

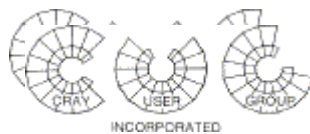


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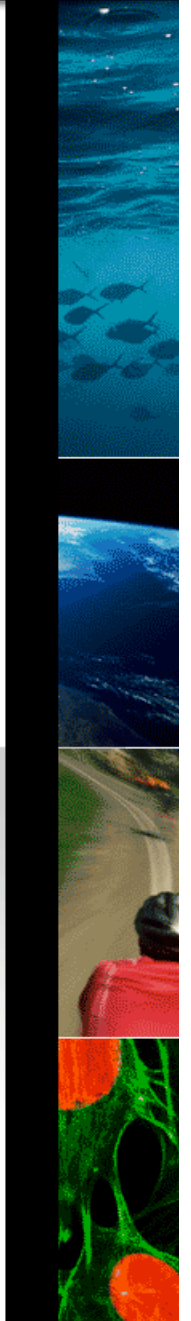
Active Manager Tutorial

“Tips and Tricks”

Amar Shan, Ron Westfall, Dave Strenski

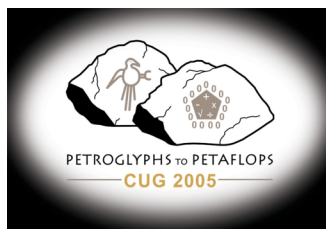


CUG 2005

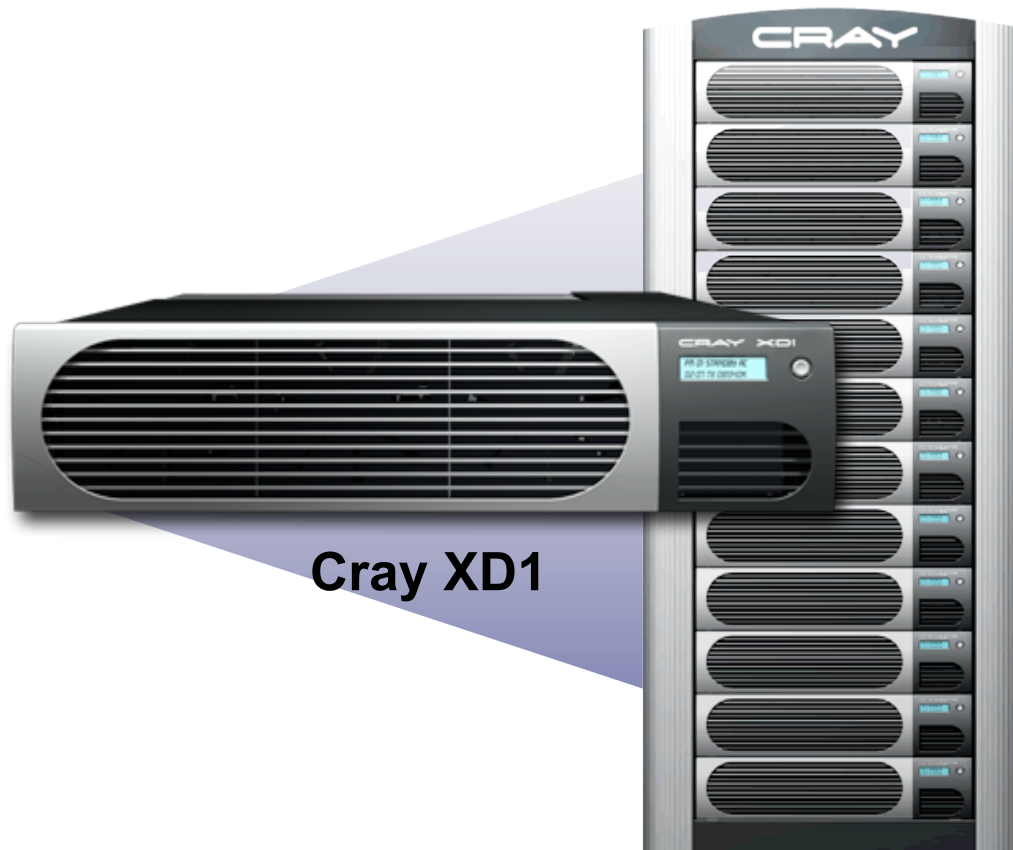


Agenda

- Active Manager Rationale – “why”?
- “Tips and Tricks”
 - Effective Use of Partitions
 - Customizing Alarm Handling
 - Using XML
 - Fabric Error Detection and Correction
 - A few other smaller features ...



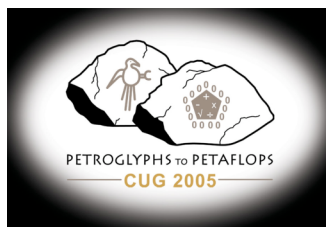
The Cray XD1



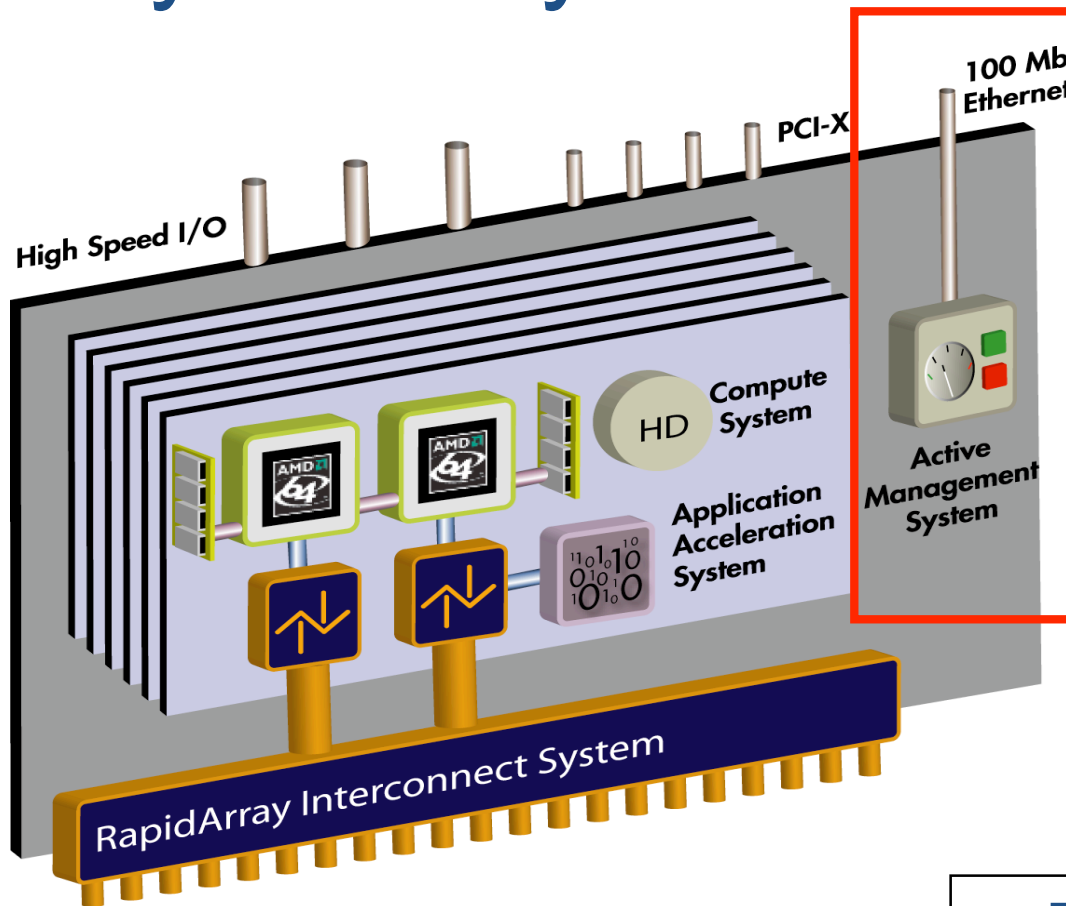
Cray XD1

- **Built for price/performance**
 - Interconnect bandwidth/latency
 - System-wide process synchronization
 - Application Acceleration FPGAs
- **Standards-based**
 - 32/64-bit X86, Linux, MPI
- **High resiliency**
 - **Self-configuring, self-monitoring, self-healing**
- **Single system command & control**
 - Intuitive, tightly integrated management software

Purpose-built and optimized for high performance workloads



Cray XD1 System Architecture



Compute

- 12 AMD Opteron 32/64 bit, x86 processors

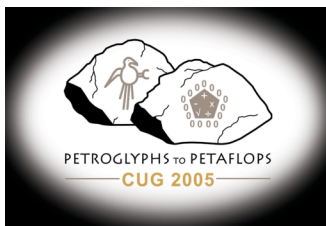
RapidArray Interconnect

- 12 communications processors
- 1 Tb/s switch fabric

Active Management

- **Dedicated processor**
- ## Application Acceleration
- 6 co-processors

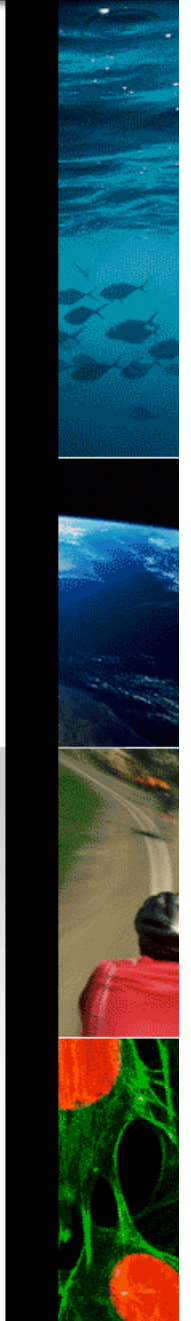
Processors directly connected via integrated switch fabric



