Processor Analysis and Tuning

Velocity Software Inc.
196-D Castro Street
Mountain View CA 94041
650-964-8867

Velocity Software GmbH
Max-Joseph-Str. 5
D-68167 Mannheim
Germany
+49 (0)621 373844

Barton Robinson,
barton@velocitysoftware.com

If you can't measure it, I'm just not interested….

Processor Topics

- What is CPU utilization
- Common problems
- LPAR, HYPERDispatch, Horizontal
- Overview of Processors
- Processor measurements
- Steal time
- Master Processor
- PLDV, Dispatch rates
- MFC, SMT

Processor Performance Concepts - Utilization

What is important?

- TOTAL IFL Utilization (at 100%, everybody complains)
- LPAR Utilization (at 100%, everybody in lpar complains)
- "My" share (is there enough left for me?)

CPU Utilization used for:

- Performance Analysis
- Capacity Planning
- Accounting/Chargeback
- Operational alerts

Processor Performance Concepts - Utilization

What is CPU Utilization?

- Percent of what?

Utilization measured in many ways

- Virtual Linux measures what?
  - Percent of wall clock originally, now "steal timer"
- z/VM measures what? CPU Seconds
- Hardware measurement only valid method of measuring CPU

Percent of Percent misleading

- Can not be used directly for capacity planning
- Can not be used directly for accounting/chargeback
- Often misleading for performance analysis

Processor Performance Concepts - Utilization

All zVPS numbers are measured in CPU Seconds

- Percent is always based on CPU seconds divided by wall clock
- 200% means using 2 engines worth of CPU seconds
- Measured by the hardware in microseconds

Impacts measurements of

- LPAR
- z/VM Virtual Machines
- Linux processes
- zVSE Jobs/Partitions

All Levels of Hierarchy have Allocation Settings

1) CEC has some number of engines
2) Each LPAR has weight, results in "entitlement of engines"
3) Each Virtual Machine's "share" results in "virtual entitlement"
4) Processes in Linux have "priority", "nice" settings

- What is my share of the CEC's engines?

Linux only measures Linux and "steal time"

- Bottom up analysis vs top down

If Linux process does not get enough CPU, Top Down:

1) Are engines on CEC highly utilized?
2) Is LPAR sufficiently entitled?
3) Is z/VM Share sufficient?
4) Is process niced?

CPU Allocation

Each LPAR has weight, results in "entitlement"

- Entitlement divided equally by VCPU
- Each VCPU in LPAR has part of entitlement
- Work running on VCPU
  - Does NOT get LPAR entitlement
  - Does get vcpu entitlement

Each Virtual Machine's "share" results in "entitlement"

- Each Virtual Machine has "share"
- Each vcpu of virtual machine has equal part of share
- Linux process running on virtual machine vcpu
  - Does NOT get virtual machine entitlement
  - Does get virtual machine vcpu share

Processes in Linux have "priority", "nice" settings

Common Reported CPU Performance Problems

Problems from "linux perspective":

- Workload timing out
- Applications running slow
- Workload/Server in "CPU" wait (steal time high)

Analysis must be top down

- LPAR Weights vs IFL utilization (entitlement)
- LPAR VCPU vs SHARE (entitlement spread over more vcpu)
- z/VM Share settings poor (share spread over more vcpu)
- Operation on GP, not IFL (happens)
- Processor utilization high

Miscelaneous Causes – Workload

- z/VM Master processor
- Cron jobs synchronized (100 processes across 100 servers)
- Spin locks - Diag 44,9C (too many virtual machine vcpu)

Managing Processor Distribution

Objective: Operate at high utilization

- Requires management decisions, prioritization
- Alternative to management is more hardware/software

Managing Distribution – LPAR Share of IFLs

- Based on weight of LPAR
- Weight divided by vcpu in LPAR
- More VCPUs, the less entitlement to each vcpu
- Horizontal vs Vertical using HYPERdispatch

Managing Distribution – virtual machine SHARE of LPAR

- Share defined in relative or absolute
- Share divided over number of vcpu
- More VCPUs, the less entitlement to each vcpu

z/VM entitlement of IFLs (zvmqa, 15% of 10 IFLs)

Report: ESALPARS Logical Partition Summary

Time	<--Complex--> Phys CPUs	Dispatch Slice	Name	Nbr	Virt CPUs	CPU Type	<%Assigned> Total	Ovhd	<Assigned <---LPAR--> Weight	Pct
00:15:00	23	Dynamic	Totals:	0	22	CP	506.0	4.5	99	100
			Totals:	0	23	IFL	903.1	8.6	1000	100
			ZVMQA	11	6	IFL	374.8	0.9	150	15.0
			MVSPRD	7	10	CP	320.1	3.2	860	86.1
			MVSQA	1	6	CP	181.8	1.1	71	7.1
			ZVMDEQ	9	4	IFL	131.6	2.0	100	10.0
			ZVMPRD	8	10	IFL	333.7	4.9	650	65.0
			ZVMSHR	12	3	IFL	63.0	0.8	80	8.0
			MVSTST	17	3	CP	5.1	0.1	8	0.8

Totals by Processor type:

<----------CPU-------> Type	Count	Ded	shared	<-Shared Processor busy-> Total	Logical	Ovhd	Mgmt
CP	7	0	7	511.9	501.5	4.5	5.9
IFL	10	0	10	915.6	894.5	8.6	12.5
ZIIP	3	0	3	23.9	22.3	0.4	1.2

Processor Utilization Components

LPAR LEVEL:

LPAR Physical Overhead

LPAR Assigned time – Overhead

LPAR Assigned time - Virtual

z/VM Level (LPAR Assigned time - Virtual)

- System Time (z/VM Control Program)
- User Overhead (allocated system time)
- Emulation (z/VM Guest time)

Linux (Emulation (z/VM Guest time))

- System time (kernel time)
- IRQ Time
- User time ("real application work")

IDLE

VELOCITY SOFTWARE

z/VM share of IFLs (always start here)

```
Report: ESALPARS     Logical Partition Summary
-------------------------------------------------------------------------
          <--Complex--> <--------Logical Partition-------> <-Assigned
          Phys Dispatch                 Virt CPU  <%Assigned> <---LPAR-->
Time      CPUs     Slice Name     Nbr CPUs Type Total  Ovhd  Weight  Pct
--------  ---- -------- -------- --- ---- ---- -----  ----  ------ ----
00:15:00    23  Dynamic Totals:    0   22  CP  506.0   4.5     999  100
                        Totals:    0   23 IFL  903.1   8.6    1000  100
                        ZVMQA     11    6 IFL  374.8   0.9     150 15.0
                        ZVMDEQ     9    4 IFL  131.6   2.0     100 10.0
                        ZVMPRD     8   10 IFL  333.7   4.9     650 65.0
                        ZVMSHR    12    3 IFL   63.0   0.8      80  8.0
Totals by Processor type:
<---------CPU-------> <-Shared Processor busy->
Type Count Ded shared  Total  Logical Ovhd Mgmt
---- ----- --- ------ ------ -------- ---- ----
IFL     10   0     10  915.6    894.5  8.6 12.5
```

- ZVMQA is **allocated** 150/1000 of 10 SHARED IFLs (6 vcpu)
- ZVMQA is **using** 37.5% of 10 SHARED IFLs
- IFLs running 91.6% busy
- ZVMQA using more than entitled, ZVMPRD using less.

