



CEC 2008

Learn it. Live it.
Make **IT** real.



Fishworks

Brendan Gregg
Cindi McGuire

Sun Microsystems



Fishworks is the name of an engineering team at Sun Microsystems

- FISH: “Fully Integrated Software and Hardware” - a suitable acronym to describe our strategy
- Our goal – to provide a unified management framework for appliances built on Solaris

Fishworks Overview

- **Fully Integrated Software and Hardware**
- **Unified User Interface**
- **Turning Solaris into an appliance**
- **Example: NAS appliance**

What Does it Take to Build an Appliance?

- **Solid OS foundation**
 - **Key Solaris 10 building blocks:**
 - SMF (Service Management Facility)
 - FMA (Fault Management Architecture)
 - DTrace (Dynamic Tracing)
 - Networking
 - Security
- **Common user interface**
- **Integrated higher-level management and configuration tasks with OS**

Unified User Interface

- **One User Interface to rule them all**
 - **BUI: Browser User Interface**
 - **CLI: Command Line Interface**
- **This is possible in the confines of an appliance**
 - **A special-purpose server confined to a limited set of configuration and management tasks**

BUI: Browser User Interface

- **Consistent look and feel**
- **As fast as possible**
- **Usability – no special OS knowledge required**
- **Value add – a real BUI (not a CLI wrapper)**
 - **Pie charts, traffic lights, plots, dialogs, navigation, ...**
- **Status updated live – no need to refresh**
- **Not a(nother) skin – speaks to akd, which speaks to OS**
- **Communication secured over HTTPS**
- **Extensive test framework**
 - **Required writing a JavaScript CLI**

BUI Examples

Masthead:

