PAY-PER-VIEW: SAN ANTONIO - A SYSTEM CASE STUDY

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ABSTRACT

Two-way technology was among the first methods of implementing pay-per-view. Despite its early promise, the use of two-way technology has not become widespread and its use appears to be decreasing. After a review of some of the technical and operational issues we will describe an interactive two-way cable system that is successfully operating. A look to future services will also be made.

INTRODUCTION

Despite its early adoption and seeming promise, two-way interactive cable has not become widespread, and appears to be decreasing in terms of usage. Early interactive pay-per-view services are being disbanded, leaving only franchise determined security systems and cable operator plant communications as the primary uses. Despite the increasing number of CATV systems being built with two-way capabilities, only a very small number of active two-way plants exist.

Conventional Wisdom

The primary reasons for the apparent failure of two-way technology have been:

- The systems are not reliable.
- The operating and maintenance costs are too high.
- Subscriber terminal costs are too high.
- In real time systems peak ordering capabilities are limited.

Technology Issues

Most of the previous real-time approaches used a polling technique to interrogate the individual subscriber terminal transaction status. In its simplest embodiment, the cable headend would poll downstream in a predetermined sequence, the status of each susbcriber terminal. The subscriber terminal, upon being polled, would transmit to the headend its transactional status. If a buy had been made, the necessary data would be transmitted upstream.

If peak loads become large, polling speed and the rate of data transmission become important. As polling speed and data transmission rates increase, bandwidth requirements increase, and as bandwidths increase, noise becomes a problem. Noise arises from a variety of sources, internal and external to the cable plant. In an attempt to isolate noise generated within and without the plant, provisions for isolating sections of the cable plant can be implemented. Bridger switching is such an approach, but it primarily serves to reduce internally generated noise. Ingress, which is a point source of noise, remains a problem within the bridger switch isolated section. These approaches to high polling and data rates resulted in increased bandwidths, bridger switching and increased complexity at the headend.

Why Real-time?

Many of the problems cited could have been mitigated by the use of store-and-forward techniques instead of real-time. Slower polling and data rates, as well as simpler headend implementation could be possible if no real-time requirement was imposed. Careful analysis revealed that the trade-off would result in non-volatile data stored on-premise along with a self-authorizing subscriber terminal. It was felt that the potentially vulnerable links among the subsriber upstream transmitter,

addressable converter and the return path would create potential security problems. Minimizing these security problems within the existing technologies available would result in a subscriber terminal that was not cost effective.

Economic Issues

Cost, particularly in-place cost, is an extremely important criterion in any two-way, or for that matter, in any pay-per-view system. If we examine a hypothetical pay-per-view transaction at $5.00, half of that goes back to the programming provider. That leaves $2.50, out of which must come contribution against profit, equipment amortization and overheads. Let us assume that a typical subscriber will make three $5.00 pay-per-view transactions per month and that on a per transaction basis the cable operator wants a 30% margin, or $1.50, leaving only $1.00 to contribute against equipment amortization and other cost. If one assumes $0.75 for other costs and $0.25 for subscriber terminal amortization, the cost of a telephone call, one is left with $0.75 a month to write off the in-place cost of subsriber terminal. On a seven year basis that is less than $50.00!

Design Criteria

With the previous discussion in mind, the final criteria for a two-way interactive pay-per-view system that would meet the challenge of a real-world consumer CATV application were:

- The system had to be reliable
- The system had to be secure to protect a valuable revenue stream
- The system had to be capable of operating in the CATV plant environment without the costs of earlier two-way technologies
- The technology had to be cost effective, with the subscriber transmitter terminal at less than $50
- The implementation be user-friendly and capable of true impulse pay-per-view transactions.

SYSTEM DESIGN

The first task in designing the system was to understand the dimensions of the CATV plant environment. An engineering task force was organized and spent the better part of a year traveling among cable plants. This time was spent measuring and characterizing a number of plants, and entailed hauling and setting up spectrum analyzers and other test gear throughout the country. These tests have been described previously (reference 1), and the results were that a sizeable amount of noise exists, consisting of white noise, common-mode distortion and significant amounts of ingress.

