LSV 2
ONBOARD DATA ACQUISITION SYSTEM (ODAS)

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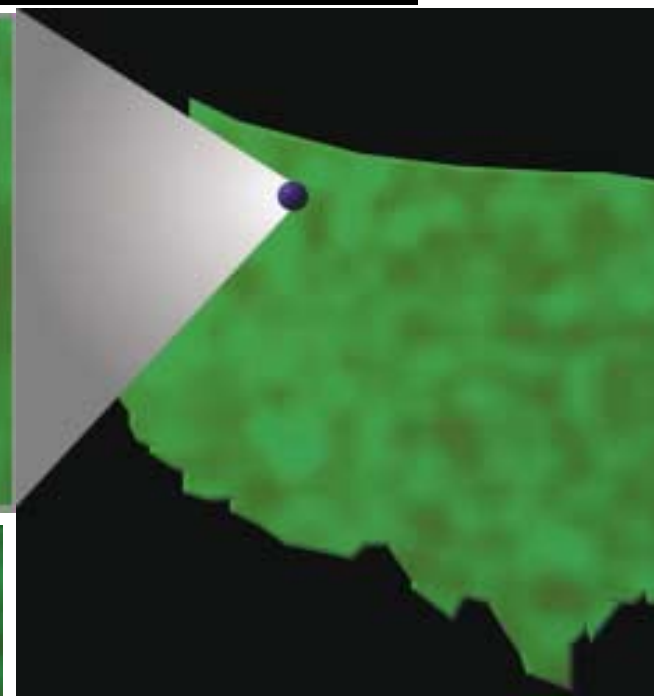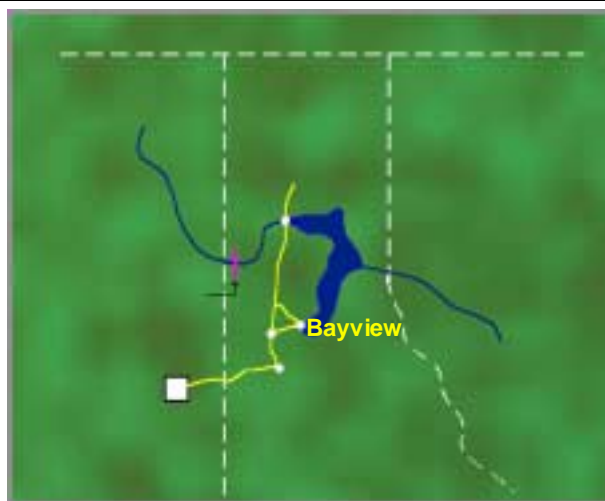