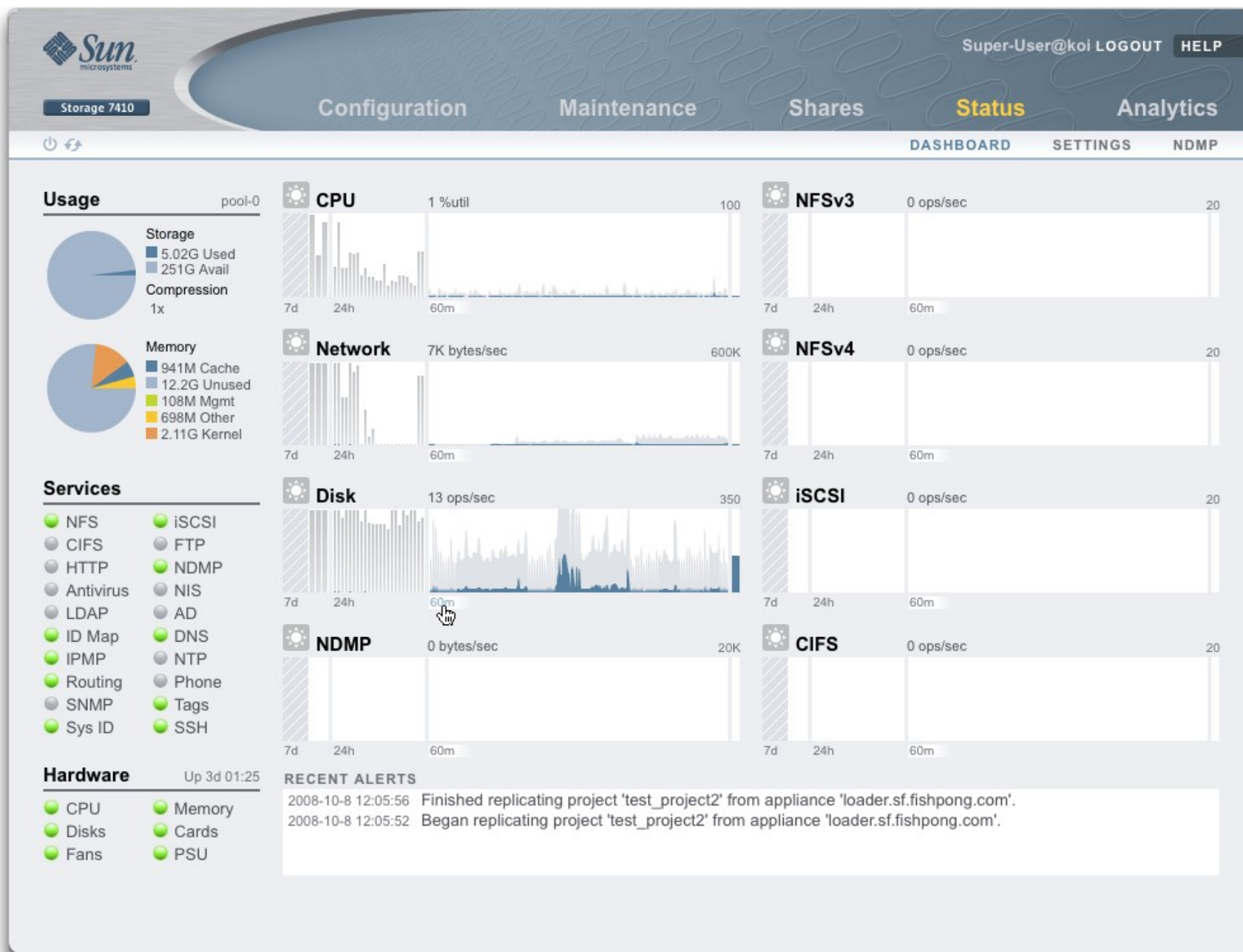


Lists:

A screenshot of the "Filesystems" list in the BUI. The header shows "Filesystems" with a plus icon, "LUNs" with a vertical ellipsis, and "25 Total". On the right, there are navigation controls: "1-20" and a search icon. The table below lists several filesystems with columns for "NAME", "SIZE", and "MOUNTPPOINT". The "admin /traffic" entry is selected and highlighted in blue, with a mouse cursor pointing at it. To the right of this entry are edit and delete icons.

NAME ▲	SIZE	MOUNTPPOINT
admin /accounts	18K	/export/accounts
admin /exports	18K	/export/exports
admin /primary	18K	/export/primary
admin /traffic	18K	/export/traffic
admin /workflow	18K	/export/workflow

Dashboard:



CLI: Command Line Interface

- **Mirror BUI functionality as much as possible**
- **Standard framework – a tree of contexts**
- **Usability**
 - **Help for every context**
 - **Tab-completion ++**
- **Rich scripting environment**
 - **Stripped-down JavaScript**
 - **SSH keys can be added for automated scripts from a different host**

CLI Example

```
vimba:> tree
```

```
|
+----> configuration
|
|   +----> net
|   |
|   |   +----> datalinks
|   |   |
|   |   |   +----> devices
|   |   |   |
|   |   |   |   +----> interfaces
|   |   |   |
|   |   |   +----> services
|   |
|   +----> services
```

```
...
```

```
vimba:> configuration net interfaces select e1000gtab
```

```
e1000g0 e1000g1
```

```
vimba:> configuration net interfaces select e1000g1
```

```
vimba:configuration net interfaces e1000g1> set v4dhcp=tab
false true
```

CLI Scripting Example

```
% ssh root@vimba << EOF
configuration net interfaces
select e1000g1
show
EOF
```

Properties:

```
        <state> = up
          class = ip
          label = Untitled Interface
          admin = true
          links = nge0
dhcp_clientid =
dhcp_hostname =
  dhcp_primary = false
    v4addrs = 192.168.2.124/22
      v4dhcp = true
    v6addrs =
      v6dhcp = false
```

Solaris Server Configuration

For example...

