Open Enhancements to Lustre Security
Whitelist Patch Example

LUG 2016

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Overview

- “Secure” is never yes/no – no system is either secure or non-secure
- Anything that can be *accessed* can theoretically be *hacked*
- Anything that *cannot* be accessed is rather less useful for HPC
- Therefore “Secure Lustre” *must* be a balancing act
- Our balance formula is:
  - No “vendor lock” allowed
  - Reasonably easy to implement
  - Reasonably low performance impact
  - Reasonably useful improvement to security
- Focus on one example of enhancing security within that formula

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Caveats etc.

- WARP *only* does ZFS solutions
  - "x" over ZFS
  - Comprehensive set of ZoL enhancements and tools
  - ZFS^2 architecture
  - Basically, we're the "go to" guys for commercially supportable ZoL...
- But we have done nothing with ldiskfs since 2011
- Testing for WARP's Open Secure Lustre recommendations has been done on WARP's hardware and OS, not on any other platform

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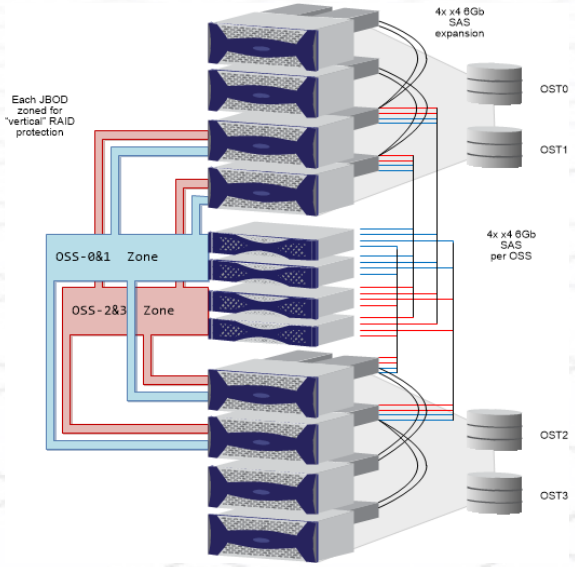
Test Scale Systems

- WARP has a number of PB scale test systems
- These are not 10s of PB, but representative of 1x SSU
- Security processes were tested on this example SSU before it went production last year:

- 8x high density JBODs
- Connected to 4x ZFS OSSs
- Separate HA ZFS MDS/MGS
- Running 2x Lustre FSs
- Uses SSD/HDD hybrid

- Planning to test in larger scale systems next month



2PB to 4PB Lustre/ZFS WARP SSU design

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Linux Security

- Often, Lustre servers are “the exception” to “normal” security
  - SE Linux off, IP tables off, etc.
- *Might* be valid, up to a point...
- But if somebody can hack the *OS*, does securing *Lustre* help?
- Example: One WARP customer wanted “enhanced” Lustre security, but had literally not even changed default passwords
- In short, do the basic stuff first
- E.g., no SUID/SGID bits allowed on FS

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SSH and other services

- Change default port for ssh

```
vi /etc/ssh/sshd_config
```

→ Port 40122

- Disable **all** services that you **aren't** using

```
chkconfig smb off ; chkconfig nfs off ; chkconfig fcoe off ...
```

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IP Tables with Lustre

- At minimum, set it up on the MGS
  - Maximum effect with minimum performance overhead
  - If a client tries to connect outside of correct IP range, MGS won't talk to it

```
iptables -P INPUT ACCEPT ; iptables -F ; iptables -A INPUT -i lo -j ACCEPT
iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
iptables -A INPUT -p tcp --dport 22 -j ACCEPT
                              # change above to correct SSH port
iptables -P INPUT DROP ; iptables -P FORWARD DROP ; iptables -P OUTPUT ACCEPT
iptables -L -v

chkconfig iptables on
service iptables start
```

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SE Linux with Lustre

- Since Lustre 2.3, SELinux <u>can</u> work with Lustre
- BUT, has noticeable performance impact as well as admin overhead
  - E.g., could reduce performance by 50% on typical workloads
  - Even higher for "ls -l" type workloads
- May have minimal benefit, so may be more trouble than it's worth
- If you want to go there… Set "permissive" &reboot, see what's happening; adjust

```
# grep -i "SELinux is preventing" /var/log/messages

Mar  7 14:52:19 WARPhpc-658-RC1 setroubleshoot: SELinux is preventing
/bin/bash from read access on the lnk_file /etc/sysconfig/network-
scripts/ifcfg-eth0. For complete SELinux messages run sealert -l
2ecf8ed8-3608-4c07-9d5a-e687d477ca10
```

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Account and Password Policies

- Change root password – we see default passwords on “appliances”
- Limit sudo and don’t log in directly as root
- Disable all local user-level accounts for log in
- WARP can support 100% diskless OSS/MDS/MGS – centralizes all account security, right? Still need to remember IPMI accounts
- Anything with clear text IPMI password needs to be locked down
- Look at /etc/login.defs and /etc/pam.d/system-auth for:
  - Password Aging
  - Password Length
  - Password Complexity
  - Number of Login Failures
  - Re-Used Password Deny

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Data at Rest Encryption

- Several options for encrypting disks
- Plenty involve replacing disks etc, but there's also this:

```
cd /dev/disk/by-vdev
cryptsetup create eXXpAdYY eXXpAdYY
cryptsetup luksFormat /dev/mapper/eXXpAdYY
         # cryptsetup luksOpen eXXpAdYY eXXpAdYY
mkfs [ ... ] /dev/mapper/eXXpAdYY
```

"Substantial" performance impact for SSDs, e.g. 50%

(Note: e_p_d_ is WARP's meaningful UDEV scheme for disk names)

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Lustre White List / Black List

- Credit: Feature funded by Naval Research Lab (NRL)
- Jeremy Filizetti (ultrascale.net) created a white list:
  - review.whamcloud.com/#/c/18672

- Assume you already have appropriate Lustre server kernel
- Git 2.7 or 2.8 source, and apply patch

```
git clone git://git.whamcloud.com/fs/lustre-release.git
cd lustre-release
git fetch http://review.whamcloud.com/fs/lustre-release
refs/changes/72/18672/1 && git cherry-pick FETCH_HEAD
```

- Make patched Lustre RPMs

```
sh autogen.sh ; sh configure && ( make && make rpms )
```

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Lustre White List / Black List *(cont.)*

```
# lctl get_permitted_nids
ALL

# lctl list_nids
10.0.0.221@tcp

# lctl set_permitted_nids 10.0.0.221@tcp

# lctl get_permitted_nids
10.0.0.221@tcp
```

NID range format is same as root squash; supports "NONE" and "ALL" as well

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Lustre White List / Black List *(cont.)*

- Does not implement "black" list expressly
- However, white list function implies black list function
- E.g., say you specify NID range 192.168.1.0/24
- You want to "knock out 192.168.1.100 temporarily
- Change white list to 192.168.1.1-99 + 192.168.1.101-254
- Less efficient for sure... But...

- 1. Change range
- 2. Send "offending" NID to

  `/proc/fs/lustre/obdfilter/*OST*/evict_client`

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