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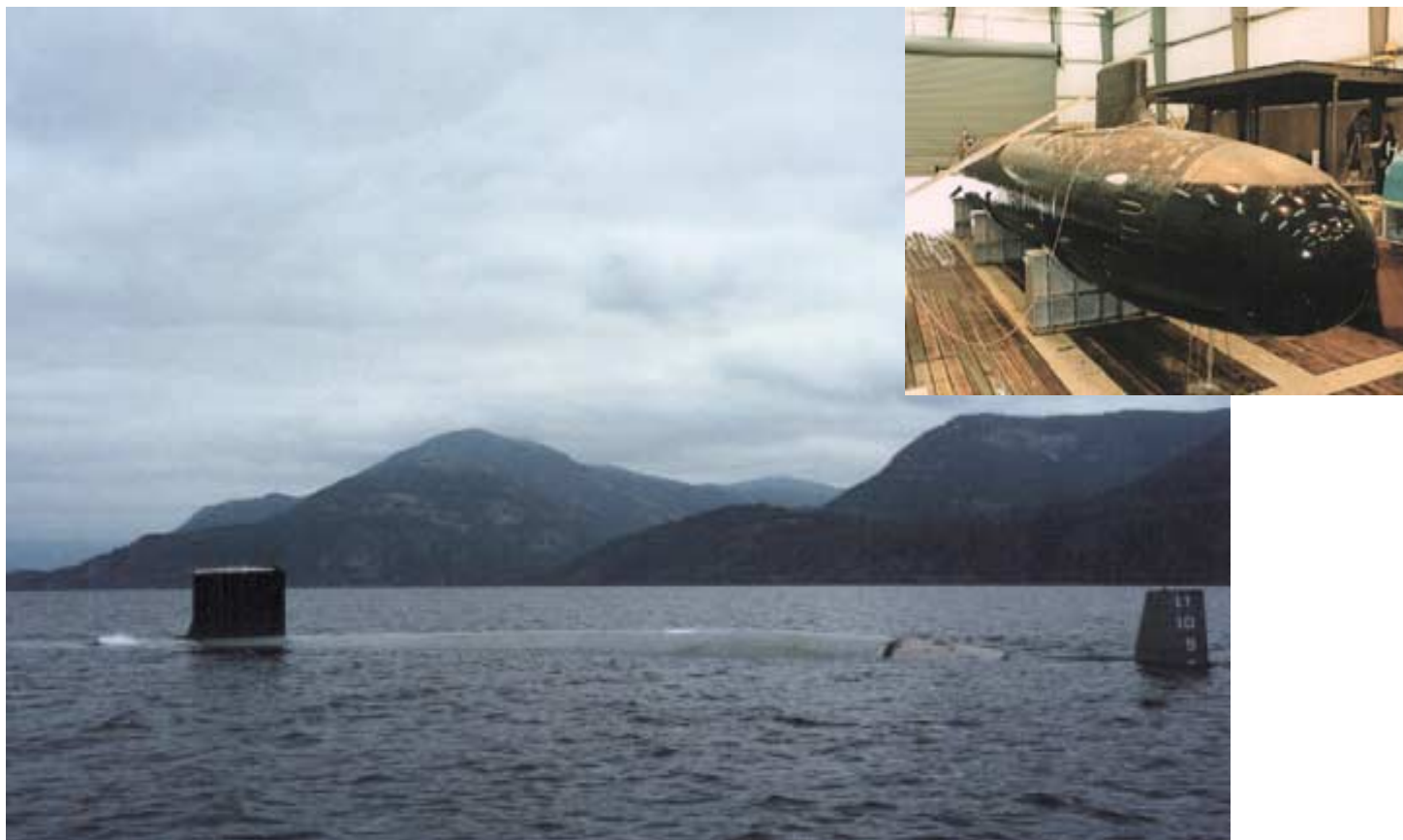
Acoustic Research Detachment - Bayview, Idaho

