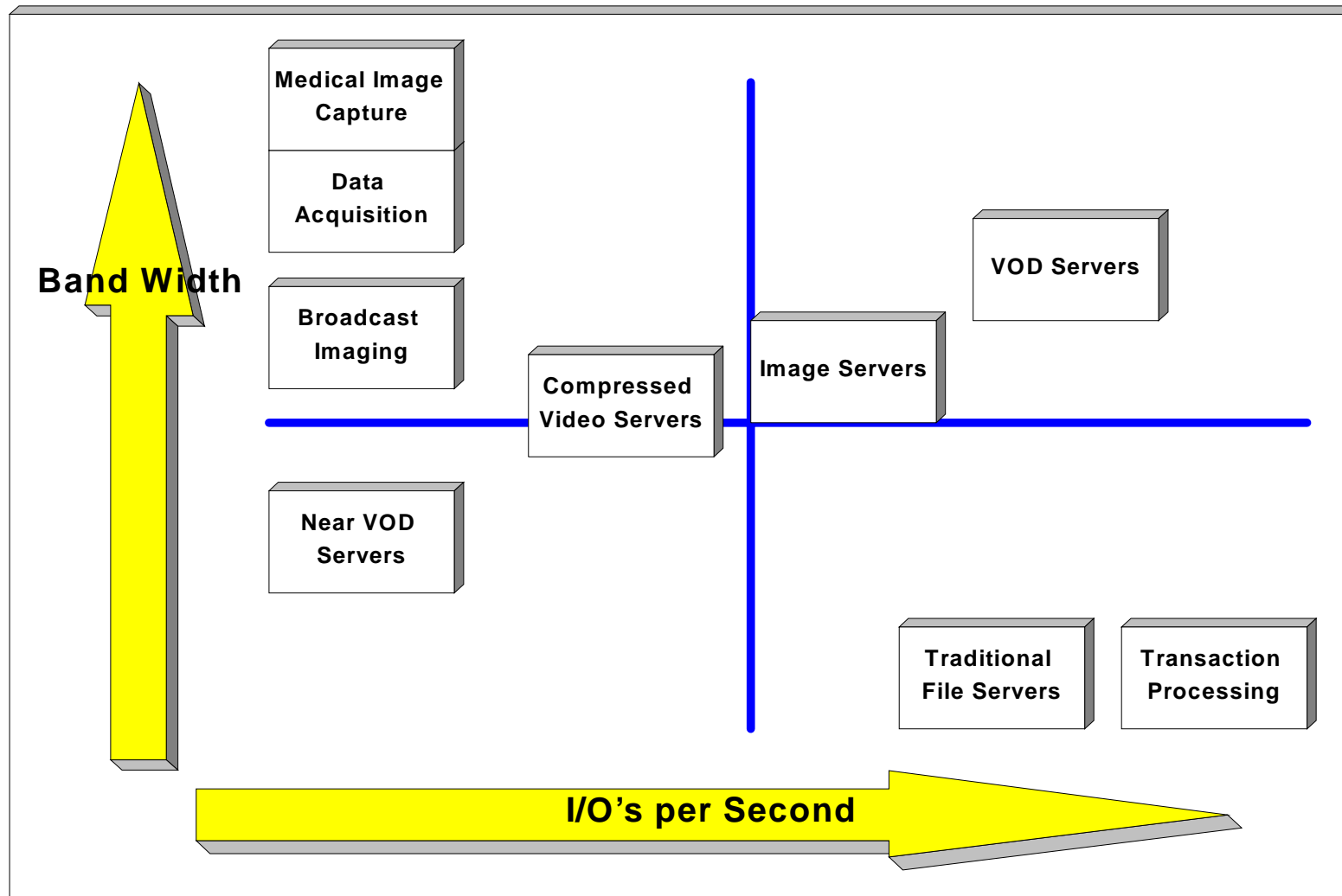


Emulating High Speed Tape with RAID

Presented by
Martin Bock
Storage Concepts, Inc.