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Rationale for Active Manager



What Matters to Users

IDC Cluster User Study – 2004

“Top technical problems facing organizations using clusters”

- Inadequate throughput capacity (31%)
- Difficulties in scaling systems and capacity fast enough to meet user needs (31%)
- Costly maintenance and support (22%)

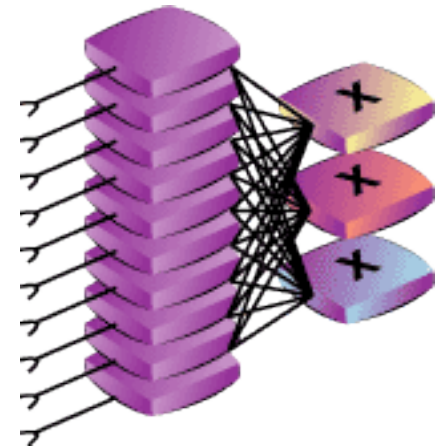
“The biggest challenge to implementing clusters is systems management (43%)”

“Users are primarily concerned about the usability, manageability and long term operation of installed cluster systems”

“Clusters of 15 to 20 machines were the norm....now you typically have clusters of 50 to 100 machines, up to over 1000” (Donald Becker, Beowulf founder, 2004)

“One cluster user described the management problem this way: All the components work, they just don’t always work together”

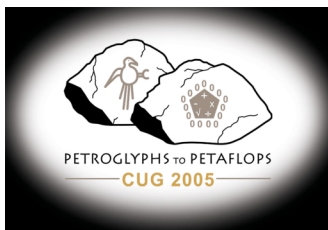
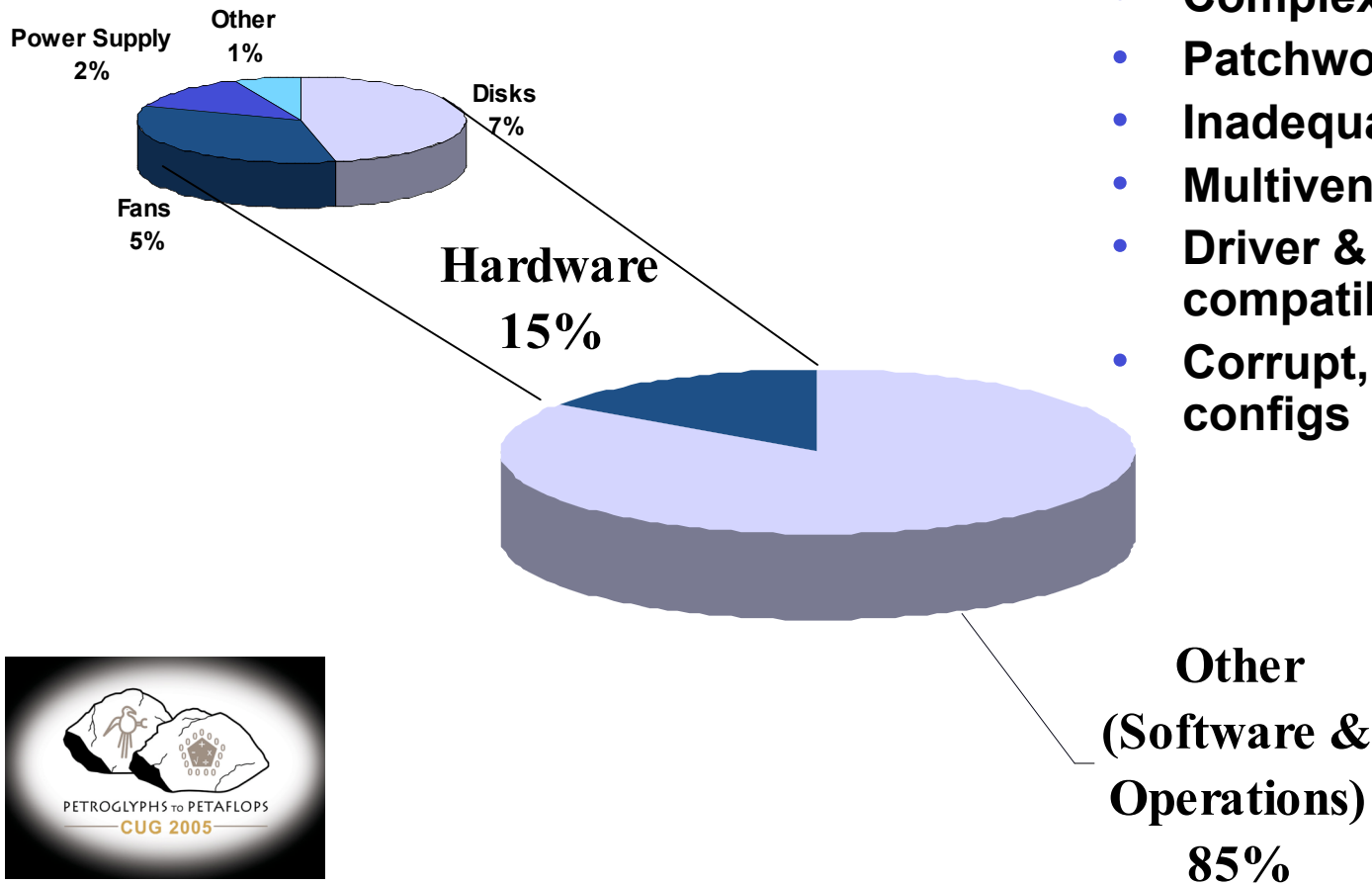
(IDC 2002)



It is crucial to address the management issues

Causes of System Outages

- **Most problems occur during:**
 - Upgrades,
 - Problem diagnosis,
 - Configuration
- **Complex systems**
- **Patchwork software**
- **Inadequate tools**
- **Multivendor h/w, s/w**
- **Driver & software compatibility**
- **Corrupt, stale software & configs**



Source: UC Berkeley

Active Manager System



CLI and Web Access



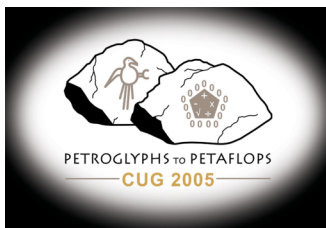
Active Management Software

Usability

- Single System Command and Control

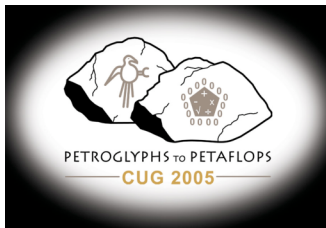
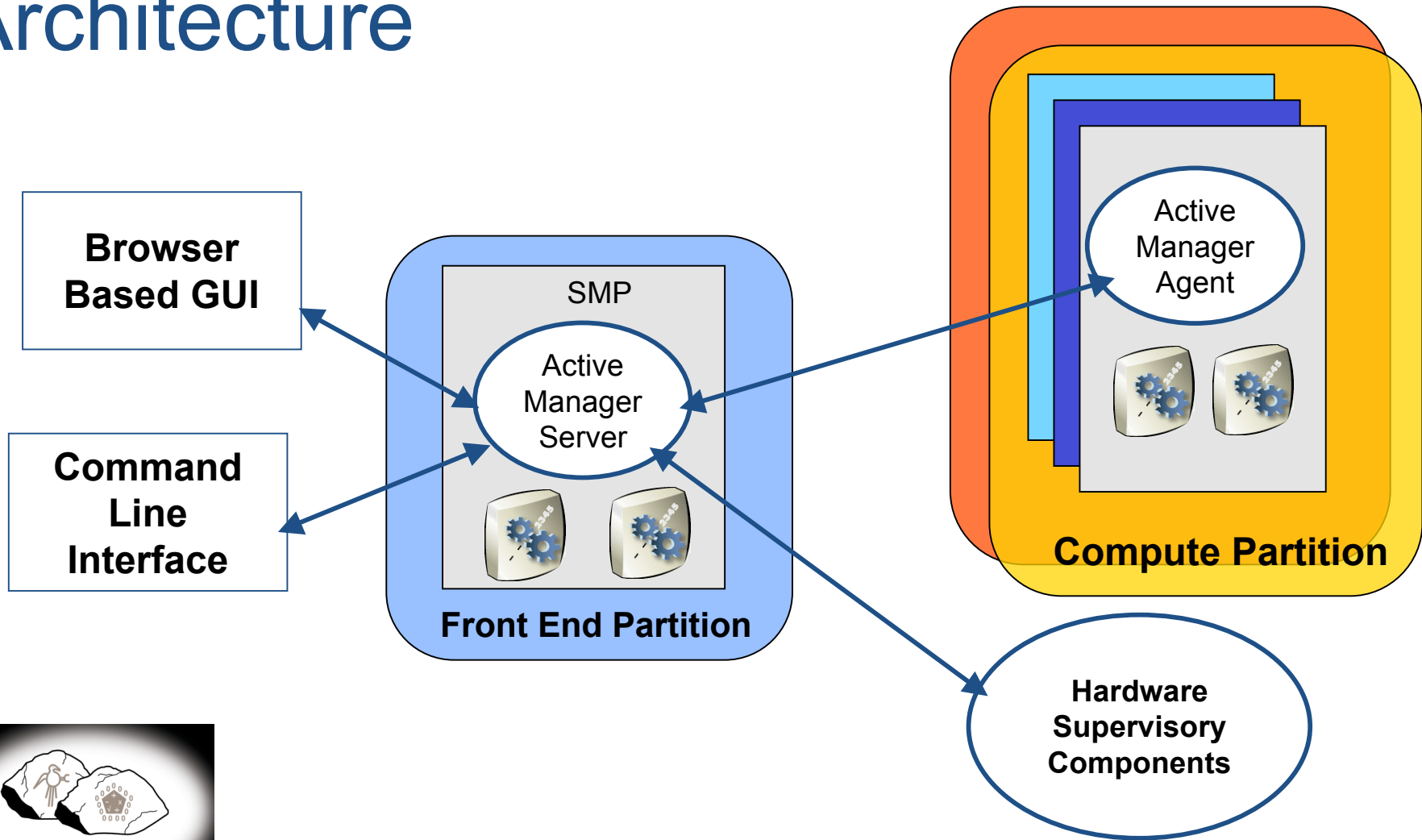
Resiliency

