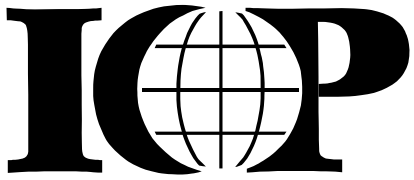

Digital Audio Broadcast Store and Forward System Technical Description

International Communications Products Inc.

Including the
DCM-970 Multiplexer,
DCR-972 DigiCeiver,
And the
DCR-974 DigiCeiver

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1 INTRODUCTION

1.1 DIGITAL AUDIO TRANSMISSION BY SATELLITE

`Audio programming is usually transmitted to multiple receiving locations by satellite using one of two methods. The first is called single channel per carrier (SCPC) whereby a single satellite carrier carries a single audio channel. The second is called multiple channel per carrier (MCPC), where several audio channels that have been multiplexed together, are transmitted using a single satellite carrier.

Transmission can be either analog or digital. Digital transmission provides for significantly better audio quality and uses significantly less satellite capacity than analog. Digital satellite receivers also generally have a much higher level of sophistication and added features not available in analog receivers, while providing superior signal-to-noise performance of a quality comparable to compact discs. Generally 7.5/10 kHz audio requires 64 kbps digital capacity, with 15/20 kHz mono requiring 128 kbps, and stereo generally requiring 256 kbps to 384 kbps for "CD" quality.

Digital SCPC and MCPC signals are normally transmitted using phase shift key (PSK) modulation. The two normal modes of PSK modulation are Bi-Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK). BPSK modulated carriers use twice as much satellite bandwidth as QPSK carriers, but at low data rates, such as 64 kbps, generally provide better service into smaller dish receive stations. BPSK modulation is not as sensitive to LNB frequency drift and phase noise, and generally allows the use of less expensive non stabilized LNB's at lower data rates than QPSK modulation.

BPSK and QPSK signals use exactly the same satellite power for equivalent performance. QPSK modulation however occupies half the satellite bandwidth of BPSK. Because it provides more efficient use of the satellite bandwidth, it therefore yields more channel capacity per transponder.

The higher quality satellite receivers available today, such as the International Communications Products, Inc. (ICP) DigiCeiver product line provide for operation with non stabilized LNB's, both in BPSK and QPSK mode at data rates of 128 kbps and higher.

1.2 DIGITAL AUDIO SYSTEM OVERVIEW

The ICP digital audio system utilizes the latest digital technology to provide state-of-the-art broadcasting of audio programming by satellite. The ICP system can be provided in either an SCPC configuration, or in an MCPC configuration. This white paper will describe the operation of a typical store and forward system in MCPC configuration.

The digital audio system includes MPEG audio encoders, TDM multiplexers and the modulator subsystems at the uplink/head-end location as well as ICP's unique programmable DigiCeiver® audio receivers containing demodulators, demultiplexers, MPEG decoders and an optional audio store and forward function feature at each of the receive locations.

1.3 AUDIO CHANNELS

The MPEG Layer II coding has become the international standard for high quality digital audio distribution. The use of MPEG Layer II audio compression, coupled with the total bit rate agility of the DigiCeiver equipment, provides very high performance audio transmission as well as the flexibility of many different encoding and decoding modes and data rates. This provides the ability to trade off audio performance with bandwidth to optimize system performance and value. Additionally, this flexibility allows the ability to evolve the system to meet ever-changing requirements as the system needs grow or change.

1.4 NETWORK CONTROL SYSTEM (NCS)

In ICP MCPC audio/data systems, in addition to the audio and voice/data channels there is an 8 kbps network control (NCS) channel multiplexed into each carrier, which allows complete control of each audio receiver from the head end multiplexer.

The paragraphs below describe the equipment used in the digital audio subsystem as well as how this equipment is configured to provide the required services.

2 CONVENTIONAL SYSTEM – HEAD END DESCRIPTION

2.1 MPEG ENCODERS

One MPEG encoder is required for each audio channel to be transmitted. Each encoder takes a live analog audio stream at its input and converts it to MPEG encoded audio.