Market View, Bandwidth vs I/O's





Company Focus

- ◆ Highest Performing Disk Storage Solutions
 - Superior Data Transfer rates
- ◆ Flexible Product Offerings
 - Various Interfaces, Tailored Configurations
- ◆ Real-Time Storage Systems
 - Guaranteed Continuous Sustained Performance
- ◆ Product Solutions
 - Integrated for Video, Imaging and High Bandwidth



Storage Concepts Partners

Servicing the Following Industry Leaders:

**Aerospace Corp.
Bell Northern
BE Aerospace
Computing Devices
DBA Systems
E-Systems
Florida Atlantic
GE Medical
Hitachi
Hughes
Honeywell
IBM**

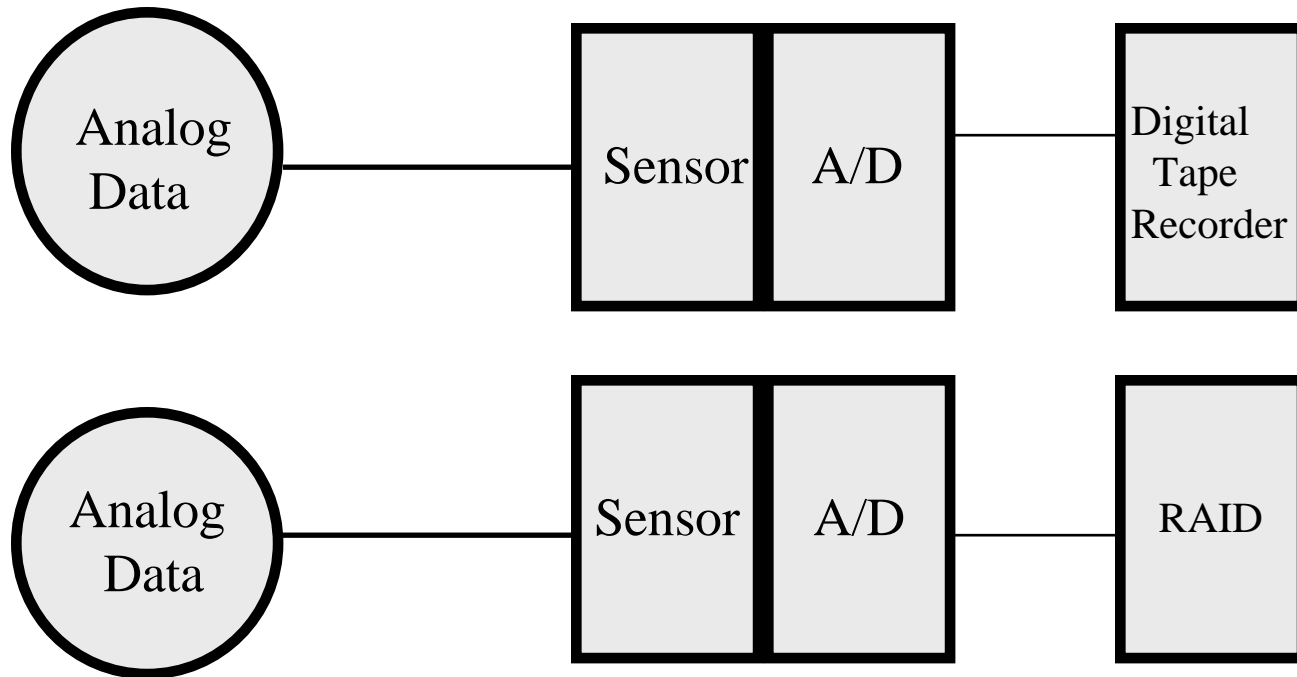
**JVC
Kodak
Kaman Sciences
Lockheed
Loral
Martin Marietta
MacDonald Dettwiler
NASA
NTT
OEC Disonics
Picker International
Philips**