LPAR Weights

Each LPAR gets a weight,

- each vcpu in lpar gets part of weight

LPAR's entitlement:

- (LPAR Weight) / SUM(LPAR Weights)

Processor share of system (horizontal):

- (LPAR entitlement) / (Number CPUs in LPAR)

Processor share of a CPU is

- (Processor share of system) * (Number physical processors)

LPAR Weights Example

ESALPAR (Partial report, horizontal scheduling)

Note each vcpu running at 10%?

z/VM can dispatch 8 concurrent virtual machines

- Less queueing, slower service
- But, each single vcpu runs "VERY slow"

	<--Complex-->		<--Logical->		<--------Logical Processor--------				
Time	Phys CPUs	Dispatch Slice	<-Partition> Name	No.	VCPU Addr	<%Assigned> Total	Ovhd	Weight	Cap-ped	Wait Comp
Average:	8	Dynamic	ZVM	6	0	8.3	0.2	10	No	No
					1	10.2	0.2	10	No	No
					2	11.0	0.2	10	No	No
					3	11.1	0.2	10	No	No
					4	10.5	0.2	10	No	No
					5	10.5	0.2	10	No	No
					6	10.5	0.2	10	No	No
					7	10.6	0.2	10	No	No
					LPAR	82.8	1.4			

VELOCITY SOFTWARE

LPAR Share Example – Why HYPERdispatch needed

Processor Details

- 30 LPARs configured
- 4 LPARs active
- Total of all active lpar shares: 60
- z/VM Weight: 10 (out of 60)
- z/VM Logical Processors: 8
- Physical processors online: 8

Guaranteed processor share (speed)

- (Share of system / nbr logical processors) * nbr phys
- ((10 / 60) / 8) * 8 = .16

Each virtual cpu at peak runs at 16% rated speed

(go back to processor performance concepts)

LPAR Share Example

Processor Details: If change to 4 logical processors:

- 4 LPARs active
- Total of all shares: 60
- z/VM Weight: 10 (out of 60)
- z/VM Logical Processors: 4
- Physical processors online: 8

Guaranteed processor share (speed)

- **((10 / 60) / 4) * 8 = .32**
- Real problem in many installations
- Why HYPERdispatch required, vertical scheduling

Too many logical processors will slow you down!

- Specifically the master processor….
- The same concept applies to Linux virtual processors

LPAR Summary Report

```
Report: ESALPARS     Logical Partition Summary                          TEST MAP
Monitor initialized: 08/04/03 at 18:52:10 on 2084 serial 4B54A     First recor
-------------------------------------------------------------------------------
          <--Complex--> <-------Logical Partition--->  <-Assigned Shares---->
          Phys Dispatch              Virt <%Assigned>  <---LPAR--> <VCPU Pct>
Time      CPUs    Slice Name     Nbr CPUs Total  Ovhd  Weight  Pct /SYS /CPU
--------  ---- -------- -------- --- ---- -----  ----  ------ ---- ---- ----
Average:     8  Dynamic Totals:    0   22 188.7   2.1      60  100
                         ZVM        6    8  82.8   1.4      10 16.0 2.00 16.0
                         CF01       1    1  99.9   0.0      10 16.0 16.0  128
                         LINUXSW    2    2     0     0      10 16.0 8.00 64.0
                         S01        3    4   4.6   0.4      10 16.0 4.00 32.0
                         S02        4    0
                         VMTPC      5    5   1.2   0.2      10 16.0 3.00 24.0
                         ZVMCSS1   16    2   0.2   0.0      10 16.0 8.00 64.0
```

"ZVM" Allocated 16% of 8 CPUs

Each virtual cpu allocated 2% of system (8 CPUs)

Each processor rated at 16% speed of real processor

VELOCITY SOFTWARE

LPAR with HYPERDispatch

Stated Purpose of HYPERDispatch and vertical scheduler:

- Localize work to L1/L2 cache
- Reduces impact of installation configuration errors
- **Increase weight for unparked engines** in proportion

Impact

- Virtual CPUs disabled, share redistributed
- Faster master processor for z/VM
- L1/L2 cache impact negligible in Linux environment

```
ESAOPER:
07:00:41 CPU Park from 15 to  13 CPUUtil= "12.9",
07:00:43 CPU Unpark from  13 to  15 CPUUtil= "12.5
07:05:35 CPU Park from 15 to  13 CPUUtil= "12.2",
07:05:37 CPU Unpark from  13 to  15 CPUUtil= "12.0
07:05:53 CPU Park from 15 to  12 CPUUtil= "12.0",
07:05:55 CPU Unpark from  12 to  15 CPUUtil= "10.4
07:07:13 CPU Park from 15 to  13 CPUUtil= "12.5",
07:07:15 CPU Unpark from  13 to  15 CPUUtil= "11.9
07:07:19 CPU Park from 15 to  13 CPUUtil= "12.1",
07:07:21 CPU Unpark from  13 to  15 CPUUtil= "11.8
07:07:29 CPU Park from 15 to  13 CPUUtil= "12.1",
```

VELOCITY SOFTWARE

LPAR with HYPERDispatch

HYPERDispatch requires Vertical scheduling

High/Medium/Low obvious

Report: ESALPAR Logical Partition Analysis
Monitor initialized: 05/31/16 at 00:00:00 on 2827 serial 2F5A7

Time	Complex Phys CPUs	Dispatch Slice	Logical Partition Name	Partition No.	VCPU Addr	%Assigned Total	%Assigned Ovhd	VCPU TYPE	Logical Processor Weight
07:15:00	19	Dynamic	VSSYSG	2	0	87.9	0.8	IFL	400
					1	89.3	0.7	IFL	400
.....									
					11	81.9	0.8	IFL	400
					12	77.5	1.0	IFL	400
					13	75.5	0.9	IFL	400
					14	60.9	0.7	IFL	400
					LPAR	1245	11.8		
			VSSYS1	3	0	48.6	2.1	IFL	500
					1	35.5	1.6	IFL	500
					2	40.4	1.7	IFL	500
					3	38.9	1.5	IFL	500
					4	36.8	1.7	IFL	500
					5	38.8	1.7	IFL	500
					6	40.1	1.3	IFL	500
					7	32.5	1.3	IFL	500
					8	30.0	1.2	IFL	500
					9	18.6	0.9	IFL	500
					10	17.8	1.4	IFL	500
					11	0.0	0.0	IFL	500
					12	0.0	0.0	IFL	500
					13	0.0	0.0	IFL	500
					14	0.0	0.0	IFL	500
					LPAR	378.1	16.4		

