Oracle Solaris Security: Mitigate Risk by Isolating Users, Applications, and Data

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Is this Risky/Scary?

Separate servers, locally attached storage.
More or less Risky/Scary?

Servers now zones, locally attached storage.
Now?

Now facing and now using SAN.
Solaris 11 Secured Cloud Hosting
Security Is An Arms Race

• Constant race between the attackers and defenders.
  – Mostly the same old bugs for 20+ years
  – More ways to exploit the bugs in new and old code

• Solaris needs to provide:
  – Security features
  – Solid runtime environment

• A lot of Solaris Security Engineering is small focused changes to other parts of the system to add more *built in* security assurance and features.
  – We can and do change any part of Solaris for security features

• Cloud and Virtualization don't really add new problems
  – But they do change the deployment threat model and assumptions around security...
A “Cloud/Visualization” Threat Model

• Hosting provider and the hosted environment have complementary but differing views of the threat model
  – In a data centre these might be the same groups
• Both care about securing the system
• Client may be mostly concerned with:
  – Unauthorized access to their data
  – “All disks/tapes leave the data centre eventually”
  – Attack on running system, eg website defacement
  – Trojaned runtime environment
• Provider may be mostly concerned with
  – Unauthorized access to hosting environment
  – Resource utilization
  – Reputation for providing a secure system
Key Messages

• Protect data at Rest and in Motion
• Prevent unauthorised access
• Delegation of control / Separation of Duty
• Reduce risk of “damage” or “theft” if unauthorised access does happen
• Audit trail of change for Compliance
• Highlights of some Solaris 11 security features
Mitigating the Risk
“Some Security Features”

• Many levels of “access control”
• Traditional UNIX permissions
• ZFS has NFSv4/Windows NT style ACLs
  – CIFS shares have ABE for share level restrictions
• Mandatory Access Control
  – *New* Zone file-mac-profile
  – Trusted Extensions labeling
• File System & block device encryption
• Application Sandboxes via Zones, privileges and resource controls
System Integrity Protection
“Get the right bits on disk and keep them right”

• Network package installation over HTTPS
  – Protect sensitive package content in transit
• Solaris 11 packages are cryptographically signed
  – You can add additional signatures
• System policy to require and verify signatures
  – YOU choose who to trust per system image
• ELF binaries are still cryptographically signed
  – Know they came from Oracle RE process
• For non packaged files bart(1M) provides a passive manifest comparison system using cryptographic hashes
System Integrity Protection
“But some things are editable”

• Solaris 10 “sparse root zones” partially read-only
  – wasn't really a security feature

• Solaris 11 zone “file-mac-profile”
  – Controls which parts of the zone are writeable even for root
    • *none*, *flexible-configuration*, *fixed-configuration*, *strict*
  – Underlying technology based on whitelist & blacklist, maybe extended to other sandboxing use cases in future releases

• ZFS checksums and self healing

• ZFS encryption for data file systems & ZVOLs
  – Can encrypt Zone file systems
Isolating Applications

• Solaris Zones as an application fault boundary
  – Service Management Framework
    • Restart & notification (SMTP, SNMP),
    • Per service firewall rule
  – Resource Controls (CPU, Memory, ...)
  – File system name space isolation
  – Solaris 11 per Zone administration delegation

• Privileges for sub-zone security boundary
  – Including removing new basic privileges:
    • net_access, file_write, file_read

• Zone system integrity via “file-mac-profile”
Remote User Authentication

- Solaris defaults to ONLY SSH remotely accessible
- No remote root login & root is a role by default
- SSH & Kerberos easier to manage centrally using X.509 certificate based authentication
  - YOUR Certificate Authorities as Trust Anchors
- Kerberos protection for NFSv3 & NFSv4 traffic
- Active Directory/Kerberos authentication for CIFS/SMB network shares
Data in Motion Protection

• Zone file system security boundary now applies to NFS server as well.
  – Each zone can serve a separate NFSv4 domain
  – Each zone can be in a separate Kerberos Realm

• Per Zone IPsec policy

• Kernel SSL/TLS proxy
  – Allows keeping private keys outside of the zone

• Hardware crypto acceleration on SPARC and Intel CPUs reduces overhead of encrypting network traffic
  – SSH, IPsec/IKE, Kerberos, OpenSSL, KSSL
Data at Rest Protection

• Encryption for UFS & other legacy filesystems via lofi driver.