**Raytheon
Rockwell
SAIC
Siemens
Toshiba
TRW
UCLA Medical
Unisys
VTE GMBH
Vortech
Whittaker
X-Tech**

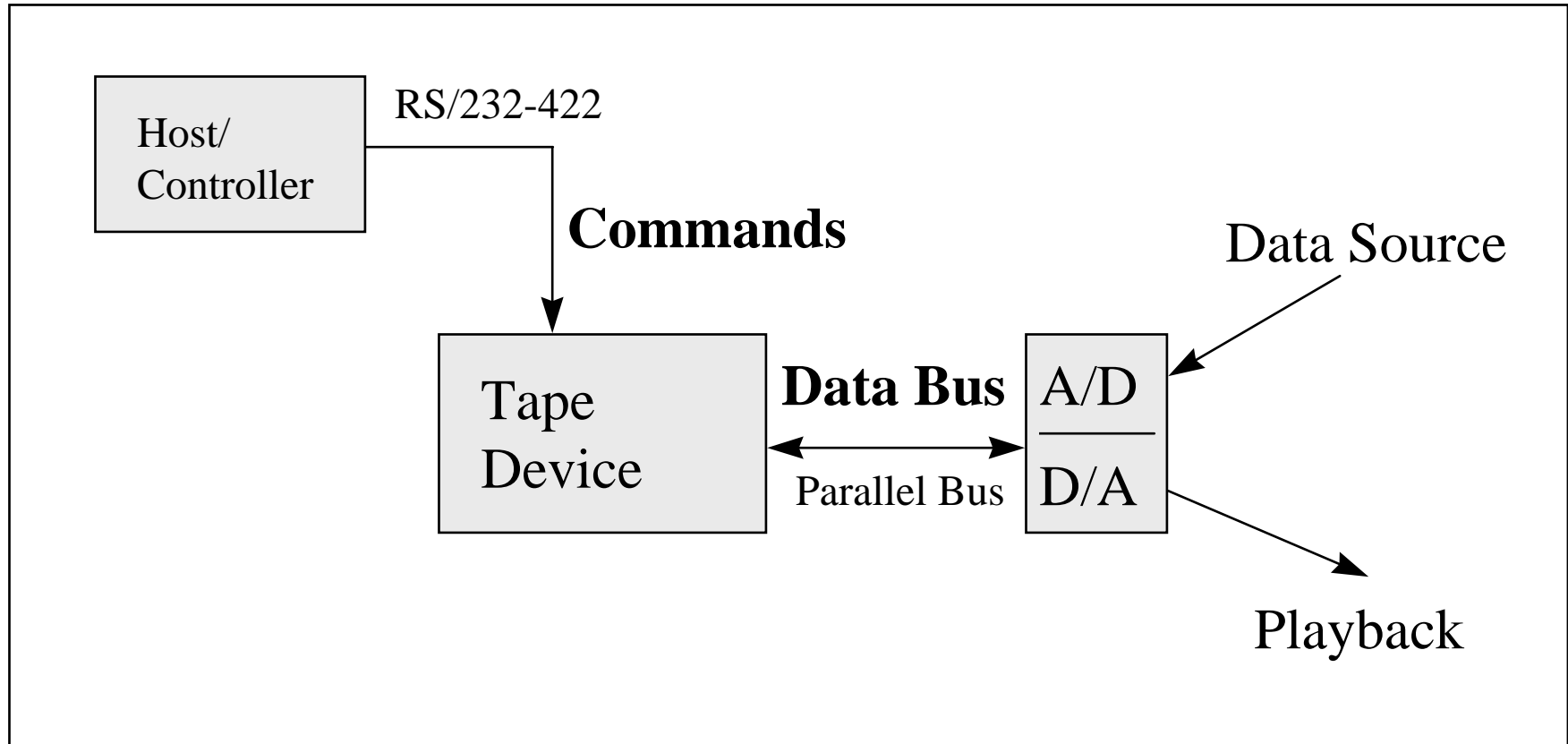
ETC.

OUR OBJECTIVE

DATA



Architectural Objective





Selecting The Appropriate RAID Level

RAID

0

Data is striped without redundancy protection

- Performance improvement
- Error handling is a problem

1

Data is mirrored across duplicate drives

- Typically one redundant drive for each data drive

2

Bit-interleaved data is transferred across group of disks, then enough check disks are added to supply single-error correction and double-error detection (similar to DRAM ECC approach).

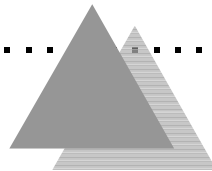
3

An array of disk drives transferring data in parallel with one redundant drive that functions as a parity check disk. Together they work as one large virtual drive.

- Parity is the Exclusive-OR of data on drives 1 through 8
- Drive spindles are synchronized
- Parallel data paths are supplied to each drives
- Number of data drives is expandable

5

An array of drives with the ability to read and write data and parity across all disks. No dedicated parity drives exist..





Why RAID 3?

Paralleling Data Drives Provide Maximum Sustained Throughput

- Spindle skew and latency is minimized
- Each Channel has dedicated hardware; not shared
- Striping done in hardware to provide “real time” performance
- Data transfer is drive transfer rate times number of data drives

Error Correction Is Done “On The Fly”

- Done in dedicated hardware

Redundancy Factor is 20% or Less

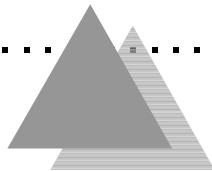
- Vs RAID 1 which is 100%

RAID 3 is Optimized for Large Data Transfers

- 1 megabyte+
- RAID 5 is optimal for many small requests of 512 bytes

Real-Time issues addressed:

