CABLE SERVICE: A DATA DISTRIBUTION LINK

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ABSTRACT: The following paper describes a potentially high profit business for well managed, forward looking cable companies.

There now exists a complete turn key data distribution system that can be simply added to existing cable operations. It requires no additional bandwidth as it can be added as a subcarrier to FM broadcast stations. It can show a substantial profit to the operator as it has the ability to deliver information to customers in a "broadcast" mode. This not only reduces distribution costs, but also allows simultaneous reception of information by a large number of users. This is a highly valuable feature for users of the system that have "time fragile" information (such as price changes) and want it sent to a relatively large number of recipients.

Dubbed LADD for "Local Area Data Distribution", the system is a viable alternative to dial up or leased phone lines for customers with multiple terminals and time fragile information.

The Information Processing Industry now has available a new link-technology between information and the information user. The new link is the local cable service operator. The technology is existing digital modulation/demodulation techniques to achieve digital transmission.[1]

"For the purpose of discussion, we will refer to this new link-technology as LADD (Local Area Data Distribution). LADD . . . is not a data communications network in itself, but a system element. As a system element, it is available for use by all data communications network operators who find it useful.

"One of the beneficial qualities of Ladd is that it is not a leading edge technology which needs refining to be reliable, predictable, and cost effective. Rather, it is simply the union . . ." of existing local cable distribution techniques with digital modulation-demodulation (Modem) techniques to achieve digital transmission. ". . . One of the difficulties in relating LADD to other data communications technologies is the lack of basic data communications research experience in the LADD service frequency range and bandwidth.

". . . The LADD system's configuration, as illustrated in figure 1, includes several components:

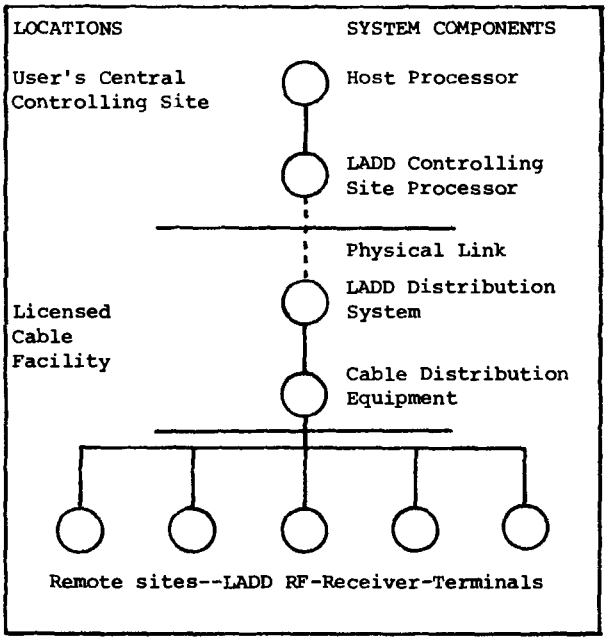

Figure 1 - LADD System Components

"The physical link to the data communications network which is utilizing LADD as a systems element: this link connects the controlling site processor within the network . . ." to the LADD Distribution System. ". . . Normally this link is a conditioned leased line utilizing BSC protocol. More sophisticated means of implementing error detection and correction on this link are possible and compatible with LADD configuration. The capability of a dial back-up of this physical link is built in to the LADD system to improve systems reliability."

The controlling site processor is the gateway from the user's network for data messages that are to be distributed. It regulates the flow of addressed data messages received over the physical link according to user priorities to the LADD transmission system.

The controlling site system, therefore, acts as a store-and-forward device at the customer location. Upon requests from the LADD transmission system it will send data to the LADD unit for distribution via the cable network.

The LADD Transmission System exists at the cable operator's facility. It is linked to the data communications network controlling site processor via the physical link. The LADD Transmission System provides a regulated signal to the cable operator to be injected into the RF transmission stream.

