Best Practices for Linux on Z

"If you can't Measure it, I am Just Not Interested ™"

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Configuring z/VM for Linux on zSeries

- Must configure z/VM – many defaults incorrect or out of date
- Linux must be configured for shared resource environment
- Many actions not intuitive
- “Best Practices”

Infrastructure unknowns for “new” installations

- How to manage performance / capacity planning?
- Is chargeback important?
- Operational support for 1,000 servers?
- What are the limits of a configuration and how to measure
- How to share resources to INCREASE the ROI

Measurement and Tuning for z/VM IS Required

- Start with Proper Configurations

Configuration Options

General Storage Options

Linux Options

- Storage Sizes
- Swapping for Linux
- Linux virtual processors
- Network

z/VM Configuration

- Network, I/O, FTP Topics
- MDC
- Paging and Spooling for z/VM
- DASD/Cache/Channels
- z/VM System parameters

Infrastructure

- Linux infrastructure – monitoring availability and performance

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Storage Considerations

z/VM is shared resource environment

- Over-committing improves costs per server
- Over-allocating storage decreases server performance
- Knowing the sweet spot when over allocating impacts performance

Storage requirements of Linux very high

- Linux designed for dedicated storage, references all storage
- Linux is LRU, competing with VM's reference pattern
- High percent of referenced pages – what can z/VM page out?

Linux and applications poll at high rates

- 100 timer pops per second was Linux 1st problem, fixed.
- **Current release of IBM JDK (WAS) polls 10 ms**
- **Very high rate on dispatching impacts hardware cache**

6.3/6.4 Considerations?

- **More page space required?**

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Linux Storage (RAM)

z/VM Paging

- Over commitment of storage causes paging
- **Over commitment of storage reduces cost**
- Paging is common **(manageable)** performance problem
- (6.3 / 6.4, paging rates goes up, not a bad thing)

Linux Swapping

- Swapping result of over commitment of Linux storage
- Swapping to vdisk very fast, uses storage when it happens
- Swapping to dasd very slow, always noticeable

- Understanding Linux ram (real storage) will save gigabytes real storage

Linux Cache

- Linux avoids I/O by using cache
- Linux will cache gigabytes of data if allowed
- Oracle SGA MUST fit in linux page cache
- Swap historically was slow SCSI device so storage oversized

Reduce size of Linux Virtual Machine MAJOR Knob.

- Reducing virtual machine size reduces caching of old data
- Define virtual disk for swap
- Virtual Disk paged out when not in use -
- Experiment with Linux server swapped 40,000 per second

Tailoring Linux Storage

Linux data shows
- **Real storage**
- **Swap storage**
- **"cache"**

Some Swapping is "good"
- **If not swapping,**
  - **reduce vm size**
  - **Use CMM to reduce**

Watch for opportunities
- **HIGH available**
- **No swap**

```
Report: ESAUCD2      LINUX UCD Memory Analysis   Velocity Software Corpo
 Monitor initialized: 10/03/14 at 07:22:27 on 2   First record analyzed:
-------------------------------------------------------------------------
Node/    <-------------------Storage Size (MB)------------------------->
Time/    <--Real Storage--> <-----SWAP Storage--Storage in Use--------->
Date     Total  Avail Used  Total Avail Used   Buffer Cache Ovrhd Shared
-------- ------ ----- ----- ----- ----- -----  ------ ----- ----- ------
                                    07:24:00
ORAap042 8041.5 475.9  7566  1130  1130   0.1   183.5  1512  5870      0
ORAap044  13069  7131  5939  6888  6888     0   233.0  3913  1793      0
ORAap046 8041.5  2091  5951  1130  1130   0.1   260.9  3423  2267      0
ORAap048 8041.5  2291  5751  1130  1130     0   224.8  3347  2179      0
ORAap050 8041.5 529.3  7512  1130  1130   0.1   186.9  1577  5749      0
ORAap052  10046 642.8  9403  8172  8172     0   226.5  3958  5218      0
ORAap054 8041.5  1235  6807  3036  2878 158.3   139.9 319.3  6348      0
ORAap056 8041.5 818.5  7223  5604  5592  12.2   156.4 968.3  6098      0
ORA1101b  12062  64.0 11997  4942  4758 183.6   727.5 10024  1246      0
ORA1201a  12062 218.9 11843  4942  4438 503.7   152.4  7170  4520      0
ORA1202a  12062  1668 10394  4942  4399 543.3   137.3  6435  3822      0
ORA1203a  12062  94.0 11968  4942  4443 498.5   168.6  7582  4216      0
ORA1204a  12062  90.9 11971  4942  3754  1188    70.9  8088  3811      0
ORA1205a  12062  81.8 11980  4942  4562 380.1   162.6  8115  3702      0
ORA1301b  12062  79.0 11983  4942  4760 181.7   731.4  9952  1299      0
ORA1401a  12062 334.7 11727  4942  4454 487.7   181.5  7234  4312      0
ORA1402a  12062 528.2 11533  4942  3777  1165   133.3  6976  4424      0
ORA1403a  12062 462.1 11599  4942  4420 521.8   180.6  6783  4636      0
ORA1404a  12062 439.3 11622  4942  4442 499.9   103.4  6853  4666      0
ORA1405a  12062 442.5 11619  4942  4471 471.1   127.0  6593  4899      0
WAS2a016 2502.6  89.6  2413  1130  1106  24.2   203.0 243.0  1967   48.0
WAS2a020 2502.6  29.9  2473  1130  1106  24.1   254.3 238.8  1980   47.9
WAS2a024 5520.4  2635  2885  1130  1130     0   776.4 613.3  1496   50.3
WAS2a054 2502.6  22.0  2481  1130  1106  23.4   247.9 274.1  1959   48.5
WAS2a058 2502.6  22.4  2480  1130  1106  23.5   244.5 254.9  1981   48.5
WAS2a062 6528.3  3687  2841  1130  1130     0   762.0 591.8  1487   50.3
WAS2a114 2502.6  17.7  2485  1130  1106  23.6   219.6 267.6  1998   48.4
WAS2a118 2502.6  17.6  2485  1130  1106  23.6   260.5 264.1  1960   48.2
WAS2a124 2502.6  14.1  2488  1130  1106  24.0   271.0 264.8  1953   48.0
WAS2a128 2502.6  17.8  2485  1130  1106  23.4   263.1 251.9  1970   48.4
WAS2a402 5016.4  37.7  4979  1130 907.0 222.9    15.8 418.3  4545    0.0
```