- Dedicated management processors, real-time OS and communications fabric.
- Proactive background diagnostics with self-healing.



Automated management for exceptional reliability, availability, serviceability

Active Manager Software Architecture



Active Manager GUI: SysAdmin Portal

CRAY Active Manager LOGOUT HELP

CRAY

Welcome to Active Manager

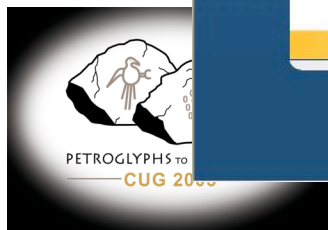
The active management subsystem delivers outstanding usability and reliability through single system command and control and self healing capabilities.

Single System Command and Control
The active management system combines partitioning, a single system view, and intelligent self configuring features to allow administrators to manage up to 12,000 processors as one or more logical computers.

Self Healing
The Cray XD1 provides extensive fault detection, isolation, and prediction capabilities, coupled with automated proactive and reactive self healing intelligence.

powered by **CRAY**

GUI provides quick access to status info and system functions



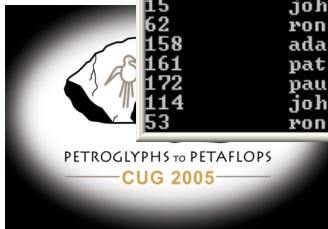
Active Manager Command Line Interface

```

Adam Lorant@Adam ~
$ lspart
Name                Login JobExec State SMPs Load JobsR JobsQ AlarmCnt
-----
Ab_Initio_Project   No    Yes    open  10   59.46 13    20
Chemistry            Yes   Yes    open  33   50.26 17     0    1
Diagnostic-Staging  No    No     N/A   3    0.84  0     0
File-Server         No    No     N/A   2    0.91  0     0
Front_End_Partition Yes   No     open  4    1.1  0     0
Physics             No    Yes    open  8    58.2  5     44

Adam Lorant@Adam ~
$ qstat
Job Id   Job Name      Owner      CPU    State   Partition
-----
157      amar_job.sh   amar       1057   running Chemistry
63       paul_job.sh   paul        0      queued  Physics
143      pat_job.sh    pat        1802   running Ab_Initio_Project
94       adam_job.sh   adam        0      queued  Physics
67       adam_job.sh   adam        0      queued  Physics
136      paul_job.sh   paul       1938   running Chemistry
125      pat_job.sh    pat       2405   running Ab_Initio_Project
86       steve_job.sh  steve     19504  running Chemistry
167      adam_job.sh   adam       331    running Ab_Initio_Project
145      paul_job.sh   paul        0      queued  Physics
96       john_job.sh   john        0      queued  Physics
95       steve_job.sh  steve       0      queued  Ab_Initio_Project
69       john_job.sh   john        0      queued  Physics
126      ron_job.sh    ron         0      queued  Physics
43       pat_job.sh    pat         0      queued  Physics
76       adam_job.sh   adam        0      queued  Ab_Initio_Project
144      ron_job.sh    ron         0      queued  Physics
79       pat_job.sh    pat         0      queued  Ab_Initio_Project
152      pat_job.sh    pat         0      queued  Physics
155      auji_job.sh   auji        0      queued  Ab_Initio_Project
44       ron_job.sh    ron         0      queued  Physics
117      paul_job.sh   paul       2498   running Chemistry
90       paul_job.sh   paul        0      queued  Physics
132      steve_job.sh  steve       0      queued  Ab_Initio.
88       pat_job.sh    pat         0      queued  Physics
149      adam_job.sh   adam       1365   running Ab_Initio.
58       adam_job.sh   adam        0      queued  Physics
36       paul_job.sh   paul        0      queued  Ab_Initio.
59       steve_job.sh  steve       0      queued  Ab_Initio.
16       pat_job.sh    pat         0      queued  Ab_Initio.
15       john_job.sh   john      12375  running Physics
62       ron_job.sh    ron       2797   running Chemistry
158      adam_job.sh   adam        0      queued  Ab_Initio_Project
161      pat_job.sh    pat        483   running Ab_Initio_Project
172      paul_job.sh   paul       205   running Ab_Initio_Project
114      john_job.sh   john        0      queued  Physics
53       ron_job.sh    ron         0      queued  Physics
    
```

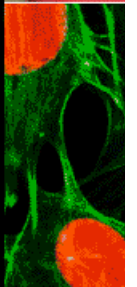
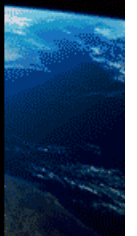
Administrators can access Active Manager software and Linux through the CLI



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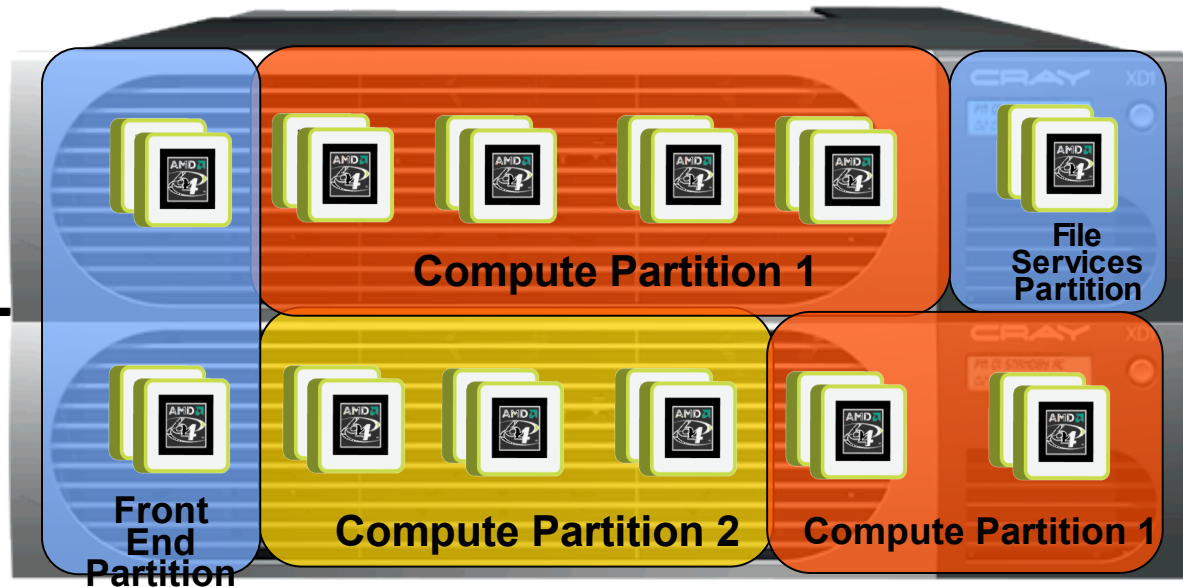
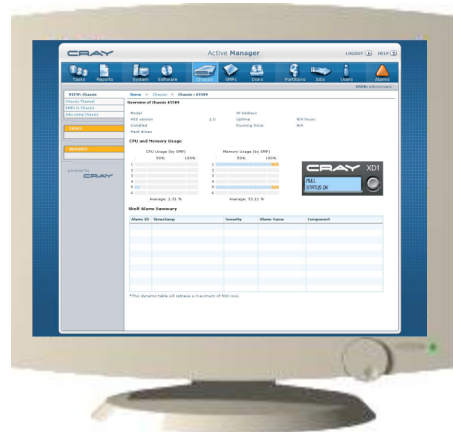
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Partitions