The functions of the Transmission System are:

" - Maintain the physical link protocol to the controlling site processor."

- Provide the transmission signal of data messages which includes encapsulation of data messages according to LADD protocol (see Figure 2--LADD Transmitted Data Organization); multiplexing messages for optimum use of the transmission channel; and modulation of messages to comply with cable service requirements.

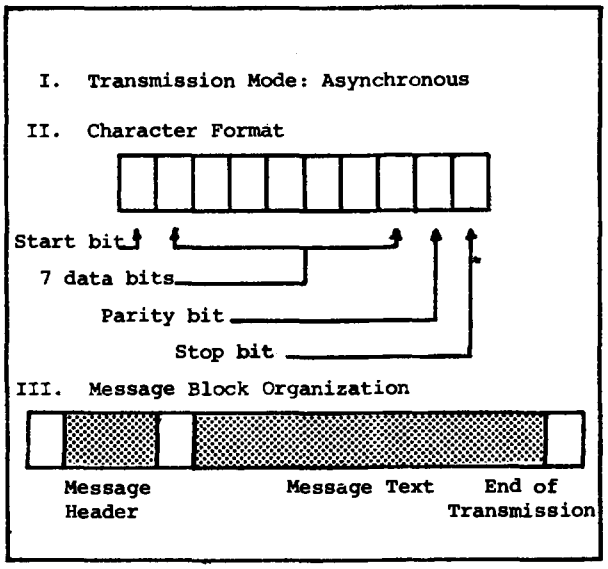

Figure 2 - LADD Transmitted Data Organization

" - Provide selective data message special handling capabilities. Data messages from the controlling site may be 'tagged' to indicate such special handling as encryption, forward error correction (FED), and time and date stamping.

"- Collect accounting data on the utilization of LADD."

- Provide feedback to the controlling site on the status of the LADD Transmission System.

The licensed cable service operator simply accepts the signal from the LADD Transmission System, injects the signal into the transmission stream, and distributes the signal as part of his normal operations.

The LADD RF-Receiver-Terminal is the final component handling the flow of data messages within LADD. The RF-Receiver receives the RF signal and delivers it to the Receiver. The Receiver, upon receiving the RF signal from the cable, demodulates the RF signal to a digital and demultiplexes the signal, preserving only the data message sent to its related Terminal. In addition the Receiver performs necessary receiving-end functions required by selective special data message handling. The Terminal disposes of the digital signal in accordance with the wishes of the user.

The distribution capabilities of the licensed cable service operator are "key elements in the physical organization of LADD with respect to determining applications capabilities. . ." The three major applications-related factors are:

The channel bandwidth authorized for data. This is the maximum allowable bandwidth dedicated for data transmission.

Transmission mode. ". . . The two available modes are broadcast and point-to-point. The difference between broadcast and point-to-point mode is contrasted in Davis et al[2] when introducing Packet Broadcast Systems. The LADD RF data channel inherently has broadcast mode capabilities" as a result of the cable services medium. ". . . Point-to-point mode communications are a result of the channel protocol's ability to selectively address individual terminals. Even when broadcast mode is inherent and point-to-point mode is enabled by channel protocol, the ability to use one mode or the other, within the law, is . . ." a question of regulation.

The normal reception range of the Transmission Service. A LADD message transmitted via cable is only limited by the amount of cable and access to it. Before selling a system, adequate attention must be given to the cable coverage provided or contemplated to assure that the customer's requirements can be met.

". . . It is well at this point to summarize what LADD is, and what it is not.

"LADD is not leading edge technology but is a practical union of RF communication and Data Modem techniques. It is a data communications system but is not a data communications network. It requires no FCC license for the user because transmission capability can be purchased" from cable service operators. ". . . It requires a controlling site processor in order to interface with a data communications network." It can distribute information ". . . in broadcast mode as well as point-to point mode. It is one-way in operation with outbound transmissions. . . .It has primarily voice-grade (300-9600 baud) net transfer rate capabilities.

