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

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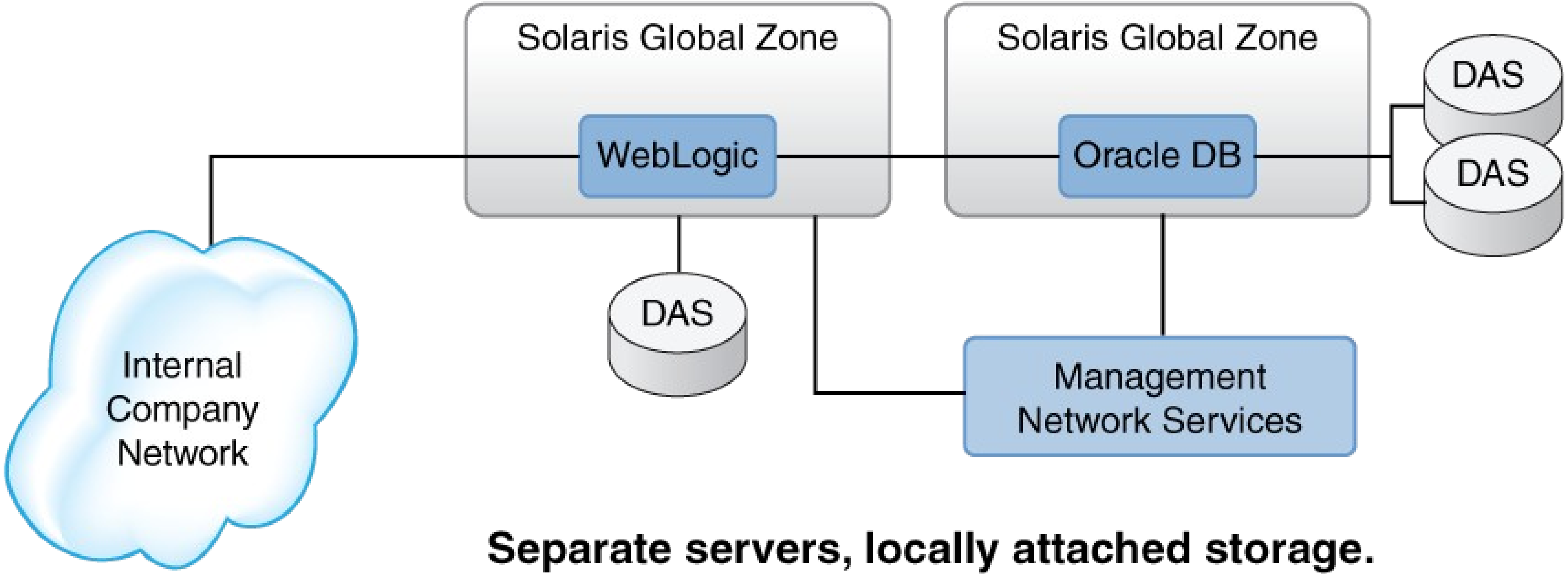
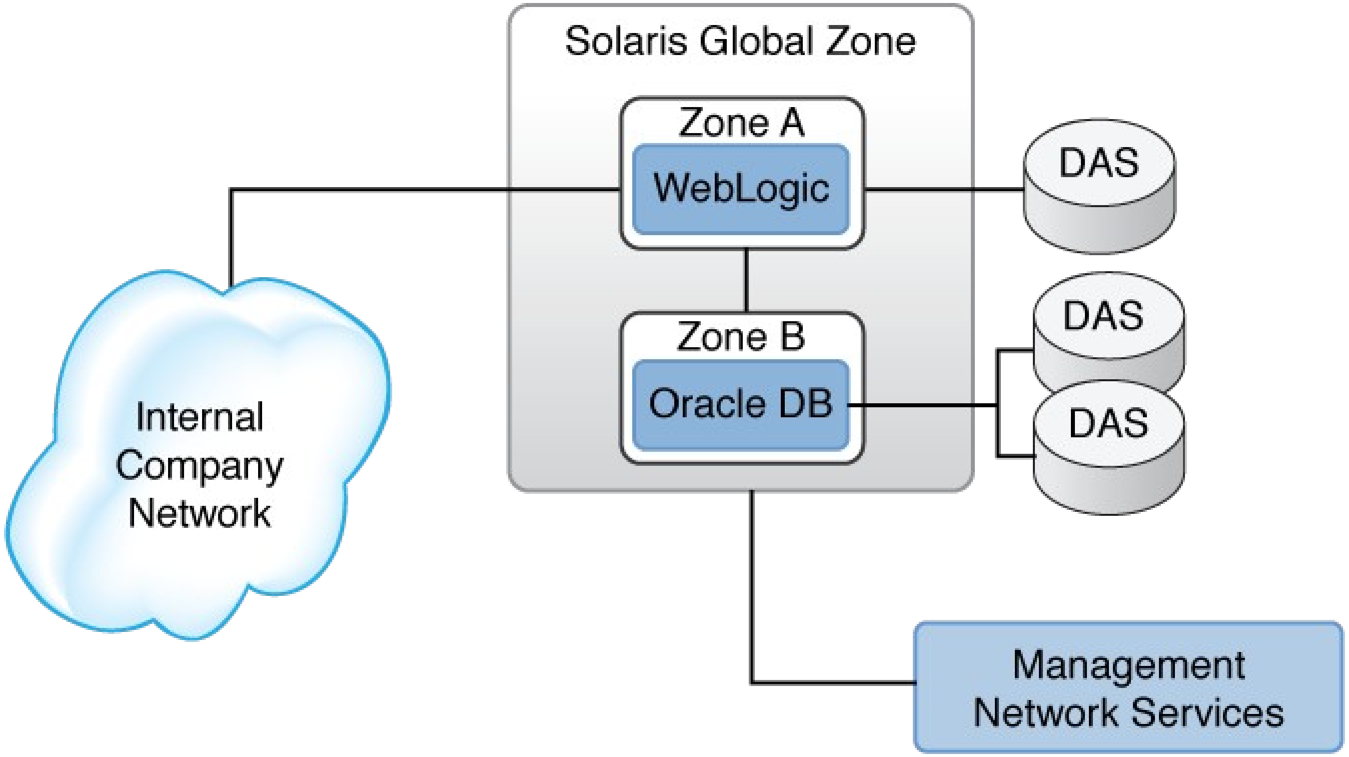
# Is this Risky/Scary ?