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Linux Swapping

Reducing virtual storage size may cause swap

- Linux does not swap until out of storage

Swapping to disk

- VERY VERY SLOW
- Other platforms increase storage size because disk is slow
- **Swap to disk if you want to penalize a server**
- Max swap rate maybe 200 on a very good day

Linux Swapping to Vdisk

- Not a performance degradation
- 40,000 / second is FAST

Swap Guideline:

- **Define 2 virtual disks, prioritized swap**
- **First one "smaller", 2nd on 2GB (Insurance)**
- More swap devices for SAP as needed (they are essentially free)
- Use DIAG driver instead of FBA - Reduces I/O by factor of 8

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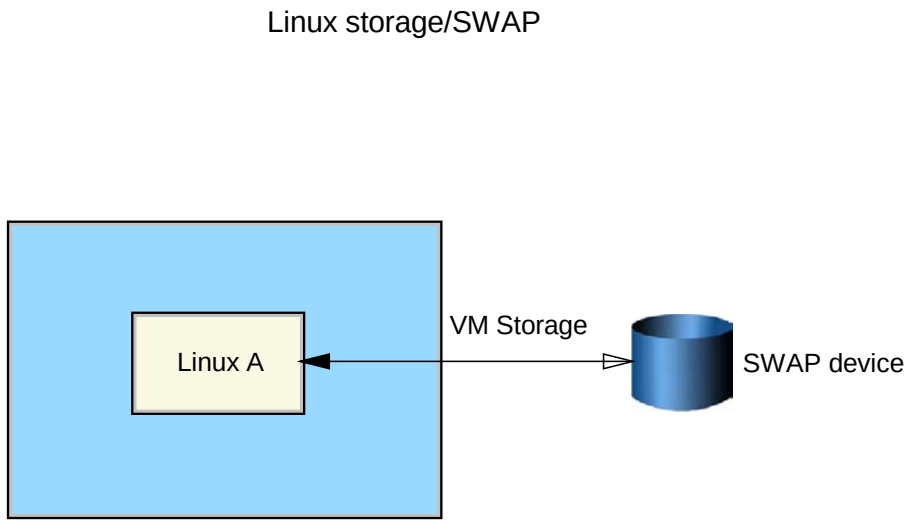
Linux traditional perspective