"With the LADD system described, one has only to review a few trends and events of the 1970's in the areas of Information Processing in order to appreciate how such a capability could fit into data communications network designs.

"New service competitors of Bell System services have emerged and are focusing on the data communications market.

" - Leased Line Services face lower priced competition in all grades: sub-voices, voice, and wideband.

" - Hybrid Services have no significant new competition.

"The Bell System changed from a uniform rate structure (pre-1974) to a Hi-Lo density rate structure (mid-1974 to mid-1976), and then to MPL rate structure, resulting in sharp decreases in long haul rates and sharp increases in short haul rates.[3]

"Decreasing computer prices have stimulated growth in the number of computer sites, especially for mini-computers.

"The microprocessor has become a standard element in most terminal equipment, giving terminals computational capability.

"The demand for data communications, hardware, staff, and services continues to grow at a high rate.

"In summary, more installed computing capability, increasingly dispersed computing capability, and improved Leased Line long haul pricing rates have created a need[4] for local (short haul) data distribution. While LADD cannot satisfy all of this need because of its specific capabilities, it can help satisfy some of it.

"Analysis of the LADD capabilities measured against the general attributes of remote terminals and message traffic within a data communications network yields a means of measuring applicability. Attributes which, when analyzed, measure the applicability of LADD as a system element of data communications networks. . ." are shown in Tables I and II.

"Another way to estimate the applicability of LADD is to analyze it relative to data communications network design constraints. A point by point review produces a general view of LADD specific enough to determine if the technology can be beneficially added to an existing data communications network. The following paragraphs are just such a review based on the design constraints identified in Doll[5] regarding network design preliminary information:

Application Attribute	Application More Desirable	Application Less Desirable
Number	many	few
Throughput	high	low
Movements and changes	frequent	infrequent
Installation Delay Tolerance	must be within a few days	can sustain 6 weeks, 8 weeks, or longer

REMOTE TERMINALS ATTRIBUTES

TABLE I

Application Attribute	Application More Desirable	Application Less Desirable
Volume	high	low
Proportion common to multiple remote terminals	high (broadcast mode)	low (point-to-point mode needed)
Patterns of flow	erratic	predictable
Maximum instantaneous bandwidth required	less than 4800 baud	greater than 4800 baud
Priority levels	many	few
Immediat delivery	required for some of the volume	not required
Delivery within 24 hours	required (or tolerable) for some of the volume	not required (or tolerable)
Security (encryption)	required on a selective message basis	not required
Transmission error detection	not required	required
Transmission error detection and correction (FEC)	not required	required

MESSAGE TRAFFIC ATTRIBUTES

TABLE II

"Number and locations of Processing Sites: A key factor in implementing Local Area Data Distribution (LADD) is that there be a single controlling site regulating the flow of data traffic to be distributed from the processing sites. Therefore, the number and locations of processing sites in a data communications network is inconsequential to the ability to implement LADD. Both centralized and distributed data communications networks will find LADD applicable to their operations.

"Number and Locations of Remote Terminals: The locations of remote terminals is a key design parameter for implementing LADD. All remote terminals located within the range. . ." of the cable service will have essentially equal ability to receive data messages. The number of remote terminals within the service range is not a parameter affecting the physical implementation of LADD.

"Information Flow Patterns between Terminals and Processing Sites: Information flow using LADD is, by definition, outbound only from the processing sites through the controlling site to the remote terminals. Erratic patterns of information flow which would make it impossible to economically install a leased line network to distribute data have no effect on LADD's ability to distribute data.

"LADD can function as the outbound channel in two-way communications, wherein the inbound and outbound data each have dedicated channels. In this way, for example, high volume printing on multidrop networks can be sent via LADD, thereby maintaining low response times for terminals.