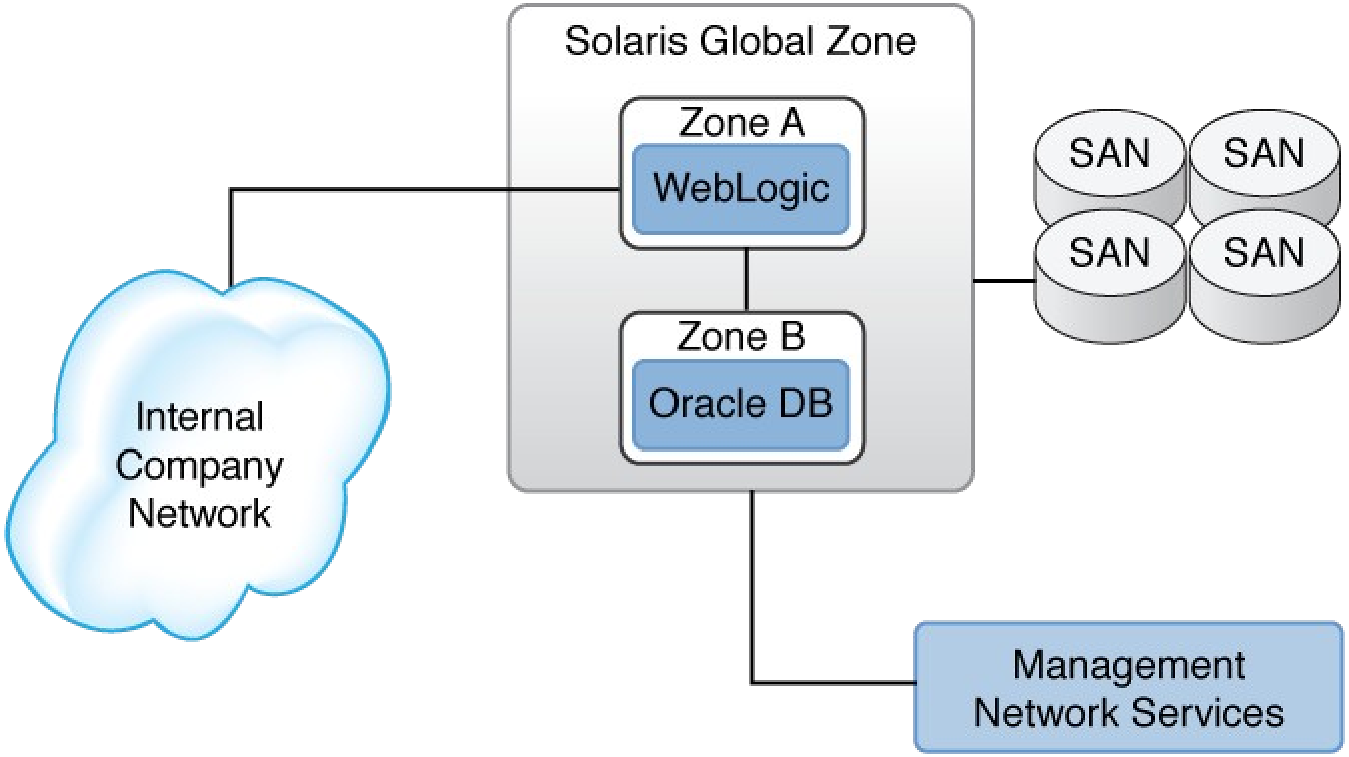
**Separate servers, locally attached storage.**