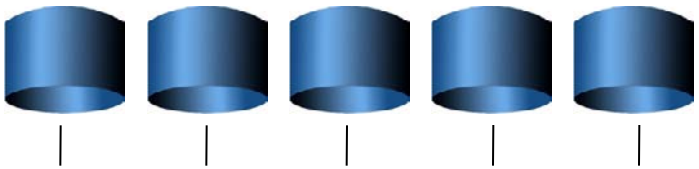


z/VM Paging Hierarchy

Utilize features of z/VM – Virtual Disk

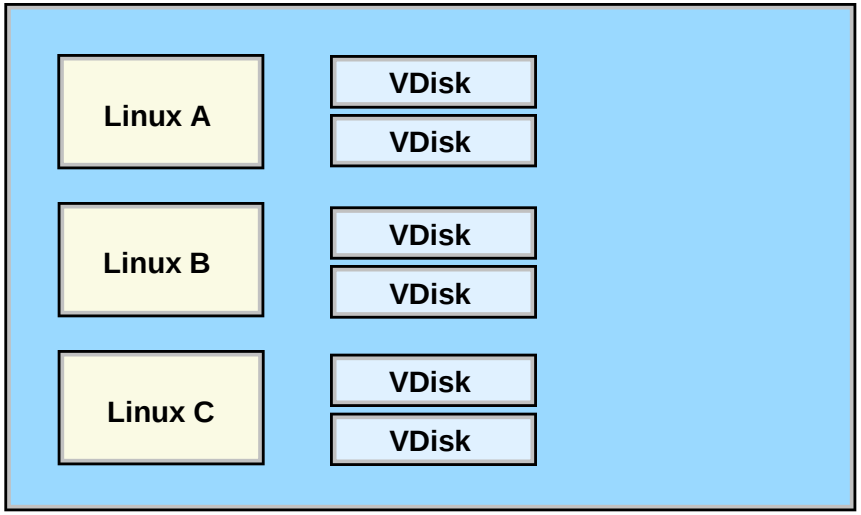
- **Linux not limited in swap rate,**

- **z/VM supports high paging band width over many exposures**



Page volumes

z/VM Paging bandwidth VERY HIGH



Central processor storage

Linux Swap bandwidth VERY HIGH

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Linux Storage Case Study

First case study:

- Process took hours, system paged significantly
- Reduced size of Linux Virtual Machine, 128mb to 24mb
- Defined 100MB Swap disk
- Linux reduces storage requirement
- Process took minutes

Virtual Disk paged out when not in use

- This works!!! Paging greatly reduced, Linux performance greatly improved!!!

This research critical to using Collaborative Memory Mgmt (CMM)
CMM allows dynamic reduction in Linux storage requirements

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LINUX Swapping to VDISK (micro test)

Change 128MB Server to 24MB with 100MB Swap

Reduction of Overall Storage Requirements of 100MB

- Unused VDISK is paged out

Screen: ESAVDSK Velocity Software, Inc.

Time	Owner	Space Name	<--pages--> Resi-dent	Lock-ed	DASD Page Slots	X-Store Blks
12:15:01	LINUX001	VDISK$LINUX001$0202$0009	36	0	50	0
12:16:01	LINUX001	VDISK$LINUX001$0202$0009	36	0	50	0
12:17:01	LINUX001	VDISK$LINUX001$0202$0009	173	0	50	0
12:18:01	LINUX001	VDISK$LINUX001$0202$0009	293	0	35	0
12:19:01	LINUX001	VDISK$LINUX001$0202$0009	293	0	35	0
…..						
12:39:01	LINUX001	VDISK$LINUX001$0202$0009	259	0	35	0
12:40:01	LINUX001	VDISK$LINUX001$0202$0009	259	0	35	0
12:41:01	LINUX001	VDISK$LINUX001$0202$0009	207	0	86	0
12:42:01	LINUX001	VDISK$LINUX001$0202$0009	207	0	86	0
12:43:01	LINUX001	VDISK$LINUX001$0202$0009	13	0	280	0
12:44:01	LINUX001	VDISK$LINUX001$0202$0009	13	0	280	0
12:45:01	LINUX001	VDISK$LINUX001$0202$0009	13	0	280	0

Virtual Storage vs Virtual Disk tradeoffs

Virtual Disk I/O 838K / 900 seconds

- About 900 - 1,000 per second
- (NOTE MDISK HIT RATE!!!!)

```
Report: ESAUSR3      User Resource Utilization - Part 2 Domino Redbook ESAMAP 3.4.0
Monitor initialized: on 2066 serial 71CE3 First record analyzed: 08/21/03 12:00:00
--------------------------------------------------------------------------------
                DASD MDisk Virt Cache I/O    <---Virtual Device---->
UserID    DASD Block Cache Disk   Hit Prty   <----I/O Requests----->
/Class     I/O   I/O  Hits  I/O   Pct Queued  Cons   U/R  CTCA Other
-------- ----- ----- ----- ---- ------ ----- ----- ----- ----- -----
08/21/03
12:15:00  613K     0  248K 838K  74.8      0  1510     0   321     0
**Top User Analysis***
LINUXA    610K     0  246K 838K  74.8      0     1     0     0     0
--------------------------------------------------------------------------------
12:30:00  615K     0  250K 822K  74.6      0  1487     0   324     0
**Top User Analysis***
LINUXA    613K     0  248K 822K  74.6      0     0     0     0     0
--------------------------------------------------------------------------------
12:45:00  631K     0  260K 884K  75.5      0  1634     0   321     1
**Top User Analysis***
LINUXA    628K     0  258K 884K  75.5      0     0     0     0     0
```

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Cost of Swap

Cost of Swap daemon measurable by zVPS (esalnxp,esahsta)