VELOCITY SOFTWARE

LPAR with HYPERDispatch

HYPERDispatch requires Vertical scheduling

- Now Exposed on ESALPAR

```
Report: ESALPAR      Logical Partition Analysis
Monitor initialized: 05/11/21 at 03:36:13 on 8561 serial XXXXXX
-------------------------------------------------------------------
-
         CEC  <-Logical Partition-> <----------Logical Processor-
-
         Phys                  Pool     VCPU <%Assigned> VCPU Weight/
Time     CPUs Name      No    Name     Addr Total  Ovhd TYPE Polar
-------- ---- -------- --- -------- ---- -----  ---- ---- --- ---
03:38:00   79 VSILNX1   31         .    0   6.7   0.3 IFL  300 VHi
                                         1   5.1   0.2 IFL  300 VMe
                                         2   7.4   0.2 IFL  300 VMe
                                         3   0.0   0.0 IFL  300 VLo
                                             -----  ----
                                    LPAR  19.1   0.7

               VSIMGTA   01         .    0   3.3   0.1 CP    38 VMe
                                         1   2.8   0.1 CP    38 VMe
                                         2   0.0   0.0 CP    38 VLo
                                         3   0.0   0.0 CP    38 VLo
                                         4   0.0   0.0 CP    38 VLo
                                         5   0.0   0.0 CP    38 VLo
                                         6   0.0   0.0 CP    38 VLo
                                         7   0.0   0.0 CP    38 VLo
                                         8   0.0   0.0 CP    38 VLo
                                         9   0.0   0.0 CP    38 VLo
                                             -----  ----
                                    LPAR   6.1   0.2
```

LPAR Options

Time Slice: Dynamic, used exclusively

Weights: Sets priority between Logical Partitions

Virtual processors

Capping

- Limits Assigned time to LPAR
- Useful for outsourcing, fixed contracts

Wait Completion

- “no” gives up processor if idle (default)
- “yes”, Partition keeps processor even if idle (rarely/never used)

LPAR Overhead: Over-configure worst Case Study

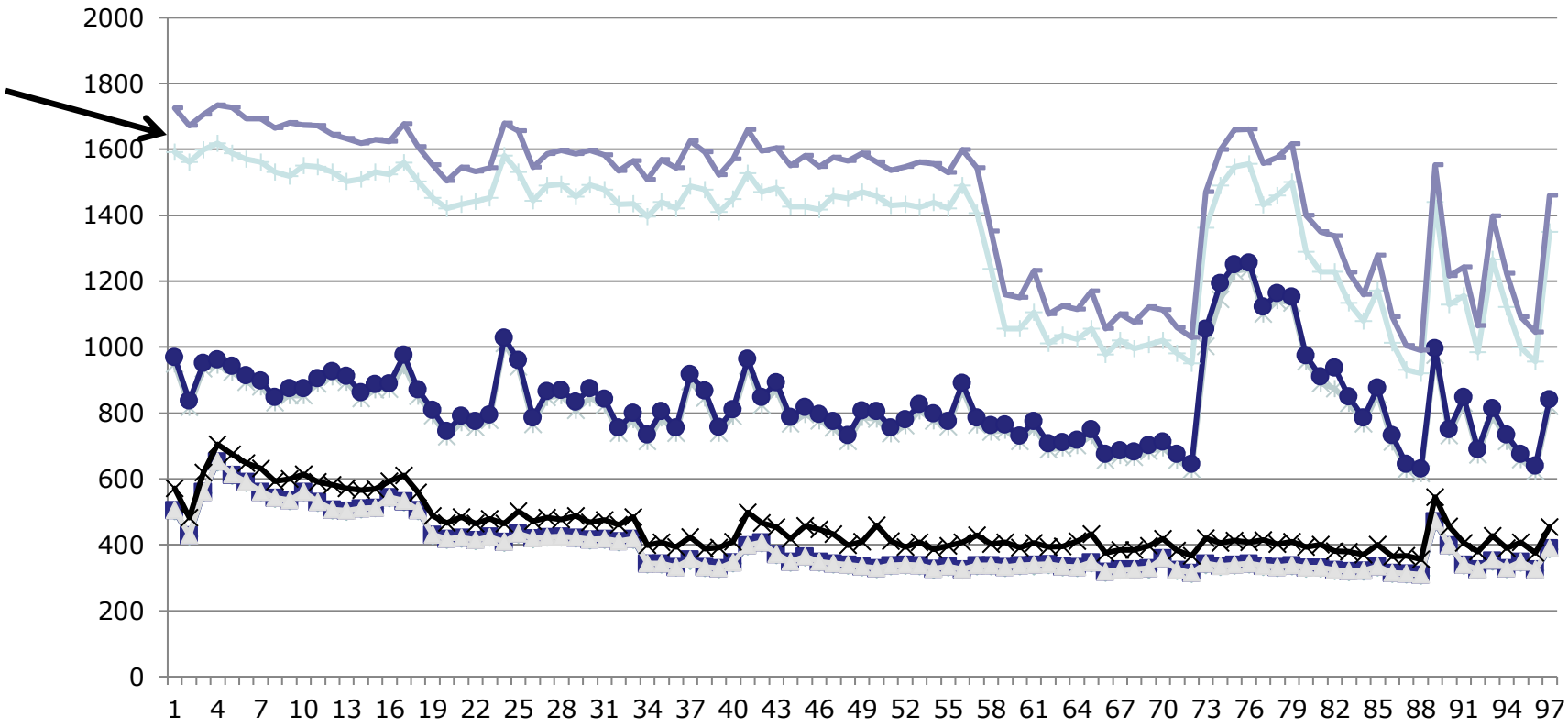
Linux Servers

- 120 servers total (Big, ORACLE)
  - 4gb-40gb
  - (1 / 2 size from original SUN servers)

Hardware

- 17 IFLs
  - 7 servers per IFL, each server multiple vcpu, normal
  - 395 vcpus (**23:1** overcommit (23 Linux vcpu / real cpu)
- 7 LPARs, each with 17 VCPU
  - Worst case possible for physical LPAR overhead

LPAR Configuration Overhead



17 IFLs, 7 lpars, 17 vcpus each, 7:1 overcommit

Physical Overhead significant from real processor overcommit

VELOCITY SOFTWARE

Managing Distribution - What is my share?