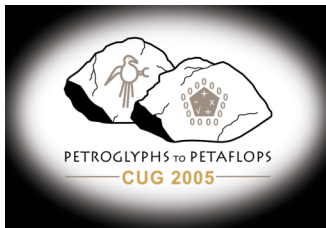
System Partitions

Users & Administrators



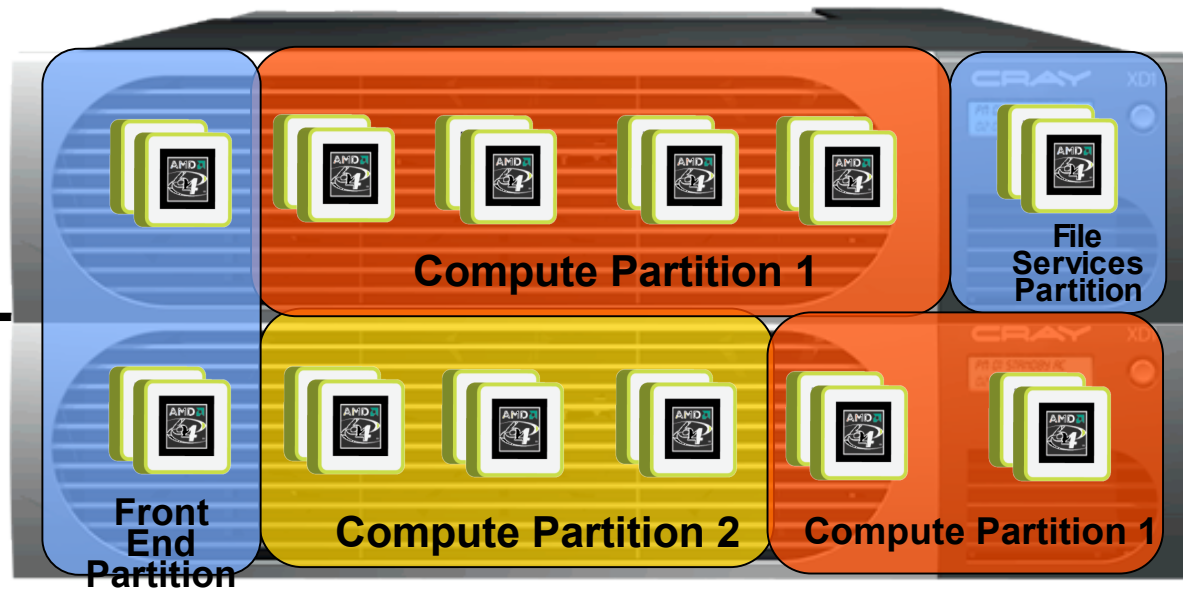
- Front End Partition
- Compute Partition
- Service Partition
 - File Services
 - Database
 - DNS

Manage multiple processors and copies of Linux as single, unified system



Automated Management

Users & Administrators



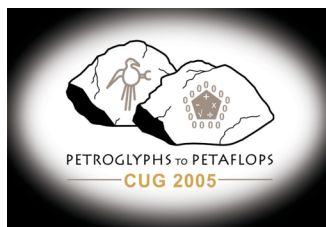
- Partition management
- Linux configuration
- Hardware monitoring
- Software upgrades
- File system management
- Data backups
- Network configuration
- Accounting & user management
- Security
- Performance analysis
- Resource & queue management



Single System Command and Control

Linux Management using Partitions

- Linux RPM Install/Deployment/Audit
- Third Party Software
- Patches
- Disk Storage Management
- File System Management
- NFS Mount Administration
- Network Configuration (IP Addresses, DNS)
- User Authentication (LDAP, NIS)
- Workload Management Queue configuration



**System Software Automatically Installed and
Configured Consistently**

Active Manager System/Partition View

CRAY Active Manager LOGOUT ▾ HELP ?

Tasks Reports System Software Chassis SMPs Disks Partitions Jobs Users Alarms

VIEW: Partitions Home > Partitions

Select partition to work with

Partitions in this System

Tasks: Create Partition, Move SMPs

Reports

powered by **CRAY**

USER: AdminUser1

Action on Selected Items:

Name	Login	Jobs	Status	SMPs	Load(1)	Load(5)	Load(15)	Jobs Running	Jobs Queued	Alarm
admin	Yes	No	open	1	0.97	1.12	1.02	0	0	0
cancun	Yes	No	open	0	0.00	0.00	0.00	0	0	0
crPart	Yes	Yes	open	0	0.00	0.00	0.00	0	0	0
crPart2	Yes	Yes	closed	0	0.00	0.00	0.00	0	0	0
czcomp1	No	Yes	open	0	0.00	0.00	0.00	0	0	0
igPart	Yes	No	closed	0	0.00	0.00	0.00	0	0	0
ira	Yes	No	open	0	0.00	0.00	0.00	0	0	0
iraPart	Yes	No	open	0	0.00	0.00	0.00	0	0	0
loginPart	No	Yes	closed	0	0.00	0.00	0.00	0	0	0
pexecution-1a	No	Yes	open	1	0.00	0.01	0.02	0	4	0
pexecution-1b	No	Yes	open	0	0.00	0.00	0.00	0	0	0
plogin-1a	Yes	No	open	0	0.00	0.00	0.00	0	0	0
sfuHPC	Yes	Yes	closed	0	0.00	0.00	0.00	0	0	0

SMP Allocation Summary

Total	6 SMPs	Partitioned	2 SMPs	Unallocated	4 SMPs
	12 Processors		4 Processors		8 Processors

Managing virtual computers instead of individual processors



Active Manager Task Wizard

CRAY Active Manager

LOGOUT HELP

Tasks Reports System Software Chassis SMPs Disks Partitions Jobs Users Alarms

USER: AdminUser1

VIEW: Tasks

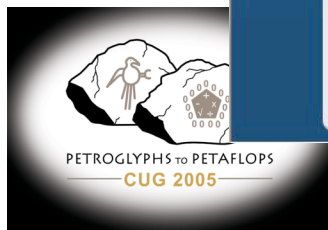
Home > Tasks

Select a Task to Execute

Task	Category	Description
Submit Job	Job Management	Submit a job to the job management system for execution.
Create Partition	Partition	Create and configure a new partition.
Move SMPs	Partition	Move one or more SMPs from one partition into another.
Manage Partition Access	User	Manage Partition Access by Group

powered by CRAY

Simplifies complex tasks to increase efficiency and reduce downtime



Active Manager Job Scheduler

CRAY Active Manager LOGOUT HELP

Tasks Reports System Software Chassis SMPs Disks Partitions **Jobs** Users Alarms

USER: AdminUser1

VIEW: Jobs Home > Jobs

Jobs in System
Completed Jobs

TASKS
Submit Job

REPORTS

powered by **CRAY**

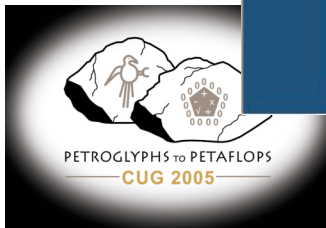
Filter By: All Partitions All Active States All Owners Completed Within: Past 24 Hours Filter

Action on Selected Items: Cancel Hold Release Suspend Resume

Job ID	Name	Owner	Procs	Partition	State	Time Processed	Time Submitted
180	myjob.script	AdminUse		pexecution-1a	queued	not processing	2004-04-26 14:32:29
178	myjob.script	AdminUse		pexecution-1a	queued	not processing	2004-04-26 14:31:04
174	myjob.script	AdminUse		pexecution-1a	waiting	not processing	2004-04-26 14:23:35
173	myjob.script	AdminUse		pexecution-1a	queued	not processing	2004-04-26 14:21:44
172	myjob.script	AdminUse		pexecution-1a	queued	not processing	2004-04-26 14:20:33

*This dynamic table will retrieve a maximum of 500 rows.

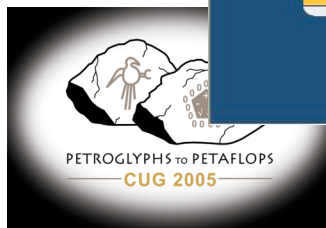
Job management is integrated with self-healing features to increase job completion rates



