142nd SMPTE Technical Conference and Exhibition
October 18-21, 2000
Presented by:

Neil S. Karsh
Technology Deployment Manager
Audio /DTV
Leitch Inc.
Overview-

Audio Compression systems
Why?
Define your needs
Choose the technology

The Technology-
apt-X™ Algorithm
How it works

Applications-
Diamond Audio
System benefits
Why Compress?

**NTSC**
- Stereo audio (2 channels)
- Mono audio (1 channel) is still used

**DTV / HDTV**
- Multi-Channel audio (5.1 channels)
- Still need stereo and mono
- M and E
- Multiple languages
Why Compress?

**Existing Infrastructure**
- based on 2 channel audio (some 4 channel)
- Most VTR's are 2 or 4 channel

**Decision**
- upgrading facility to multi-channel capability
  - Routers, DA’s, A/D’s, D/A’s =$$ $$
  - utilize high quality audio compression
  - nothing else needed!
Decision

High quality audio compression
- the obvious choice for most facilities
Define Your Needs

When looking at the available compression technologies look for........

- AES3 compatible signals
- Multiple passes - minimal degradation
- Minimal signal delays
- Robustness to errors
- Switching versatility - sync or asynchronous
- Synchronization of compressed audio to video
- Auto detection - comp and uncomp signals
- Easy / Total system integration
Define Your Needs

In Real World Terms:

The compressed signal must be able to be recorded, edited, switched, routed and embedded as if it were a linear AES3 signal.
apt-X™

- Proven technology
- Over 10 years of world wide experience
- Enhanced for even stronger performance
- **apt-X™ Current areas of implementation:**
  - Studio to transmitter, RF and other fixed digital cable links
  - Satellite and ISDN based in field broadcast links
  - ISDN based audio recording
  - Cinema and Film theater surround systems
The Technology - is the algorithm

Encode

Store

Decode

Digital Betacam
The Technology - is the algorithm

The key components:

- Sub-Band Encoding
- Linear Prediction
- Adaptive Quantization
The Technology - Sub-Band Encoding

![Graph showing hearing threshold and sub-bands](image-url)
The Technology-
Sub-Band Encoding

The Encode Process
The Technology - Linear Prediction

Prediction based on the history of previous 122 samples
The Technology - Linear Prediction

PCM In
4x16 Bit words @Fs

64 tap QMF tree

LF Sub Band 1
Lower MF Sub Band 2
Upper MF Sub Band 3
HF Sub Band 4

P

1/Q

1/Q

1/Q

1/Q

The Encode Process

APT-X Bit Stream
1x16 Bit Word @Fs x.25
The Technology-
Adaptive Quantization

The Encode Process

PCM In
4x16 Bit words @Fs

64 tap
QMF

1x16 Bit
Word @Fs x.25

LF Sub Band 1

Lower MF Sub Band 2

Upper MF Sub Band 3

HF Sub Band 4

1/Q

1/Q

1/Q

1/Q

P

P

P

P

The Technology-
Adaptive Quantization

The Encode Process
The Technology - Multiplex the Output

The Encode Process
The Technology-
*Decode = Reverse*

The Decode Process

APT-X Bit Stream
1x16 Bit Word @Fs x.25

The Decode Process

64 tap QMF tree
4x16 Bit words @Fs

PCM Out

1/Q

1/Q

1/Q

1/Q

LF Sub Band 1

+ +

P

Lower MF Sub Band 2

+ +

P

Upper MF Sub Band 3

+ +

P

HF Sub Band 4

+ +

P

1x16 Bit Word @Fs x.25
apt-X™

Distinct Advantages

- ADPCM Based Algorithm
  Not Psycho-Acoustic
- Fast
  <5.5 ms per total encode/decode cycle
- Robust
  Tolerant of bit errors
- High Data Accuracy
  > 98% data retention
- Proven Technology
  In World Wide Usage
apt-X™
Diamond Audio-

Transparent Edit, Route or Record Multi-Channel Audio on an Existing 2 Channel Infrastructure

ACE-1600

ACD-1600

Digital Betacam
Diamond Audio-

ACE-1600

DA size PC Card

1RU Frame with Local Control Panel
Diamond Audio-

ACE-1600

REFERENCE

RESAMPLER

apt-X™

COMPRESSION ENGINE

CHANNEL SELECTON and MULTIPLEX

DATA
Diamond Audio -

ACD-1600

DA size PC Card

1RU Frame with Local Control Panel
Diamond Audio -

ACD-1600

Auto Detects incoming signal configuration and set the decoder accordingly.
Diamond Audio-

ACD-1600

apt-X™
DECOMPRESSION ENGINE

REFERENCE

DEMULTIPLEX
SYNC
and
CHANNEL SWAP

DATA

01:00:01.00
01011010

01:00:01.00
01011010

DATA
Diamond Audio-

ACD-1600

Standard AES Word Format

<table>
<thead>
<tr>
<th>PRE</th>
<th>AUX</th>
<th>AUDIO DATA</th>
<th>V</th>
<th>C</th>
<th>U</th>
<th>P</th>
</tr>
</thead>
</table>

- **Preamble**
- **Auxiliary**
- **Audio**
- **Validity**
- **User Parity**
- **Channel Status**

**Four Bit ASCII Code**
Diamond Audio Applications

NTSC =
  2 Audio Channels =
  L+R or at Best Lt + Rt

ATSC DTV Spec = 5.1 Channels

Don’t forget the M+E!

Add in Multiple Languages

In the DTV world-
track count can hit double digits
Diamond Audio - Applications

Digital VTR

A/V Synchronizer

think video®
Diamond Audio Applications

AES Audio Sources

AES Router Level 1

AES Router Level 2

AES Router Level 3

AES Router Level 4

DA

DA

AES Audio Destination 1

AES Audio Destination 2

$\text{Diamond Audio}$

$\text{LEITCH}$
Diamond Audio Applications

Digital Multi-Track ATR

Digital VTR

ACE-1600
Diamond Audio-

Review

- Superior Audio Quality
- Simple to Operate
- Simple to Integrate
- Packaging and Systemization Options
- Logical Choice
Thank You-

Leitch Technology Corporation designs, manufactures and markets innovative, affordable solutions for expanding video and audio communications capabilities of television, distribution and data systems worldwide.