The ICP supplied DAE-102 MPEG encoders each provide MPEG Layer II encoding of one stereo channel. They can also be configured for dual mono mode so that two independent mono channels can be encoded. The DAE-102 is capable of encoding audio channels at all the data rates and in all the modes provided for in MPEG Layer II. Note that when dual mono is selected, both channels in the pair must be processed in the same mode. Bit rates from 64 kbps to 384 kbps are accommodated.

The MPEG encoders may be remotely controlled via a serial RS-232 link. The configuration of the encoder may be fully controlled through this port. The encoders may, of course, be manually controlled via their front panels. A summary fault relay output signal is also provided.

2.2 DCM-960 MULTIPLEXER

The ICP DCM-960 TDM multiplexer combines up to 8 data sources into a single TDM aggregate stream. Each channel is programmable in data rate, in 64 kbps increments, up to a total aggregate rate of 2048 kbps. Channel 0 of the multiplexed data stream includes an 8 kbps channel used for network control and TDM synchronization. The remainder of channel 0 may be assigned for user data. The 8 kbps control channel is designated the network control (NCS) channel. In addition to synchronization, the NCS channel provides a carrier identification signal to all receivers to identify the correct signal in a multi-carrier satellite environment. It also includes a control stream, which allows the complete configuration and control of every receiver in its network from the head-end.

In the DCM-960 connection to the NCS channel is provided via a Network Control (NCS) port. This port provides connection to the NCS computer. The ICP NCS software, running on the computer,

provides access to the NCS channel to control the field population of receivers as well as providing configuration of the DCM-960.

The channel input interfaces to the DCM-960 are provided via RS-422 electrical levels. The aggregate data output is also provided as an RS-422 signal. The NCS port utilizes an RS-232 electrical interface.

The DCM-960 provides a summary fault relay output. It also has a relay isolated input which enables the data output drivers and clock output drivers to be separately enabled or disabled allowing redundant units to be physically paralleled and then remotely enabled or disabled for redundancy protection.

The main control functions of the NCS software are summarized below:

- The ability to configure and monitor the DCM-960.
- The ability to remotely configure a single receiver or all receivers in the network.
- The ability to download operating code to the receivers.

2.3 MODULATOR

The RC240M Modulator is both data rate and frequency agile. It receives RS-449 (RS-422 levels) data from the DCM-960 TDM multiplexer and provides a 70 MHz IF output.

The modulator may be fully remote controlled via an RS-232 serial link. All configuration parameters may be controlled either from the front panel or through the remote port.

3 CONVENTIONAL SYSTEM - RECEIVING EQUIPMENT

3.1 ANTENNA AND LNB

The receiver uses a small dish antenna of a diameter appropriate for the signal being received. The LNB may be a PLL type, or a digital ready DRO LNB with low phase noise and defined frequency stability.

3.2 DCR-972 (non- store and forward) RECEIVER

The model DCR-972 DigiCeiver is a multi-function SCPC/MCPC programmable data/audio receiver intended for use in satellite-based broadcast systems. Its many applications include worldwide news services, radio program distribution to network affiliates, nationwide advertising distribution, financial and banking services, paging broadcasts, music distribution, corporate data base updates, and software distribution. In the DCR-972 audio decoding is provided by the four-channel DAP-104 daughter boards, which are "plugged" directly into the receiver motherboard. A configuration USING two DAP-104 cards provides the receiver with 4 stereo or 8 mono outputs in pairs

The DCR-972 DigiCeiver is an all-digital satellite receiver employing the latest digital demodulation technology. The receiver accepts an input RF signal in the frequency range of 950 MHz to 1450 MHz. The desired signal is first down converted to an internal intermediate frequency of 480 MHz and them to a second intermediate frequency of 45 MHz.