Entitlement / Share analysis:

- **ESAHDR for basic configuration**
- **ESALPARS for LPAR / IFL utilization**
- **ESACPUU / ESACPUA for z/VM perspective**
- **ESAUSRC for share settings**
- **ESAUSP2 for how much am I getting out of used**

"z" Processor Overview (ESAHDR)

```
Machine Model/Type                      Z13:2964/725
Multithreading Status:Enabled
System Sequence Code                     00000000000B9177
Processor  0 model/serial               2964-725  /0D9177
Processor  1 model/serial               2964-725  /0D9177
Processor  2 model/serial               2964-725  /0D9177
Processor  3 model/serial               2964-725  /0D9177
Processor  4 model/serial               2964-725  /0D9177 Master
Processor  5 model/serial               2964-725  /0D9177
……
Processor 18 model/serial               2964-725  /0D9177
Processor 19 model/serial               2964-725  /0D9177

 Power of processor in terms of service Units: 56939
 CPU Capability Factor:                  492
 CPU(GP) Capability Factor:              492
 CPU Cycles/ns:                         5000
 CPU Cycles/ns (GP):                    5000
 Operating on IFL Processor(s)
 Channel Path Measurement Facility(CPMF) Extended is installed
```

Service units from table

Understand the CEC (two books)

z/VM (IFLs)

Processor Measurement

```
Report: ESACPUU      CPU Utilization Report                          Linux Test
Monitor initialized: 05/06/08 at 12:00:00 on 2094 serial AEA7D     First record analyzed:
-------------------------------------------------------------------------------------
         <----Load---->     <-----CPU (percentages)-----> <------External (per second)---
         <-Users-> Tran      Total   Emul   User    Sys   Idle <--Page---> <--Spool-->  RSCH+
Time     Actv In Q /sec CPU  util    time ovrhd ovrhd   time   Read Write   Read Write   SSCH
-------- ---- ---- ---- -   -----  ----- ----- -----  -----  ----- -----  ----- -----  -----
12:01:00  103  118  9.1  0   92.8   88.6   2.3   1.9    7.2     11    52      0     0    220
                        1   93.8   90.5   2.2   1.0    6.2     14     0      0     0    182
                        2   94.4   90.9   2.2   1.2    5.6     17     0      0     0    196
                        3   94.5   90.9   2.1   1.5    5.5     13     0      0     0    179
                           -----  ----- ----- -----  -----  ----- -----  ----- -----  -----
System:                    375.4  361.0   8.9   5.5   24.4     55    52      0     0    778
```

Processor utilization has three components:

- Emulation time – running users in Interpretive Execution
- User overhead – CP time performing services for a user
- System overhead – CP “housekeeping”
- Note master processor – only problem if architecturally constrained

VELOCITY SOFTWARE

Processor Measurements User View

ESAUSP2:

CPU Consumption in percent

- Total all user
- By user
- By Class

Note

- one server dominates CPU

T:V Ratio is Total to Virtual,

- 1.0 is best

```
Report: ESAUSP2       User Resource Rate Report
Monitor initialized: 05/06/08 at 12:00:00 on 2094 serial
-------------------------------------------------------------

          <---CPU time--> <----Main Storage (pages)----->
UserID    <(Percent)> T:V <Resident> Lock <-----WSS----->
/Class    Total  Virt Rat Totl Activ  -ed Totl Activ  Avg
-------- ----- ----- --- ---- ----- ---- ---- ----- ----
12:01:00 369.9 361.0 1.0  17M   17M  417  17M   17M 129K
 ***User Class Analysis***
*Servers  1.95  1.72 1.1 7566  7555   49 8674  7444  207
*Linux   184.0 180.6 1.0  15M   15M  305  15M   15M 185K
*Misc    183.7 178.5 1.0   2M 1642K   11   2M 1642K 328K
 ***Top User Analysis***
LXPWK001 183.5 178.4 1.0   2M 1641K    3   2M 1641K   2M
LXWKB215 37.63 37.01 1.0 782K  782K    1 782K  782K 782K
LXWKB211 33.97 33.88 1.0 514K  514K    0 514K  514K 514K
LXWKB210 17.64 17.55 1.0 298K  298K    2 298K  298K 298K
LXWKB214 16.86 16.68 1.0   1M 1188K    0   1M 1254K   1M
LXWKB228  6.01  5.98 1.0 731K  731K    3 731K  731K 731K
LXWKB222  5.06  4.94 1.0 621K  621K    5 621K  621K 621K
LXWKB183  4.70  4.57 1.0 231K  231K    0 230K  230K 230K
LXWKB220  3.69  3.66 1.0 125K  125K    8 124K  124K 124K
LXWKB225  3.65  3.52 1.0 780K  780K    0 780K  780K 780K
ESATCP    0.45  0.35 1.3 1038  1038    1 1037  1037 1037
TCPIP2    0.02  0.01 2.0 1142  1142   48  198   198  198
```

VELOCITY SOFTWARE

Master Processor Overview

Every operating system has multiple methods

Much system code NOT re-entrant

- Must be single threaded
- Can not update one control block by multiple processors simultaneously

Implementation

- hardware locks: TS, CS, CDS instructions
- software locks: “ownership” of resources
  - (such as in database)
- running on the Master Processor

SPIN Locks

- Test for lock, if fail, test for lock
- Linux uses “spin lock”, replaced with Diag44 -> DIAG9C
- Linux spin locks an issue, cost in CPU

Resource Serialization Master Processor

Many CP processes run "master only" to ensure integrity of system

- Spooling
- some IUCV services (*MSG, *RPI, *ACCOUNT from CP)
- Page migration
- execution of ALL CP commands
- Line mode console I/O

Master processor utilization shows up

- higher System Overhead and
- Higher User Overhead.

Higher Master CPU busy higher on a system with more processors.

- Master calls is measured
- Simulation wait is measured
- Processor imbalance can be a problem

Master Processor Problem

CPU Example

- User overhead high on master
- System overhead high on master
- Master processor can be a limiter

```
Report: ESACPUU      CPU Utilization
-------------------------------------------------------------------------------------------------
         <----Load---->     <-----CPU (percentages)-----> <------External (per second)------->
         <-Users-> Tran     Total  Emul  User   Sys  Idle <--Page---> <--Spool--> RSCH+
Time     Actv In Q /sec CPU  util  time ovrhd ovrhd  time  Read Write  Read Write  SSCH  ExInt
-------- ---- ---- ---- --- ----- ----- ----- ----- ----- ----- ----- ----- ----- -----  -----
09:19:12    7  5.0  0.1   1  99.4  20.9  58.8  19.8     0     0     0     0     0     3    140
                           2  84.7  43.6  30.7  10.3  15.0     0     0     0     0     0    154
                           3  84.2  43.2  30.9  10.1  15.5     0     0     0     0     0    153
                           4  84.5  43.6  31.1   9.7  15.2     0     0     0     0     0    155
                              ----- ----- ----- ----- ----- ----- ----- ----- ----- -----  -----
System:                       352.7 151.3 151.6  49.9  45.7     0     0     0     0     3    602
```

Would adding another processor help this system?

Processor Dispatch Vector Activity

Report: ESAPLDV Processor Local Dispatch Vector Activity Linux Test ESAMAP 3.7.4

Time	<Users> Logged	Actv	In Q	Tran /sec	CPU	<VMDBK Moves/sec> Steals	To Master	<PLDV Lengths> Avg	Max	Mstr	MstrMa	%Empty	Dispatcher Long Paths
12:01:00	129	103	118	9.1	0	0	**2.5**	3.2	4.0	**0.0**	1.	8.3	4497.1
					1	0	0	2.1	4.0	.		38.3	3942.1
					2	0	0	2.0	4.0	.		41.7	3942.7
					3	0	0	1.8	3.0	.		38.3	3741.7
System:						0	2.5	9.2	15.0	0.0	1.	126.7	16123.5

Each processor has a “processor local dispatch vector”

The Dispatcher selects users from the PLDV.

The Master Processor has a special PLDV from which “master only” work for users is selected.