- Drive drop-out problems
- Seek errors





Real Time Performance

Eliminating the Barriers to Real Time

TCAL

- ◆ **Thermal Calibration delays introduced by SCSI Disks are eliminated**

Error Correction Delays

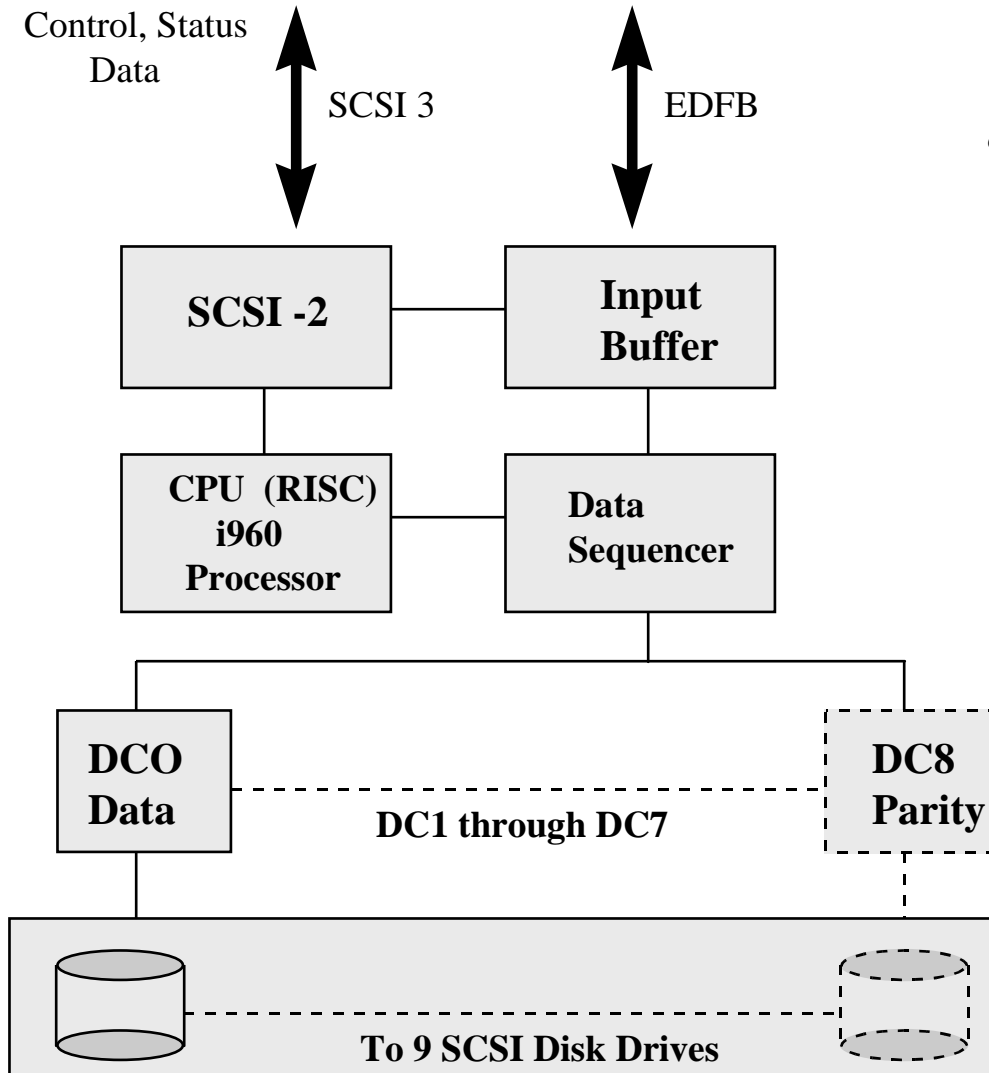
- ◆ **Error correction is performed “on the fly” by the controller**
 - Slow Disk Corrections are disabled
 - No performance hit when drives fail

Other Drive Anomalies

- ◆ **Headers, Track to Track and Cylinder seeks are masked**

Dual Bus Architecture

“Creating a Real-Time Data Path”