• ZFS data set encryption (file system & ZVOL)
  – Comprehensive wrapping key management
    • Delegation: key use vs key change vs key location/type
    • Local or Centralised
    • Integrated with Oracle Key Manager via pkcs11_kms
    • 3rd Party key management integration
      – zfs(1M) key subcommand is scriptable
      – Keys from any https:// location – policy on server side
      – Data encryption key change at clone or on demand
Unique in the Industry: Trusted Extensions (TX)

- Only enterprise OS that includes multilevel functionality as a bundled feature
  - Full support of TX included in standard Solaris license
  - TX benefits from all Solaris 11 enhancements
  - Zones architecture makes labeling completely transparent to applications

- Only OS to ever achieve Common Criteria certification for security target including a multilevel desktop
  - Unique integration with GNOME labeled workspaces
  - Integrated with Oracle's Virtual Desktop Infrastructure
Data sensitivity labeling

• Tag the data everywhere
  – At rest in the file system
  – In motion in the network
  – In the application
• Allows controlling the data flow between applications, hosts and users
• Trusted Extensions provides:
  – Enhanced Zone based integrity & isolation boundary
  – File system level tagging of data sensitivity
  – IPsec based labeling of data in transit
  – Multi-level GNOME desktop with robust lockdown
Solaris 11 New Trusted Extensions Features

• Automatic persistent labeling of ZFS datasets
  – Labels are encrypted objects on disk
• NFS now provided by per label (zone) server
  – Improved isolation of NFS server (per label IP address)
  – Allows for separate NFSv4/Kerberos domains per label
• Improved CLI & GUI management tools
  – tncfg (local & LDAP)
• Labelled IPsec
• **PLUS** Lots of generic Zone improvements:
  – Exclusive IP stack, auto VNIC, Auto Installer integration, file-mac-profile...
• Infiniband support
Audit trail for Compliance and Reporting

• Comprehensive audit trail: 20+ years of development
  – System service & system call level
  – SMF is heavily audited – any property or service change

• Auditing now “ON” by default
  – Login/logout events
  – No reboot to change audit policy

• Audit inside or outside the zone
  – Can't see what auditing is happening or the audit trail

• Audit trail export to XML

• Client for transporting audit trail securely off the system
  – Protected by GSS/Kerberos for authentication/integrity/confidentiality
“But it is all too hard to use”

- Some of this was traditionally hard to use
- Solaris 11 has much better scriptable CLI for user and RBAC management with support for LDAP
- Firewall rules integrated with services (svc.ipfd)
- 'zfs create -o encryption=on pool/data'
  - Yes it can be that simple!
- Hardware encryption use is transparent
  - Solaris, Java, OpenSSL, and Oracle RDBMS
  - Even more so with SPARC T4 and Intel AES-NI
Solaris 11 Features Addressing Threats

• Multiple tenant application containment via Zones
  – RBAC Delegated administration (i.e. give access to console & zone reboot only)
  – Read Only Zone Root (*Mandatory Access Control*)
  – ZFS data set encryption of zone & data

• Application Sandboxing
  – More “basic privileges” - read/write files, network access (to become fine-grained in S11 updates)
  – Read Only Zone Root

• Data at Rest Encryption (ZFS)
  – With centralized & delegated key management

• Assurance that software hasn’t been compromised
  – Signed packages & secure package transport
  – Signed binaries / libraries
Solaris 11 Features Addressing Threats

• Accountability / Audit Trail
  – Now on by default (authentication events logged)
  – Near zero performance overhead
  – Audit trail off machine via secured transport
  – Many more things audited (lots via SMF) and more still to come
  – sudo is integrated with Solaris Audit trail

• Easier deployment of network security protocols:
  – X.509 support in Solaris 11 for SSH & Kerberos simplifies deployment
    and provides centralised management
  – NFS authentication, integrity, confidentiality via Kerberos

• Easier to user management tools
  – CLIs now support LDAP backend & more comprehensive
  – Fine grained delegation eg, change user but not root password
Solaris 11 Launch Event

9th November

http://oracle.com/goto/solaris11event