- **NFS**

 - `/etc/default/nfs`

 - `/var/svc/log/network-nfs-server:default.log`

- **DNS**

 - `/etc/resolv.conf, /etc/nsswitch.conf`

 - `/var/svc/log/network-dns-client:default.log`

- **Networking**

 - `ifconfig, dladm, netstat, route, routeadm`

 - `/etc/inet/hosts, /etc/inet/ipnodes, /etc/hostname.*`

 - `/var/adm/messages, /var/svc/log/*`

- **Consider NIS, LDAP, FTP, Apache, iSCSI, etc...**

Fishworks Server Configuration

The screenshot displays the Sun Fishworks Server Configuration web interface. At the top left is the Sun Microsystems logo and the text "Storage 7110". The top right shows the user "Super-User@vimba" with a "LOGOUT" button and a "HELP" link. The main navigation bar includes "Configuration", "Maintenance", "Shares", "Status", and "Analytics". Below this is a secondary navigation bar with "SERVICES", "STORAGE", "NETWORK", "CLUSTER", "USERS", "PREFERENCES", and "ALERTS".

The left sidebar lists various services: Active Directory, CIFS, DNS, FTP, HTTP, Identity Mapping, IPMP, iSCSI, LDAP, NDMP, NFS, NIS, NTP, Phone Home, Routing, Service Tags, SNMP, SSH, System Identity, and Virus Scan. The "NFS" service is selected and highlighted.

The main content area shows the "NFS" service configuration. It includes a status indicator (a green dot and a power icon) and the text "2006-2-15 02:07:52 Online". There are "REVERT" and "APPLY" buttons. The configuration options are:

- Minimum supported version: NFSv3
- Maximum supported version: NFSv4
- Maximum # of server threads: 500
- Grace period: 90 seconds
- Use DNS domain as NFSv4 identity domain:
- Use custom NFSv4 identity domain: domain

Fishworks Server Configuration

```
vimba:> configuration services nfs  
vimba:configuration services nfs> show  
Properties:  
        <status> = online  
        version_min = 3  
        version_max = 4  
        nfsd_servers = 500  
        grace_period = 90  
        mapid_dns = true  
        mapid_domain = domain
```

```
vimba:configuration services nfs> set grace_period=30  
        grace_period = 30 (uncommitted)  
vimba:configuration services nfs> commit  
vimba:configuration services nfs> get grace_period  
        grace_period = 30
```

Solaris Server Status

For example...

- **Hardware**

`fmadm faulty`

- **Services**

`svcs` (if the service is in SMF, otherwise application specific commands and log files must be used to determine service status)

- **Consider older Solaris (and other OSes):**

`ps -ef, iostat -En, netstat -i`
`/var/adm/messages, /var/log/*`

Fishworks Server Status

The screenshot displays the Sun Storage 7110 management interface. At the top, the Sun logo and 'Storage 7110' are visible. The user is logged in as 'Super-User@loader'. The main navigation bar includes 'Configuration', 'Maintenance', 'Shares', 'Status', and 'Analytics'. Below this, there are tabs for 'HARDWARE', 'SYSTEM', 'PROBLEMS', and 'LOGS'. The current view is 'HARDWARE', showing the server ID '0810QAS004' and various status indicators for Disks, Slots, CPU, Memory, Fans, PSUs, and SP. A physical server rack diagram is shown on the left with 'TOP', 'BACK', and 'FRONT' views. The main area contains a table of 16 HDDs.

ID	MANUFACTURER	MODEL	SIZE	TYPE		
HDD 0	SEAGATE	ST914602SSUN146G	137G	System	🟢	🔧
HDD 1	SEAGATE	ST914602SSUN146G	137G	System	🟢	🔧
HDD 2	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 3	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 4	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 5	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 6	SEAGATE	ST914602SSUN146G	137G	Spare	🟢	🔧
HDD 7	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 8	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 9	SEAGATE	ST914602SSUN146G	137G	Spare	🟢	🔧
HDD 10	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 11	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 12	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 13	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 14	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧
HDD 15	SEAGATE	ST914602SSUN146G	137G	Data	🟢	🔧

Fishworks Server Status

```
tarpon:> maintenance hardware show
```

```
Chassis:
```