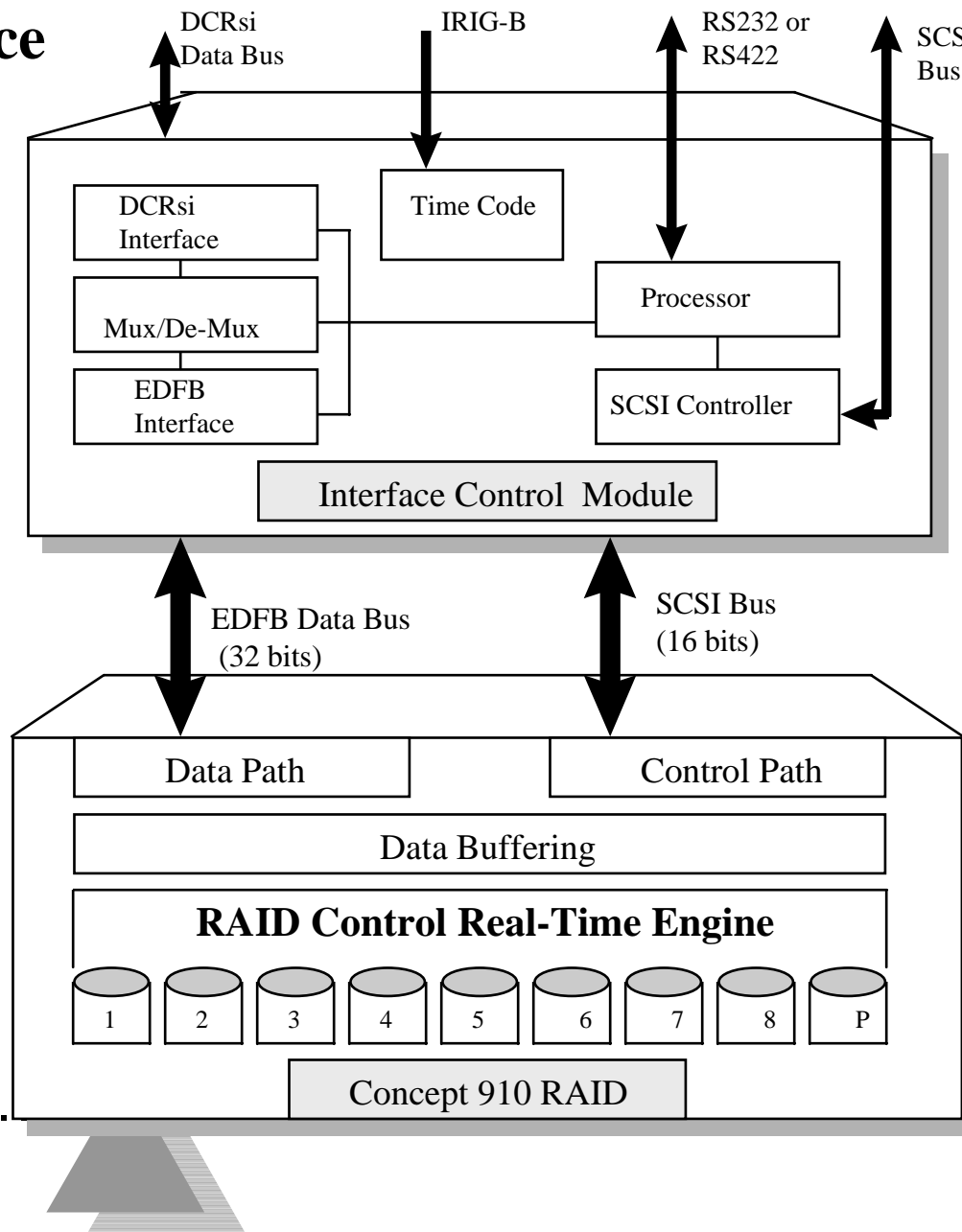
← Elastic store buffer

← High-performance RISC CPU
Real-time error handling

← Separate channel per disk

← High-performance, high-capacity, Ultra SCSI disks

Adding the Tape Interface





The DTE Product Series Concept

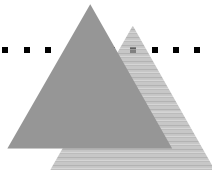
A product with proven RAID 3 Design and Capabilities

The DTE 140

- ◆ Based on the SC Concept 812 Real-Time Storage Array
- ◆ (5) or (10) 3.5 SCSI Disk Drives
- ◆ DCRsi Interface Control Module

The DTE 280

- ◆ Based on the SC Concept 910 Real-Time Storage Array
- ◆ (9) 3.5 SCSI Disk Drives
- ◆ DCRsi Interface Control Module





The DTE Product Series Offers:

- ◆ Emulation of Ampex DCRsi™ interfaces, control software and electrical compatibility
- ◆ Real-time data capture
- ◆ Random access to data
- ◆ Continuously variable rate buffer
- ◆ Enhanced data rates to 30 Mbytes/sec sustained and 37.5 Mbytes/sec burst
- ◆ Storage capacity to 72 Gbytes per chassis, expandable to 15 chassis per system
- ◆ Additional user fast and wide SCSI - 3 interface
- ◆ RAID data protection