- **at 1000 swaps per second:**
- **about 10% (on z800)**

Report: ESAHSTA LINUX HOST Application Report Domino Redbook ESAMAP

Node/ Date Time	Process/ Application name	<-Application Process Counts-----> Total	active	Running	ResWait	Loaded	<-----Processor----> <---Utilization----> Percent	seconds	Avg
08/21/03 12:15:00									
LINUXA	java	15.0	15.0	2.0	13.0	0	10.3	92.6	0.7
	kswapd	1.0	1.0	0	1.0	0	9.1	82.2	9.1
	router	11.0	11.0	0	11.0	0	10.6	95.4	1.0
	server	67.0	67.0	1.0	63.0	3.0	63.2	568.5	0.9
	snmpd	1.0	1.0	1.0	0	0	3.3	29.3	3.3
	update	3.0	3.0	1.0	2.0	0	10.2	91.7	3.4
12:30:00									
LINUXA	java	17.0	17.0	2.0	15.0	0	9.5	85.9	0.6
	kswapd	1.0	1.0	0	1.0	0	8.8	79.5	8.8
	router	12.0	12.0	2.0	9.0	1.0	11.0	99.3	0.9
	server	61.0	61.0	4.0	55.0	2.0	62.7	563.9	1.0
	snmpd	1.0	1.0	1.0	0	0	3.2	28.8	3.2
	update	4.0	4.0	0	4.0	0	12.0	107.8	3.0
12:45:00									
LINUXA	java	16.0	16.0	0	16.0	0	10.3	92.4	0.6
	kswapd	1.0	1.0	0	1.0	0	9.5	85.6	9.5
	router	10.0	10.0	0	10.0	0	11.1	99.6	1.1
	server	67.0	67.0	9.0	53.0	5.0	64.3	578.6	1.0
	snmpd	1.0	1.0	1.0	0	0	2.4	21.9	2.4
	update	5.0	5.0	0	5.0	0	13.0	116.9	2.6

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VDISK Case Study

VDisk for swap rules:

- **Two small virtual disks for swap, prioritized**

Breaking the rules increases storage:

Typically, vdisk is a very small component of storage

Note case study, vdisk large? WHY???

```
Report: ESASTR1
Monitor initialized: 032094 serial 9E14C     First record analyzed: 03/05/08
-------------------------------------------------------------------------------
         Users <-------Pages-----------------------------------------
         Loggd System   <Available> Systm  User  NSS/DCSS  <-AddSpace> VDISK
Time        On Storage  <2gb  >2gb  ExSpc Resdnt Resident  Systm User  Rsdnt
-------- ----- -------  ----- ----- ----- ------ --------  ----- -----  -----
03/05/08
02:15:00    28 1310719    802  4377  1124 967698     2950   230K 10866   229K
02:30:00    28 1310719    784  4635  1123 967458     2952   230K 10866   229K
02:45:00    28 1310719    806  3129  1124 967570     2950   230K 10867   229K
```

VDISK Case Study

VDisk for swap best practice: Two small disks, prioritized

- **Two disks per server, goodness**
- **Should be 1 small swap disk, plus 2nd large disks, goodness**
- **Prioritized backward though, badness….**

```
********************************************************************************
                                <--Size--->  <--pages--> ----->  DASD    X-
                                AddSpc VDSK  Resi- Lock-  Stg->  Page Store
Owner    Space Name             Pages  Blks   dent    ed T Migr Slots  Blks
-------- ---------------------- ----- -----  ----- ----- - ---- ----- -----
Average:
LINUX1   VDISK$LINUX1$$$0101$0041 65791  8738   3.0     0      0   568     0
LINUX1   VDISK$LINUX1$$$0112$0042  524K 69905   170     0    0.0 61212    11
LINUX2   VDISK$LINUX2$$$0101$0043 65791  8738   3.0     0      0   571     0
LINUX2   VDISK$LINUX2$$$0112$0044  524K 69905   85K     0    0.4  346K  2047
LINUX3   VDISK$LINUX3$$$0101$0045 65791  8738   3.0     0      0   571     0
LINUX3   VDISK$LINUX3$$$0112$0046  524K 69905   2.0     0      0  5767     0
LINUX4   VDISK$LINUX4$$$0101$0047 65791  8738   3.0     0      0   571     0
LINUX4   VDISK$LINUX4$$$0112$0048  524K 69905   147K    0    0.3  223K 35967
LINUX5   VDISK$LINUX5$$$0101$0049 65791  8738   3.0     0      0   568     0
LINUX5   VDISK$LINUX5$$$0112$004A  524K 69905   2.0     0      0  4321     0
. . . . . .
                                ----- -----  ----- ----- - ---- ----- -----
System Totals:                  5901K 39321  233K    0     0.7  669K 38631
```

Additional Storage Performance

Named Saved System

- Fast IPL, shared kernel storage
- Saves 1mb per server, difficult to implement

DCSS with XIP File System

- Load all programs into shared DCSS,
- Saves 20-100mb/server, easy to implement
- Used VERY SELDOM

CMM: Collaborative memory management

- Dynamically manage storage size
- Saves GB/server, requires feedback
- Used in different forms frequently

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How many Virtual Processors?