Polling versus Contention

Polling techniques, when implemented in a real-world CATV plant suffered. The compromises necessary to achieve high speed data and polling rates, bandwidth and plant isolation from noise with bridger switching were essentialy conflicting and had given rise to many of the problems that caused two-way to be written off. A fresh approach was needed, and that was provided by two departures from previous technology. The departures were in the use of contention instead of polling as the technology for the return data mechanism, and in the use of bi-phase shift keying instead of frequency shift keying as the modulation mechanism.

Access Protocol

Tree-and-branch topology is used in the majority of two-way cable plants with the downstream channel broadcasting to all the subscriber terminals at the same time from the system headend. As a consequence there is no collision or message interference since there is only one user, the headend. The upstream or return channel is a different situation; here many users are trying to reach one node, the headend, and unless some arbitration mechanism is enforced there will be message collisions and interference.

In the polling systems, the headend provides the arbitration mechanism by selectively isolating all but one susbscriber terminal at a time in an orderly time or frequency sequence. The rationale for choosing the slotted aloha contention system has been previously

described (reference 2) and is based upon developments in satellite and local area networks.

This system operates in dual-modes. Contention is used to obtain fast response for a large number of users under bursty data traffic conditions. To achieve more reliable operation and higher throughput, two upstream channels are used, with the subscriber transmitter alternating between the two with a proprietary backoff algorithm. All transactions originating from the headend utilize a polling technique, in contrast with those originating from the subscribers, which use the contention technique.

Modulation

Bi-phase shift keying modulation is used for optimum performance and efficiency in the bandwidth and spectrum chosen for the upstream channels. The headend receivers use a narrow IF, matched filtering and digital correlation techniques which, along with the data format, provide high message throughput under heavy impulse noise and ingress. The resulting system is extremely robust and operates remarkably well at C/N ratios of less than 12 dB.

Headend Considerations

Since the system operates in real-time, existing approaches used in billing and system control were not suitable since many of these require seconds for an individual transaction. A new system controller was developed, along with the necessary software, to process all the elements of a transaction external to the billing computer. This includes data reception, account and authorization updating and addressable decoder authorization. These transactions, along with a subscriber file, are in active memory and do not require disc access. Upon command from the billing computer, this information is downloaded into the billing system at some convenient time post-event.

Hardware Implementation

The final subscriber hardware is extremely user-friendly and consists of an add-on two-way module that is user installed by plugging the module into an existing Z-TAC one-way addressable decoder using two cables. These cables provide power, control signals and RF loopthrough. There are no adjustments required at installation, thus the customer self-install helps eliminate a service call and to achieve the <$50 in-place cost target.

The unit has three LED indicators: WAIT (yellow), ERROR (red) and OKAY (green). When the user initiates a transaction the WAIT light is illuminated for a few seconds, after which the OKAY or ERROR light is activated. In addition, the scrambled channel, to which the subscriber is tuned, becomes unscrambled along with the illumination of the OKAY LED. Because the system was designed at a time when the industry was regulated, opinion polling was provided and is capable of of up to 99 multiple responses.

System Monitoring

For the CATV operator, two important monitoring features were provided: channel and status monitoring. In the polling mode the headend system controller can interrogate the subscrber terminals to determine to which channels they are tuned. This data is stored in macro form to provide subscriber anonymity and to avoid privacy problems. If necessary the terminals can be modified at the time of manufacture to delete this feature. Status monitoring is available in two ways. Subscriber transmitter power output is adjustable, and at the time of installation it is performed automatically by the headend system controller. The headend receiver measures power and the adjusted power output level is stored in the computer for future reference. Measurements of power and signal-to-noise are also available for plant maintenance purposes. Up to 50 two-way converters can be monitored to determine plant status and to help predict possible problems. These "canaries" are placed in strategic locations such as hubs and branch ends.

