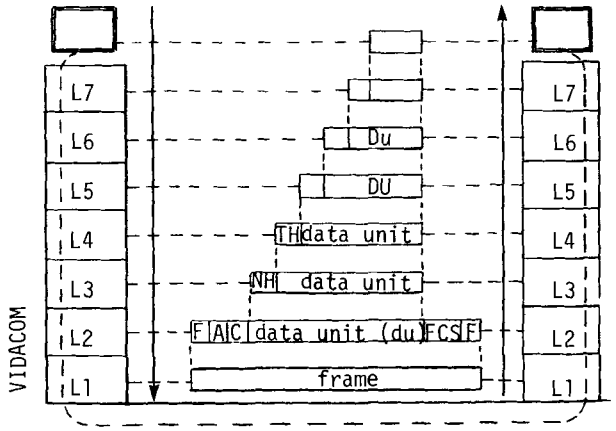
Packet transmission is used worldwide in data network of X25 type in telephone network environment. The implementation of a packet transmission system working in both one-way and two-way modes on a broadband and long distance CATV network is particularly new, specially in residential area network. The objectives of high speed of transmission, low cost of user interface and currently used CATV network architecture did define specific design requirements applicable to hardware components and communication protocols.

The choice of the structure of the communication protocol, namely OSI model of ISO, was made considering its applicability to the diversity of services to be supported. The first three layers of the OSI protocol were defined for VIDACOM™ leaving other levels for future definition depending of the type of services to be supported.

Figure III.B shows the standard levels of the OSI model. Of particular interest, the logical level (2) is also defined in Figure III.B. This format is used for all data services handled by VIDACOM™.

FIG.: III.B

OSI PROTOCOL LEVELS



Legend:

L1:	PHYSICAL	L5:	SESSION
L2:	DATA LINK	L6:	PRESENTATION
L3:	NETWORK	L7:	APPLICATION
L4:	TRANSPORT		

The addressability features of VIDACOM™ offers the capacity to direct any packet of variable size (0-2K bytes) or multiple packets to any specific user linked to the network. These packets are service's format transparent which mean that the coding structure of the information contained in every packet may be different from one to the other. That feature defines the capabilities of PTV addressability, of videotex pages transmission (ASCII, MOSAIC, GEOMETRIC) of any format, of binary software transmission (home computers) and more as required by the end-user application.

The system's communication protocol concurrently supports one-way and/or two-way transmission. This feature permits, in a one-way mode, to broadcast a sequence of packet containing various types of services on the network. The user may be authorized to select some of the services if he has previously been addressed for the proper tiers. This system, based on a capacity of 1,000 packets/sec. is equivalent, at the user level, of having access in an interactive fashion to a data base of nearly 20,000 pages (information, software, etc...). This mode is often called one-way interactive because the user has the impression of interacting with a computer data-base. An important result is the fact that no matter the number of users interacting with this data base, the average response time is constant.

In the two-way mode, the user may inquire for information not available in the one-way mode or send transactions for remote processing. The system is built to support up to 10,000 users active on any one trunk of a head-end system. This limit is well over the capacity of any host processor known today. Interconnections to multiple remote data bases or processing centers are provided through head end gateways systems.

IV. NETWORK ARCHITECTURE

Considering the present technologies of network design and the investment done by cable operator, one main concern in defining VIDACOM™ was to define a data communication system that can be implemented in standard networks of various capacity such as 12, 20, 35 or 50 and over channels capacity. It should not be necessary to change the architecture of the network because of the introduction of new services. In addition, it should not be necessary to install a large amount of new hardware in the network except bidirectional transmission modules.

When designing VIDACOM™ , it has been concluded that many new services can be offered with a one-way system which should smoothly be able to evoluate to full two-way capabilities when and where required.

Because of its end to end design approach (head-end to subscriber), the system does not require large investment in network upgrading or modernizing. A head-end system is installed with one-way or two-way user's interfaces that can concurrently exist in the same network.

For evolution, compatibility and modularity, a 6MHz bandwith is used for downstream while two 1 MHz bandwith are used upstream. The downstream bandwith, equivalent to a TV channel, may use any of the channel available in the spectrum of the cable network. The system can also work in dual cable or mid-split system.

Full compatibility with AML (low-high power) is achieved by the signal formatting and modulation used. This permits to serve many remote sub-head-end system from a central or regional head-end. At both, the head-end communication center of VIDACOM™ and at the subscriber's interface level, gateways or ports are available to interconnect with remote service's center or to attach peripherals units to the interface such as a home computer.