- Linux is multiprocessor capable
- Global lock is large issue on older Linux
  - One processor acquires lock
  - Other processors attempt to spin
  - On 390 – spin converted to Diagnose 44 (now 9C)
- Problem easily detected
  - High Diagnose -> Instruction Simulation -> SIE
  - High TV ratio
  - Guideline: Minimize virtual processors
  - CASE STUDIES>>>>

How many Virtual Processors

```
Report: ESACPUA      CPU Utilization Analysis
-------------------------------------------------------------
             <CPU percents><--Internal (per second)--> SIGP
              Totl Ovrhead Diag Inst    SIE Fast  Page Rate
Time     CPU Util Usr Sys nose  Sim intrcp path fault /sec
-------- --- ---- --- --- ---- ---- ------ ---- ----- ----

16:01:00  0  66.6  12  25  80K  82K  83275 2108   0.1  350
          1  67.6  12  25  89K  91K  91879 1051     0  332
          2  62.3  12  24  83K  85K  85768 1219   0.1  383
          3  62.7  11  25  77K  78K  79354  776     0  293
          4  63.6  12  24  84K  85K  86175 1047   0.0  329
          5  63.1  11  26  82K  84K  85064 1188   0.0  297
          6  64.1  11  22  83K  84K  84874 1079   0.0  304
          7  57.3  10  22  73K  75K  75481 1044   0.0  323
          8  62.7  10  26  53K  57K  58761 1421   0.1  267
             ---- --- --- ---- ---- ------ ---- ----- ----
System:       570 101 218 704K 723K 730630  11K   0.2 2879
```

- CPU Performance typical of many Linux Apps:
  - High Diagnose 44 -> Instruction Simulation -> SIE
  - z/VM 5.2 modified logic, Some linux use diag9c
  - VALIDATE YOUR LINUX SERVERS

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How many Virtual Processors

Report: ESADIAG Diagnose Rate Report

Date /Time	CPU Count	<--Total--> <Diags/Sec> User	IBM	<----------Diagnose DIAG: Rate	DIAG:Rate	DIAG: Rate	DIAG: Rate
10:45:00	0	0	1954	0000: 0.0	0008: 0.9	000C: 0.1	0024: 0.0
				0068: 0.0	007C: 0	0098: 0	009C: 1733
	1	0	2593	0000: 0.0	0008: 0.9	000C: 0.1	0024: 0.0
				0068: 0.0	007C: 0.0	0098: 0	009C: 2403
	2	0	1891	0000: 0.0	0008: 2.4	000C: 0.2	0024: 0.0
				0068: 0.0	007C: 0	0098: 0	009C: 1654
	3	0	2174	0000: 0.0	0008: 0.6	000C: 0.0	0024: 0.0
				0068: 0.0	007C: 0	0098: 0	009C: 1977
	14	0	1473	0000: 0.0	0008: 0.5	000C: 0.1	0024: 0.0
				0068: 0.0	007C: 0	0098: 0	009C: 1351
System:		0	26540	0000: 0.1	0008: 11.5	000C: 1.1	0024: 0.1
				0068: 0.2	007C: 0.0	0098: 0.0	009C: 24K

- CPU Performance typical of many Linux Apps:
  - High Diagnose 9C -> Instruction Simulation -> SIE
  - Still a problem if too many VCPU

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How many Virtual Processors

```
Report: ESACPUA      CPU Utilization Analysis
-------------------------------------------------------
         <----Load---->    <CPU percents><--Internal (per
         <-Usrs--> Tran     Totl Ovrhead Diag Inst    SIE
Time     Actv In Q /sec CPU Util Usr Sys nose  Sim intrcp
-------- ---- ---- ---- --- ---- --- --- ---- ---- ------
10:45:00   65  132  1.7   0  90.7 1.8 2.3 1954 3124 9134.7
                          1  91.7 1.7 2.2 2593 3787 9724.0
                          2  91.4 1.7 2.3 1891 3059 8805.9
                          3  91.9 1.7 1.9 2174 3380 8843.5
                          4  91.9 1.6 1.9 2156 3245 8627.6
                         12  79.5 1.8 2.4 1375 2430 7065.5
                         13  78.9 1.7 2.1 1851 2857 7179.6
                         14  75.1 1.6 2.0 1473 2402 6483.7
                             ---- --- --- ---- ---- ------

System:                      1285  25  31  27K  43K 116734
```

- CPU overhead much better with Diag9C
  - High Diagnose 9C -> Instruction Simulation -> SIE
  - Still a (smaller) problem if VCPU is over configured