The 45 MHz signal is digitized with all subsequent processing being performed digitally. The first process is the demodulation of the signal (BPSK or QPSK) with the demodulator providing a soft

decision output to the sequential forward error correction (FEC) circuitry for BER improvement. This then provides the received baseband signal to the baseband processing circuitry.

Once the baseband signal has been recovered, it is passed to the demultiplexer where the carrier identification and TDM signals are extracted. The NCS data stream is also recovered to provide the off-air control channel for receiver configuration. The demultiplexer also recovers each selected TDM channel from the aggregate stream to provide the input to each audio decoder. In addition to control from the head-end via satellite and local control from the panel, the DCR-972 provides a serial remote port, which allows full control over all receiver parameters.

3.2.1 DAP-104 dual audio decoder

The DAP-104 MPEG audio decoder utilizes a programmable audio decoder to recover each channel pair (or stereo channel) from the aggregate data stream. High quality digital to analog converters (DAC's) then provide the analog audio output. An electronically balanced audio driver providing the required audio output levels, as well as a high degree of longitudinal balance and low distortion buffers the analog output. An AES/EBU digital output signal is also provided from the decoder.

Each DAP-104 card holds two audio decoders, which can provide two stereo or 4 monaural channels (or 2 monaural and one stereo channel).

4 THE ICP STORE AND FORWARD SYSTEM

To add store and forward capability to the ICP product line, the original system concepts have been enhanced and extended.

In the communications channel in the conventional system, we saw that a reserved 8 kbps time slot was used for code downloads, and basic receiver control. In a store and forward audio system this channel is still required for the same purpose as before. The channel is however too slow to cope with the need for real time switching of audio signals to the precision required in the broadcast industry. The system has been therefore expanded to add several other time slots, each of which may be set up to match up with the required communications needs.

The control channels are:

- **Original (slow) NCS channel**

As in all ICP systems, this channel carries carrier ID information, allows code download to receivers and carries configurations commands such as demodulator and time slot settings.

- **Real Time NCS channel**

This is a high-speed communications channel, which carries commands to the receiver in real time with low latency to cause events to happen at the receiver at precisely the required moment. The channel speed can be specified by the customer to best suit the needs of the system.

- **File Download channel**

This channel is designed to allow background download of files from the headend to the receiver. In a simple system, a small capacity download channel, which allows audio downloads to trickle over the link at slower than real time may be adequate. On the other hand, in a busy system the download channel could be large, to allow audio files to download many times faster

than real time.

5 STORE AND FORWARD SYSTEM – HEAD END DESCRIPTION

Figure 1 shows a block diagram of the head end, which is built from the following pieces.

5.1 MPEG Encoders

One MPEG encoder providing MPEG Layer II encoding is required for each audio channel to be transmitted as already described.

5.2 DCM-970 Multiplexer

The new ICP DCM-970 TDM multiplexer is the heart of the store and forward system at the head end. It combines up to 32 data sources into a single TDM aggregate stream. Each channel is programmable in data rate, in 64 kbps increments. Just as in the DCM-960, channel 0 of the multiplexed data stream includes an 8 kbps channel used for network control and TDM synchronization. In addition to synchronization, the NCS channel provides a carrier identification signal to all receivers to identify the correct signal in a multi-carrier satellite environment. It also includes a control stream, which allows the complete configuration and control of every receiver in its network from the head-end.

In the DCM-970 the NCS functionality is built into the DCM-970 itself as an NCS software package. This NCS software package provides control of all DCM-970 functionality through a secure web browser interface. This easy to use graphical user interface (GUI) allows systems configuration to made from any authorized computer connected to the DCM-970 though a local area network.

The channel input interfaces to the DCM-970 are provided via RS-422 electrical levels. The aggregate data output is also provided as an RS-422 signal. The NCS port utilizes an RS-232 electrical interface.

There is a summary fault relay output and also an isolated relay input. This enables the data output drivers and clock output drivers to be separately enabled or disabled allowing redundant units to be physically paralleled and then remotely enabled or disabled for redundancy protection.