- 1000' deep, quiet lake

- Technologies supported include:
  - Advanced submarine propulsor designs
  - Submarine sonar dome designs
  - Structural acoustics
  - Target strength
  - Hull treatments
  - Active noise control
  - Wide aperture arrays
  - Towed arrays

Bayview

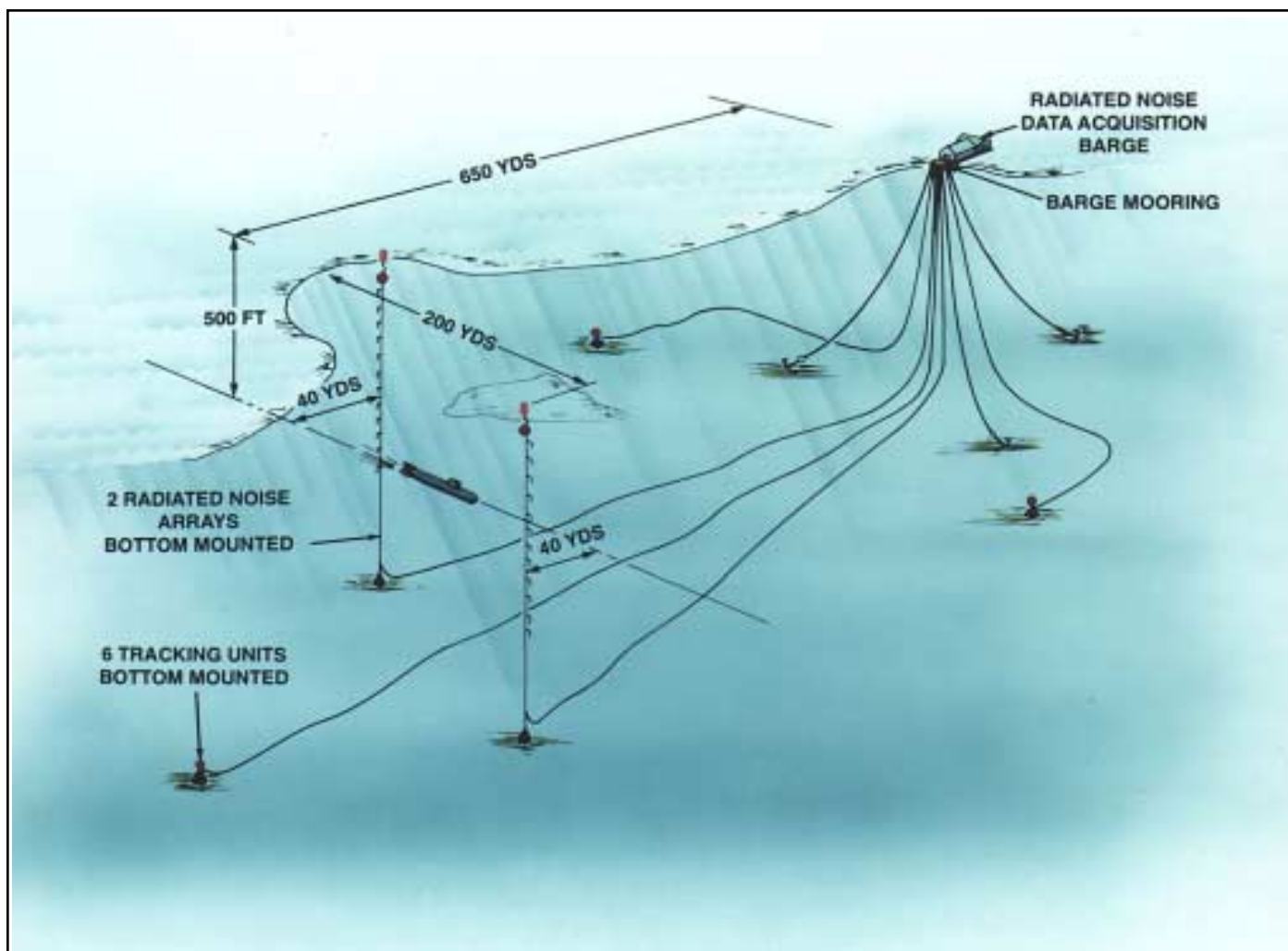03 Oct 2000

Large Scale Vehicle (LSV) KOKANEE

Surface Warfare Center Division

RADIATED NOISE
DATA ACQUISITION
BARGE

BARGE MOORING

650 YDS

500 FT

200 YDS

40 YDS

2 RADIATED NOISE
ARRAYS
BOTTOM MOUNTED

40 YDS

6 TRACKING UNITS
BOTTOM MOUNTED

System Overview

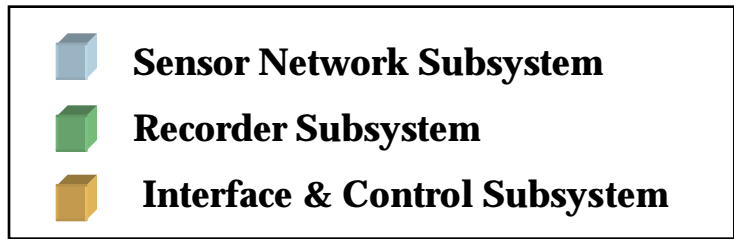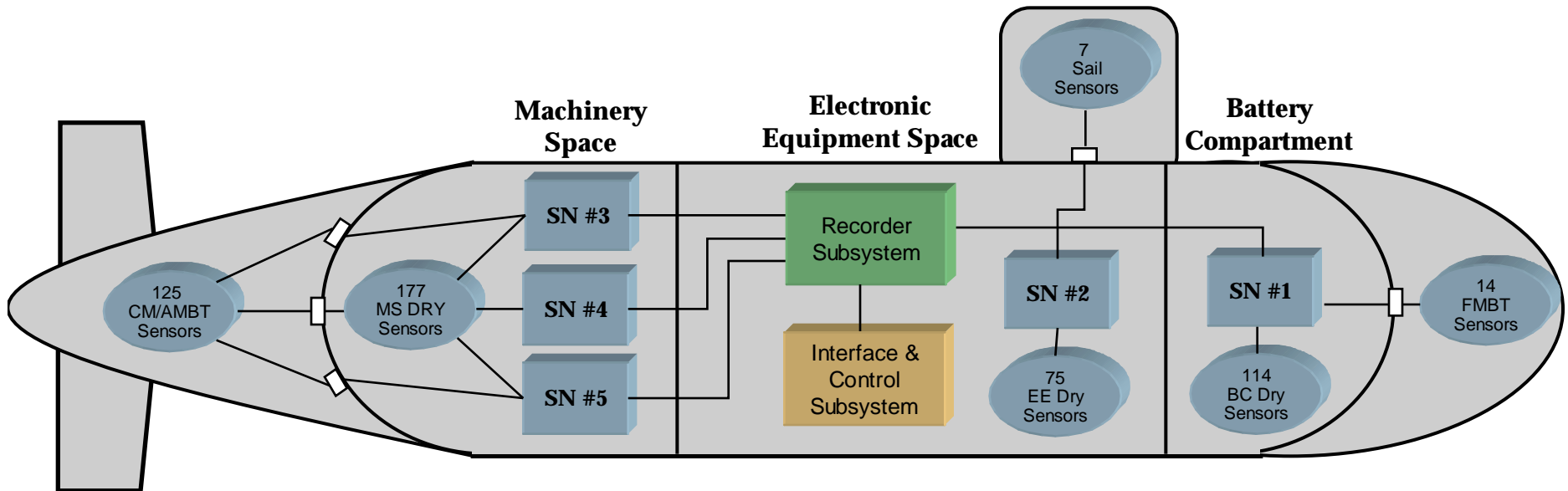☐ **Autonomous hydro-dynamic and acoustic data recording system onboard Large Scale Vehicle 2 - CUTTHROAT**

- **512 channel analog sensor inputs, analog signal conditioning, A-to-D conversion at variable sample rates up to Fs = 196.6 KS/sec**

- **80 MB/sec data rate over Asynchronous Transfer Mode (ATM) sensor network (at delivery)**

- **80+ MB/sec record rate via COTS Fibre Channel RAID system**

ODAS System Laydown

Machinery Space

Electronic Equipment Space

Battery Compartment

7 Sail Sensors

SN #3

SN #4

SN #5

125 CM/AMBT Sensors

177 MS DRY Sensors

Recorder Subsystem

Interface & Control Subsystem

SN #2

75 EE Dry Sensors

SN #1

114 BC Dry Sensors

14 FMBT Sensors

Sensor Network Subsystem

Recorder Subsystem

Interface & Control Subsystem

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ODAS System Diagram

Channels 1-128

Channels 129-256

Channels 257-384

Channels 385-512

Shaft Telem Dynamometer Propulsor

128 Channel Sensor Nodes

Cal   Clock   ATM

Timing, Cal, & Data Network

ATM-SONET 622 Mbit/s OC-12 links

Fiber Channel

Interface Chassis

Fore ASX-1000 ATM Switch

SGI Origin 2000 Network Server

SGI Origin FibreVault RAID

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Design Approach

☐ **Leverage recent advances in high-speed computers and interfaces for instrumentation recording**

☐ **Modular design permits easy expansion throughout system**

- **System expandable to 1536 channels**
- **300 MB/sec. bandwidth**

☐ **COTS and Open Architecture maximizes supportability by on-site personnel**

- **Single Vendor Configuration Management**
- **Single SW Development Environment**