# More or less Risky/Scary ?



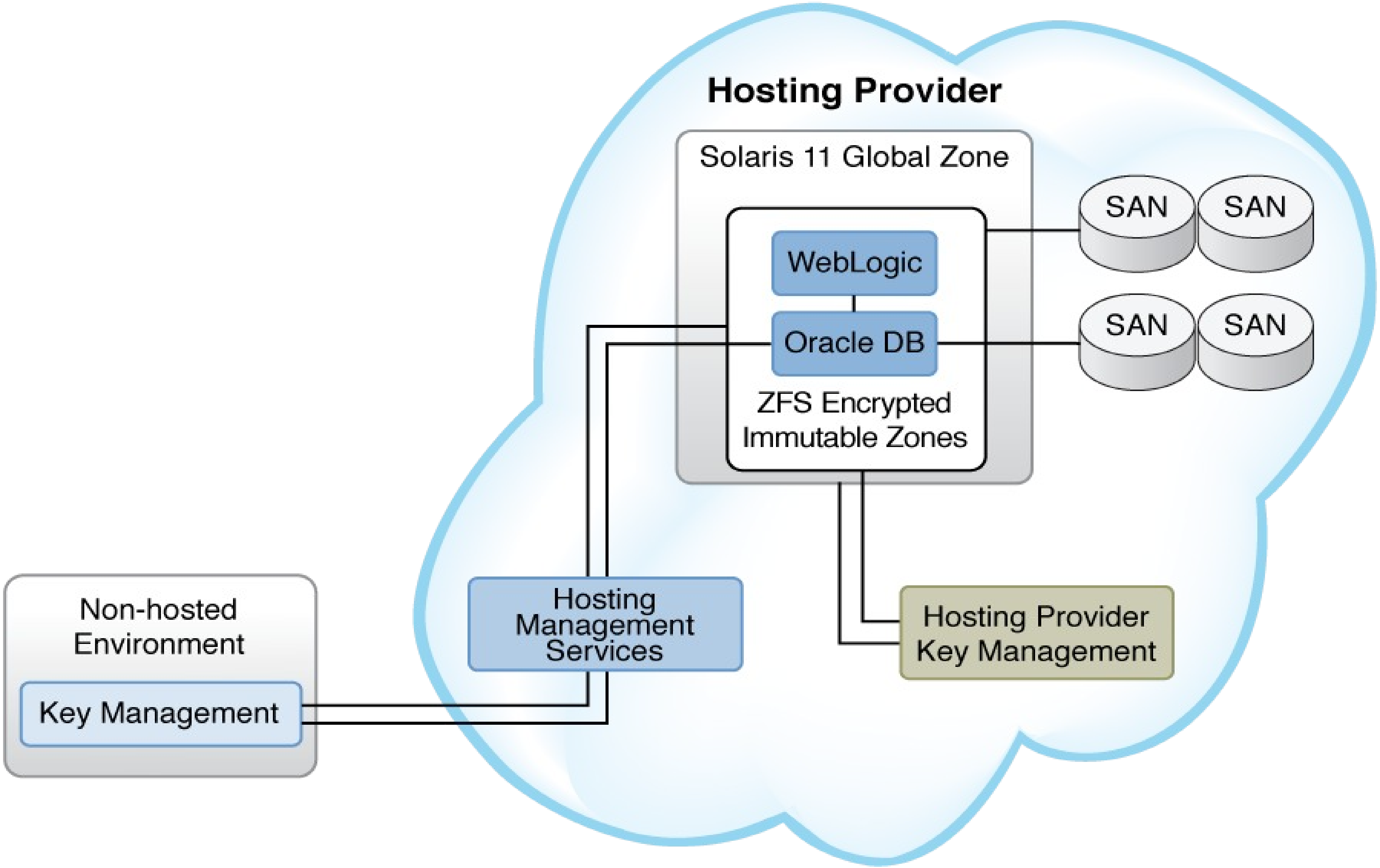
Servers now zones, locally attached storage.

# Now ?



**Internet 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

- Built for clouds
- Best for enterprise applications
- Best for Oracle

**Solaris 11 Launch Event**

**9th November**

**http://oracle.com/goto/solaris11event**

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