Product Specifications

The DTE 140

◆ Transfer Rate

- ◆ Sustained 17 MB/sec
- ◆ Burst 20 MB/sec

◆ Formatted Storage Capacity

- ◆ (5) 4GB 3.5" SCSI 16 GB/chassis
- ◆ (5) 9GB 3.5" SCSI 36 GB/chassis
- ◆ (10) 9GB 3.5" SCSI 72 GB/chassis

◆ Redundant Features

- ◆ Redundant Parity Disk
- ◆ User Swappable Fan Modules

The DTE 280

- ◆ 30 Mbytes/sec
- ◆ 37.5 Mbytes/sec

- ◆ (9) 4GB 3.5" SCSI 32GB / chassis
- ◆ (9) 9GB 3.5" SCSI 72GB / chassis

- ◆ Redundant Parity Disk
- ◆ User Swappable Fan Modules



Product Specifications (cont.)

The DTE 140

- ◆ **RAID Interfaces**
 - ◆ Host: Fast & Wide SCSI - 3
 - ◆ Data: Differential Fast Bus

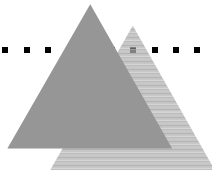
- ◆ **Dimensions:**
 - RAID only: 5.25"x19"x22"
- ◆ **Weight:** 35 LB.
- ◆ **Power Consumption**
 - ◆ 1 Lun = 302 W
 - ◆ 2 Lun = 442 W

The DTE 280

- ◆ Fast & Wide SCSI - 3
- ◆ Extended Differential Fast Bus

- ◆ RAID only: 7"x19"x16.5
- ◆ 75 LB.

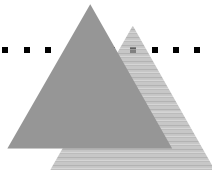
- ◆ 375 W





Interface Control Module

- ◆ **DCRsi™ Compatible Interfaces**
 - ◆ DCRsi™ Format Data Bus
 - ◆ RS232/RS422 Control Bus
 - ◆ IRIG Time Code Interface
 - ◆ Auxiliary Data Compatibility
- ◆ **Software Control**
 - ◆ User Log Compatibility
 - ◆ DCRsi™ Compatible
- ◆ **Additional Support Bus**
 - ◆ Fast & Wide Differential, 16 bit SCSI
- ◆ **Dimensions**
 - ◆ 19" x 3.5" x 22"
- ◆ **Weight**
 - ◆ Approximately 15 LB.
- ◆ **Power**
 - ◆ 150 W



DTE Product Series & Ampex DCRsi Product Comparison

| | Storage Concepts | | | Ampex | | Storage Concepts Ampex | |
|----------------------|--|-------------|--------------|-------------------------|-------------|------------------------|-------------|
| | DTE 140 | | | DCRsi | DCRsi | DTE 280 | DCRsi |
| | C812-SW-5-4 | C812-SW-5-9 | C812-SW-10-9 | 75 | 107 | C910-SW-9-9 | 240 |
| Bandwidth | 17.5 MB/sec | 17.5 MB/sec | 17.5 MB/sec | 9.3 MB/sec | 13.4 MB/sec | 35 MB/sec | 30 MB/sec |
| - Sustained | 20 MB/sec | 20 MB/sec | 20 MB/sec | 9.3 MB/sec | 20 MB/sec | 40 MB/sec | 37.5 MB/sec |
| - Burst | | | | | | | |
| Capacity | 16 Gbytes | 36 Gbytes | 72 Gbytes | 48 Gbytes | 48 Gbytes | 72 Gbytes | 48 Gbytes |
| Bit Error Rate | 10e-22 | 10e-22 | 10e-22 | 10e-9 | 10e-9 | 10e-22 | 10e-9 |
| Access To Data | Random Access ----- | | | Sequential Access ----- | | Random | Sequential |
| Network Connectivity | Multi-user via SCSI Attached Workstation ----- | | | None | None | See DTE 140 | None |
| IRIG-B Time Code | Available ----- | | | Available ----- | | Available | Available |
| Aux Data Channel | Available ----- | | | Available ----- | | Available | Available |
| Maintenance Costs | Very Low ----- | | | Very High ----- | | Very Low | Very High |