	NAME	STATE	MANUFACTURER	MODEL
chassis-000	0839QCJ01A	ok	Sun Microsystems, Inc...	
cpu-000	CPU 0	ok	AMD Quad-Core	AMD Op
cpu-001	CPU 1	ok	AMD Quad-Core	AMD Op
cpu-002	CPU 2	ok	AMD Quad-Core	AMD Op
cpu-003	CPU 3	ok	AMD Quad-Core	AMD Op
disk-000	HDD 0	ok	STEC MACH8	IOPS
disk-001	HDD 1	ok	STEC MACH8	IOPS
disk-002	HDD 2	absent	-	-
disk-003	HDD 3	absent	-	-
disk-004	HDD 4	absent	-	-
disk-005	HDD 5	absent	-	-
disk-006	HDD 6	ok	HITACHI	HTE5450SASUN500G
disk-007	HDD 7	ok	HITACHI	HTE5450SASUN500G
fan-000	FT 0	ok	unknown	ASY, FAN, BOARD, H2
...				

Fishworks Server Status

Storage 7410

Super-User@koi LOGOUT HELP

Configuration Maintenance Shares Status Analytics

NETWORK SERVICES CLUSTER USERS PREFERENCES ALERTS STORAGE

Services

- Active Directory
- CIFS
- DNS
- FTP
- HTTP
- Identity Mapping
- IPMP
- iSCSI
- LDAP
- NDMP
- NFS
- NIS
- NTP
- Phone Home
- Routing
- Service Tags
- SNMP
- SSH
- System Identity
- Virus Scan

Data Services

NFS	Online	2008-10-8 04:45:31	↻ ⏻
iSCSI	Online	2008-10-6 09:37:05	↻ ⏻
CIFS	Disabled	2008-10-6 09:34:56	↻ ⏻
FTP	Disabled	2008-10-6 09:34:59	↻ ⏻
HTTP	Disabled	2008-10-6 09:34:57	↻ ⏻
NDMP	Online	2008-10-8 04:45:41	↻ ⏻
Virus Scan	Disabled	2008-10-6 09:35:05	↻ ⏻

Directory Services

NIS	Disabled	2008-10-8 04:45:29	↻ ⏻
LDAP	Disabled	2008-10-8 04:45:29	↻ ⏻
Active Directory	Disabled	2008-10-6 09:35:06	↻ ⏻
Identity Mapping	Online	2008-10-8 04:45:31	↻ ⏻

System Settings

DNS	Online	2008-10-8 04:45:42	↻ ⏻
IPMP	Online	2008-10-8 04:45:28	↻ ⏻
NTP	Disabled	2008-10-6 09:34:55	↻ ⏻
Routing	Online	2008-10-6 10:25:14	↻ ⏻
Phone Home	Disabled	2008-10-9 11:57:58	↻ ⏻
SNMP	Disabled	2008-10-6 09:34:57	↻ ⏻
Service Tags	Online	2008-10-8 04:45:41	↻ ⏻
System Identity	Online	2008-10-8 04:45:30	↻ ⏻

Remote Access

SSH	Online	2008-10-6 09:37:00	↻ ⏻
-----	--------	--------------------	-----

Fishworks Server Status

```
vimba:> configuration services show
```

```
Services:
```

```
    ad => disabled
    cifs => disabled
    dns => online
    ftp => disabled
    http => disabled
identity => online
    idmap => online
    ipmp => online
    iscsi => online
    ldap => disabled
    ndmp => online
    nfs => online
    nis => disabled
    ntp => disabled
```

&

Solaris Server Performance Observability

For example...

