Solaris 10 New Features

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Client Solutions

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Sun microsystems

We make the net work.

Agenda

- What's New ?
- N1 Grid Containers - Zones
- Dynamic Tracing - DTrace
- Predictive Self Healing - SMF
- Java Desktop System - JDS

What's New ?

- N1 Grid Containers - Zones
- Dynamic Tracing - DTrace
- Predictive Self Healing - SMF
- Security - privileges(5)
- A new file system: ZFS
- Desktop: JDS based on Gnome 2.6
- Solaris on Sparc, x86 and AMD Opteron
- Java 1.5
- A new logo !

What's New ?

Janus Linux Compatibility

- A LSB compliant environment, under Solaris x86, to execute unmodified Linux binaries
- You can develop Linux applications on Solaris taking advantage of its performance, scalability and security, even your production is RHAS !
- Next-generation *lxrun* replacement
  - lxrun = user-space emulation layer
  - Janus = direct support of Linux kernel interfaces

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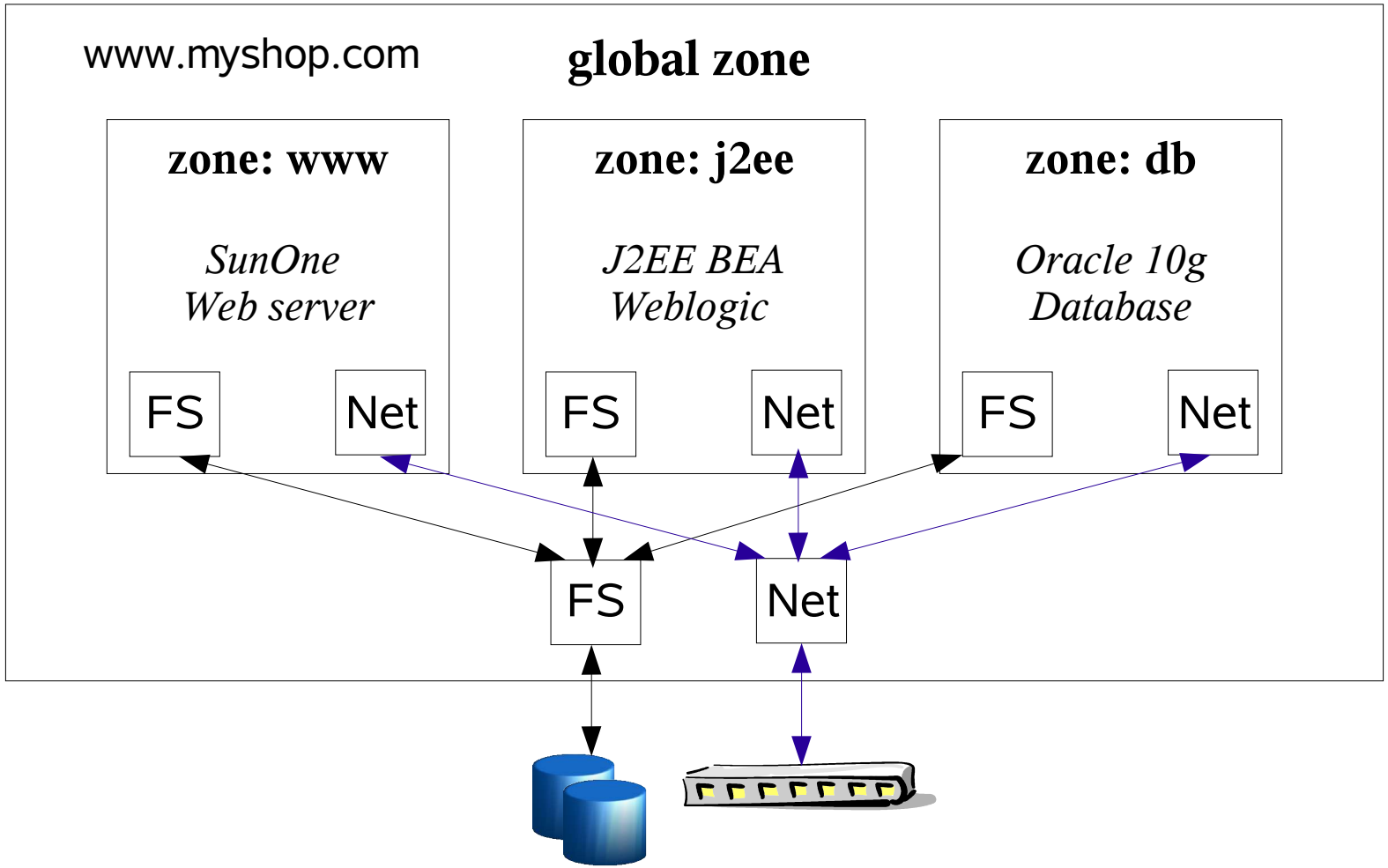
N1 Grid Containers - Zones