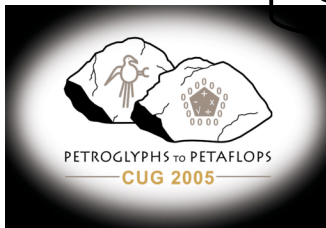
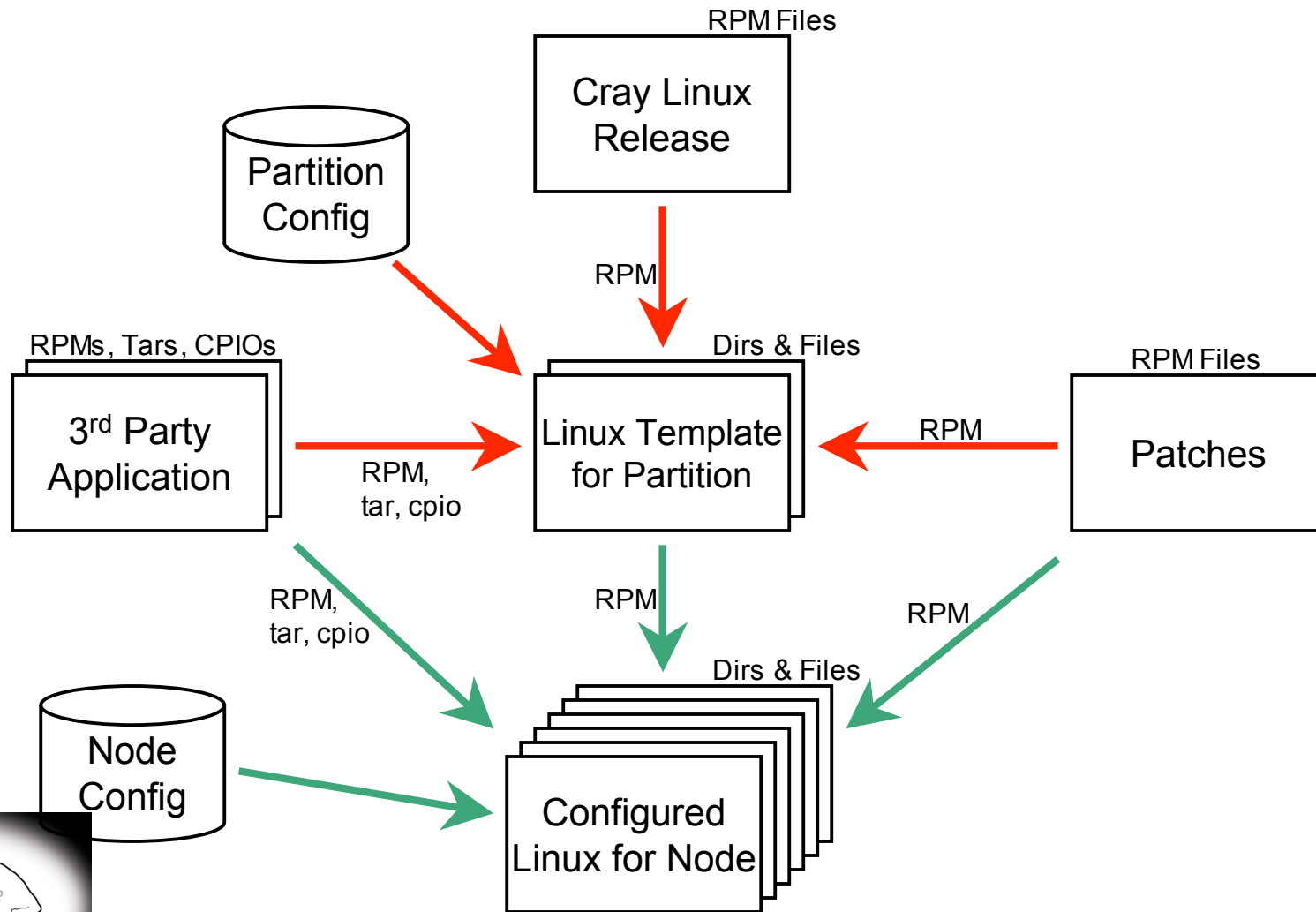
Active Manager User Portal



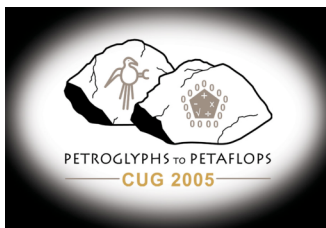
Intuitive user access for job submission and status lets users focus on applications, not computing



Software Deployment



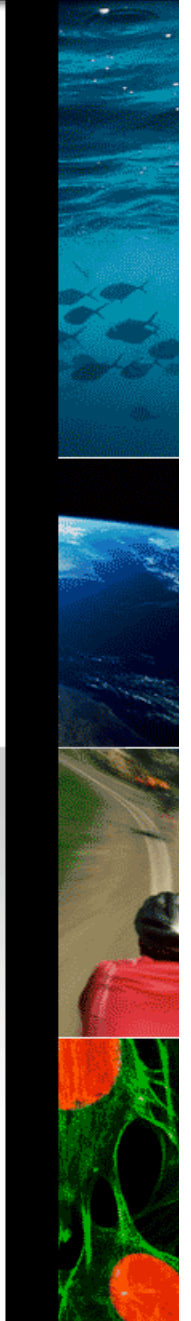
Partition Demo ...



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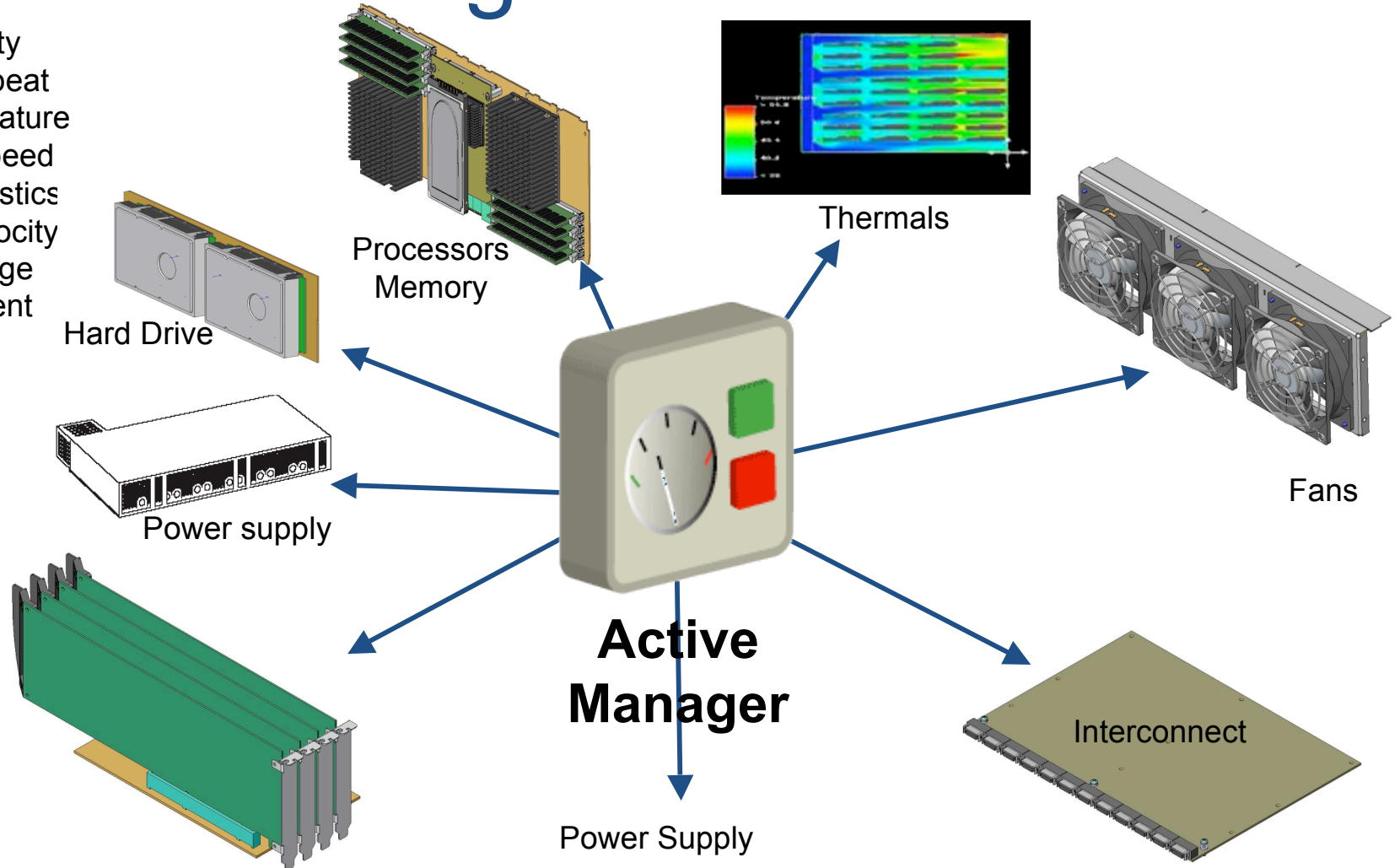
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Customizing Event Handling



