Building a strong z/VM and Linux on the mainframe architecture

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Client context

... DGTIC ...
Client context
The DGTIC

- IT service provider for many Québec government offices (125)
  - Already a mainframe shop
  - 5 z/890 + 1 z/800 + 1 G5 on the floor on 3 sites
  - 1 z9-EC dedicated to Linux on z/VM
  - 450+ physical servers (750+ logical) (HP, SUN, pSeries, …)

- DGTIC orientations:
  - Promote the mainframe environment
  - z/VM is the prime choice for future projects
  - Server consolidation is a priority
  - This project is in line with the new « online government » policy
Client context
Environment

- 1 z9-EC mainframe with 5 IFLs (~ 3000 mips)
- 5 LPARs
  - Oracle/DB
  - WAS
  - TAM & LDAP
  - Service Zone
  - Lab Zone
- 40 internal networks
- Software
  - SuSE Linux (versions 8 & 9)
  - z/VM v.5.2 +
  - Oracle/DB (versions 9i & 10g)
  - Velocity Software Performance Tools
  - CA products (Automation & Scheduler)
**Client context**

**Environment**

- Oracle/DB – Migration Project Status
  - Golden images
  - 165 Oracle instances with 125 Linux virtual machines
  - Growth of over 100 new instances planned per year for the next few years
  - 25 instances in production as part of the government portal
  - For the first migrations (~ 60), on average
    - 1 migration per day (20-25 databases per month)
  - Our current challenge is to synchronize the migrations with date restrictions imposed by our external clients
Architecture
• The DGTIC serves the needs of over 125 clients, some large, some small.
• Clients must have their applications and data separated from each other.
• The challenge is how to do this in a centralized shared environment.
• System z hardware with z/VM leads the way!
• Old school IBM mainframe virtualization
  • 35+ years of storage and CPU sharing with integrity and isolation
• LPARs
  • Hardware partitioning
• Networks within the box
  • Hipersockets, guest lans, and Vswitch
• Securing resources with RACF
Virtual storage isolates the memory of address spaces (virtual machine memory). Memory is isolated in both main and auxiliary storage devices, and controlled by CP.

Two virtual machines, VMA and VMB are shown.
The CPU(s) are time shared. The CPU scheduler and dispatcher subsystem organize the virtual machine work. Control of the CPU is given for milliseconds. In the example VMA gets cycles before VMB.
LPAR and z/VM provide the most virtualization of any platform. Logical partitioning of the physical resources with PR/SM (up to 30 LPs) and software partitioning with z/VM (thousands of virtual machines).
In the System z platform the hardware resources are logically distributed among multiple control programs. Each instance runs simultaneously and independently. The set of resources available to each control program is called a logical partition (LP). Resources are logical CPUs, storage, and I/O.
• A variety of choices for networks that keep the clients isolated
  • OSA devices
    *Traditional connectivity from mainframe to physical switches*
  • Hipersockets
    *Inter and Intra LPAR connectivity*
  • Guest lans
    *Connect virtual machines on virtual networks within an LPAR*
  • Vswitches
    *Connect guest lans to physical switches using OSA devices*
RACF ensures isolation as it provides security for these protected resources and events in z/VM:

- Logon
- Link
- Vswitch
- Vlan
- Shared File system
- VM FTP
The Linux golden images are hardened, tested and certified by an independent team before allowing the image to be cloned.

Hardening tasks:
- Removing unneeded login accounts
- Removing many supplied services such as FTP, Telnet, and NFS.
- Sifting through the startup /etc/rc.d tasks and removing unneeded tasks.
- Using PAM authentication with strong password practices.
- Using Tripwire to inventory software and for file anomaly detection.
- Ethical hacking done on a regular basis for penetration testing and cracking.
  - Certified by an independent team.
• We use a lot of Vswitch networks.
  • Over 40 ….
• Vswitch connects to OSA port as conforms to the physical network topology.
• Redundancy provided only for production networks.
  • Handled within Vswitch connecting to multiple unique OSA ports.
  • Does not require VIPA
• Some OSA ports shared across zones in multiple LPARs.
• Firewalling done downstream from the mainframe.
• 15 production networks have redundancy with dual OSA ports.
  
  All others (25+) do not have redundant networking

• Managed by Vswitch.
• Connect to different physical switches.
• Switches are bridged.
I’m the best!

Practice makes perfect
In our project we planned to utilize best practices for systems and network management.

Examples of in use best practices:

- Networking:
  - Performance data collection using private Vswitches
  - Manage multiple networks from a single TCPMAINT

- Systems:
  - Golden images (z/VM & Linux)
  - Cloning engine
  - Sharing resources the DGTIC way
  - Sharing resources the IBM way
Best Practices
Performance data collection using private Vswitches

- A TCPIIP stack with multiple guest lans and vlans collects data for the Velocity SNMP data collection.
- The Vswitches are defined without real devices.
- Membership in the Vswitch and vlan is RACF protected.
Best Practices
Administering multiple z/VM TCPIP machines from a single TCPMAINT
Our z/VM golden image:
- z/VM 5.2.0 RSU 0602+ reach ahead service
- All production mdisks on one volume per system
- Goal is to service from one system
- One flavor

Our Linux on the mainframe golden images:
- SuSE SLES 8 or 9 (evaluating v.10)
- Service pack 2 or 3
- Hardened
- One application flavor (Oracle or WAS or TAM/LDAP)
- Input to the cloner
- Both are rigorously tested and certified
The golden image is really black and white and waddles on ice but not until:

- Installed
- Serviced
- Hardened
- Tested by various groups
- Passes security penetration tests and certification

- There are a few masters and many many many many clones!
• Hand crafted
• Pride of ownership
• Not a disk copier
• Intelligent decisions:
  • Choice of Linux
  • Choice of application
  • System and application position
  • Vswitch membership
  • Vlan membership
  • IP address
  • Data replicated
  • Strong passwords

I am a clone. I have the same DNA as the master. I have a custom IP and I can live in any zone.