- A new isolation primitive for Solaris: secure, flexible, scalable and lightweight
- Isolations: Partitioning/Domains, VMs, software partitions (Zones, Jails, Linux Vservers)
- Reduce costs by running multiple workloads on same system and isolates applications from each other
- Resource management framework + Zones = N1 Grid Containers

Zones: Global and Non-Global



Primary Zone States

- Configured: The configuration is done and committed to stable storage
- Installed: Packages have been installed under the zone's root file system
- Ready: Virtual platform it is up: logical network interfaces are plumbed, file systems are mounted, devices are created /dev
- Running: User processes are executing in the zone

Configuring a Zone

Use zonecfg(1M) to start configuring a zone

- zonepath: path in the global zone root directory under which zone will be installed
- autoboot: to boot or not to boot when the global zone boots
- pool: resource pool to which zone should be bound
- fs: file system
- net: network device
- device: device
- inherit-pkg-dir: directory inherited from the global zone

Configuring a Zone

Start configuring a zone under /zone/1

```
# zoneadm list -vc
  ID NAME             STATUS         PATH
   0 global           running        /

# chmod -R 700 zone
# ls -lap /zone
total 6
drwx------   3 root     root         512 Nov 20 22:53 ./
drwxr-xr-x  40 root     root        1024 Nov 20 22:53 ../
drwx------   2 root     root         512 Nov 20 22:53 1/

# zonecfg -z zone1
zone1: No such zone configured
Use 'create' to begin configuring a new zone.
zonecfg:zone1> create
zonecfg:zone1> set zonepath=/zone/1
zonecfg:zone1> set autoboot=true
```

Configuring a Zone

```
zonecfg:zone1> add net
zonecfg:zone1:net> set address=192.168.1.20
zonecfg:zone1:net> set physical=iprb0
zonecfg:zone1:net> end
zonecfg:zone1> info
zonepath: /zone/1
autoboot: true
pool:
inherit-pkg-dir:
        dir: /lib
inherit-pkg-dir:
        dir: /platform
inherit-pkg-dir:
        dir: /sbin
inherit-pkg-dir:
        dir: /usr
net:
        address: 192.168.1.20
        physical: iprb0
```

```
zonecfg:zone1>
zonecfg:zone1> verify
zonecfg:zone1> commit
zonecfg:zone1>
```

Configuring a Zone

Lets check our zone, zone1

```
# zonecfg -z zone1 info
zonepath: /zone/1
autoboot: true
pool:
inherit-pkg-dir:
        dir: /lib
inherit-pkg-dir:
        dir: /platform
inherit-pkg-dir:
        dir: /sbin
inherit-pkg-dir:
        dir: /usr
net:
        address: 192.168.1.20
        physical: iprb0
```

And now lets check all zones

```
# zoneadm list -vc
  ID NAME             STATUS         PATH
   0 global           running        /
   - zone1            configured     /zone/1
```

Installing a Zone

Next, install the zone using zoneadm(1M)

```
# zoneadm -z zone1 install
Preparing to install zone <zone1>.
Creating list of files to copy from the global zone.
Copying <97980> files to the zone.
Initializing zone product registry.
Determining zone package initialization order.
Preparing to initialize <1157> packages on the zone.
Initialized <1157> packages on zone.
Zone <zone1> is initialized.
...
The file </zone/1/root/var/sadm/system/logs/install_log> contains a
log of the zone installation.

# zoneadm list -vc
  ID NAME             STATUS         PATH
   0 global           running        /
   - zone1            installed      /zone/1
```

Booting a Zone

And then boot and start using the zone:

```
# zoneadm -z zone1 boot
# zoneadm list -vc
  ID NAME             STATUS         PATH
   0 global           running        /
   1 zone1            running        /zone/1

# ping 192.168.1.20
192.168.1.20 is alive

# zlogin -C zone1

# uname -a
SunOS zone1 5.10 s10_72 i86pc i386 i86pc
```