VELOCITY SOFTWARE

Effects of Logical Partitioning – Case Study

```
Report: ESASSUM Subsystem Activity Velocity Software, Inc.
-------------------------------------------------------------------------------------------------------------------
         <---Users----> Transactions <Processor> Storage (MB) <-Paging--> <-----I/O-----> <MiniDisk> Spool
         <-avg number->    Per  Avg. Utilization Fixed Active <pages/sec> <-DASD--> Other <-Cache--> Page
Time       On Actv In Q Minute  Resp Total Virt.  User Resid. XStore DASD Rate Resp  Rate  Rate %Hit Rate
-------- ---- ---- ---- ------ ----- ----- ----- ----- ------ ------ ---- ---- ---- ----- ----- ---- -----
08:00:08 1479  244 34.3 1310.1 0.603   124    87  36.9  192.0    888  451  641 15.4    40 687.9 49.3    36
08:01:08 1500  248 46.0 1260.9 0.543   147   110  37.3  192.7    904  494  732 20.1    37 881.6 53.9    32
*************************************************Summary*************************************************
Average: 1483  245 37.3 1297.8 0.589   130    93  37.0  192.1    892  461  664 16.7    39 736.4 50.7    35
```

The fallacy of not going top down

- You will have to explain this to Linux admins…

A high-level view of processor utilization shows a system with some capacity to spare.

- Using 147% out of 300%

Next step, "zoom" to processor configuration

VELOCITY SOFTWARE

Effects of Logical Partitioning – Case study

Report: **ESACPUU CPU** Interval Analysis Velocity Software, Inc.

	<----Load---->				<-----CPU (percentages)----->					<---Internal (per second)---->				
	<-Users->		Tran		Total	Emul	User	Sys	Idle	Diag-	Inst.	SIE	Fast	Page
Time	Actv	In	Q /sec	CPU	util	time	ovrhd	ovrhd	time	nose	sim.	intrcp	path	fault
08:00:08	244	34.3	24.6	0	**48.5**	27.3	**16.7**	4.5	9.9	1449	1478	1753	0	18
				1	**35.9**	28.8	5.2	1.9	11.8	818	599	716	0	9
				2	**39.5**	31.4	5.9	2.2	13.5	902	682	815	0	11
System:					**124.0**	87.4	27.9	8.7	35.3	3170	2758	3284	0	37
08:01:08	248	46.0	24.0	0	**53.6**	32.5	**16.7**	**4.4**	7.1	1557	1588	1806	0	24
				1	**44.6**	37.2	5.4	1.9	6.5	843	594	685	0	11
				2	**48.8**	40.2	6.4	2.2	7.4	903	704	817	0	12
System:					**147.0**	109.9	28.5	8.6	21.0	3303	2886	3308	0	48

A more detailed view of processor utilization seems to confirm this hypothesis. CPU to spare?

VELOCITY SOFTWARE

Effects of Logical Partitioning – Case Study

```
Report: ESAXACT Transaction Analysis Velocity Software, Inc.
-------------------------------------------------------------------------------
                      <--------------Percent non-dormant------------------>
UserID   <-Samples->                          E-   D-   T-      Tst             Lim Pct
/Class    Total   In Q Run  Sim  CPU  SIO  Pg SVM  SVM  SVM  CF Idl  I/O  Ldg Oth Lst Elig
-------- ----- ----- --- ---- ---- ---- --- --- ---- ---- ---- --- ---- ---- --- --- --- ----
System:   5936   149 5.4   34  8.7    0   3   0    0  6.0   2  36  4.7    .   0   .    0
Hi-Freq: 176K   7057 2.0   17  2.8    0   1   0  3.8  4.2  49  17  3.1    0   0   .    0
***Resource use by User Class
*Servers 3720    568 3.0   29  4.2    0   0   0   21  6.9   1  28  7.6    0   0   .    0
*Keys    1080    490 1.6  0.6  6.7    0   0   0   16   19   1  43   13    0   0   .    0
*TheUsrs 172K   6108 1.9   16  2.6    0   1   0  1.2  3.0  57  14  2.5    0   0   .    0
```

User state sampling shows wait compared to “running”

- Significant amount of CPU wait
- Simulation wait even greater.

Effects of Logical Partitioning – Case Study

Report: ESALPAR Logical Partition Analysis Velocity Software, Inc.

	<----Load---->			<--Complex-->	<--Logical->		<--------Logical Processor---------->					
	<-Users->	Tran	**Phys**	Dispatch Slice	<-Partition> Name	No.	VCPU Addr	<%Assigned> Total	Ovhd	Weight	Cap- ped	Wait Comp
08:02:08	244	34.3	24.6	**3**	Dynamic	CMS2	1	0	**58.7**	0.2	155	No Yes
								1	47.8	0.1	155	No Yes
								2	53.2	0.1	155	No Yes
								LPAR	**159.7**	**0.4**		
						SWCF	2	0	36.6	0.1	130	No Yes
								1	43.0	0.1	130	No Yes
								2	46.7	0.1	130	No Yes
								LPAR	126.3	0.3		
						CMS8	3	0	9.1	0.1	15	No Yes
								1	4.6	0.2	15	No Yes
								LPAR	13.7	0.3		

Total Logical Partition busy: **299.6**
Total Physical Management time: 0.366

z/VM system does not have access to 100% of each processor.

- 51% entitlement, 1.5 processors (155 / 300)
- Each vcpu entitled to 50% of one real CPU, master processor is constrained
- Reducing CMS2 LPAR to 2 processors will perform better.

VELOCITY SOFTWARE

z/VM CPU Allocation

z/VM Allocates CPU based on SHARE

- ABSOLUTE SHARE is percent of LPAR
- RELATIVE SHARE is comparable to LPAR "weight"

SHARE is "normalized" to percent of system

- Normalized share is the "guarantee"

When to use Absolute vs Relative?

- If share should go up as workload increases (TCPIP,RACF) then use ABS
- If share should go down as more users logon, use REL

IBM Defaults are broken….

Limiting users by Limiting Shares

```
Q  share vmservu
USER VMSERVU :RELATIVE SHARE= 100 MAXIMUM SHARE= NOLIMIT
Ready; T=0.01/0.01 16:58:54
```

LIMITs

- LIMITHARD caps resource consumption regardless of other user demands
- LIMITSOFT caps resource consumption unless all users have received their target minimum, and there are no unlimited users who can consume resources

```
set share vmservu relative 200 500 limitsoft
USER VMSERVU : RELATIVE SHARE= 200 MAXIMUM SHARE=LIMITSOFT
RELATIVE 500
Ready; T=0.01/0.01 17:01:12

set share mvsys1 abs 5% abs 20% limithard
USER MVSYS1 : ABSOLUTE SHARE = 5%
MAXIMUM SHARE = LIMITHARD ABSOLUTE 20%
Ready; T=0.01/0.01 14:40:49
```

User's complain, InQueue skyrockets, why?