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New Linux mib from linux 370 diagnose table

```
Report: ESALNXG      LINUX VSI System Analysis Report                Velo
Monitor initialized: 01/23/18 at 16:03:59 on 2828 serial 0314C7      Firs
-------------------------------------------------------------------------
Node/    <cpu> <------------Diagnose Rates Per Second-------------------
Time     nbr    008  00C  010  014  044  064  09C  0DC  204  210  224
-------- ---   ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- ---- -
16:05:00
sles12    1       0    0    0    0  283    0  0.0    0    0    0    0
          2       0    0    0    0  0.1    0  0.2    0    0    0    0
-------------------------------------------------------------------------
16:06:00
sles12    1       0    0    0    0 14.6    0  0.0    0    0    0    0
          2       0    0    0    0  269    0  0.0    0    0    0    0
-------------------------------------------------------------------------
16:07:00
sles12    1       0    0    0    0  306    0    0    0    0    0    0
          2       0    0    0    0  0.0    0  0.1    0    0    0    0
```

- **The next release of the Velocity mib exposes the Linux data**
  - **Our sles12 server does diag 44**

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FTP Benchmarks: Results NOT intuitive

Compare Linux Asynchronous I/O vs synchronous I/O

- Asynchronous is default (applications write to buffer)
- Synchronous writes data without buffering
- DASD response time
  - Asynchronous: 50ms (6 I/O / second, 512k / IO),
  - Synchronous: 1.5ms (300 I/O / second, 4k / IO)
- Which is better throughput?

Guideline: Use Asynchronous - default

- DASD Response time rot don't work
- Use synchrounous when application requires absolute valid data

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CP algorithms VERY poor at sizing MDC Storage
Control the size of MDC!

```
Report: ESAMDC       Minidisk Cache Analysis                          .     ESAMAP 3.6.1 02/08/07  Pg  2660
Monitor initialized: 02/07/07 at 00:00:05 on 2084 serial 447AA     First record analyzed: 02/07/07 00:00:05
-------------------------------------------------------------------------------------------------------------------
         <----Load---->     <IO per><Insertions> <-----Main Storage MDC--> <-Expanded Storage MDC------> <External>
         <-Users-> Tran Hit <second> Usr Per Not <-Sizes (MB)--> </Second> <-Sizes (MB)--> <Per Second > <I/O rate>
Time     Actv In Q /sec Pct rds hits Max Min Ald Avg MIN MAX Obj Stls Delt Avg MIN MAX Obj Rds Wrts Stls Pages DASD
-------- ---- ---- ---- --- --- ---- --- --- --- --- --- --- --- ---- ---- --- --- --- --- --- ---- ---- ----- ----

12:20:00   26 18.7  2.2  63  33 20.4  8K 7.5   0  2K   0  8K  2K  0.1  180  1K   0  3K  1K  55    0  0.1   253  261
12:35:00   26 19.1  2.1  63 8.5  5.4 10K 5.8   0  2K   0  8K  2K  0.0 69.9  1K   0  3K  1K  10    0  0.0    53  185
12:50:00   26 18.3  2.0  69 6.0  4.2 11K 4.7   0  1K   0  8K  2K  0.0 43.6  1K   0  3K  1K  12    0  0.0    33  167
13:05:00   27 19.5  2.2  38  29 11.0 12K 5.2 0.4  2K   0  8K  2K  1.2 1062  1K   0  3K  2K  63  0.0  1.3   571  406
13:26:00   31 17.4  1.7  28  28  8.0 14K  12 0.7  4K   0  8K  4K  2.8 1324 272   0  3K  2K 3.7  0.0  4.5  1090  356
13:41:00   25 19.9  2.9  69  60 41.5 14K 7.5   0  3K   0  8K  3K  0.5  483 727   0  3K  2K 2.0    0  0.2   742  422
```

Guidelines:

SET MDC STORAGE 128M 128M

VELOCITY SOFTWARE

z/VM Page Space

Overcommitting real storage is good, reduces cost

- Back up is Paging storage

If 40GB main storage

- Overcommit factor of 2 - How much paging storage needed?
- VM installations often very underconfigured
- **Guideline: Paging storage should still be 2 times requirement**

Number of paging devices? Number of channels?

- ROT not valid, model-27 often used for page space
- Hyperpav now valid for page devices

Lack of page space planning is top reason for first installation z/VM outage

As of z/VM 6.3, “pre-write” can fill up page space. ALERT!

VELOCITY SOFTWARE

Original problem documented in 1992

- If VTAM has (recommended) REL SHARE 10000, looping user consumed CPU
- If VTAM had ABS 5%, looping user constrained
- Velocity recommended ABS shares for critical servers

Creating EXCESS SHARE

- Setting SHARE to 10000 (compare 100 servers at REL 100)
- Linux servers that are idle, but inqueue servers count
- NOTE: VMRM (very dead component) often used SET REL 10000

Starting with 3 looping users REL 100.