Zone Security

- A zone has a security boundary around it
- Cannot compromise another zone or entire system
- Processes running in non-global zones are not able to affect activity in other zones
- Global zone root user can do and see everything
- Restrictions: loading/unloading kernel modules, accessing kernel memory, details of physical resource are hidden

Process Model in a Zone

- Processes in the same zone interact as usual
- Processes may not see or interact with processes in other zone
- Information via proc(4) for processes from that zone only
- Each active zone contains a process zsched
- The process tree in a zone is rooted at the zsched
- Global zone is able to see processes in all zones

File Systems in a Zone

- Virtualized view of the file system namespace
- The root of the zone is *$zonepath/root* and it is part of the configuration
- Processes cannot escape out of a zone
- Private: */* , */etc* and */var*
- Shared: */usr*, */lib*, */platform* and */sbin* read-only loopback mounts, lofs(7FS) from global zone and */proc /etc/mnttab* are virtualized for each non-global zone

Networking in a Zone

- Single TCP/IP stack for the entire system
- Zones are assigned one or more IPv4/IPv6 addresses
- Zones cannot view another zone's network traffic but inter-zone traffic is permitted
- When a zone is booted a logical interface is plumbed for each of its addresses
- Except for ICMP, raw IP socket access is not allowed within zone

More information ?

Sun BigAdmin site
http://www.sun.com/bigadmin/content/zones/

Man pages:

- getzoneid(3C), getzoneidbyname(3C)
- getzonenamebyid(3C)
- zcons(7D), zlogin(1)
- zoneadm(1M), zonecfg(1M)
- zonename(1), zones(5)

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Dynamic Tracing - DTrace

- A new power tool for real-time analysis and debug. System and process centric
- Hard to debug transient problems with: truss(1), pstack(1), prstat(1)
- Only mdb(1) designed for systemic problems but only for postmortem analysis
- Designed for live production systems: a totally safe way to inspect live data on production systems

Dynamic Tracing - DTrace

- Safe and comprehensive: over 30.000 data monitoring points, inspect kernel and user space level
- Reduced costs: solutions usually found in minutes or hours not days or months.
- Flexibility: DTrace lets you create your own custom programs to dynamically instrument the system
- No need to instrument your applications, no need to stop or restart them

Concepts

- Probe: it is a point of instrumentation, made available by a provider, which has a name
  - defined as (provider: module: function: name)

  E.g.: syscall::read:entry

- Provider: a methodology for instrumenting the system. Makes available all know probes e.g. syscall, lockstat, fbt

Concepts

- Consumer: a process which interacts with DTrace, dtrace(1) for instance
- D Language: a simple dynamically interpreted language what dtrace uses. It is like a C language with some constructs similar with awk(1)
  - Supports ANSI C operators, support for strings
  - D expressions based on built-in variables: pid, execname, timestamp, curthread

Concepts

- D Language:
  - Actions: are taken when a probe fires. You can use trace() which records the result of trace into a specific buffer. Actions are indicated by following a probe specification with “{ action }”

    E.g:

    ```
    dtrace -n BEGIN'{trace(“Im here”); exit(0)}'
    ```

  - Predicates: allow actions to only be taken when certain conditions are met. A predicate has this form : “/predicate/”

    E.g:

    ```
    dtrace -n syscall:::entry'/execname==”mozilla-bin”/{...}'
    ```

Hello World

```
BEGIN
{
trace("hello, world");
exit(0);
}
```

Call it from a script:

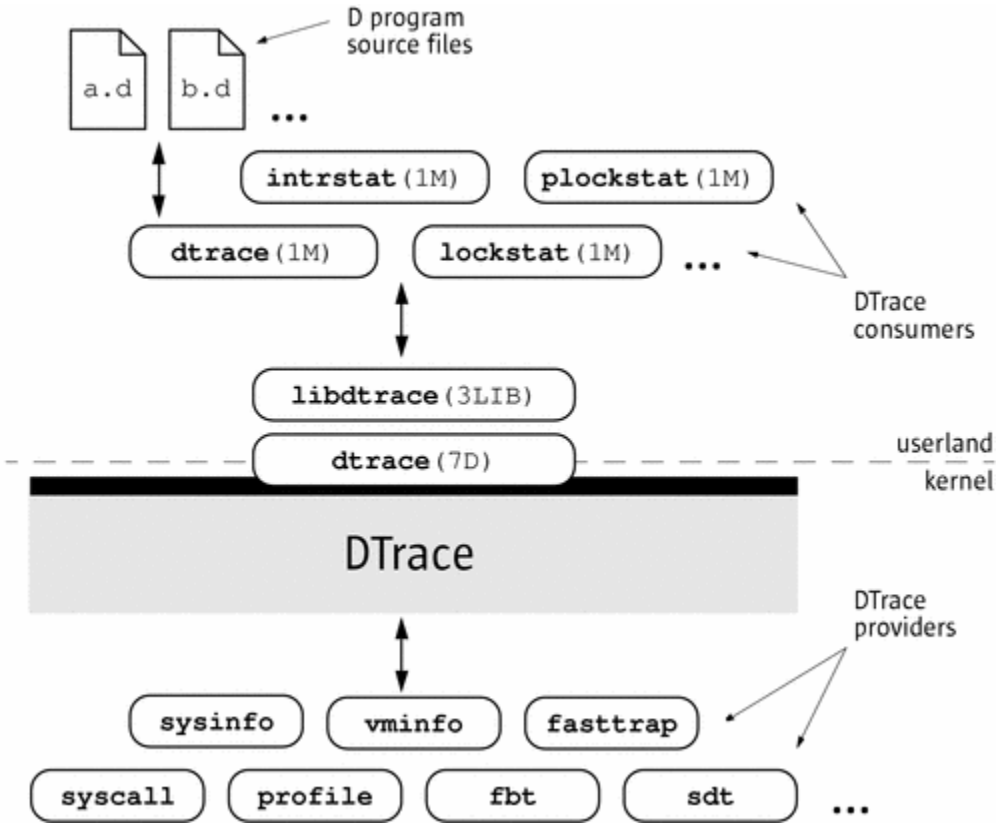
```
# dtrace -s hello.d
dtrace: script 'hello.d' matched 1 probe
CPU     ID                    FUNCTION:NAME
  0     1                           :BEGIN   hello, world
```

or from command line:

```
# dtrace -q -n BEGIN'{ trace("Hello world"); exit(0) }'
Hello world
#
```

Behind DTrace

- Compilation: D programs are compiled into a safe intermediate form that is used for execution when your probes fire which is validated by DTrace.



Behind DTrace

- Programming mistake: DTrace will report your error to you, disable your instrumentation
- Execution environment: DTrace also handles any run-time errors: dividing by zero, dereferencing invalid memory, and so on, and reports them to you
- Safe: you can never construct a bad script that would cause DTrace to damage the Solaris kernel or one of the processes running on your system

A simple case

Listing all probes offered by different providers:

```
# dtrace -l | more
   ID   PROVIDER       MODULE  FUNCTION   NAME
    1     dtrace                  BEGIN
    2     dtrace                    END
    3     dtrace                  ERROR
    4    syscall                  nosys   entry
    5    syscall                  nosys   return
    6    syscall                  rexit   entry
    7    syscall                  rexit   return
    8    syscall                  forkall entry
    9    syscall                  forkall return
   10    syscall                  read    entry
   11    syscall                  read    return
   12    syscall                  write   entry
   13    syscall                  write   return
   14    syscall                  open    entry
   15    syscall                  open    return
   ...
```

A simple case

Count all probes offered by all providers:

```
# dtrace -l | wc -l
   39270
```

Count all probes offered by the syscall provider:

```
# dtrace -l -P syscall | wc -l
     451
```

Count all probes offered by the ufs module:

```
# dtrace -l -m ufs | wc -l
     900
```

How to enable a proble: run dtrace without -l

```
# dtrace -q -n BEGIN'{trace("Hello World");}'
Hello World
```

A simple case

What's happening on my system:

```
# dtrace -n syscall:::entry
```

Which applications are using these system calls

```
# dtrace -n syscall:::entry'{trace(execname)}'
```

We want to aggreagate on each application name:

```
# dtrace -n syscall:::entry'{@[execname] = count()}'
^C
    ssh                                3243
    metacity                           3270
    wnck-applet                        4040
    search                             9072
    mv                                 9316
    awk                               15630
    Xorg                              16239
    sort                              26578
    sh                                41929
    tar                              151067
```