Self-Monitoring

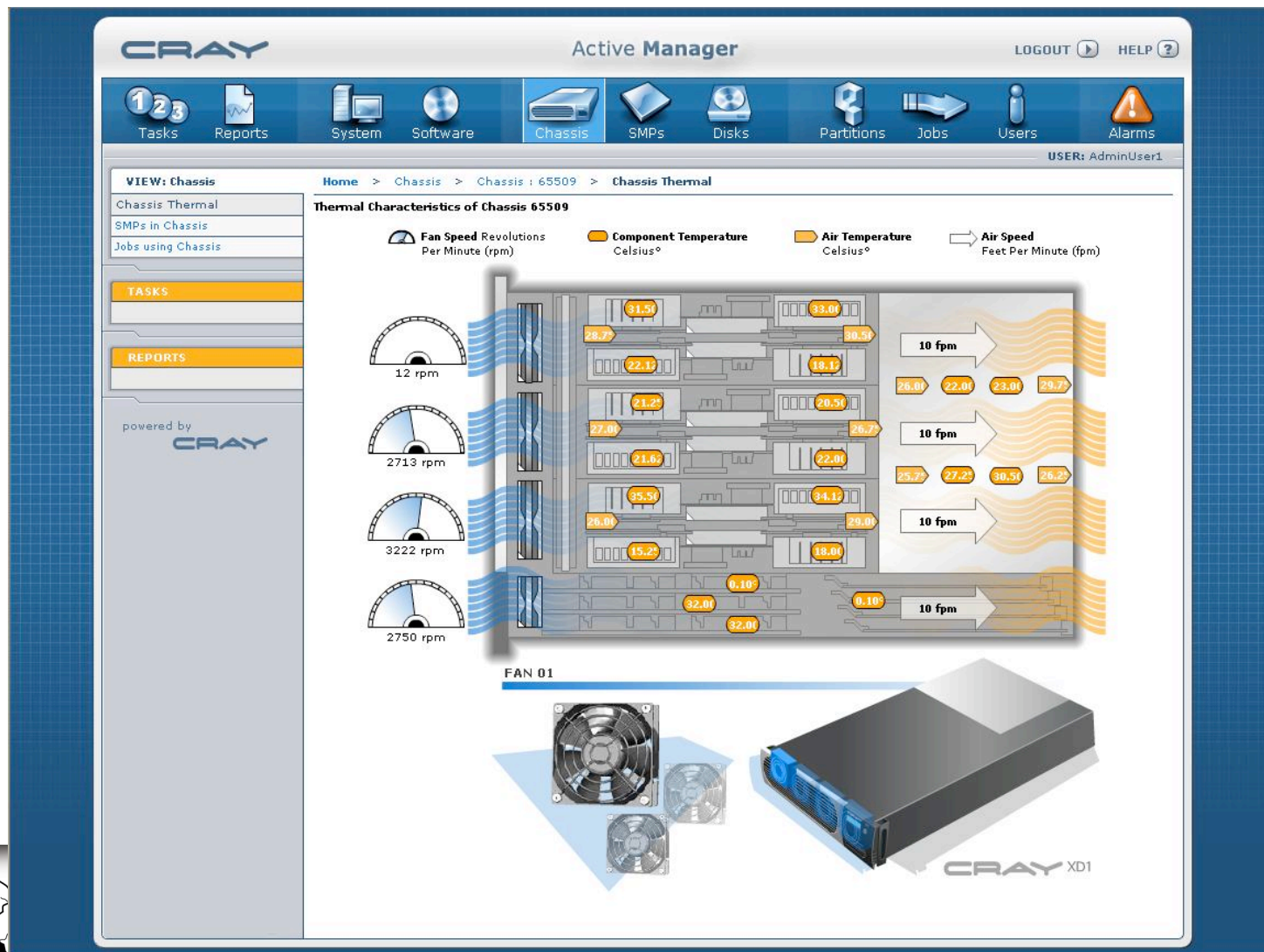
- Parity
- Heartbeat
- Temperature
- Fan speed
- Diagnostics
- Air Velocity
- Voltage
- Current



Dedicated Management Processor, OS, Fabric



Active Manager Thermal Management



Active Manager Alarm Management

CRAY Active Manager LOGOUT ▾ HELP ?

Tasks Reports System Software Chassis SMPs Disks Partitions Jobs Users Alarms

VIEW: Alarms USER: AdminUser1

Home > Alarms

Alarms

Severity: Triggered Within: Acknowledged: Filter

Filter By: Filter

Action on Selected Items:

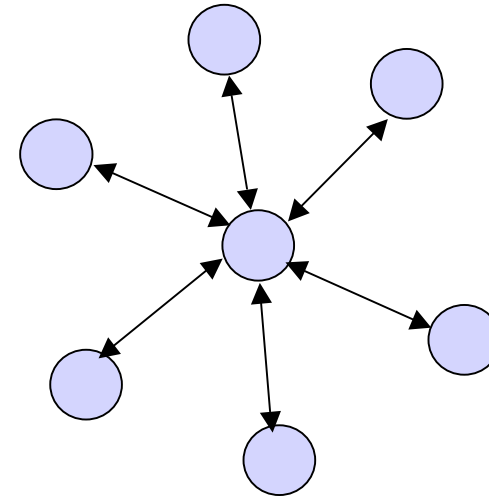
Alarm ID	Timestamp	Severity	Alarm Name	Component	Attribute	Value	State	Ack	Fault Resp
15	2004-04-23 17:17:05	major	AlarmTest6	mainboard smp	tmp2	33	active	no	yes
14	2004-04-23 17:17:02	major	AlarmTest5	mainboard smp	tmp2	33	active	no	yes

*This dynamic table will retrieve a maximum of 500 rows.

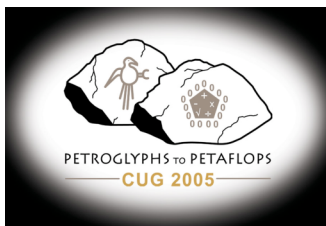


Building Alarm Scripts

- Events are published through a Central Database
- Associate Scripts with Alarms for Custom Handling

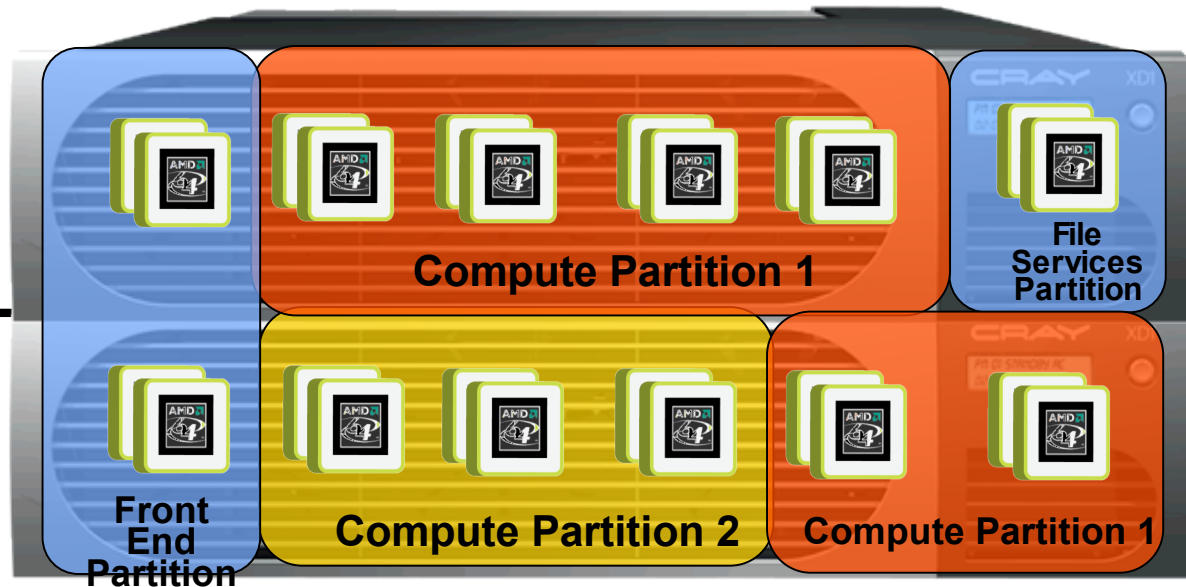
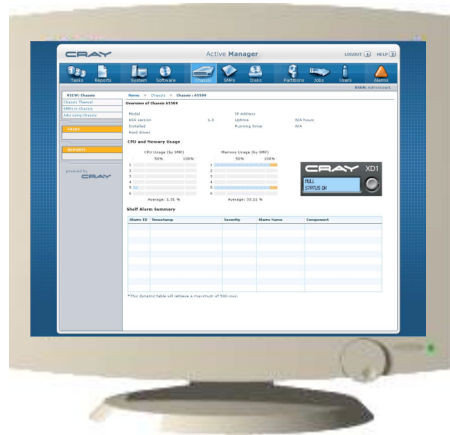


**Centralized Event Handling
Through
A “Publish/Subscribe”
Event Model**

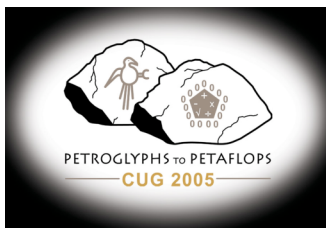


Self-Healing

Users & Administrators



- Continuous Monitoring
- Detect (Future) Failure
- Attempt reset
- Isolate failed component
- Re-allocate resources (N+1 sparing or policy-based)



Automated Recovery Reduces MTTTR from hours to minutes

Active Manager Self Healing Policies

The screenshot displays the CRAY Active Manager web interface. The top navigation bar includes icons for Tasks, Reports, System, Software, Chassis, SMPs, Disks, Partitions, Jobs, Users, and Alarms. The current view is 'VIEW: Alarms' for 'Alarm : 84'. The main content area is divided into sections: Alarm Details, Measurement Information, Fault Response Details, and Fault Response Events.

Alarm Details

- Date/Time: Fri Mar 26 01:42:15 PST 2004
- Severity: major
- Alarm State: active
- Acknowledged: no
- Alarm Id: 84
- Alarm Name: SMPFailed

Measurement Information

- Component: [SMP 102426.5](#)
- Metric: active
- Value: false

Fault Response Details

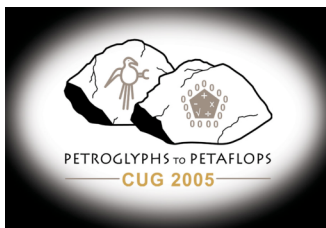
- Start Time: Fri Mar 26 01:42:17 PST 2004
- End Time: Fri Mar 26 01:43:18 PST 2004

Fault Response Events

- 01:42:17 Closed SMP 102426.5.
- 01:42:17 Resubmitted job 118 owned by auji.
- 01:42:17 Resubmitted job 124 owned by amar.
- 01:42:17 Rebooting SMP 102426.5...
- 01:42:37 ...reboot timed out.
- 01:42:37 Rebooting SMP 102426.5...
- 01:42:57 ...reboot timed out.
- 01:42:57 Rebooting SMP 102426.5...
- 01:43:17 ...reboot timed out.
- 01:43:17 SMP 102426.5 failed: unable to boot.
- 01:43:18 Added spare SMP 103704.3 to partition Chemistry.