- They all get equal share of the resources
- this is as we expected.

```
Screen: ESAUSP2  Velocity Software-Test VSIVM4  ESAMON 3.778
 1 of 3  User Percent Utilization                CLASS * USER
                              <-------Main Storage-------->
         UserID   <Processor> <Resident->  Lock <-WSSize-->
Time     /Class   Total  Virt Total  Actv   -ed Total  Actv
-------- -------- ----- ----- ----- ----- ----- ----- -----
00:11:00 ROBLNX1  32.39 32.38 15862 15862    11 15536 15536
         ROBLX2   32.12 32.11 66136 66136   259 78478 78478
         ROBLX1   32.02 32.01 38219 38219   176 37790 37790
         ROB2LV    0.01  0.00  2246  2246     0  2246  2246
```

We now give ROBLX2 a REL 200

- because that is a more important service
- (nothing with virtual 2-way).
- Not as expected, it gets the excess share

```
Screen: ESAUSP2  Velocity Software-Test VSIVM4
1 of 3  User Percent Utilization                    CLASS * USER
                                <-------Main Storage-------->
         UserID   <Processor> <Resident->  Lock <-WSSize-->
Time     /Class   Total  Virt Total  Actv   -ed Total  Actv
-------- -------- ----- ----- ----- ----- ----- ----- -----
00:14:00 ROBLX2   68.71 68.68 66211 66211   258 78478 78478
         ROBLX1   14.00 14.00 38245 38245   256 37790 37790
         ROBLNX1  13.99 13.99 15879 15879    11 15536 15536
         ROB2LV    0.01  0.00  2246  2246     0  2246  2246
```

Excess Share Analysis

Now for the experiment

- we reduce the relative share for all idle users down to 1
- (using the allocated share computation below and showing how much allocated / consumed share is).
- This ELIMINATES “EXCESS SHARE” bucket
- Note, unrealistic to completely eliminate excess share
- USE ABSOLUTE FOR TCPIP, RACF, critical servers

VELOCITY SOFTWARE

Excess Share Analysis

And when we set ROBLNX1 to REL 300

- it works again: 48% 32% and 16%
- exactly like the REL 300, 200 and 100 we set.

```
Screen: ESAUSP2  Velocity Software-Test VSIVM4  ESAMON 3.778
1 of 3  User Percent Utilization                CLASS * USER
                                <-------Main Storage-------->
         UserID   <Processor> <Resident->  Lock <-WSSize-->
Time     /Class   Total  Virt Total  Actv   -ed Total  Actv
-------- -------- ----- ----- ----- ----- ----- ----- -----
00:23:00 ROBLNX1  48.15 48.14 16170 16170    11 15536 15536
         ROBLX2   32.86 32.86 67190 67190   211 80047 80047
         ROBLX1   16.44 16.43 39016 39016   193 37790 37790
         ROB2LV    0.01  0.00  1680  1680     0  1680  1680
```

SET SHARE

- Use RELATIVE 100 for single virtual CPU
- Use RELATIVE 200 for two virtual CPU
- **Use ABSOLUTE for shared or critical resource servers**

Note many SRM settings no longer functional:

- SET SRM STORBUF – allow overcommit
- SET SRM LDUBUF – DO NOT allow overcommit
- SET QUICKDSP – no function as of z/VM 6.3

Infrastructure Requirements

Requirements:

- **Performance management**
- **Capacity planning**
- **Chargeback**
- **Operations**

Shared resource environment:

- Avoid unnecessary work
- Avoid “waking up Linux”

Availability Monitoring – application dependent

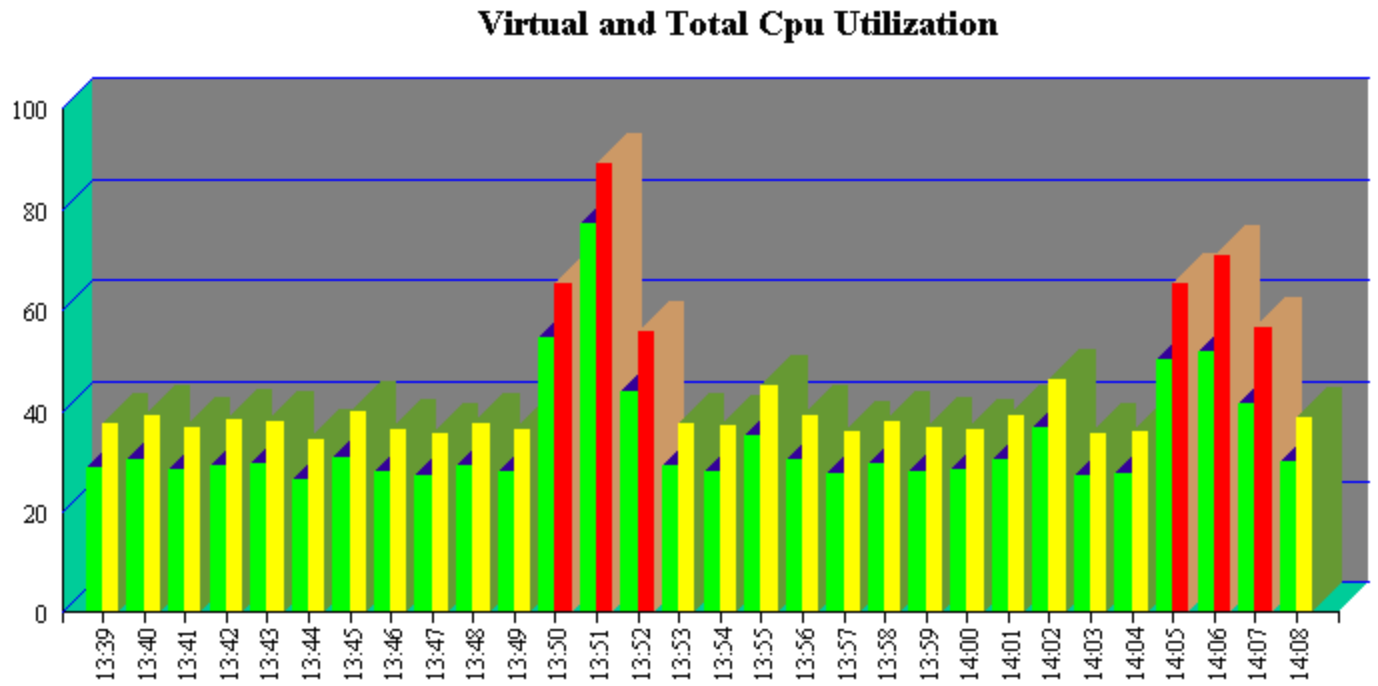
High Availability – cost? (DB2, RAC)

