# CABLE TELEVISION OPPORTUNITIES IN THE LODGING INDUSTRY WITH IMPULSE PAY PER VIEW TECHNOLOGY

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## I. INTRODUCTION

Historically impulse pay-per-view (IPPV) on a broad CATV basis has proven to be impractical. However the technology exists to make impulse pay-per-view practical on a smaller scale if adequate care is taken to ensure that the design best utilizes the existing resources. The commercial MATV environment is an ideal location for utilizing two-way addressability to implement a true impulse pay-per-view entertainment system.

This paper will discuss the technical parameters involved in implementing such a system. Additionally the incorporation of this IPPV system into an existing hotel television system will be discussed.

## II. TYPICAL MATV SYSTEM

Television delivery in the lodging industry is typically viewed as a necessary evil rather than an opportunity to increase revenue. Consequently most existing hotel/motel television systems are not built to the standards of quality typically seen in the CATV industry. This has resulted in many serious limitations that must be considered when developing and implementing an IPPV system.

Historically the hotel head-end has consisted of a set of off-air antennas and the associated amplifiers and combiners required to receive local broadcasts. Due to the additional distribution loss at UHF frequencies, UHF stations have been typically converted to unoccupied VHF channels for distribution in the MATV system. Satellite television delivery has prompted many hotel operators to install earth stations.

Most hotels are located in areas that are passed by existing CATV plant. Consequently there is an increasing number of hotels that receive television from CATV drops. Herein lies the opportunity for increased revenue for the CATV system operator. The CATV system can, in effect, take the place of most of the hotel MATV system head-end.

A typical MATV distribution system is entirely passive, consisting principally of RG-59, splitters and taps. The absence of amplifiers results in typical system losses of up to 50dB. Such losses require output levels as high as +65dBmv at the MATV headend. The construction techniques as well as the types of splitters and taps limit useful bandwidth to less than 216 MHz. Roll-off below channel 2 is also common, becoming severe below 20 MHz.

The small size of a typical hotel MATV system, compared with a CATV system, limits the problems with ingress and egress. Therefore the shielding in such a system is minimal. Taps are often unshielded and drop-to-drop isolation can be as low as 10dB. Taps consisting of resistive dividers can result in poor return loss.

## III. SYSTEM ARCHITECTURE

The discussion of the hotel MATV system given above suggests several constraints for the design and implementation of a two-way addressable impulse pay-per-view system for the hotel/motel environment. Any hardware that is intended for retrofit into an existing MATV system should require a minimum of modification to that MATV system. The billing interface for the hotel operator should be user-friendly while providing a high levels of security for the programming supplier.

One scheme to implement a true

impulse pay-per-view system requires continuous and rapid communication between the components of the system, especially between the individual guest room and system controller. This scheme has had limited success as such rapid communication is often difficult if not impossible to make happen. Delays in processing a purchase are perceived by the hotel guest as inadequacies in the system.

A more reasonable approach utilizes a distributed intelligence approach to the system. There is a central supervisory computer that periodically monitors the overall system performance. However, there is an intelligent set-top terminal in each room capable of handling all transactions independently of the supervisory computer. Purchase and status information need only be reported by the set-top terminal when it is polled by the supervisory computer. This makes all guest transactions occur instantaneously.

An overall system block diagram describing this approach is shown in Figure 1. The system consists of four major components:

1. Supervisory Computer
2. Premium Programming Interface
3. Data Interface
4. Set-Top Terminal

SYSTEM BLOCK DIAGRAM

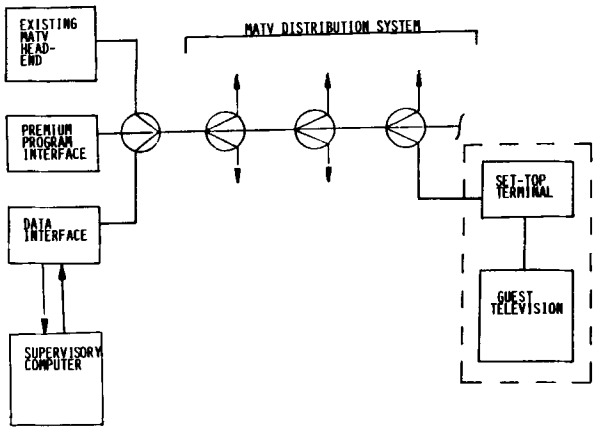


FIGURE 1

The Supervisory Computer controls overall system operation and acts as a billing interface for the hotel operator and/or programming supplier. The premium programming interface combines the actual premium programming material with the other programming on the existing MATV system. The Data Interface handles communication between all system components providing among other things the data link between the Supervisory Computer and the Set-Top Terminals. The Set-Top Terminal (STT) acts as programming selector and purchase point for the individual hotel guest. These components will be discussed in greater detail later.

In order to best utilize the available bandwidth without rebuild, the system should be designed with delivery of the supplemental or premium programming in the VHF midband (channels B thru H). This selection of band plan allows delivery of supplemental programming utilizing the same cable as premium programming and minimizes the requirements for existing MATV system rebuild and upgrade. Channel I is unused to provide a guardband between standard and premium entertainment.

Data communications should be implemented over two RF channels, carried over the same cable as the standard and premium programming. One channel would carry downstream communication consisting of inquiries and system configuration commands from the Supervisory Computer to the STTs. The other channel would carry upstream communications consisting of inquiry responses and purchase status information from the STTs to the Supervisory Computer. All data should be FSK and Manchester encoded to ensure reliable communications.

One-way addressable converter technology is well established and understood. Communications from the Supervisory Computer to the STTs would be handled within the framework of this technology. Data communications within the system should be half duplex. In this situation, each STT is given a unique address and is polled in a "round robin" fashion. Status and purchase information is returned to the Supervisory Computer from each individual STT immediately after that particular converter is polled by the Supervisory Computer. The upstream communication frequency should be chosen above 20 MHz in order to best utilize the existing MATV system performance.

A suggested band plan is shown in Figure 2.

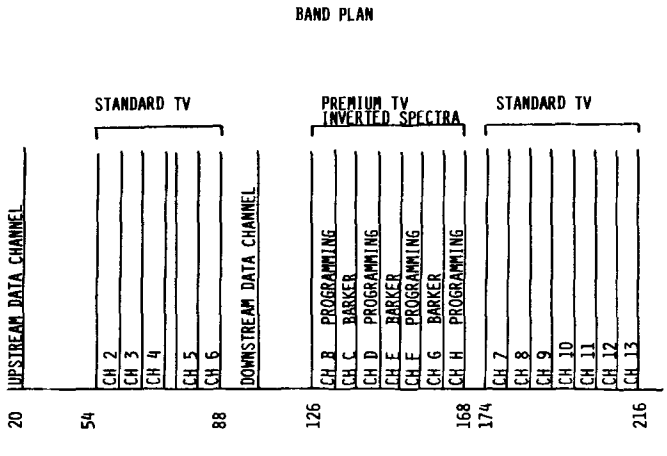


FIGURE 2

## IV. SET-TOP TERMINAL

The heart of the IPPV System is the Set-Top Terminal. The STT is the interface to the system that is used by the hotel guest to make purchases of premium entertainment. The terminal must be designed to operate independently of the rest of the system and should report status and purchase information only when polled by the Supervisory Computer.

Extreme care must be taken regarding the mechanical design of any set-top terminal for use in the lodging industry. Hotel guests will be more likely to abuse any piece of electronics that they encounter on a temporary hotel visit than they will electronics that are a part of their own home. Additionally, care must be taken to minimize the possibility of tampering.