An important feature is the capacity to evoluate from a one-way system to a two-way system when the CATV network is upgraded to more channels and two-way transmission. This offers to any present network the capacity to start offering new services and increase these services when necessary without obseleting equipment already installed.

V. SERVICES

All services offered via the system are managed or controlled by tiering of services using up to

256 different tiers per subscriber. These tiers can be remotely changed by direct addressability of each unit at a rate of 10,000 subscribers / sec.

These tiers cover video, audio, information or data services which permit to any user to subscribe to a different mix of services. The security of addressability and tiering is achieved by using the high speed data channel which is encrypted at communication level. Complexity of utilisation of services is minimized by providing to each user simple procedure to get access to preferred services or services available.

The system uses a built-in user's manual that the user can easily access by entering "?". This action will give him access to a specific chapter of the user's guide related to what the user was doing or trying to do when he hit the question mark. After reading the necessary information, the user may resume its operation at the point he left when he asked to access to the user's guide.

This feature offers an up to date documentation of the "how's" and what's" describing the functions and the services supported by the system. This user friendly approach is equivalent to a self educating process of how to use the system.

The information requested is displayed on the screen in full page format based on a subset of TELIDON (NAPLPS) supporting ASCII, MOSAICS, DRCS and graphics capabilities or in an overlay mode with the TV picture. In the field trial a full PLPS decoder is provided in addition to a mini-TELIDON decoder with enhenced features such as overlay and animation. Final decision of features of displays will be determined taking into account the various information services and the user's feed back gathered during the field trial.

Special services such as multi-language captioning is supported by the system permitting to display NCI or CCDA captioning format. (Associations).

In the selective mode (1-way), the users have access to a data base of information and softwares structured in a CODASYL like manner. This means that any pages may direct the user to select from an index / menu with next / previous request capabilities. A 20,000 pages sequence is broadcasted giving access to specific part of the data base only by authorized users.

The data base is subdivided in many smaller data base defining groups of pages on specific subjects. The sequence of pages broadcasted in a random and asynchronus pattern may be updated any time by the provider of each service. At specific period of the day, particular content are made available based on demand. An important feature is the constant response time that every user gets no matter the number of users accessing the data.

Actually, a keypad is used to control the converter through infra-red communication. This keypad is fully reprogrammable (keys) depending of the mode and service being used and accessed. For instance, as a cable converter different keys do control channel selection, scan of preferred channel, volume control, TV on-off and display of clock and channel number on the screen.

When the user wants to access other services, he asks for the main menu ("?" key) which is displayed in overlay on the TV picture. From that menu the user may select to access to the user's or service's guide, to the videotex data bases, to videogames, to captioning or to software downloading for its home computer or videogames console.

After this selection, the user may select directly one of its preferred service for which he has previously been authorized.

When accessing a PTV program, all validation necessary will take place to verify program tier versus user's tier and decode the program only if a match is found. For program encoding, VIDACOM™ uses a high security of signal processing based on speudo random algorithms that are initialized and controlled by special tagging received as a public key via a different signal from the scrambled video signal and intermixed with other data transmission of VIDACOM™ . The long term security of the unit which is software driven takes care of box thief or pirate boxes that cannot receive the proper signal to decode the scrambled video signal received.

The free format of packet that may be transmitted allow the distribution of videogames softwares and home computers software through a standard interface (RS232C). Presently most of the home computers have been interconnected to the VIDACOM™ system and software can be selectively downloaded to each of them concurrently. Special development are presently on-going for the interfacing of videogames type devices. With this capability, the cable operator can support a broader range of user's terminal defining a broader base for offering software distribution compared to system where only one type of user terminal or software library system is supported.

CONCLUSION

At this point of the field trial, the capability of the VIDACOM™ system to support a diversity of services and contents do permit the conduct of various market research and specific definition of new services adapted to the interests of the users. If these needs change or evoluate with time, it will be possible to modify the mix of these services to respond to specific demand or add new services in the data transmission system.

The user friendly approach supported by an online user's guide for functions or services description creates an environment where the user rapidly "play" with the system. When he requires "help" he only has to use the "?" and instant information is provided.

The capacity of VIDACOM™ to merge video program with information or data contents will shortly offer the capacity of interactive video programs , of video catalog, of video and data

related programm and more.

The field trial is conducted over a period that will end at the beginning of 1984 permitting adjustments of software components that will be implemented in the final product which will be offered starting mid 1984. This test bed based on prototypes is available for evaluation or demonstration to other cable operators.