The main control functions of the NCS software are summarized below:

- The ability to configure and monitor the DCM-970.
- The ability to remotely configure a single receiver or all receivers in the network.
- The ability to download operating code to the receivers.
- The ability to configure the file download channel
- The ability to configure the real time audio channels
- The ability to download files to the receivers.
- The ability to pass commands to the receivers.

5.3 DOWNLOADING FILES TO RECEIVERS

The DCM-970 with its NCS interface allows the user to download audio files (and other file types as required) to DCR-974 DigiCeivers on the network over the file download channel.

The files can be downloaded to a single receiver specified by its address, or to all receivers. It is also possible to set up groups of receivers and to download to one or more groups of receivers.

5.4 DOWNLOADING CODE UPDATES TO RECEIVERS

The NCS can also be used to update the receiver operating code at any time. The receiver code consists of six different code modules. If a code update is released for any of the code modules to add new features for example, the code update can be downloaded to the receivers over the NCS channel. As with the file download, code downloads can be made to a single receivers, all receivers, or to a group of receivers.

5.5 SENDING COMMANDS TO THE RECEIVERS

A serial port on the DCM-970 is the interface through which real time commands can be sent to the DigiCeivers.

In the simplest manual system, a PC running a terminal program can be used to send these commands. They could be typed directly into the terminal program for real time control. More likely they would be stored as short text files and sent out at the appropriate time by a single key press.

A second method of sending commands could be through relay closures. ICP offers an optional Relay Interface computer. This Relay interface computer senses up to 128 relay inputs. When a change of state of a relay is sensed, the computer sends a short serial stream to the DCM-970, and from there, out over the satellite link. At the receiving site, the DCR-974 can be programmed to respond to any of these relay closures. For example, one relay could start a file playing from the local hard drive on one receiver, at the same time causing a different file to play at another receiver.

A third possible use for this input is to allow the connection of a compatible automation system. The automation system can be programmed to send out a serial stream to the serial port on the DCM-970, and from there over the satellite link to command the receivers to perform specific actions.

5.6 MODULATOR

The RC240M Modulator is data rate and frequency agile. It receives RS-449 (RS-422 levels) data from the DCM-970 TDM multiplexer and provides a 70 MHz IF output.
The modulator may be fully remote controlled via an RS-232 serial link. All configuration parameters may be controlled either from the front panel or through the remote port.

5.7 AUDIO FILE SERVER

The audio file server is a computer, which is connected to the DCM-970 through a local area network. The function of the file server is to be the originating point for the download of files through the DCM-970 to the remote receivers. These are usually audio files for the store and forward application, but can in fact be any type of file. The audio file server may be customer provided.

5.8 NCS CONTROL

Network control of the DCM-970 is through a secure LAN interface. Any PC connected to the LAN and running standard web browser software is capable of being permissioned to control and monitor the network. The DCM-970 can be controlled and monitored from by more than one PC at the same time without causing conflicts.

6 STORE AND FORWARD SYSTEM – RECEIVER DESCRIPTION

6.1 DCR-974 STORE AND FORWARD DIGICEIVER.

6.1.1 INTRODUCTION.

The DCR-974 Digiceiver retains the same capabilities with live audio as the DCR-972, but adds store and forward functionality. The DCR-974 in its standard configuration is provided with a companion SAP-104 audio card for full audio store and forward operation.

Other enhancements include an increase in the maximum data rate to 4.096 Mbps. The DCR-974 is available with Viterbi or sequential error correction decoding as a factory option.

The SAP-104 card supports the standard ISO/MPEG layer 2 audio format. Standard data rates and sample rates are supported as well as the standard modes including mono, dual mono, stereo, and joint stereo. Standard MPEG layer 2 file formats are supported for the store and forward functions. The SAP-104 card decodes up to four audio streams, each available as an analog or AES/EBU output.