The following items should be considered:

1. Spillage of Liquids (Including Beverages)
2. Cleaning with Common Cleansers
3. Shock and Drop Testing
4. Durability of Enclosure
5. Durability of Controls (Buttons)
6. Durability of Labels and Instructions
7. Electrostatic Discharge
8. Lightning and Surge

The set-top terminal should be designed to be transparent to standard (non pay-per-view) programming. Such programming would be carried on the hotel MATV System on channels 2 through 13. The guest would tune this programming using the tuner in the television exactly as if the set-top terminal were not present.

The purchase of a premium program must be easy to make while minimizing the chance for false purchases.

A suggested purchase scenario follows:

To view a premium program the guest tunes the television to channel 3 (or 4 depending on the STT model). The guest then selects the desired premium program by pushing the button on the STT that corresponds to that program. In case of selection of premium programming where there is no charge the STT will tune directly to the desired program. Selection of a pay-per-view program will result in a preview sequence.

The preview sequence allows the viewer the opportunity to decide whether he or she wishes to purchase the program that has been selected. It also acts as a guide as to how to make the purchase.

Immediately upon pushing the button for a pay-per-view program the STT will tune to a "barker" channel. The barker channel will consist of a character generated set of instructions to guide the guest through the purchase.

The STT will then tune to the requested premium channel giving the guest a preview of the program in progress.

At the end of this preview the STT will return to a barker channel (this may be the same channel tuned in the first part of the preview or it may be another barker channel with additional instructions). If no action is taken by the hotel guest the STT will return to standard TV mode. However, if the guest wishes to purchase the program, he or she need only push the button associated with that program a second time before the end of the second barker channel display. When this happens the STT will tune to the premium program and will not default to standard TV until the end of that program.

The purchase scenario is designed to prevent false purchases, as two positive actions are required in order to purchase a program.

The length of the barker channel

displays and previews should be software programmable in order to customize the system to the individual requirements of each installation. These parameters should be downloadable from the Supervisory Computer and remain resident in the STT for operation independent of the Supervisory Computer. Which buttons are pay-per-view and which are free supplemental programming as well as the frequency to be tuned when the buttons are pushed should be downloaded from the Supervisory Computer and be resident in the STT in order to maximize system flexibility. Such parameters should be downloadable globally and by unique terminal address.

It is assumed that the premium programming will not be received without the use of the STT. This makes possible the simplification of the system hardware. The only frequency conversion done by the STT is done on the premium channels. Consequently these channels can be injected into the MATV system with inverted spectrum, permitting the use of a single conversion with high side local oscillator in the STT. Standard TV programming is maintained in its standard format as these channels are tuned by the guest's television directly. The inverted spectrum adds some incremental security to the system since the majority of hotel TVs are limited to channels 2-13 (non-midband). Additionally, the majority of TV's in hotels capable of midband reception are not able to receive inverted spectrum. If necessary a midband trap can also be added.

In order to support the purchase scenario given above, the STT must contain the following seven sections:

1. Microprocessor and digital support circuits
2. Keypad and display
3. RF switch
4. Down converter
5. Data receiver
6. Data transmitter
7. Power supply

A block diagram is shown in Figure 3.

The microprocessor in the STT must control all the functions of the terminal. It must also interpret all the messages received from the Supervisory Computer, implement the address recognition function, and formulate responses for the inquiries from the Supervisory Computer.

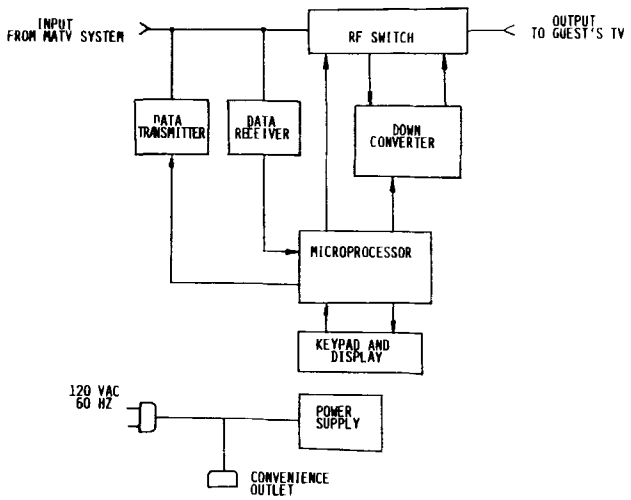

FIGURE 3

The STT should be equipped with a keypad and display. This keypad may be connected directly to the microprocessor and is intended for use by the guest to select premium channels.