☐ **Lowest Risk:**

- **Network Server eliminated potential board-level integration problems**
  - » **Server is a pre-integrated high-speed data handling system with hardware and software support from single vendor**
- **System elements communicate through standard vendor supported interfaces**
  - » **ATM, Fibre Channel, Ethernet**

☐ **Lowest Cost:**

- **Identical development and target systems reduce software cost**
  - » **Standard development environment**
  - » **Short test cycle**
- **Server eliminates component integration costs**
- **Upgrades can utilize future hardware advances**

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Sensor Network

□ **Multi-function Signal Conditioning on 6U VME Board**

- 16 channels/board
- Power & calibration distribution to various acoustic & hydrodynamic sensors (CVLD, CCLD, & differential or single ended)
- Gain & Filtering (12 x 5 dB, pre-whitening & anti-alias)

□ **Analog-to-ATM Conversion on Single 6U VME Board**

- Planning Systems, Inc. AtA-16b-32AD-V1
- 32 channels/board, OC-3c output
- 5 operator selected sample rates per channel, Max. Fs = 196,608 Sample/sec
- Converts analog inputs to digital ATM AAL5 Protocol Data Units (PDU's)
- 53 Byte cells optically telemetered via OC-3c SONET to ATM switch

□ **ATM Switch**

- Fore Systems ASX-1000
- Switches OC-3c inputs from Analog-to-ATM boards to Recorder subsystem via OC-12c network modules

Recorder Subsystem
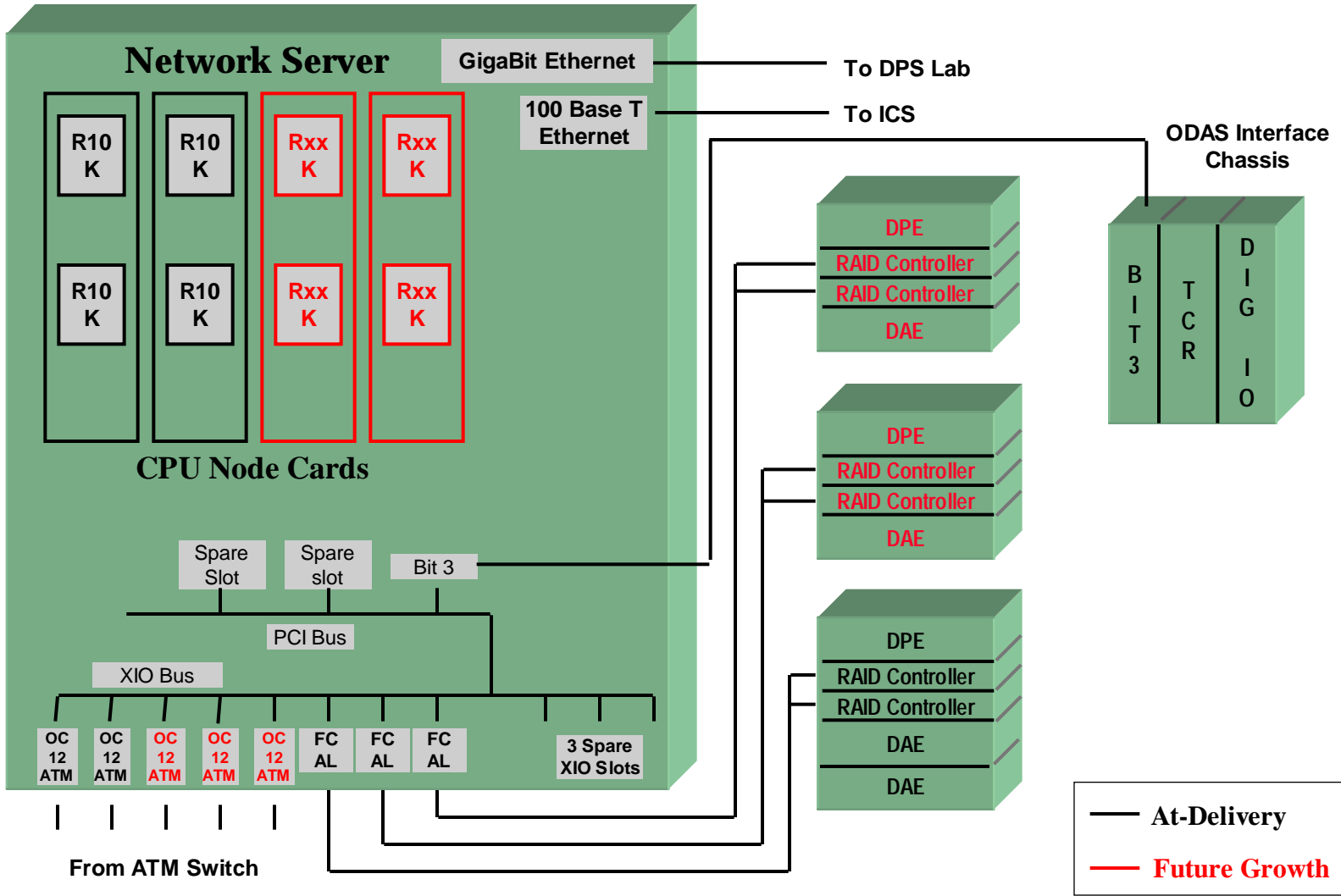
□ **COTS Recording Hardware**