6.1.2 AUDIO FILE STORAGE

The DCR-974 contains a mass storage device, which can either be a hard disc drive or a flash memory drive. The drives do not hold any part of the operating system for the receiver, so the presence of the drive is not necessary for the receiver to function as a real time receiver.
The store and forward features of the receiver allow audio and data files to be stored on the mass storage device in the receiver. It also allows audio files to played back from the receiver on command.

The storage capacity is dependent on data rate and disk size. The standard hard drive can store 30 or more hours of audio at 128 Kbps.

The files are stored on the drive using the familiar DOS file system. In this way, audio and data files can be organized in a way most convenient to the user of the system. When an audio file is to be played, all that is necessary is to issue a play command, and to reference the full path name of the file to be played. The controller then recovers the file from the hard drive, and passes it to the designated in-built MPEG decoder to be played out of the receiver.

In the unlikely event of the failure of the hard drive, a new drive can be pre-loaded at the head end and sent out to the affected site. Because files are stored using the DOS system, a PC at the head end can be used to pre-load a new hard drive with all of the necessary files

6.1.3 STORAGE OF OTHER TYPES OF FILES

The DCR-974 is not only able to store audio files but can in fact store files of any type. These could be documents. HTML files, or weather maps for example.

One important feature of the DCR-974 is that is also able to store files containing sets of instructions called scripts, which the receiver can process and act on when commanded to by these scripts.

6.1.4 RELAYS

The DCR-974 has 16 relay inputs. On receipt of a change in state on the relay input, the receivers can initiate actions within the receivers such as file play, or record.

The DCR-974 also has 16 relay outputs. These relay outputs can are designed to trigger events at the local station. These relay outputs could be made for example to fire at the start of a station break and could be used to trigger a local cart machine. The closures would normally be commanded to fire from the head end.

6.1.5 AUDIO MIXERS

DIRECT OUTPUTS
Two of the audio outputs on the SAP-104 are direct audio outputs, which output the signal from an associated MPEG audio decoder.

MIXED OUTPUTS
For added versatility, the other two audio outputs are each fed from a built-in three input audio mixer. Each of the three mixer inputs can be turned on and off, or combined in any proportion. The three inputs are

1. The output from the MPEG decoder dedicated to that output.
2. The output of the MPEG decoder, which feeds one of the direct audio outputs.
3. The analog signal from an auxiliary input on the rear panel.

In their default state, the mixers route the outputs of their dedicated MPEG decoders to the audio output port. In this mode, the SAP-104 acts as a classic four-channel receiver.

When activated by software, the mixers can change state, allowing many useful functions to be implemented. Each of the three inputs has a separately programmed gain, allowing the level of each channel to be set at the output. In addition the transition time from one gain setting to another is also programmable.

6.1.6 LAN INTERFACE

The receiver is provided with a 100 Base T LAN Interface. This interface may be connected to a networked computer. The system can then direct files from the headend to the receiver and directly out to the local computer.

The files placed on to the local computer could be audio files, or they could be data files that are needed on the local computer such as weather maps or word processor files.

The local computer can also be used to place files on to the DCR-974 hard drive.

One possible configuration of the system is to have all files that are downloaded to the DCR-974 to also be automatically also sent to the hard drive of the connected computer. In this way, there is a complete local back up of all of the files that are on the DCR-974.

6.1.7 REAL TIME CLOCK

The receiver contains a real time clock. The date and time of day to the nearest second can be displayed on the front panel. The time is retained through a power outage. The internal clock module is specified accurate to one minute per year. The time and date can be set at the receiver or through the satellite link at regular intervals if desired for even higher accuracy.

The presence of a real time clock provides the basis for additional receiver features based on actions occurring at specific times of day. Such features could be added to the receiver software at a later date as the need arises.

6.1.8 CONTROL OF THE RECEIVER WITH AUDIO CONTROL LANGUAGE

A unique feature of the DCR-974 is that it does not only react to direct instructions, but can also react to sets of instructions pre-stored on the hard drive. These instructions are written in ICP Audio Control Language and are referred to as ACL files. These ACL files can be stored on the hard drive in an appropriate directory structure. When they are played back from the hard drive, the controller recognizes them as sets of instructions and begins obeying the instructions just as if they had been directly given.