A simple case

What “tar” is doing on my system ?

```
# dtrace -n syscall:::entry'/execname==”tar”/{@[probefunc] = count
()}'
dtrace: description 'syscall:::entry' matched 228 probes
^C

  waitsys                 13
  execve                  13
  vfork                   13
  sigpending              13
  lstat64                 14
  ...
  brk                    196
  write                  201
  mmap                   210
  lseek                  420
  llseek                6862
  read                  7967
```

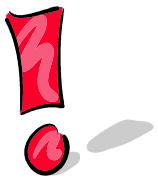
A simple case

We will try to find out what process is and get its pid

```
# dtrace -n syscall:::entry'/execname=="tar"/{@[pid] = count()}'
dtrace: description 'syscall:::entry' matched 228 probes
^C

     3898                      5
     3873                      5
     3893                      5
     3878                      5
     3857                    145
     3917                    206
     3862                    558
     3882                    559

     3877                    565
     3902                    566
     3912                    567
     3907                    568
```



A simple case

We know now: that there are many “tar” processes running, but what file(s) and who is the user ?

```
# dtrace -s /usr/demo/dtrace/iosnoop.d
    DEVICE                                          FILE RW
       sd1      /export/home/stefan/archivelibs.tar  W
       sd1                                    <none>  R
       sd1                                    <none>  W
       sd1           /var/tmp/stmAAAzJa43n.00000001  W
       sd1      /export/home/stefan/archivelibs.tar  W
       sd1           /var/tmp/stmAAAyNaG4n.00000001  W
       sd1      /export/home/stefan/archivelibs.tar  W

# dtrace -s /usr/demo/dtrace/whoio.d
^C
    DEVICE                  APP        PID           BYTES
       sd1                  tar      12393           12288
       sd1                  tar      12413           12288
       sd1                  tar      12358           16384
       sd1                  tar      12388           16384
      ...
```

A simple case

We found the filename, the process name and we know that there are many tar processes running from time to time. But why !?

```
# ptree `pgrep tar`
7     /lib/svc/bin/svc.startd
  233   /usr/lib/saf/sac -t 300
    249   /usr/lib/saf/ttymon
  330   /usr/lib/saf/ttymon -g -d /dev/console -l console -T sun-
color -m ldterm,ttcomp
511   /lib/svc/bin/svc.startd
  609   /usr/lib/saf/sac -t 300
    612   /usr/lib/saf/ttymon
  617   /usr/lib/saf/ttymon -g -d /dev/console -l console -T sun-
color -m ldterm,ttcomp
2170  /usr/bin/gnome-terminal
  2191  ksh
    6221  /bin/ksh -p ./search
      16107 tar uvf /export/home/stefan/archivelibs.tar ./
iconv/amd64/UTF-32LE%UTF-8.so
```

Solution: A simple case

One of developers was working to one script, called search:

```
...
while true
do
 ...
 for file in $(find /usr/lib/iconv -type f -name \*.so)
 do
  tar cvf ${HOME}/archivelibs.tar $file 2>&1 > /dev/null
 done
 ...
done
```

So, that's why dtrace was reporting us lots of tar processes running. The developer fixed the code as:

Solution: A simple case

```
...
while true
do
 ...
 tar cvf ${HOME}/archivelibs.tar $( find /usr/lib/iconv -type f -name
\*.so )  2>&1 > /dev/null
 ...
done
```

At the end: using DTrace we were able to detect a slow and bad written application, to see what this was executing and to report and fix the problem !

More information ?

Sun BigAdmin site
http://www.sun.com/bigadmin/content/dtrace/

Man pages:

- dtrace(1M), dtrace(7D)
- libdtrace(3LIB)