- Impact really is quickdsp and Q3 –Really long running transactions.

```
Report: ESAUSRQ      User Queue and Load Analysis                    Veloc
-------------------------------------------------------------------------
         <-----------User Load------------>      <-----------Average Num
UserID   Logged  Non-           Disc- Total  Tran <-------Dispatch List--
/Class       on  Idle  Active  conn  InQue  /min    Q0    Q1    Q2    Q3
-------- ------ ----- ------- ------ -----  ---- ----- ----- ----- -----
14:01:00 1061.0     .   156.0      .  20.0  1175   5.0   6.0   2.0   7.0
14:02:00 1063.0     .   157.0      .  25.0  1184  10.0   5.0   4.0   6.0
14:03:00 1064.0     .   188.0      .  52.0  1423   3.0   2.0   8.0  39.0
…….
14:18:00 1064.0     .   154.0      .  31.0  1185  10.0   5.0   6.0  10.0
14:19:00 1065.0     .   161.0      .  36.0  1130   6.0   4.0   3.0  23.0
14:20:00 1065.0     .   186.0      .  47.0  1143  13.0   3.0   1.0  30.0
14:21:00 1066.0     .   190.0      .  72.0  1140  25.0  15.0   8.0  24.0
14:22:00 1065.0     .   213.0      .  73.0  1189  35.0   3.0   1.0  34.0
14:23:00 1067.0     .   243.0      .  88.0  1157  31.0   3.0   1.0  53.0
14:24:00 1067.0     .   259.0      .  81.0  1105  11.0   2.0   5.0  63.0
14:25:00 1067.0     .   215.0      .  46.0   932  12.0   6.0   3.0  25.0
…..
14:30:00 1069.0     .   266.0      . 108.0  1227  34.0   6.0   7.0  61.0
14:31:00 1069.0     .   274.0      . 116.0  1183  30.0   2.0   2.0  82.0
14:32:00 1067.0     .   266.0      . 126.0   960  47.0   4.0   5.0  70.0
14:33:00 1067.0     .   257.0      . 105.0  1230  43.0   7.0  13.0  42.0
```

VELOCITY SOFTWARE

Check processor, cpu is a constant, I/O is constant

Report: ESASSUM Subsystem Activity Velocity Software

	<---Users---->			Transactions		<Processor>		Storage (MB)		<-Paging-->		<-----I/O----->		
	<-avg number->			Per	Avg.	Utilization		Fixed	Active	<pages/sec>		<-DASD-->		Other
Time	On	Actv	In Q	Minute	Resp	Total	Virt.	User	Resid.	XStore	DASD	Rate	Resp	Rate
14:01:00	1061	156	20.0	763.0	0.733	41	35	18.5	999.5	5	5	536	1.0	27.5
14:02:00	1063	157	25.0	803.0	0.594	41	35	18.5	1022.0	7	4	634	1.0	27.8
14:03:00	1064	188	52.0	981.0	1.112	41	35	18.5	1162.0	7	5	318	1.0	33.4
14:18:00	1064	154	31.0	729.0	1.055	41	36	18.5	986.5	0	3	277	1.0	26.3
14:19:00	1065	161	36.0	727.0	0.704	41	34	18.5	1061.1	226	3	303	1.3	35.3
14:20:00	1065	186	47.0	773.0	1.954	41	35	18.5	1315.9	432	2	377	1.1	30.8
14:21:00	1066	190	72.0	843.0	2.160	41	34	18.7	1308.9	1	2	769	0.8	38.9
14:22:00	1065	213	73.0	833.0	2.367	41	35	18.7	1394.9	1	3	548	0.9	31.1
14:23:00	1067	243	88.0	830.0	2.824	41	35	18.9	1537.0	1	3	858	0.8	29.8
14:24:00	1067	259	81.0	775.0	2.389	41	34	18.7	1660.4	13	3	683	0.8	18.2
14:25:00	1067	215	46.0	509.0	1.095	41	34	18.7	1452.4	8	2	583	0.8	28.5
14:30:00	1069	266	108	838.0	1.623	41	35	19.2	1618.2	5	3	511	0.8	28.8
14:31:00	1069	274	116	787.0	0.655	41	35	19.2	1630.7	8	3	569	0.8	29.0
14:32:00	1067	266	126	650.0	1.191	41	34	19.2	1580.9	4	3	774	0.8	30.7

Check LPAR Configuration

- Check weights
- VM shares with MVS and TEST, share is 179 / (179+260+5) = 40%
- (Only one CP defined)
- VM LPAR is capped!!!! At 40% of one CPU. VM running 100%

```
Report: ESALPARS     Logical Partition Summary   Velocity Software
-------------------------------------------------------------------------------------
          <--Complex--> <-------Logical Partition--->  <-Assigned Shares---->            Proce
          Phys Dispatch              Virt <%Assigned>  <---LPAR--> <VCPU Pct> Cap-  Wait Type
Time      CPUs    Slice Name     Nbr CPUs Total  Ovhd  Weight  Pct /SYS /CPU  ped   Comp
--------  ---- -------- -------- --- ---- -----  ----  ------ ---- ---- ----  ----  ---- ----
14:01:00     1  Dynamic Totals:    0    3  80.4   0.5     444  100                          
                        VM         1    1  41.2   0.1     179 40.0 40.0 40.0   Yes    No CP
                        MVS        2    1  39.2   0.4     260 59.1 59.1 59.1    No    No CP
                        TEST       3    1     0     0       5  1.0 0.96 0.96    No    No CP
                        TESTTEST   5    0
```

Limiting Processor Case Study

Check User Wait States

- Running went down as percent of non-dormant, inqueue time.
- CPU wait stayed the same
- Asynchronous I/O wait is bottleneck – but DASD I/O was constant?
- Clue – something was on the Limit List – this is result of SHARE CAP
- Wait state sampling tests I/O Wait before testing Limit. If I/O wait, stops.

```
Report: ESAXACT      Transaction Delay Analysis                    Velocity Software
-------------------------------------------------------------------------------------
                     <--------------Percent non-dormant---------------------->        Times
UserID   <-Samples->                          E-  D-  T-     Tst <Asynch>       Lim  Pct    I/O
/Class    Total  In Q Run Sim CPU SIO Pag SVM SVM SVM  CF Idl I/O Pag Ldg Oth Lst Elig Throttl
-------- ----- ----- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---- -------
14:01:00  1061    20 5.0 5.0  40   0   0   0   0  10   0  35   0       .   0   0    0       .
Hi-Freq: 62599  1880 3.1 1.5  39 2.8   0   0  23 4.3 3.3  22 0.8   0   0   0 3.0    0       0
-------------------------------------------------------------------------------------
14:31:00  1069   116 0.9 0.9  34   0   0   0   0 1.7   0 3.4  59       .   0   0    0       .
Hi-Freq: 64140  7755 0.7 1.2  39 1.0   0   0 9.1 2.1 0.3 4.0  42   0   0 0.5   0    0       0
-------------------------------------------------------------------------------------
14:32:00  1067   125   0 4.0  46   0   0   0   0 2.4   0 5.6  42       .   0   0    0       .
Hi-Freq: 64020  7508 0.8 1.2  42 1.0   0   0 8.7 2.1 0.3 3.7  40   0   0 0.5   0    0       0
```