How many different monitoring tools do you need?

Measure your infrastructure and determine scalability!

VELOCITY SOFTWARE

Infrastructure: SOP Valid?



Question:

- Why always hit every 15 minutes?

SOP: Standard Operating Procedures need to be evaluated

VELOCITY SOFTWARE

Detect and alert looping processes

```
Report: ESAHST1      LINUX HOST Software Analysis Report
Monitor initialized:                    on 2066 serial 71CE3
-------------------------------------------------------------------
Node/    <-----Software Program-------> <CPU Seconds> CPU  StgSize
Time     Name      ID    Type   Status  Total Intrval Pct  (Bytes)
-------- --------  ----  ------ ------- ----- ------- ---- -------
08:32:00
LINUXA
         init         1  Applic ResWait   0.9     0.0  0.0   61440
         kjournal    95  Applic ResWait   2.5     0.0  0.0       0
         db2fmd     596  Applic ResWait   0.3     0.0  0.0  573440
         sshd      1081  Applic ResWait   0.4     0.0  0.0  204800
         event    10787  Applic ResWait  19.5     0.0  0.0  11188K
         snmpd    10861  Applic Running 193.4     4.2  7.1   1492K
         adminp   11452  Applic ResWait  58.5     0.0  0.1  13848K
         server   11525  Applic ResWait   1.0     0.1  0.1  35720K
         server   11533  Applic ResWait   4.3     0.0  0.0  35720K
         server   11537  Applic Running 44697    58.3 99.2  35720K
         java     13024  Applic ResWait   0.0     0.0  0.0   6632K
         java     24016  Applic ResWait   1.9     0.0  0.0   6632K
         java     24024  Applic ResWait   4.9     0.0  0.0   6632K
         server   24192  Applic ResWait  19.0     0.1  0.1  35720K
         java     26352  Applic ResWait   0.4     0.0  0.0   7320K
         sshd     26477  Applic ResWait   0.2     0.0  0.1   2028K
```

Show process by ID

- Status
- Total CPU
- Percent CPU
- Storage

(Non-velocity mib)

VELOCITY SOFTWARE

Performance Instrumentation

- Cost of instrumentation often excessive
- “Native Linux” tools will not detect many problems
- Agents may take 5-10% of a processor (Per server)

Cost of instrumentation should be < .1% (of ONE CPU) per server

- **Performance instrumentation should not change performance**

Active agents vs Passive agents

- Active agent wakes up at constant interval and records data
- Passive agent only responds to external request

A 1% agent on 1000 servers costs 10 IFLs (running 100% busy)

Linux Configuration Summary

Virtual machine size

- Minimize until some swap

Swapping

- Swap to virtual disk
- Define 2 virtual disks,
  - One to meet the average requirement
  - Second one for overflow - Insurance
- Use DIAG driver instead of FBA
  - Reduces I/O by factor of 8

Virtual processors

- Minimize to meet the workload/application requirement

Infrastructure costs

- Minimize – shared resource architecture

VELOCITY SOFTWARE

z/VM Subsystem Configuration

DASD Channels

- ECKD “Measurable” by channel hardware
- FCP/SCSI measurable from inside each linux

Paging

- How much paging is required to support 2 times over commitment of 40GB z/VM system?
- At least 80 GB.

MDC

- Caches data – read-ahead, often used data
- Default too high
- SET MDC STORAGE 128M 128M

VELOCITY SOFTWARE