The RF diode switch is used to route RF either directly to the guest's TV for standard TV mode or to route the RF to the down converter for premium mode.

The down converter is used to convert premium programming from the VHF midband to the output channel of the STT (3 or 4 depending on the model). The down converter should consist of filtering, a mixer and a phase-locked loop local oscillator.

The filtering in the down converter should be sufficient to insure a passband flatness on the desired output channel of less than 3 dB peak-to-peak while providing attenuation of at least 60 dB at frequencies of +/-12 MHz of the desired picture carrier frequency (<-60dB at the "semi-adjacent" channel picture carrier frequency). This would prevent theft of service by preventing the hotel guest from being able to tune the television to a free premium program and then view a pay-per-view program by tuning the TV to a channel other than the desired output channel of the STT (see Figure 4).

The STT must be equipped with a data receiver to receive commands and inquiries from the Supervisory Computer. The output of the data receiver would be fed directly to the

microprocessor for decoding.

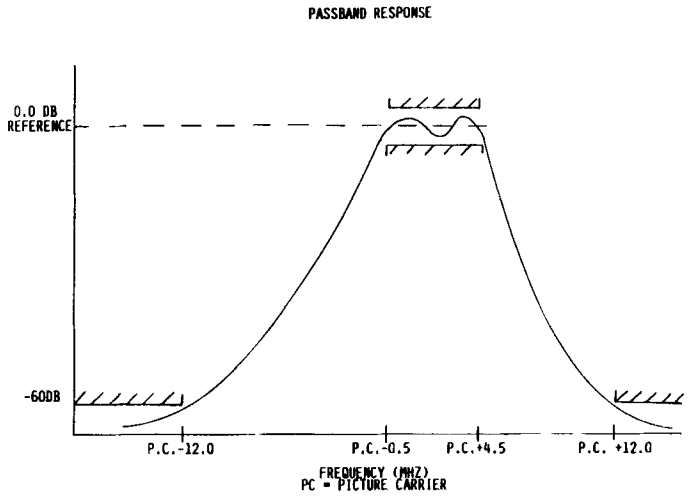

FIGURE 4

In order for the STT to respond to inquiries, report status information and report purchase information, it must have a data transmitter. The circuit could be a simple crystal controlled narrowband FSK transmitter. Output power must be sufficiently high to ensure reliable communications over the lossy upstream data channel while not creating harmonic energy of sufficient amplitude to generate interference in the received television channels.

The transmitter would be normally inactive. It would become active under the control of the microprocessor. A circuit should be incorporated in the data transmitter to prevent system failures that would occur if the transmitter of one STT became active continuously. If this situation were to occur, communications with all the other terminals in the system could break down because the upstream data channel would be occupied continuously. It is suggested that a circuit to prevent this must monitor the time a transmitter has been active and "time out" if the transmitter has been active for more time than is required for normal communications. The circuit must also monitor the length of the delay between subsequent transmissions. If the delay between transmissions becomes too short, the circuit should prevent the transmitter from becoming active. As a consequence of these functions the circuit has been named the "Anti-Babbling" circuit.

The power supply, as the name implies, should provide D.C. power for the other circuits in the STT. A non-switched A.C. convenience outlet should be provided to ensure a location for plugging the television in the guest room.

## V. DATA INTERFACE

The Data Interface acts as the main communication interface for the entire system. The device is also used to transfer data, not only between the STTs and supervisory computer but also from the remote control interfaces. Additionally the unit generates baseband composite video signals for use as "barker" channels.