This feature is called Network Based Timing with Local Execution. The network knows when to start a break, but the receiver is capable of carrying out a complex procedure autonomously. This is a critical distinguishing feature of the system

For any applications that depend on time of day to initiate, additional software could be downloaded to meet future customer needs.

7 OPERATION OF THE STORE AND FORWARD SYSTEM

7.1 DOWNLOADING FILES TO THE RECEIVER

There are several ways of downloading audio files to the receiver. These ways include.

- Download the file in the background over the file download channel.
- Directly record a real time feed from the live audio. The files created may be as short as a few seconds for recording a station ID. They also may be as long as several hours for use in delaying a program for later playback.
- Load file into the receiver through its Ethernet port remotely if the receiver is connected to the Internet for that purpose.

7.2 PLAYING AUDIO FILES FROM THE RECEIVER – FILE SELECTION

Files may be played back from the receiver by issuing the PLAY command. The receiver can

- Play back a specified audio file that was downloaded in the background.
- Play back a specified recording that was made of real time audio.

One important feature of the playback of real time audio is that playback of the file may be initiated before the recording has been completed. This can allow for example a 10-minute news bulletin to be delayed by five minutes.

- Initiate playback of a random file from a designated directory. For example a directory could contain a series of promotional announcements allowing a different random one to be played at each break.

7.3 PLAYING AUDIO FILES FROM THE RECEIVER – COMMANDS

There are many possible points from which a user can command a file to play back from the receiver. These include the following:

- Playback triggered from the head end by a relay closure
- Playback triggered from the head end by a manual PLAY command.
- Playback triggered from the headend by a PLAY command originated from a compatible automation system.

There are also several ways to trigger playback from the remote site

- Playback triggered by a button push on the receiver front panel to play a pre-designated file. (Actually the receiver allows up to 100 files to be pre-designated for playback using the front panel)
- Playback triggered at the remote site by a command sent to the remote port of the receiver from a local computer.
- Playback triggered over the receiver's Ethernet port.
- Playback triggered by a relay closure provided by the local station. The receiver has up to 16 relay inputs for this purpose.
- Playback triggered by a relay closure from one of the DCR-974 relay outputs, which is connected back to one of the relay inputs.

7.4 AUDIO CONTROL LANGUAGE

7.4.1 DESCRIPTION

The store and forward functions of the system are commanded in ICP's Audio Control Language. This Audio Control Language controls all real time functions in the receiver. The language is straightforward to understand and use. We have seen that to play a file, the command used is PLAY followed by the name of the file to be played. ICP publishes a document, which fully explains the details of all of the commands.

There are a large number of commands available in the ICP audio control language. Some of

them are specific to the ICP audio system such as the following:

- Command the recording of files
- Command the playback of files
- Command relays to fire
- Command the mixers to change state, or to hold their present state.
- Command mixers to change their attenuation setting

There are also other more generic commands such as those to print directories, change directories. There is also a print command, which allows the printing of the contents of a directory on the drive. In addition, files can be printed as well as program schedules downloaded from the head end. Several other DOS – like commands are also supported.

The audio command language instructions are multi-threaded which means that they can be sent to the receiver through several different paths without adverse interaction. This someone at the remote site may send a command to record a file, while at the same time, someone at the head end may send a command to fade in and play a file from the hard drive. Both sets of commands will be received by the controller in the receiver and acted upon properly.

The specific paths available are:

- Over the real time control channel from the satellite.
- From the remote port on the rear of the receiver.
- From a file containing commands played back from the hard drive.

7.4.2 EXECUTION OF SCRIPTS

One feature of the DCR-974 that makes it so versatile is that the instructions (scripts) do not necessarily have to be sent in real time. They can be pre-recorded on the hard drive. When a script is later commanded to play, it is executed at that time as if it had come in on the live command channel.