Actual RAID Applications

Data Acquisition

- ◆ Multi-Sensor Instrumentation
- ◆ Sonar Data Capture
- ◆ Wind Tunnel

Image Acquisition

- ◆ Satellite Image Download
- ◆ Digital / Thermal Camera Capture

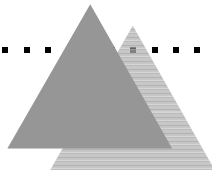
Data/Image Analysis

- ◆ Random Accessibility Allows Better Handling
and Sharing of Captured Data



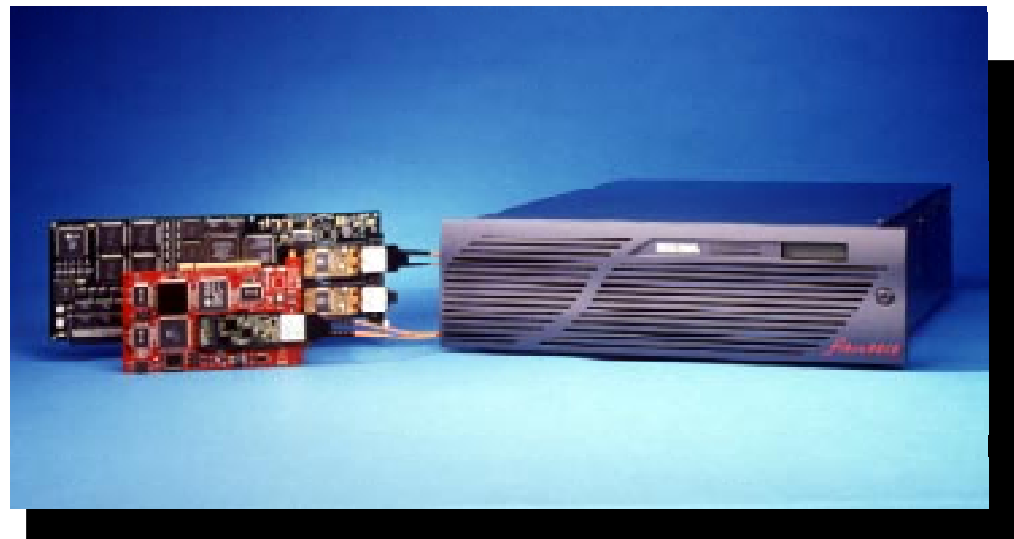
Where is RAID Going?

- Fibre Channel, IBM's SSA
- Faster, Faster, Faster -
100, 200, 400 Megabytes per Second
- More Fault Tolerance of Fan Failures, Temp,
S.M.A.R.T. (Self Monitoring and Reporting Technology)
- Hot Swappable, Universal Power Supply (47-440Hz)
110-220 VAC
- Enhanced Disk Driver Support
- Higher Density Drives - 9GB, 23 GB/SCSI Drive