SAN ANTONIO

The Rogers' San Antonio cable system is enormous, it is one of the largest cable systems in the country. Some of the system statistics:

203,000	Subscribers
4,500	Plant miles
9	Hubs

The plant was rebuilt for two-way and Zenith Z-TAC and Z-VIEW were chosen to initiate addressability and two-way interactive services. With the introduction of new tiers in August, 1984, subscribers choosing those tiers received a Z-TAC/Z-View. Over 80% of these subscribers picked up their units at cable offices and self-installed them. Less than 20% required a technician for installation. Over 30,000 units were obtained by customers waiting in long lines in 100 degree heat because demand was underestimated. In March, 1985 the San Antonio system was officially activated as a two-way interactive system with the introduction of additional pay services, among which were a movie and sports pay-per-view service. We shall now review the results of the pay-per-view service and its impact upon existing pay services. In addition, operational impact of two-way upon the system will also be reviewed.

Pay-per-view Revenue

In Figure 1 we have plotted subscriber headcount and gross revenue since the introduction of two-way interactive services in March, 1985.

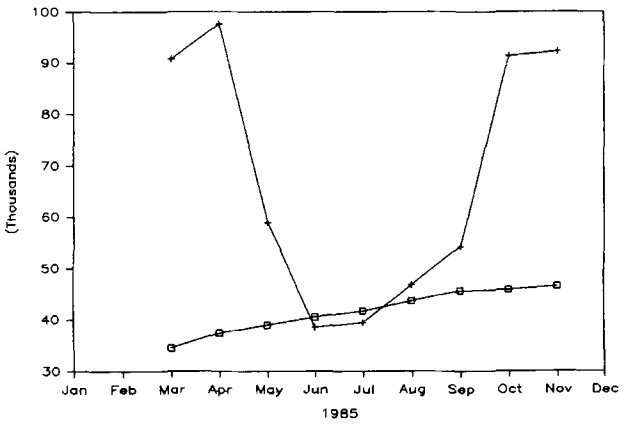

Figure 1. Gross Revenue and Subscribers for Pay-per-View

Subscriber growth is observed to be consistent and will be well over 50,000 at publication. Gross revenues show an initial peak and then drop off suddenly. The drop is attributable to the summer doldrums. From May through September, the local sports service had no offerings, and in addition the movies available for the pay-per-view service in that period gave subscribers the opportunity to seek other forms of amusement. One cannot overemphasize the necessity for strong programming choices. The increasing number of delivery vehicles for pay-per-view services should improve the situation. The availability of better movies and the return of the sports service brought the gross revenues up sharply in October, 1985. On a per Z-VIEW subscriber basis, the gross revenue curve follows a similar trend in Figure 2.