Note that a short command can be sent to trigger a whole set of instructions which could contain the complete list of activities required during a complex break. This is useful since it cuts down on satellite overhead at peak times such as the top of the hour.

A second advantage of the triggered approach is that the sets of instructions kept locally on each receiver do not need to be the same at all sites. This opens up the possibility of having receivers in different locations react in their own unique way to a single script sent from the head end. One simple application of this would be to have each local station insert a coomand to play back its own local station ID at an appropriate point in the break.

7.5 AFFIDAVITS

The receiver includes a logging function, which may be activated to provide an affidavit of all files played from the receiver. The real time clock in the receiver will provide a time stamp with the time that the file was played from the receiver. The contents of the affidavit will be retained through a power outage.

The affidavit may be produced by a command either from the head end or from the receiver. The resulting affidavit file may then be printed. It may also be sent through the Ethernet port to a local PC. The affidavit can be set up to include special formatting supplied by a file stored on the receiver's hard drive so that a formatted affidavit can be printed.

7.6 THE APPLICATION OF MIXERS AND FADERS

Two audio output ports on the DCR-974 are each fed by a three input mixer fader. The mixer fader allows up to three audio sources. The most frequent use of the mixer will use two of the inputs. The three inputs are

- The output of MPEG decoder A.
- The output of MPEG decoder B
- The audio from an analog input on the rear of the receiver.

One application of the mixer is to allow a local spot to play as a voice over, over the reduced level real time feed. The fader function is utilized to fade the real time audio to a lower level over a short time period of perhaps half a second. The spot can then be played from the hard drive over the faded real time feed. At the end of the spot, the spot can be faded back to zero and the real time audio brought up to full level.

A second application would be to have the feed from the local station fed to the auxiliary input of the receiver. The local audio could then be faded up and the satellite feed faded down for local announcements.

A third application would be to do a smooth Crossfade from real time audio to a spot, and back again at the end of the spot.

7.7 SWITCHING BETWEEN AUDIO STREAMS

The controller can select which MPEG audio stream is presented to the inputs of each MPEG decoder. The mixers and faders have been designed to allow the audio output to be smoothly faded or cross-faded from one source to another by using two MPEG decoders for the switchover, one for each stream.

If no cross fading is required, a hard switch from one audio stream to the other is possible. To mask the sudden change in level at the switch, the MPEG decoder itself can be briefly muted at the precise moment that the switch occurs, allowing a glitchless transition to be made from one audio source to the other

7.8 DISASTER RECOVERY

Due to the built in hard drive the DCR-974 can be pre-programmed so that it can provide disaster recovery back up for failure to receive the satellite signal. Such a failure could be caused by LNB failure locally, or by an outage of the satellite signal itself.

To prepare the receiver for this function, the user would pre-record one or more audio programs on the hard drive for use during any such outage. The program could be material that is not dated in any way. It could also be material set up to record over the real time audio channel on a daily basis.

When the receiver senses that the satellite signal has failed for a pre-determined period, it can be programmed to automatically play a designated file from the hard drive during the outage, and then return to the real time feed automatically once service has been restored.

This feature could also be used to cover the sun outages that occur in the Spring and the Fall.

8 DISTINGUISHING FEATURES OF THE ICP SYSTEM

The following are some of the notable features of the ICP store and forward system.

8.1 ACL LANGUAGE

The receiver's operations are all commanded by a simple, yet powerful audio command language which allows all of the audio related portions of the receiver to be controlled. The commands are described in detail in the ICP Audio Control language document.

8.2 NETWORK BASED TIMING WITH LOCAL EXECUTION

The network signals the exact time knows when to start a break, but the receiver is capable of carrying out a complex procedure autonomously.

8.3 LOCAL CONTENT CUSTOMIZATION

Because the interpreter can make logical decisions in real time, the content that is played back is customized in real time. Local content can therefore be market, time zone, or location dependent, based on current information

8.4 SCRIPTS

Although the audio control language commands may be sent one at a time, the ICP system allows groups of commands to be sent at one time as text based set of commands called a script. These scripts can be pre-written and sent out from the head end with a single key press.