Check User Share settings

- Cap on the database servers
- CPU consumption reaches point where database servers are limited
- Fall over the cliff
- Solution: Remove all caps. z/VM does a better job

```
Report: ESAUSRC      User Configuration
-------------------------------------------------------------
                                    <---------SHARE--------->
                  Account  ACI Grp  <Normal> <-Maximum>
UserID   ClassID  Code     Name      Rel Abs Type Share Limit
-------- -------- -------- -------- ---- --- ---- ----- -----
TIFSHRE  *BMAdmn  SYSTEMS          .  200   .  Abs  10.0  Soft
TIFSHRE2 *BMAdmn  SYSTEM           .  200   .  Abs  10.0  Soft
TIFSHRE3 *BMAdmn  SYSTEMS          .  200   .  Abs  10.0  Soft
TIFSHRE4 *BMAdmn  SYSTEM           .  200   .  Abs  10.0  Soft
```

Processor Measurements SMT

```
Report: ESAUSR5      User SMT CPU Consumption Analysis
-------------------------------------------------------
         <----Raw CPU Seconds Consumed (Total)---->
UserID   <Traditional> <MT-Equivalent> <MT Prorated>
/Class   Total  Virt   Total  Virtual  Total Virtual
-------- ----- -----   -----  -------  ----- -------
10:32:00 660.4  641.7  476.0    462.5  432.0   420.0
 ***User Class Analysis***
TheUsers 660.2  641.6  475.9    462.4  431.9   419.9
 ***CPU POOL User Analysis***
DB2      15.63  15.42  12.13    11.97  12.23   12.09
EEMSCSP   9.03   8.97   6.91     6.87   6.59    6.55
IIB      498.7  488.6  360.4    353.2  321.8   315.4
```

ESAUSR5/ESAUSP5 show SMT user data

Three CPU measures

1) **Traditional: Time assigned and dispatched on a thread**
2) **Time Would take if non-SMT (MT-Equivalent)**
3) **Cycles really used (approximately, prorated)**

How do you do capacity planning? What is 100% busy?

VELOCITY SOFTWARE

SMT Processor Utilization

SMT 2 has two threads

Always assigned concurrently

What if one thread is active, 2nd thread is idle?

Is "thread idle" additional capacity?

- It is not one for one. What does this mean?
- 384% - 10.0% assigned, 298% one thread idle….

<-------Logical Partition------->				<Assigned Shares---->						
		Virt	CPU	**<%Assigned>**		<---LPAR-->		<VCPU Pct>		Wait	**<-Thread**
Name	Nbr	CPUs	Type	Total	Ovhd	Weight	Pct	/SYS	/CPU	Comp	**Idle**	c
Totals:	00	61	IFL	729.9	20.8	1001	100					
VLB4	04	14	IFL	**384.1**	**10.0**	475	47.5	3.39	122	No	**298.5**	
VLBX	0F	1	IFL	0.6	0.1	50	5.0	4.99	180	No	0	
VLB1	01	24	IFL	2401	0.1	Ded	40.0	0	0	Yes	0	
VLB6	06	14	IFL	326.5	10.3	475	47.5	3.39	122	No	254.4	
VLB8	FF	0										
ZS01	0E	8	IFL	18.7	0.4	1	0.1	0.01	0.45	No	17.79	

VELOCITY SOFTWARE

SMT – When to use it?

SMT Announced on z13 without valid guidance

A few installations said "good stuff"

- **Oracle, SAP workloads**

Others said "bad stuff"

- **Java, Websphere workloads**

The question is why?

And why is z14 so much better? (Prove it)

(z15 is better)

CPU Measurement Facility for z/VM

What is the CPU Measurement Facility (Basic) (smf 113)

CPI: Cycles per Instruction (RNI does not track….)

Report: ESAMFCA MainFrame Cache Hit Analysi
Monitor initialized: 12/10/14 at 07:44:37 on 282

		<CPU Busy> <percent>		<-------Processor------> Speed/<-Rate/Sec->			CPI
Time	CPU	Totl	User	Hertz	Cycles	Instr	Ratio
07:48:35	0	20.8	18.4	5504M	1121M	193M	5.807
	1	21.6	19.6	5504M	1161M	221M	5.264
	2	24.4	22.5	5504M	1300M	319M	4.078
	3	22.4	19.7	5504M	1248M	265M	4.711
	4	19.6	17.6	5504M	1102M	194M	5.683
	5	20.4	18.6	5504M	1144M	225M	5.087
	6	23.9	22.0	5504M	1341M	341M	3.935
	7	17.6	15.4	5504M	949M	160M	5.927
	8	18.5	16.5	5504M	1005M	194M	5.195
	9	22.5	20.6	5504M	1259M	347M	3.629
System:		212	191	5504M	10.8G	2457M	4.733

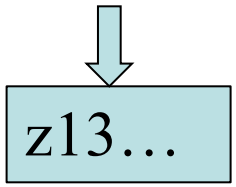
EC12…

Why you should be interested – what is a MIP?

```
Report: ESAMFC          MainFrame Cache Analysis Rep
-------------------------------------------------
                <CPU Busy> <-------Processor------>
                <percent>   Speed/<-Rate/Sec->
Time       CPU  Totl User   Hertz Cycles Instr Ratio
--------  ---  ---- ----   ----- ------ ----- -----
14:05:32    0  92.9 64.6   5000M  4642M 1818M 2.554
            1  92.7 64.5   5000M  4630M 1817M 2.548
            2  93.0 64.7   5000M  4646M 1827M 2.544
            3  93.1 64.9   5000M  4654M 1831M 2.541
            4  92.9 64.8   5000M  4641M 1836M 2.528
            5  92.6 64.6   5000M  4630M 1826M 2.536
               ---- ----   ----- ------ ----- -----
System:         557  388   5000M  25.9G 10.2G 2.542
-------------------------------------------------
14:06:02    0  67.7 50.9   5000M  3389M 2052M 1.652
            1  67.8 51.4   5000M  3389M 2111M 1.605
            2  69.0 52.4   5000M  3450M 2150M 1.605
            3  67.2 50.6   5000M  3359M 2018M 1.664
            4  60.8 44.5   5000M  3042M 1625M 1.872
            5  70.1 53.8   5000M  3506M 2325M 1.508
               ---- ----   ----- ------ ----- -----
System:         403  304   5000M  18.8G 11.4G 1.640
```

1830 mips (at 100%)

2828 Mips (at 100%) Doing 10% more work



VELOCITY SOFTWARE

TLB Analysis – z13

DAT Translation consumes 30% of cycles for ONE thread

- Two threads on one core leaves very little for real work
- Problem is very high Linux polling / dispatch rates

Report: ESAMFC MainFrame Cache Magnitudes Report ZMAP 4.2.4

		<CPU Busy>		<----------		<-Translation Lookaside buffer(TLB)-					
		<percent>		Speed/		<cycles/Miss>		<Writs/Sec>		CPU	Cycles
Time	CPU	Totl	User	Hertz	Ratio	Instr	Data	Instr	Data	**Cost**	Lost
07:45:01	0	25.9	24.4	5000M	1.704	159	742	473K	244K	19.77	257M
	1	35.9	34.7	5000M	1.491	138	731	530K	249K	14.17	255M
	2	15.8	13.9	5000M	2.868	206	826	419K	245K	36.30	289M
	3	16.6	15.4	5000M	2.508	212	825	411K	247K	34.90	291M
	23	18.1	17.0	5000M	2.144	197	815	412K	229K	29.44	268M
	24	21.4	19.9	5000M	1.865	114	533	598K	302K	21.35	229M
	25	26.2	24.9	5000M	1.742	98	503	736K	346K	18.71	246M
	26	12.9	11.6	5000M	2.050	154	631	378K	214K	29.92	194M
	27	13.1	11.9	5000M	1.987	156	630	378K	217K	29.64	195M
System:		514	476	5000M	2.257	176	724	14M	7641K	**30.69**	7917M

One Thread

TLB Analysis – Should SMT be Enabled?