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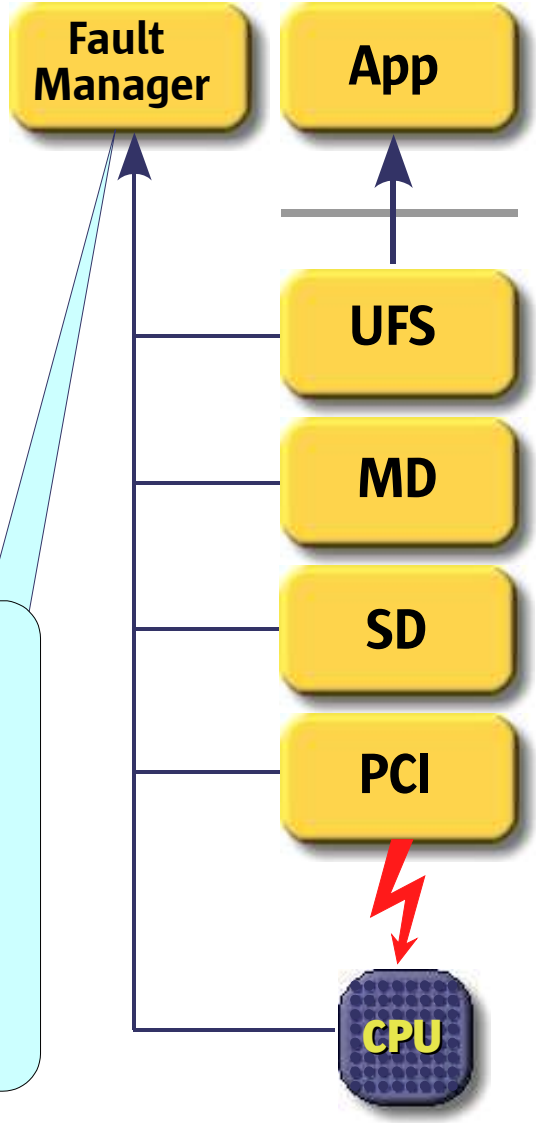
Predictive Self Healing - SMF

- New approach to service availability
  - Error detection & aggregation, auto recovery
- Reduced downtime
  - Components proactively offlined before failure
  - Automatic service restart
  - Diagnosis & mitigation in milliseconds, not hours
- Reduced complexity
  - Simplified error reporting
  - All system & service interdependencies recorded and correlated
- Reduced costs
  - Reduced system downtime, increased utilization

Predictive Self Healing - SMF

- User-friendly error messages with impact and action statements
- All events are managed and coordinated through a single fault manager service



SUNW-MSG-ID: SFV440-8000-A6, TYPE: Fault, VER: 1, SEVERITY: Major
EVENT-TIME: Thu Feb 26 18:08:26 PST 2004
PLATFORM: SUNW,Sun-Fire-V440, CSN: -, HOSTNAME: mix
SOURCE: cpumem-diagnosis, REV: 0.1
EVENT-ID: 322fe6d5-fe14-6a73-b802-cc6c30b2afcd
DESC: The number of errors associated with this CPU has exceeded acceptable levels.
Refer to http://sun.com/msg/SFv440-8000-A6
for more information.
AUTO-RESPONSE: An attempt will be made to remove the affected CPU from service.
IMPACT: Performance of this system may be affected.
REC-ACTION: Schedule a repair procedure to replace affected CPU.

Predictive Self Healing - SMF

The Service Management Facility smf(5) provides a new infrastructure enlarging the traditional UNIX start-up scripts, init run levels and configuration files:

- An infrastructure to start and restart services automatically
- A mechanism to formalize relationships between services
- A repository for storage of service startup behavior and configuration information

Predictive Self Healing - SMF

Components:

- svcs(1) service status listings, diagnosis
- svcadm(1M) administrative actions
- svccfg(1M) general property manipulation
- svcprop(1) property reporting

inetd(1M)specific support:

- inetadm(1M) administrative property mods
- inetconv(1M) conversion of legacy inetd.conf

private commands:

- lsvcrun(1) run legacy rc*.d scripts
- mfstscan(1) detect updated manifests

Predictive Self Healing - SMF

svcs(1) in action

- list active instances, sorted by state and time
- show dependencies (-d)
- show member processes (-p) and additional info (-v)

```
$ svcs
STATE          STIME    FMRI
legacy_run     Nov_25   lrc:/etc/rc3_d/S84appserv
legacy_run     Nov_25   lrc:/etc/rc3_d/S84patchserver
legacy_run     Nov_25   lrc:/etc/rc3_d/S90samba
online         Nov_25   svc:/system/fmd:default
online         Nov_25   svc:/platform/i86pc/kdmconfig:default
online         Nov_25   svc:/system/console-login:default
online         Nov_25   svc:/milestone/multi-user:default
online         Nov_25   svc:/milestone/multi-user-server:default
online         Nov_25   svc:/system/zones:default
offline        Nov_25   svc:/application/print/ipp-listener:default
offline        Nov_25   svc:/application/print/rfc1179:default
```