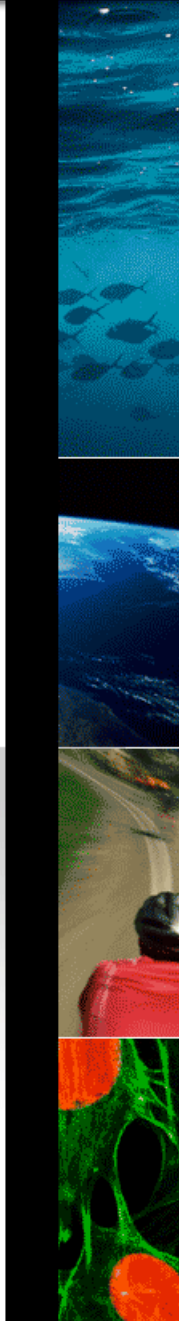
Event Handler Demo ...



Partition Demo ... (reprise)



XML Output from Commands

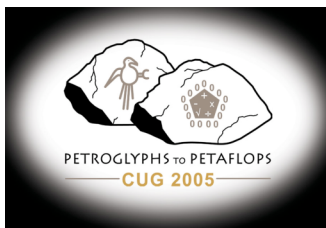


XML Integration Point

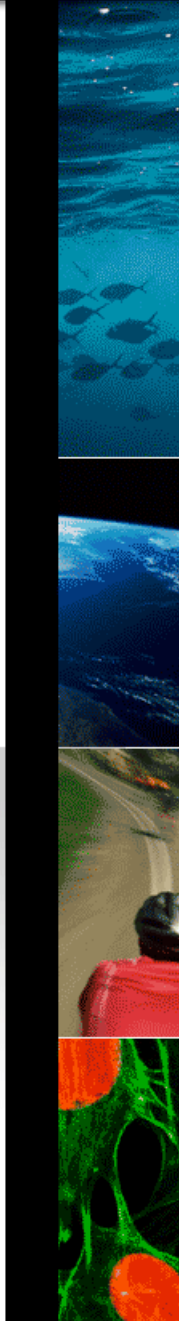
```
Adam Lorant@Adam ~
$ lspart --xml
<lspart>
  <partition name="Ab_Initio_Project" login="No" job_execution="Yes" state="open"
  " smp_count="10" load="61.53" running_jobs="11" queued_jobs="19" alarm_count=" "
  />
  <partition name="Chemistry" login="Yes" job_execution="Yes" state="open" smp_c
  ount="33" load="64.19" running_jobs="21" queued_jobs="1" alarm_count=" "/>
  <partition name="Diagnostic-Staging" login="No" job_execution="No" state="N/A"
  smp_count="3" load="1.12" running_jobs="0" queued_jobs="0" alarm_count=" "/>
  <partition name="File-Server" login="No" job_execution="No" state="N/A" smp_co
  unt="2" load="0.77" running_jobs="0" queued_jobs="0" alarm_count=" "/>
  <partition name="Front_End_Partition" login="Yes" job_execution="No" state="op
  en" smp_count="4" load="1.09" running_jobs="0" queued_jobs="0" alarm_count=" "/>
  <partition name="Physics" login="No" job_execution="Yes" state="open" smp_coun
  t="8" load="60" running_jobs="5" queued_jobs="43" alarm_count=" "/>
</lspart>
Adam Lorant@Adam ~
$
```

XML – designed to ease integration between different components by simplifying parsing of results

XML Demo ...



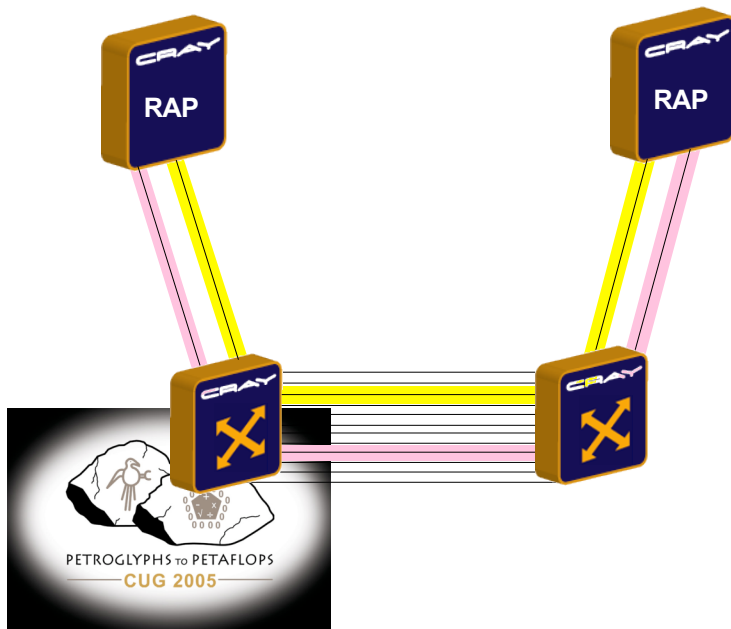
Fabric Error Detection and Correction



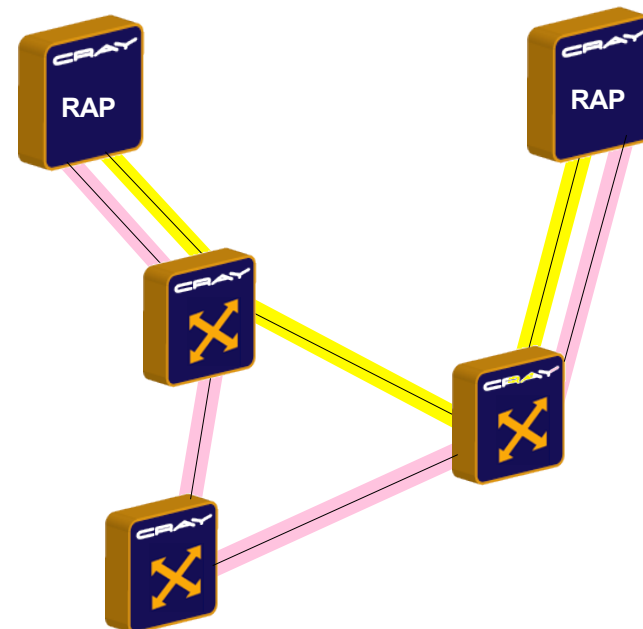
Load Sharing

- Every pair of RAPs have TWO paths between them for load sharing

eg: 2 chassis topology

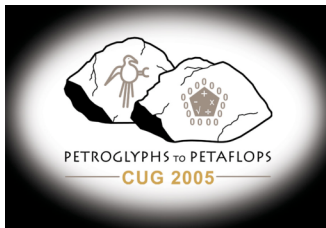
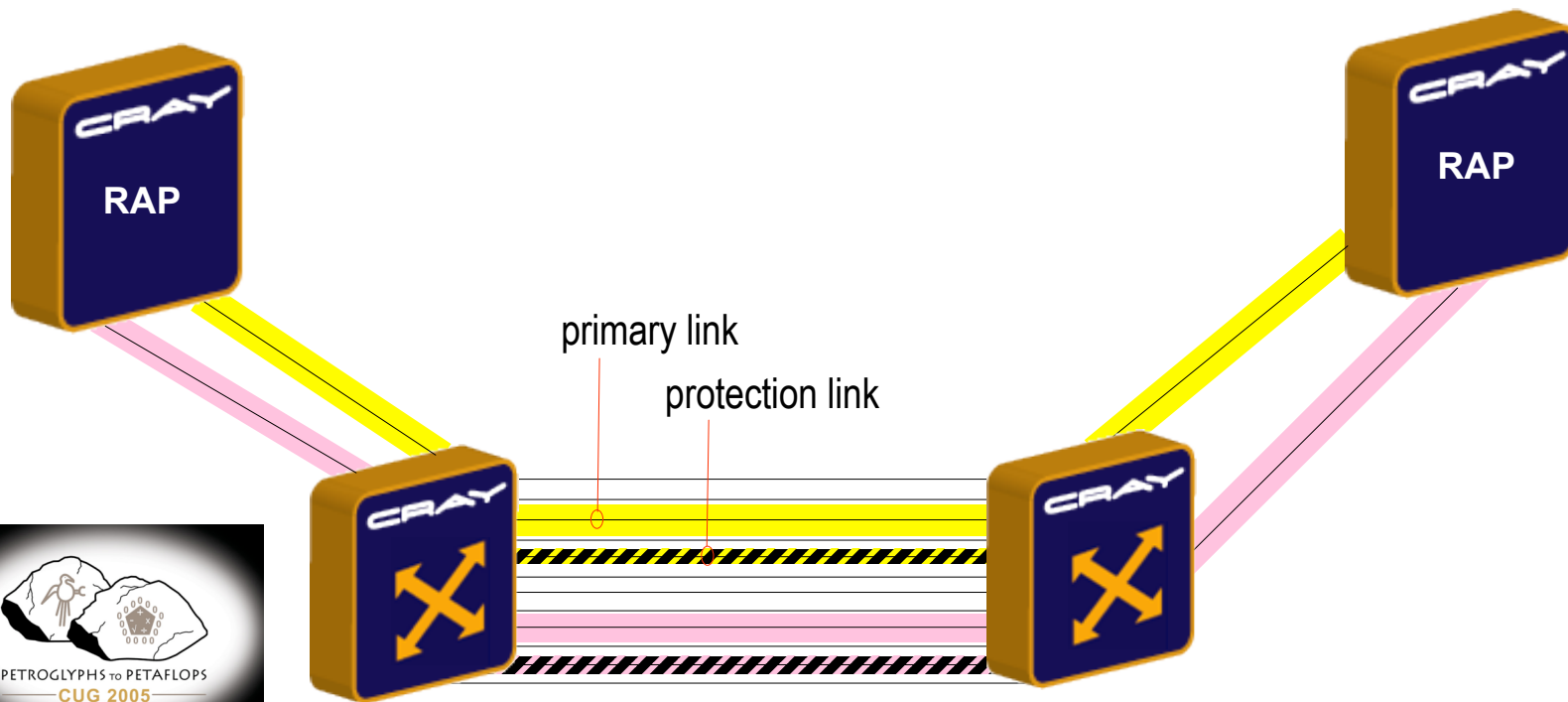