- **Network Server (SGI Origin 2000)**
- **Fiber Channel RAID (SGI Origin FibreVault RAID)**

□ **Standards Based High-Speed Interfaces**

- **Asynchronous Transfer Mode (ATM) OC-3c, OC-12c SONET**
- **Dual Fibre Channel arbitrated loop**
- **100baseTx & 1000baseTx Ethernet**

□ **COTS Data Archival/System Backup Hardware**

- **Dual DLT 7000 drives**

Recorder Block Diagram

Network Server

GigaBit Ethernet → To DPS Lab

100 Base T Ethernet → To ICS

ODAS Interface Chassis

R10 K R10 K Rxx K Rxx K

R10 K R10 K Rxx K Rxx K

CPU Node Cards

DPE
RAID Controller
RAID Controller
DAE

B I T 3 | T C R | D I G I O

DPE
RAID Controller
RAID Controller
DAE

Spare Slot   Spare slot   Bit 3

PCI Bus

XIO Bus

DPE
RAID Controller
RAID Controller
DAE
DAE

OC 12 ATM | OC 12 ATM | OC 12 ATM | OC 12 ATM | OC 12 ATM | FC AL | FC AL | FC AL | 3 Spare XIO Slots

From ATM Switch

— **At-Delivery**
— **Future Growth**

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Recorder HW Implementation

□ **Rack Mountable Origin 2000 Network Server**

- **System at Delivery (80 Mbytes/sec)**
    - » **4 R10K processors (2 per node card)**
    - » **2 XIO OC-12 ATM card**
    - » **1 XIO Dual-AL Fiber Channel Card**
    - » **1 PCI card for IRIG Time**

- **Full System (300 Mbytes/sec)**
    - » **8 processors (4 R10K + 4 R??K)**
    - » **6 XIO 4-port OC-3 or 2 XIO OC-48 ATM card**
    - » **3 XIO Dual-AL Fiber Channel cards**
    - » **1 PCI card for IRIG Time**
    - » **2.56 GB/sec sustained system bus throughput**