"Types of Transactions to be Processed: Transactions of any type can be distributed using LADD. One of the benefits of LADD's being able to operate in broadcast mode as well as point-to-point mode is the additional transaction types which can be handled. An example of such additional tranaction types is outbound policy information such as price changes. This kind of information is usually composed centrally, voluminous in nature, and delivered by mail. . ." Virtually instantaneous distribution of such critical and detailed information to all receiving sites concurrently "cannot be achieved with any other commonly available data link technology.

"Traffic Volumes for Transaction Types: Traffic cannot achieve a net transfer rate in excess of the net transfer rate. . ." of the distribution channel. This value is dependent on the cable service. "Traffic volume is a factor in judging the economy of employing LADD technology. The greater the volume of traffic addressing multiple remote terminals, the lower the cost per message delivered. Increasing the volume of traffic addressing individual remote terminals increases the cost per message delivered.

"Urgency of Information to be Transmitted: Transmission of data to remote terminals is practially instant, up to the maximum net transfer rate . . . of the distribution channel. "When the volume of data to be transmitted at any instant exceeds the maximum transfer rate of the . . . channel, the controlling site is called upon to arbitrate the message sequence priority for transmission. A mix of data messages of several degrees of priority produces the best economical performance of a LADD system by spreading the load evenly.

"Capacity reserved for Traffic Growth: The nature and volume of excess capacity is measured in terms of the maximum transfer rate . . ." of the distribution channel and "the patterns and priority of message traffic. A LADD system will have 24 hours a day availability for use under normal conditions. Generally, a LADD application will have capacity in reserve of twice the prime time capacity.

"Acceptable Undetected Information Error Rates: The information bit error rate of a properly tuned LADD is less than 10^{-7}. This rate can be improved by utilizing link forward error correction (FEC) routines. Error checking and correction routines compromise throughput for improved accuracy by reducing the maximum net transfer rate of information. . ." over the distribution channel by their overhead. "In many LADD implementations, error checking and correction may not be necessary because the technology is intrinsically superior to common carrier links, whose bit error rates, according to Doll[6], range between 5×10^{-5} and 5×10^{-6}.

"Reliability and Availability: The reliability of a LADD system will be directly related to the reliability of the controlling site system, the physical link, . . ." the LADD transmission system, the licensed cable service, and the remote RF-Receiver-Terminals. The cable service is "not only exceptionally reliable by information processing standards, but also usually has a full time on-site engineering staff to correct failures. Certain components of the system such as the physical link. . ." and the LADD distribution system "can be implemented redundantly where improved reliability is required. The availability of the system is generally 24 hours per day less down time due to equipment and power failures.

"Availability of Financial Resources: Most data communications networks with the need for LADD capabilities already have a controlling site system in place. With this environment, adding Local Area Data Distribution capaiblity to the network would include the costs. . ." for the LADD distribution system and RF-Receiver Terminals hardware purchase and their installation, "plus a monthly service charge for the physical link and for. . ." the licensed cable service, "and maintenance charges. The most exciting aspect of LADD for the financial decision-maker is that when utilized effectively it has the ability to make the cost of distributing information less than the cost of the paper it's printed on.

"Because LADD is new, and specific and limited in the applications in which it is useful, it will not be a commonly used link-technology for several years. Most probably, the initial demand will continue to come from large corporate users whose needs are a perfect fit to LADD's capabilities. Additional growth in LADD's usage will come as a surge when the value-added common carriers integrate LADD's capabilities into their hybrid networks.

"Ultimately, LADD link-technology will be just another data communications network building tool and in common use just as satellite and microwave RF communications are now becoming."

NOTES:

1 Sections of this paper contained in quotation marks are taken from Albright and Wallace, "Local Area Data Distribution", 1980 NCC Proceedings, copyright AFIPS Press.

2 Davies, Barber, Price and Solomonides, Computer Networks and Their Protocols (1979), page 155.

3 Italics added.

4 Italics added.

5 Doll, Data Communications, Facilities Networks and Systems Design (1978), page 4.

6 Ibid, page 298.