The Data Interface must, as a minimum, perform the following functions:

1. Command Processor
2. Data Transmitter
3. Data Receiver
4. Video Processors

A brief description of each is given below.

The command processor acts as a central controller. It interprets communications between itself and the outside world. It has the task of interpreting commands from the Supervisory Computer and passing appropriate information along.

The data transmitter and data receiver work together to provide data communications between the STTs. The performance must be adequate to overcome the losses in a passive MATV distribution system (approximately 70 dB worst case).

The video processors are used as character generators and generate the composite baseband video used for the "barker" channels. The information for the these screens is downloaded from the Supervisory Computer and can be entered into the Supervisory Computer remotely or locally.

An optional function is the remote control interface. A suggested realization uses 300 baud Bell 103 type data receiver. This receiver can be used in conjunction with any audio channel (such as a phone line, secondary audio channel from a satellite receiver or unused audio channel from a stereo VCR) to operate the system entirely by remote

control. All scheduling and configuration commands should be supported through this input.

## VI. PREMIUM PROGRAMMING INTERFACE

Premium programming is inserted onto the existing MATV system in the midband on channels B thru H as shown in Figure 2. Up to four channels of premium programming and three "barker" channels can be inserted in this manner.

The sources for premium programming are various. VCR delivery, satellite delivery and cable delivery are all viable alternatives. The only requirement is that the signals are placed on the hotel MATV system with inverted spectra per the accepted Band Plan.

Additionally, the premium programming interface must provide means to modulate the "barker" channel(s) composite video output of the Data Interface. The "barker" channels are also injected on the cable with inverted spectra.

## VII. SUPERVISORY COMPUTER

The Supervisory Computer consists of a personal computer executing a Supervisory Computer software package. This software initiates all system communications, controls program scheduling, provides daily bills to the hotel manager and maintains a summary of program purchases. The hardware consists of a P.C., CRT display, printer and optional phone modem. The Supervisory Computer is hard wire connected to the Data Interface.

The Supervisory Computer should have the capacity to be operated in either of two modes; console operation or operation from remote port. Console operation is done locally and is used when the system is to be operated by the hotel manager or staff. Remote operation is done by the phone modem. This mode of operation allows the programming supplier to access the system for configuration or billing information retrieval.

Operation of the Supervisory Computer should be as follows:

Console operation is initiated upon power-up. The Supervisory Computer will display an entry screen on the CRT. Access is password controlled. Individual passwords should be provided to limit the levels of access to the Supervisory Computer.

All console and remote functions are menu driven. The main menu appears after password approval. An internal clock maintains a record of time and date. All functions should be supported in console and remote modes. The Supervisory Computer should have a battery back-up to handle power outages.

Billing information is maintained within the Supervisory Computer. This information can be accessed in several forms. A billing summary can be done on a "by room". Billing information can also be retrieved by program and date in order to facilitate billing of the hotel by the programming supplier.

Inputs required by the Supervisory Computer consist of program time, type, price and title. This information is used to configure terminals for purchases and to properly interpret purchase and status information from the terminals. The information can be entered directly by the operator while in console operation or entered automatically while in remote operation by use of the automatic scheduling interface.

The operator should be capable of implementing special room overrides in order to satisfy special requirements. The STTs can be disabled on a "by room" basis or on a "by program" basis. This feature can be used as a tool for parental discretion. Similarly the STTs can be returned to normal operation using this feature. This feature is required to support cash customers and premium programs that are included in the room fee.

It should be possible to "pre-buy" a program. The operator can authorize a particular STT to receive a program without a preview sequence. The Supervisory Computer can remotely force any STT to tune a particular premium channel or even force it to tune standard TV.

Upon initial power-up the STT's must be configured by the Supervisory Computer in order for proper purchase and preview sequences to take place. The Supervisory Computer should allow the operator to configure the length of a preview as well as the length that the "barker channels" are displayed during the preview

sequence. The operator should also limit the number of previews permitted during any particular pay-per-view program. This last feature prevents a guest from simply watching a series of previews rather than purchasing the program. The Supervisory Computer should also have the ability to re-assign channels to the buttons on the STTs.