- **CPU**

`vmstat, mpstat, prstat, dtrace`

- **Memory**

`vmstat, prstat`

- **Disk I/O**

`iostat, dtrace`

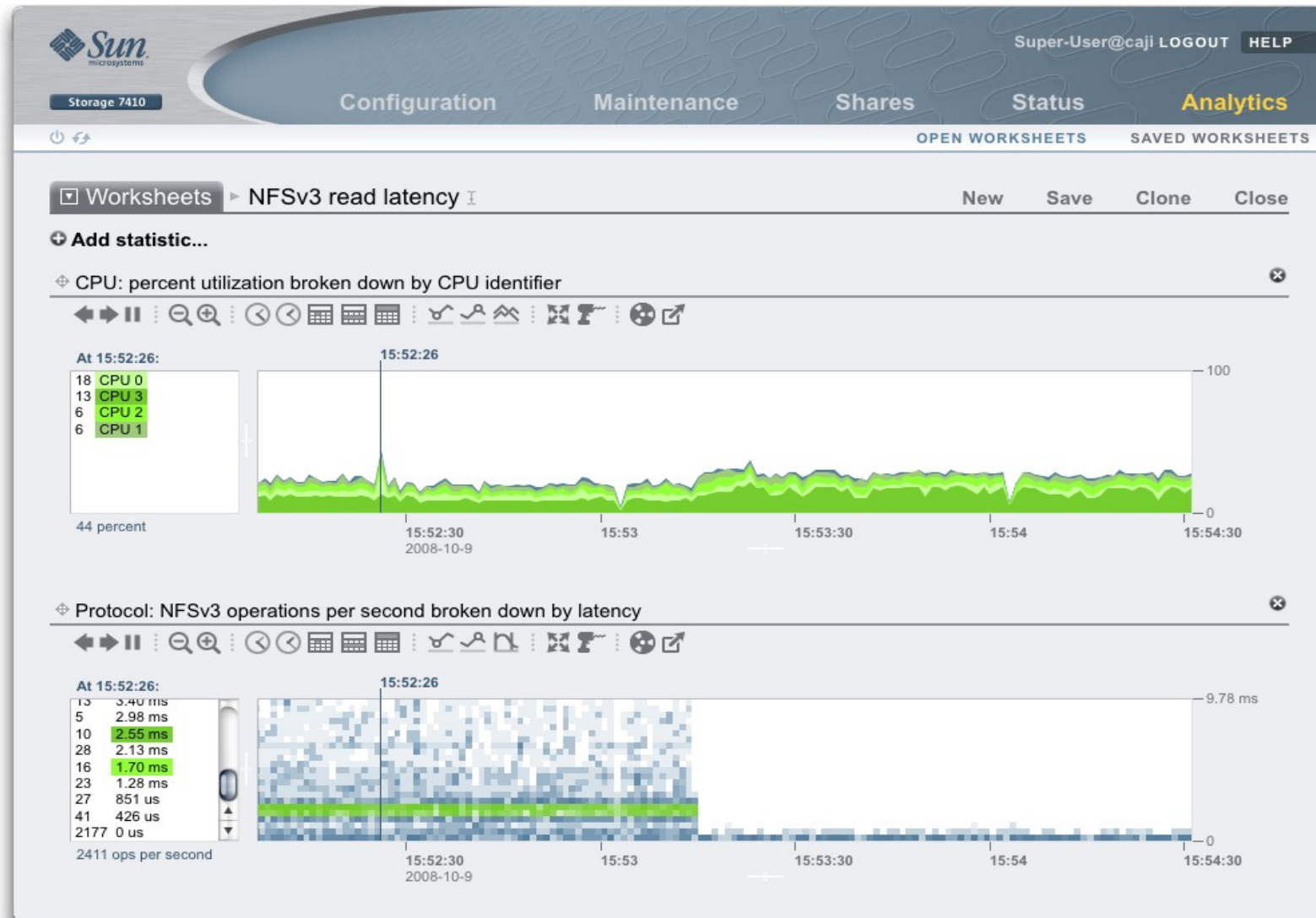
- **Network I/O**

`netstat, dladm, nicstat, nx.se, dtrace`

- **NFS**

`nfsstat, dtrace`

Fishworks Server Performance Observability



Fishworks Server Performance Observability

Ok, that's a bit hard to do in the CLI. This is one of the few differences between BUI and CLI functionality.

But while the graphs aren't available, the data is:

```
vimba:> status activity show
```

```
Activity:
```

CPU	10 %util	Sunny
Disk	2 ops/sec	Sunny
iSCSI	0 ops/sec	Sunny
NDMP	0 bytes/sec	Sunny
NFSv3	0 ops/sec	Sunny
NFSv4	0 ops/sec	Sunny
Network	3K bytes/sec	Sunny
CIFS	0 ops/sec	Sunny

And individual statistics (datasets) ...