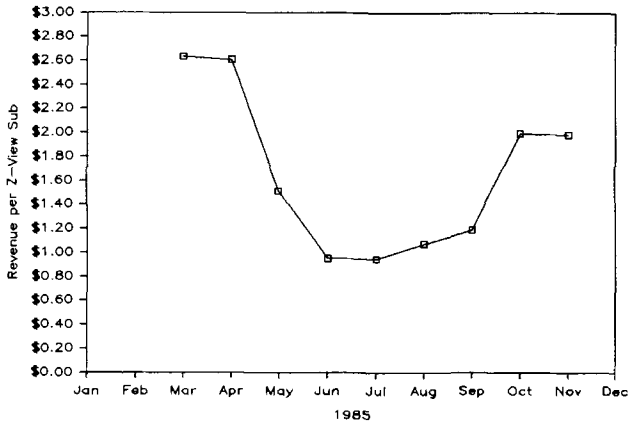

Figure 2. Gross Revenue per Subscriber for Pay-per-View

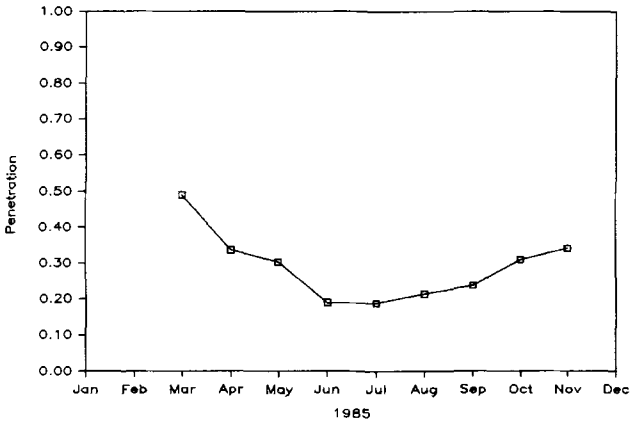

Figure 3. PPV Penetration

Figure 3 shows the effective penetration among two-way pay-per-view subscribers. It too follows a similar trend, an initial peak, declining interest with the summer doldrums, and a steady rise thereafter as the programming picks up.

Impact Upon Other Pay Services

A yet unresolved, and fear inspiring concern is the effect of pay-per-view on the existing pay services. Figure 4 shows

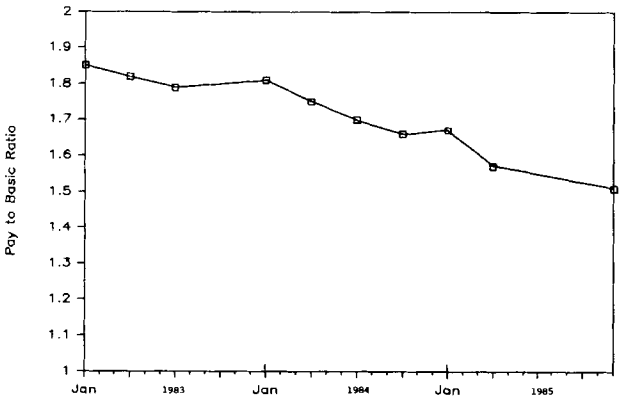

Figure 4. Pay-to-Basic Ratio for 1983, 1984 and 1985

the pay-to-basic ratio over a period of three years, with a period prior to pay-per-view. The trend is down, which mirrors system behavior elsewhere, with perturbations about the trendline explained by increases in subscriber rates in early and late 1984. The last increase in rates was also coupled with the imposition of a sales tax on cable fees. From the available evidence, limited as it is, there seems to be no strong causal impact upon existing pay services.

Subscriber Growth

Subscriber population has remained stable near the 200,000 level, having dipped below 200,000 at the time of rate and tax increases, and gradually climbing back to sligthly over 200,000.

Operational Impact

One of the most significant trends has been the positive impact upon system operation and reliability. The total number of technical staff has dropped from 369 to 250 from September, 1984 to September, 1985. The magnitude of the drop is muted by the fact that many of the district office functions have been added to that of the technical staff, thereby masking the actual decrease in technical staff needed. A significant corollary to this is the sharp drop in service calls, which have dropped 50% in the same period. A good part of this can be attributed to the status monitoring capability and the ability to see potential problems developing. The trend continues and has not leveled off yet.

A LOOK TO THE FUTURE

The number of pay-per-view channels is being increased from one to two. There will be a separate movie channel, along with a channel for sports and special events. The new delivery and pay-per-view offerings will provide additional service to subscribers and an increase in revenue potential. Opinion polling is being used in a variety of ways, some conventional and some unconventional. There is a weekly local talk show where subscribers are encouraged to register their opinions. Response is in the several hundreds. More interesting yet is the use of the two-way capability to allow subscribers to upgrade to a new service, such as the sports channel, for a month on a trial basis. A local network affiliate leases one of the cable channels and provides programming distinct from its over-the-air fare. They will be introducing an opinion polling movie choice. Viewers may select one of two movies, just prior to showing, by voting via opinion polling.

References

1) "Two-Way Cable Plant Characteristics"; R. Citta, D. Mutzabaugh; Zenith Electronics Corporation; NCTA Technical Papers, June 1984.

2) "Is Two-Way Cable Dead"; V. Brugliera, R. Citta, et al; Zenith Electronics Corporation; Communications Engineering & Design; September, 1985.