Several security functions should be implemented in the Supervisory Computer package. The Supervisory Computer should store a list of STTs that do not respond after several consecutive polls.

The Supervisory Computer should also maintain a record of terminals that have experienced power failures. If some minimum number of power failures occur on a particular terminal during any show then the Supervisory Computer should assume that a theft of service is being attempted by a guest that is trying to reset the preview counter in a terminal. Thereafter the regular polling sequence should be interrupted periodically in order to check the status of the unit in question. Reconfiguration would occur almost immediately making theft by this method impossible.

Several testing routines should be implemented for system maintenance and diagnostics.

## VIII. PROBLEM AREAS

The system as described above is extremely flexible and can be used effectively in almost all situations requiring delivery of impulse pay-per-view entertainment in a lodging industry environment. However, a few possible problem areas exist that can cause difficulties for a system operator if not dealt with properly.

1. Cable Fed Properties

   As penetration of CATV service is increased it is often seen as a cost effective means to obtain television programming by many hotel/motel operators. Consequently many hotels are directly cable fed. This creates a problem for the operator of a pay-per-view system in that the VHF midband may already be occupied with programming on the CATV system. Additionally there may be high levels of interference at the data channel frequencies. Adequate filtering of the CATV drop must be done in order to obtain proper system operation. Additionally the operator has a responsibility to see that no signals leak out into the CATV system creating interference for the CATV system. Reception of Satellite programming will soon become better controlled due to the advent of Satellite Scrambling. Revenue recovery for programming provided to hotel guests will become a significant issue in the future.

2. One Way Amplifiers

   Hotel/motel MATV distribution systems are typically entirely passive. However in a small number of larger properties there may exist distribution amplifiers. These amplifiers must be two-way in order for proper data communication to take place. Any one-way amplifiers must be upgraded to two-way in order for the the system to operate.

3. Existing System Performance

   Every care has been taken to ensure that this system will operate in almost all MATV systems with a minimum of modification. However, in extreme cases it may be necessary to rebuild a part of the MATV system in order to obtain proper performance.

## IX. CONCLUSIONS

The Impulse Pay-Per-View System described here has been designed to best utilize existing resources. Several key factors have been included in the design that are essential to successful system operation.

1. Distributed Intelligence

   Each guest room contains an intelligent set-top terminal that is capable of handling purchases and normal system operation independently. Purchase requests are therefore processed instantly. The terminal need only report status and purchase information when polled by the Supervisory Computer.

2. Band Plan

A Band Plan has been suggested that best utilizes the existing MATV system resources. In most cases it will not be necessary to rebuild any of the existing MATV system to accommodate IPPV. Premium programming is carried in the VHF midband channels B through H.

3. Data Communications

Data communications occur over two data channels; one for downstream communications from the Supervisory Computer to the guest room, and the other for upstream communications from the guest room to the Supervisory Computer. Frequency selection for these channels must consider the performance of typical MATV distribution systems. Additionally, an "Anti-Babbling" function must be implemented in order to minimize the chances of a catastrophic system communication breakdown.

4. Remote Operation

Remote operation should be supported by the system hardware. Remote operation minimizes the training required of the hotel staff. It also facilitates system configuration and billing retrieval by the programming supplier. All functions of the supervisory computer should be supported locally and remotely.

5. Purchase Scenario

The system is transparent to standard programming. Premium programming is purchased through a preview sequence. Two positive actions are required in order to make a purchase.

6. Software Configurability

The system should be designed to allow a maximum number of system operating parameters to be software configurable. This flexibility allows tailoring the system to the requirements of each individual situation.

Hotel/motel impulse pay-per-view is a vast, virtually untapped source of revenue for the CATV System Operator. The guidelines that have been presented in this paper should help the CATV System Operator to make intelligent choices when choosing and operating a hotel/motel system.