Fishworks Server Performance Observability

```
vimba:> analytics datasets
```

```
vimba:analytics datasets> show
```

```
Datasets:
```

DATASET	STATE	INCORE	ONDISK	NAME
dataset-000	active	893K	342K	arc.accesses[hit/miss]
dataset-001	active	270K	83.1K	cpu.utilization
dataset-002	active	748K	280K	cpu.utilization[mode]

```
&
```

```
vimba:analytics datasets> select dataset-006 read 5
```

DATE/TIME	%UTIL	%UTIL	BREAKDOWN
2006-2-15 15:56:55	7	6	kernel 1 user
2006-2-15 15:56:56	7	6	kernel 1 user
2006-2-15 15:56:57	29	17	user 12 kernel

```
&
```

Missing Piece

That looks great but how do we link our new Unified User Interfaces with the core OS services in Solaris?



Fishworks Unified Management

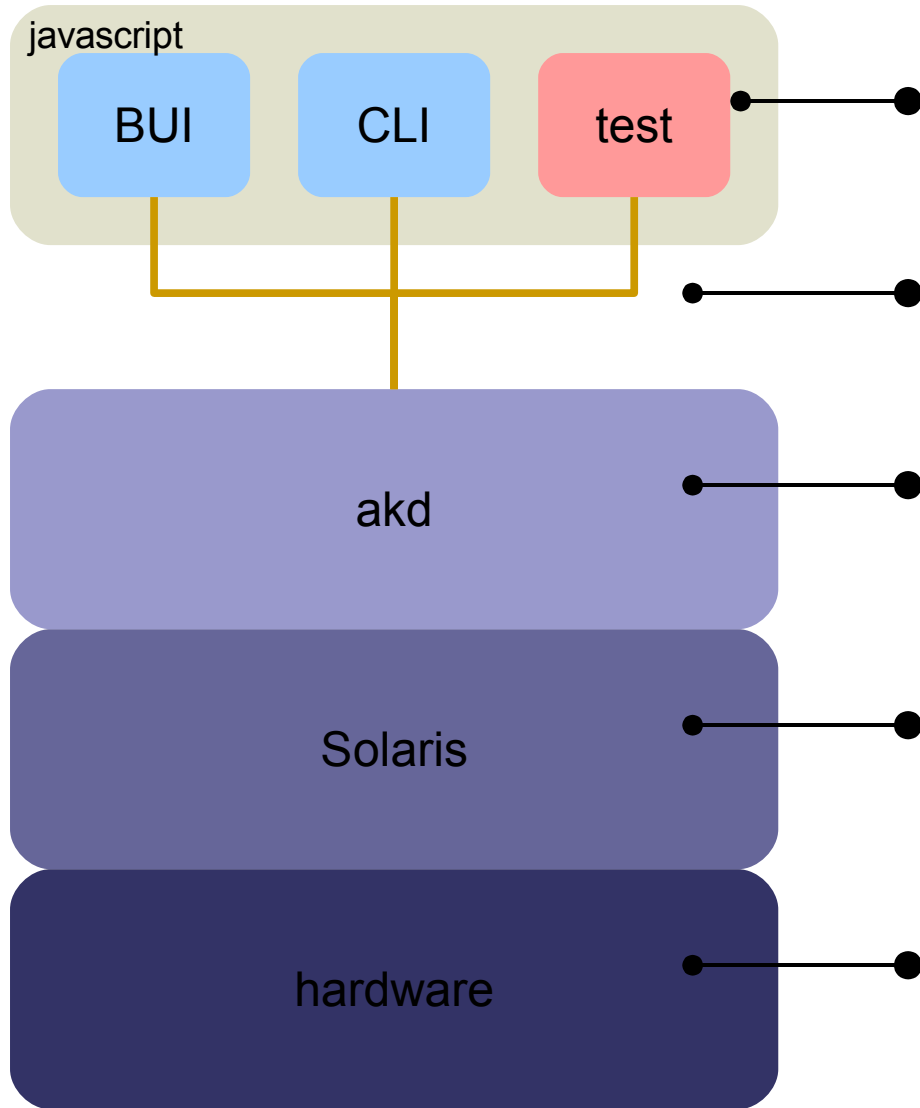
- **Appliance Kit Daemon (akd)**
 - **Not a(nother) wrapper around the Solaris CLIs**
 - **Tightly integrated with the Solaris OS libraries to provide appliance abstractions for:**
 - **Storage: ZFS, NDMP**
 - **Protocols: iSCSI, NFS, CIFS, HTTP, FTP, WebDAV**
 - **Networking: ifconfig, routing, IPMP**
 - **Security: OpenSSL, ssh**
 - **RAS: fmd, libtopo, IPMI, SMBIOS, SNMP**
 - **Service management: SMF**
 - **Observation: DTrace, kstats**