Predictive Self Healing - SMF

```
$ svcs -p /network/ssh:default
STATE          STIME    FMRI
online         Nov_25   svc:/network/ssh:default
               Nov_25       124 sshd
$ svcs -d /network/ssh:default
STATE          STIME    FMRI
online         Nov_25   svc:/network/loopback:default
online         Nov_25   svc:/system/filesystem/usr:default
online         Nov_25   svc:/system/cryptosvc:default

$ svcs -v /network/ssh:default
STATE          NSTATE        STIME    CTID   FMRI
online         -             Nov_25       27 svc:/network/ssh:default
$ svcs -x
svc:/application/print/server:default (LP Print Service)
 State: disabled since Thu Nov 25 19:36:15 2004
Reason: Disabled by an administrator.
   See: http://sun.com/msg/SMF-8000-05
   See: lpsched(1M)
Impact: 2 dependent services are not running.  (Use -v for list.)
```

More information ?

Sun BigAdmin site

http://www.sun.com/bigadmin/content/selfheal/

Man pages:

- smf(5)
- svcs(1),svcadm(1M)
- svccfg(1M), svcprop(1)
- inetadm(1M), inetconv(1M)

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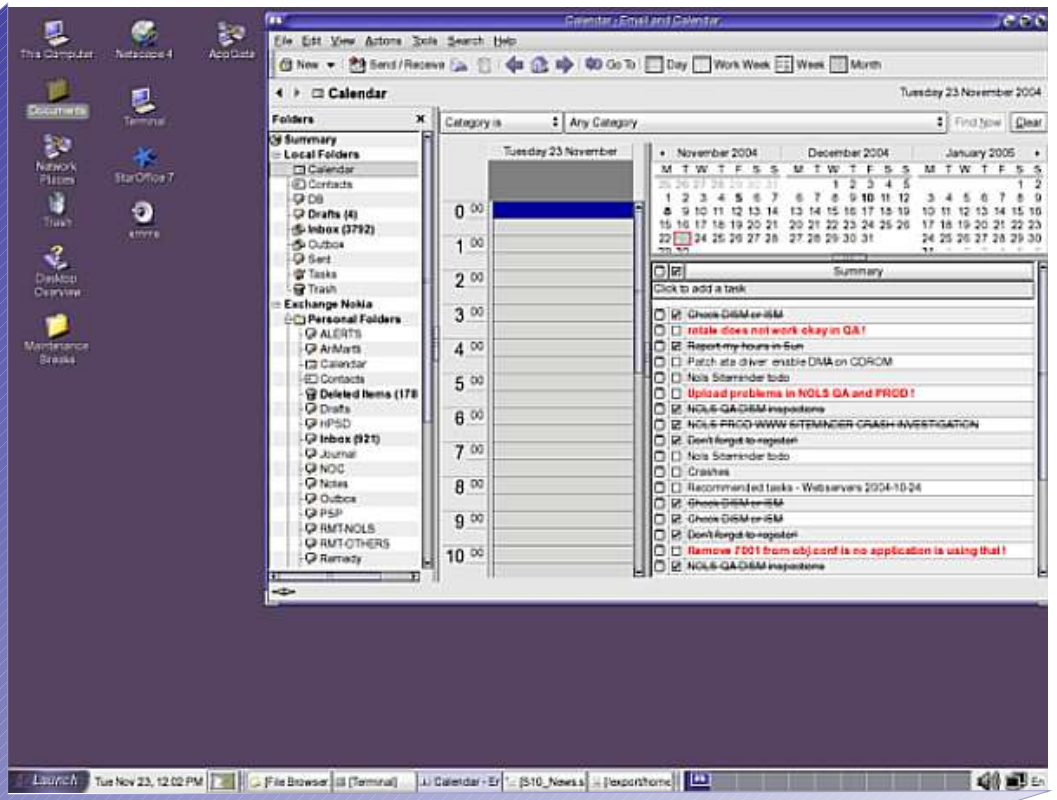
Java Desktop System - JDS

- Open
- Cost Effective
- Reliable
- Secure



StarOffice

Evolution

Mozilla

Java

GNOME Look and Feel

Solaris | Linux

Security

More information ?

Sun BigAdmin site

http://wwws.sun.com/software/javadesktopsystem/

Man pages:

- evolution(1)
- jds-help(1), gnome-*(1)

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Client Solutions

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Sun microsystems

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