8.5 USER DEFINED FUNCTIONS

The command interpreter is extensible. New commands can be defined in the receiver as new words in the ACL language. They can be retained in the receiver or erased when no longer needed.

8.6 GROUP ADDRESSING

The group addressing functionality is very powerful, due to the ability to use Boolean algebra expressions as part of the group addressing. This means for example, that one can address units that have to be members of two different groups, such as the sports group and the West Coast Group.

8.7 AFFIDAVITS

The receiver can produce an affidavit file of all material that has been played out from the receiver, annotated with an accurate time tag, and print it to a printer, or make it available to the Ethernet port.

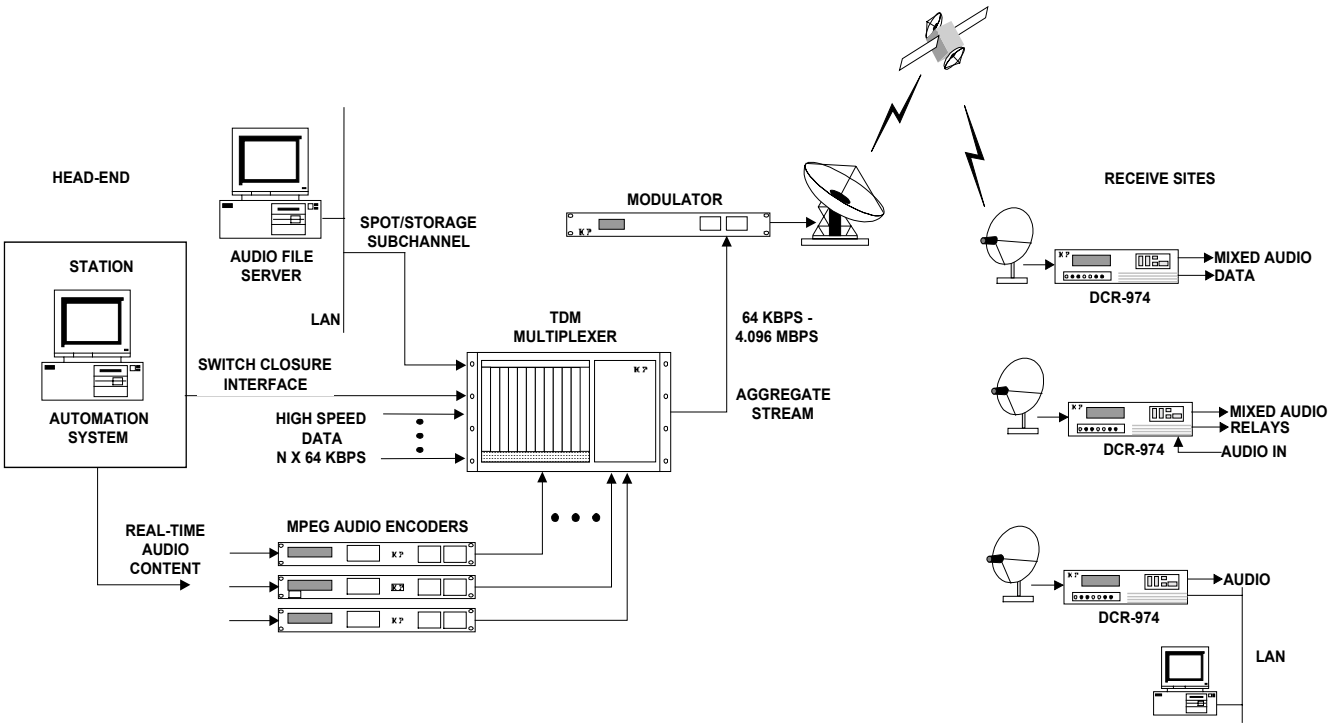

Figure 1 MCPC Audio Network