I am the master. I live in the service zone. I have been installed, hardened and tested.
Best Practices
Our cloner: Coding and interfaces

- Coded in REXX and PIPELINEs.
- Interfaces to DIRMAINT and RACF.
- Inputs include which system, application, storage size, etc.
- Interfaces with 3270.
- Can clone only from service zone to any other zone.

I am a clone. I have the same DNA as the master. I have a custom IP and I can live in any zone.

I am the master. I live in the service zone. I have been installed, hardened and tested.
Tiny minidisks with Linux filesystems written to by the cloner

15E
PARM DISK SYSTEM

15F
PARM DISK ORACLE

150
CLONED from MASTER

152
LINKED From MASTER

Best Practices
Disk layout for the Cloned Linuxen
Best Practices
The big picture of the cloning

Large Shared Linux Disks
For Executables /usr

Tiny parm disks for each Linux server with system parameters.

Tiny parm disks for each Oracle server

Large ORACLE disk shared executables
Best Practices
The cloner at the DGTIC

Service Zone
- Determine the configuration of the new server
- Pure Vanilla Package
- DGTIC Vanilla + general and management utilities
- Oracle DB + packages and utilities for Oracle

Protected/Secured Zones
- Vulnerability tests
- Architecture
- Oracle DB used for security tests
- Authorizations OK?
- Production Oracle DB

Protected / Secure Zones:
- /parm RW
- /parm2 R

* : These images reside on a virtual Linux server in the service zone for access via FTP. This server contains software libraries.
Best Practices
Resource sharing at the DGTIC

• IBM way (old school – 35+ years)
  • CPU
  • Memory
  • Minidisk i/o
  • Spooling

• DGTIC sharing:
  • Linux file systems (/usr)
  • Heavy usage of Vswitch
    • Lots of guest lans
    • Many OSA ports
Best Practices
Sharing /usr with the master
Best Practices
Resource sharing
HiperSockets network on the z9-EC

<table>
<thead>
<tr>
<th>HiperSockets 192.168.150.x</th>
<th>Chpids “BF”</th>
</tr>
</thead>
<tbody>
<tr>
<td>telnet rscs</td>
<td></td>
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<tr>
<td>z/VM protect LPAR</td>
<td></td>
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<tr>
<td>telnet rscs</td>
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<tr>
<td>z/VM secure LPAR</td>
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<td>telnet rscs</td>
<td></td>
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<tr>
<td>z/VM service LPAR</td>
<td></td>
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<tr>
<td>telnet rscs</td>
<td></td>
</tr>
<tr>
<td>z/VM other LPAR</td>
<td></td>
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</tbody>
</table>

- Internal network only.
- Used for administrative purposes.
- Applications include the cloner, telnet, RSCS (file transfer and message queues).
- Secure memory-to-memory transfer.
Best Practices
Resource sharing
Vswitch usage at the DGTIC

Legend: VSWITCH OSA port: letter
• Acceptance of virtual servers quicker than expected.
  • Grew to 100+ Oracle servers ahead of plan.
• Fully tasked personnel (big shoulders):
  • Confirmed our expectation that 2 Linux administrators can support all virtual Linux servers.
    • 100:1 ratio of Linux virtual machines to administrator
  • 2 z/VM systems programmers supporting 5 LPARs: (could support many more)
    • New to z/VM
    • Mentored by consultant
    • z/VM support will be integrated into MVS group by year end 2007
• Less than fully tasked personnel (arms and legs):
  • Security administrator
  • Network programming
  • Storage
  • Automation
  • Performance
• Big win early win with successful disaster recovery.
• Administration and reporting on centralized servers is excellent.
• Lots of new documentation and procedures integral part of project.
• Lots of training required.
• Require a lot of z/VM paging space.
  • Core memory of 32 gigabytes, 2 gigabytes of expanded storage, and 72 gigabytes of DASD paging space.
Best Practices
Lessons learned: Volume 3

• Critical mass of servers required – use more than 1 Linux virtual machine for benchmark, POCs, and business case!
• Initially, project was done for the $ savings, now the important gains:
  1. The flexibility of the solution
  2. Disaster recovery
  3. $ savings
• You must have a sponsor. Our sponsor was the operations directorate for the mainframe business interested in solving DR issues.
Best Practices
Oracle Lessons Learned

• Mostly business as usual for the DBAs:
  • Use SSH client or “X” windows (no 3270 usage)
  • DBAs comment on rapid performance of I/O
  • DB loading faster than in other platforms.
• Benign ignorance of the virtual machine
  • Linux administration performed by Linux sysadmin.
  • z/VM administration performed by VM sysprogs.
• Rapid creation of new databases in virtual machines for testing, acceptance, and production.
• Initial install was difficult but once incorporated into cloning methods subsequent installs quick and easy.
• Almost all client needs satisfied with ORACLE cloned image (they don’t know).
  • ~ 2% require some sort of customizing.
Questions ?

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