eg: 13 chassis topology

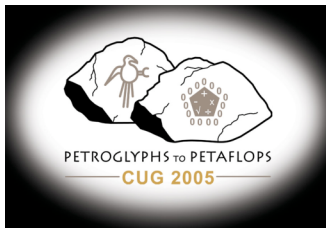
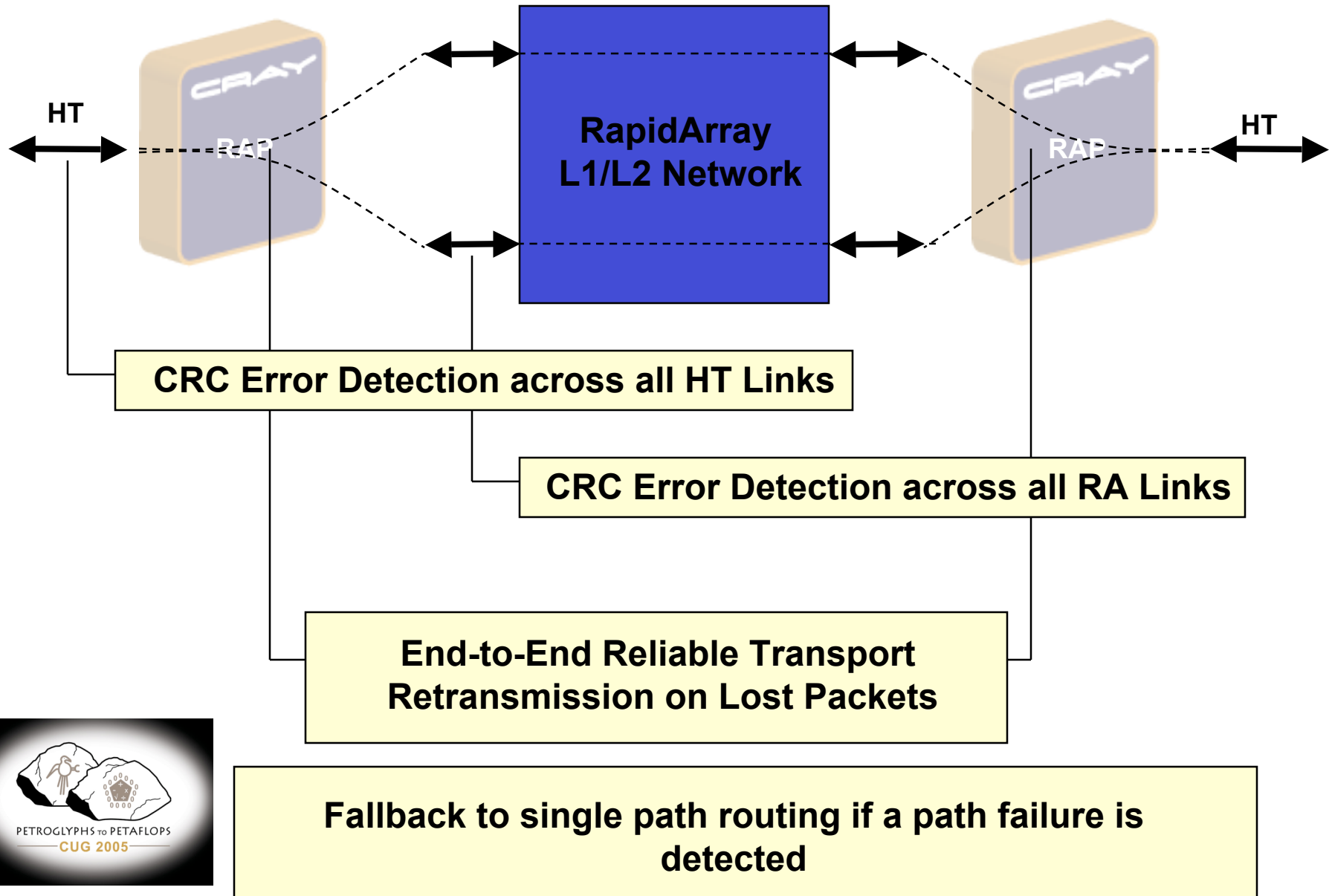


Path Redundancy

- Every RapidArray path is protected with a backup path
- Failover is automatic (alarm will be generated)
- Reliable Transport ensures no data loss

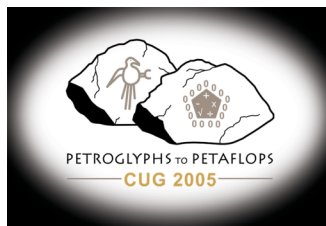


Network Data Integrity and Reliability

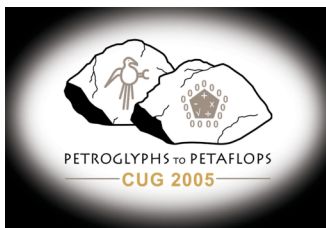


Verifying Fabric with Active Manager

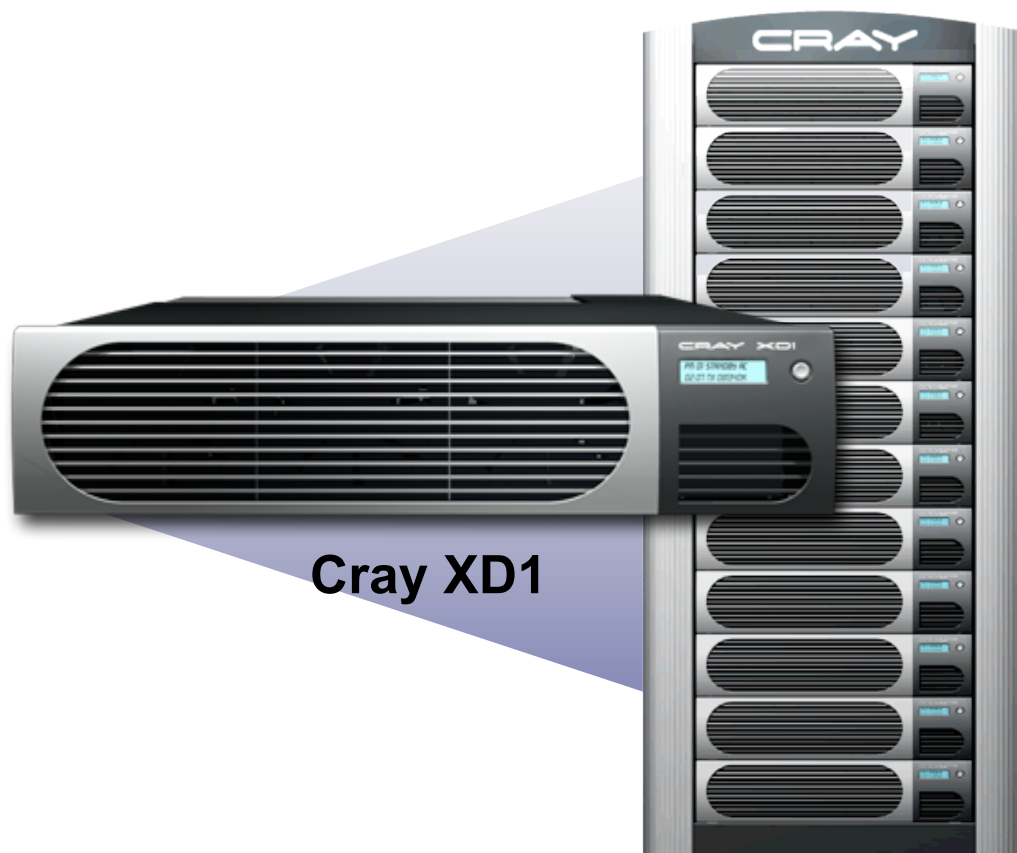
- Present topology
 - Simply connect cables from diagrams
 - Active Manager will auto discover all links
- Expected topology
 - Defined in an XML file
 - Commands to test present vs. expected



Fabric Error Demo ...



The Cray XD1



Cray XD1

- **Built for price/performance**
 - Interconnect bandwidth/latency
 - System-wide process synchronization
 - Application Acceleration FPGAs
- **Standards-based**
 - 32/64-bit X86, Linux, MPI
- **High resiliency**
 - **Self-configuring, self-monitoring, self-healing**
- **Single system command & control**
 - Intuitive, tightly integrated management software

Purpose-built and optimized for high performance workloads