Fishworks Unified Management

- **Additional features added to support appliance-specific tasks**
- **Clustering**
- **Software upgrade/rollback**
- **Integrated phone home, service tag, and audit capabilities**
- **Roles and authorizations**
- **Secure communication channel for BUI and CLI**
- **Customers interact with the BUI or CLI, akd interacts with Solaris**



Putting it All Together



Common BUI, CLI, and test framework to drive management software: JavaScript

Standard protocol for communication: XML-RPC

Common control point (akd) to OS libraries

Enhance OS to leverage appliance hardware: clustering and ZFS L2ARC

Hardware supported by FMA

SMF: Service Management Facility

- **Service abstraction for a running application, device state or set of other services**
- **SMF(5) provides a common infrastructure for service:**
 - **Configuration**
 - **Fault monitoring**
 - **Restart**
 - **Observability**
- **All appliance applications and facilities run under the SMF**

FMA: Fault Management Architecture

- **Appliance software and hardware errors reported to fmd(1M)**
 - **CPU/Memory, PCI-Express, HBA controllers, fans, power supplies, and disks**
 - **Appliance kit software instrumented for FMA**
- **Faults and defects reported using the Sun Fault Messaging Standard with problem resolution at <http://www.sun.com/msg>**
- **Guided FRU replacement made possible by FMA topology libraries**
- **IPMI, SMART, and other sensor data collected and reported to fmd(1M)**
- **Configurable SNMP traps and alerts**

DTrace

- **Analytics uses DTrace (and Kstat) to visualize statistics in real-time**
 - **Not just bolting on a GUI, but rethinking how to visualize performance – and investigating what new features GUIs make possible**
- **Statistics can be archived and saved forever**
 - **Investigate performance issues after the event**
- **Analytics can answer high level questions:**
 - **“What clients are making NFS requests?”**
 - **“What CIFS files are being accessed?”**
 - **“How long are disk operations taking?”**

DTrace: Analytics

Demonstrating how GUIs can *add value*

DEMO

A Word about the Solaris Shell

- **The appliance is entirely manageable from the BUI and CLI: no Solaris shell access required. For example:**

ifconfig → `huri:> configuration net`

route → `huri:> configuration services routing`

ping/nslookup (builtins)

`huri:> ping kipper`

`huri:> nslookup 192.168.2.104`

- **akd manages resources such as ZFS, use of the original zpool/zfs commands can easily create issues that are extremely difficult to troubleshoot**
- **The Solaris shell is available for trained Sun Service staff to use only if absolutely necessary.**

Example: NAS appliance

- **Features from Solaris 10:**
 - Enterprise-class scalability, RAS, and performance
 - IPv4 and IPv6 networking, LACP, IPMP, VLANs, ...
 - NFSv3, v4, FTP, HTTP, WebDAV, iSCSI, and now CIFS
 - Scalability of all key subsystems to 64 cores and beyond
 - Unique innovations: ZFS, DTrace, FMA, SMF, ...
- **Features added/enhanced for this appliance:**
 - ZFS: L2ARC, log devices, RAID-Z DP
 - Integration with Solaris CIFS and Windows Identities
 - Clustering
 - ...

Example: NAS appliance

A tour of the interface and features

DEMO

Thank you

CEC 2008

Learn it. Live it.
Make **IT** real.