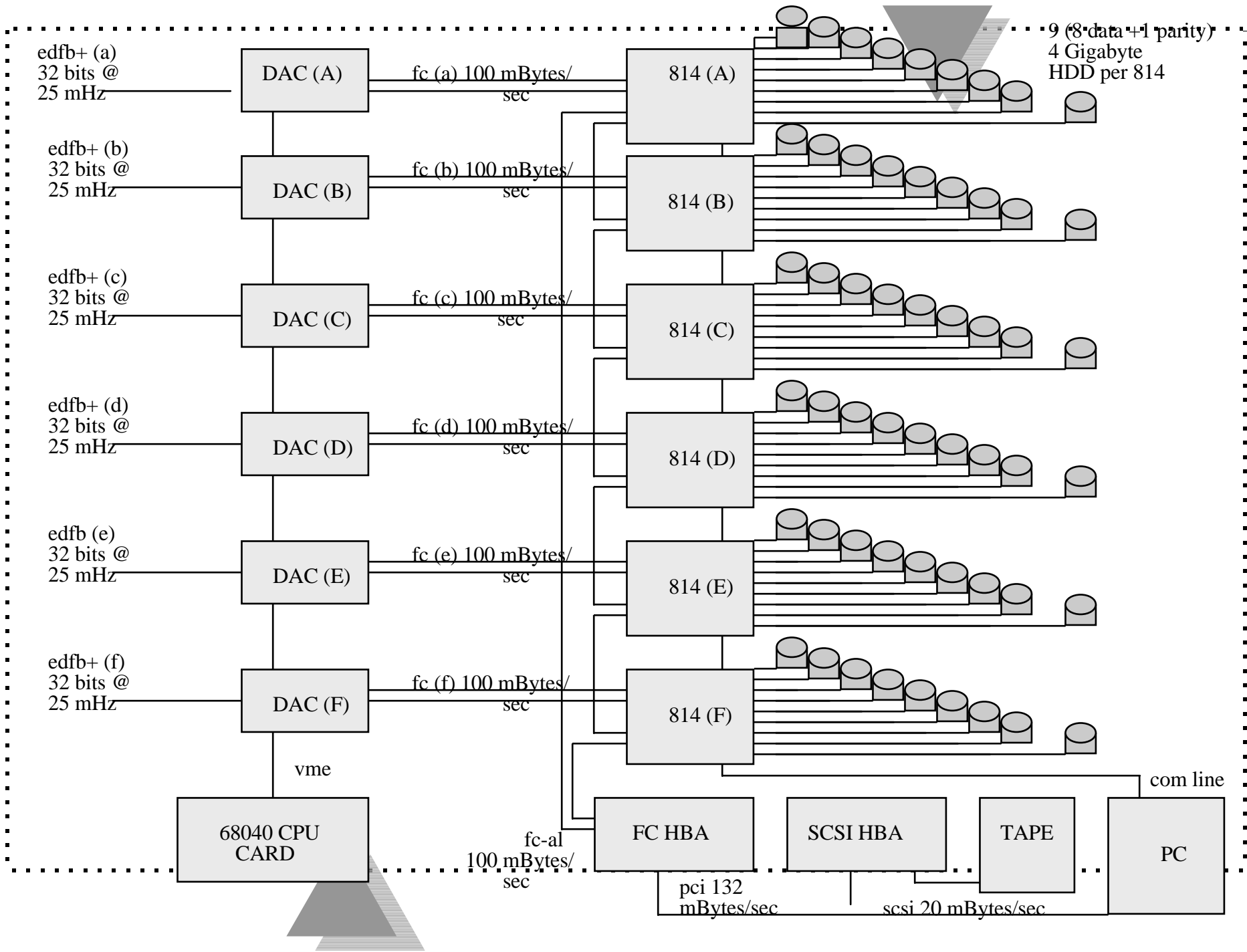


Concept 814 Family

- Real Time RAID
- Fibre Channel Interface
- 100 Mbytes/sec.
- 5.25" Rack Mount
- 72 GBytes/ Chassis
- 4+0, 4+1, 8+0, 8+1 Configurations
- RAID Protection
- SGI and PCI Host Support



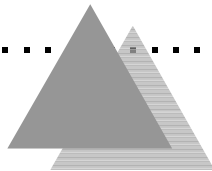
Concept 814 FCS



Summary

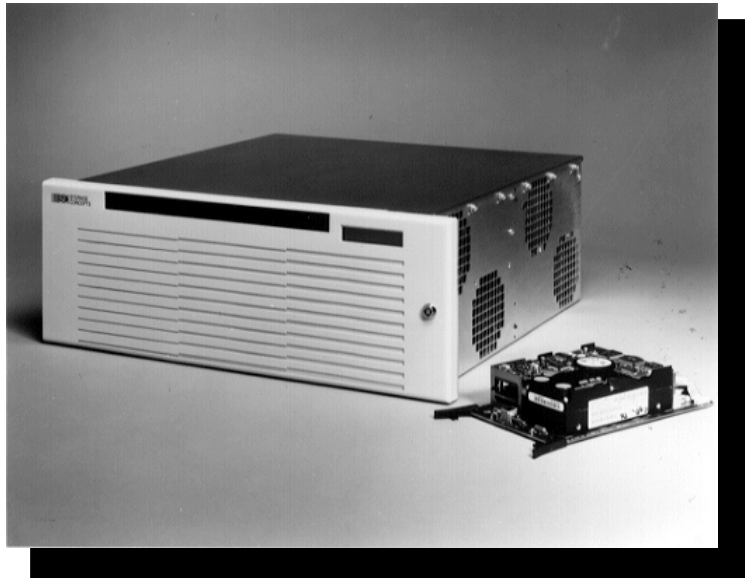


- ◆ RAID products, configured as Real-time devices, can participate in markets traditionally reserved for tape
- ◆ RAID can offer many connectivity advantages as well as random accessibility to the data set.
- ◆ RAID has superior error handling and lower maintenance costs compared to high speed tape
- ◆ Tape products will have advantages in length of data captured, due to the ability to swap tapes.
- ◆ RAID and tape can work together in applications which need a high speed random access buffer, and a deep data storage capability.





Concept 910 Family



Concept 910

- ◆ Real Time RAID
- ◆ Dual Bus Architecture
 - SCSI/EDFB (20/50 MB/Sec)
- ◆ 40 MB/sec Sustained
- ◆ RAID Redundancy
 - Redundant Disk Drives

Concept 812 Family



Concept 812

- ◆ Real Time RAID
- ◆ Multiple Interfaces
 - SCSI/DFB (20/25 MB/Sec)
 - HIB/DFB (0.15/25 MB/Sec)
- ◆ 19 MB/Sec Sustained
- ◆ (2) LUNs per Chassis
- ◆ Rackmount