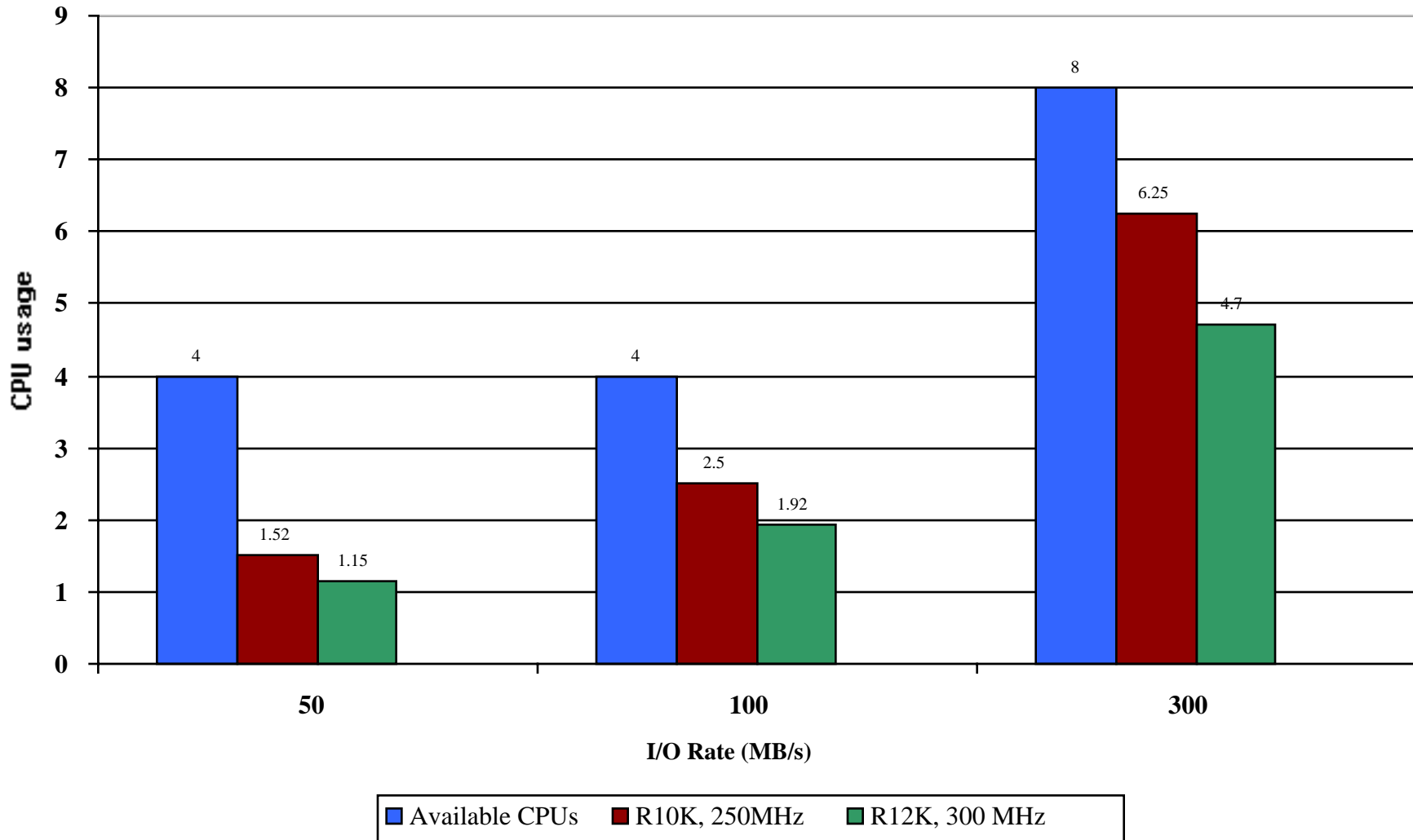# Recorder HW Implementation

☐ **Silicon Graphics Fiber Channel RAID System**

- **RAID Level 3 implementation**
- **Dual Arbitrated Loop interface with server**
- **System at delivery (80 MBytes/sec)**
  - » **1 Disk Processor Enclosure (DPE)**
  - » **2 Disk Array Enclosures (DAE)**
  - » **2 RAID Controllers (in the DPE)**
  - » **100+ MB/sec throughput, 432 GB capacity**
- **Full-Up System (300 MBytes/sec)**
  - » **3 Disk Processor Enclosures (DPE)**
  - » **4 Disk Array Enclosures (DAE)**
  - » **6 RAID Controllers (in the DPE's)**
  - » **300 MB/sec. throughput, 2.0 TB+ capacity**

CPU Utilization

RAID Throughput

RAID Throughput % Utilized

I/O Rate (MB/sec)

■ At Delivery   □ Future Growth