Evaluate other data points from other z13 systems:

- z/VM Linux workloads issue: VERY HIGH dispatch
- Why z14 should be great….
- Don't enable SMT if one thread is consuming your DAT

Report: ESAMFC MainFrame Cache Magnitudes Report

	<CPU Busy>		<----	<-Translation Lookaside buffer(TLB)->					
	<percent>		Speed	<cycles/Miss>		<Writs/Sec>		CPU	Cycles
##	Totl	User	Hertz	Instr	Data	Instr	Data	Cost	Lost
Mem1	907	874	5504M	54	232	117M	36M	29.55	14.8G
Mem2	1188	1140	5000M	147	364	30M	26M	23.62	14.0G
VLB4	1703	1366	5000M	185	567	66M	46M	44.59	38.2G
z13N	216	212	5000M	192	598	3084K	1802K	**15.94**	1669M
TCPN	892	757	5000M	217	947	32M	17M	51.46	23.0G
MTRN	947	868	5000M	265	1283	33M	17M	65.25	30.8G ←

VELOCITY SOFTWARE

TLB Analysis – Should SMT be Enabled?

Z14 is "Awesome…."

- IBM doesn't sell value of z14 chip,
- DAT gives a lot of cycles back.
- 12% DAT cycles (SMT) vs. 30% z13, NO SMT….

ESAMFC MainFrame Cache Magnitudes Rate ZMAP 5.1.0
initialized: 04/08/19 at 19:00:00 on 39064/08/19 19:00:00

	<CPU Busy>		<-------Processor------>				<-Translation Lookaside buffer(TLB)->					
	<percent>		Speed/<-Rate/Sec->				<cycles/Miss>		<Writs/Sec>		CPU Cycles	
CPU	Totl	User	Hertz	Cycles	Instr	Ratio	Instr	Data	Instr	Data	Cost	Lost
0	29.5	28.0	5208M	1535M	822M	1.867	177	284	243K	364K	**9.55**	147M
1	26.8	25.3	5208M	1399M	748M	1.871	178	294	248K	359K	**10.71**	150M
2	37.3	35.1	5208M	1945M	877M	2.219	135	210	446K	818K	**11.91**	232M
3	36.9	34.8	5208M	1925M	914M	2.107	136	212	449K	821K	12.19	235M
4	22.6	20.9	5208M	1181M	530M	2.228	158	263	316K	445K	14.18	167M
5	23.4	21.8	5208M	1219M	590M	2.066	156	260	316K	449K	13.63	166M
6	23.9	21.5	5208M	1248M	615M	2.030	170	284	236K	364K	11.49	143M
7	26.9	25.5	5208M	1402M	730M	1.921	166	265	237K	391K	10.19	143M
8	31.2	29.5	5208M	1628M	792M	2.055	163	257	338K	507K	11.39	185M
9	32.9	31.3	5208M	1715M	878M	1.954	159	247	326K	508K	10.34	177M
10	20.9	19.4	5208M	1093M	504M	2.171	166	276	257K	391K	13.79	151M

VELOCITY SOFTWARE

Z14 advantages

Z13 Problem:

- z/VM does NOT support large pages
- Linux with java/websphere has VERY high dispatch
- Direct address translation (dat) required for all parts of instruction
- No cycles left after dat….
- IBM Hardware development “notified”

z14

- The fix seems like a secret
  - published by at least one IBMer for z/OS
- If one dat per core is the bottleneck, put on 4…..
- Z14 – no complaints about SMT
- Z15 the same

LPAR Weights, parking

The Problem:

- If too many lpar virtual cpu defined, performance declines
- Cache competition, Overhead
- Errors on weight settings by installations

The solution: HYPERdispatch, implemented in z/OS, z/VM

- parking of low entitlement virtual cpus
- Parking level determined every 2 seconds…. – TOO MUCH PARKING
- Recommendation, 4 engines or less, horizontal is better
- CP SET SRM UNPARKING LARGE
- cp set srm excessuse type ifl high

```
00:00:03 CPU Park from 20 to  18 CPUUtil= "8.75", Projected= "9.26"
00:00:05 CPU Unpark from  18 to  22 CPUUtil= "8.09", Projected= "8.97"
00:00:09 CPU Park from 22 to  18 CPUUtil= "7.39", Projected= "8.98"
00:00:11 CPU Unpark from  18 to  20 CPUUtil= "7.32", Projected= "8.80"
00:00:13 CPU Park from 20 to  18 CPUUtil= "8.15", Projected= "8.98"
00:00:17 CPU Unpark from  18 to  20 CPUUtil= "8.40", Projected= "8.97"
00:00:29 CPU Park from 20 to  18 CPUUtil= "8.62", Projected= "10.2"
00:00:37 CPU Unpark from  18 to  20 CPUUtil= "8.40", Projected= "8.96"
00:00:39 CPU Park from 20 to  18 CPUUtil= "8.48", Projected= "8.96"
00:00:41 CPU Unpark from  18 to  20 CPUUtil= "8.31", Projected= "8.93"
00:00:43 CPU Park from 20 to  18 CPUUtil= "8.27", Projected= "8.93"
00:00:53 CPU Unpark from  18 to  20 CPUUtil= "8.57", Projected= "8.76"
00:00:57 CPU Park from 20 to  18 CPUUtil= "7.82", Projected= "8.91"
```

LPAR Entitlement

Many "newer" installations have questions about parking

- Parking based on entitlement and srm setting
- LPAR weights define both
- Point of HYPERdispatch, parking is to reduce errors

ESALPARS Logical Partition Summary **(141 IFLs on box, big z13)**

<-------Logical Partition------->				<%Assigned>		<-Assigned Shares----			
		Virt	CPU			<---LPAR-->		<VCPU	Pct
Name	Nbr	CPUs	Type	Total	Ovhd	Weight	Pct	/SYS	/CPU
Totals:	00	387	IFL	4451	156	3860	100		
L1A1	21	4	IFL	2.6	0.4	50	1.3	0.32	44.3
L1D1	01	50	IFL	167.0	10.1	500	13.0	0.26	35.5
L1D2	02	40	IFL	490.8	38.7	900	23.3	0.58	79.9
L1D3	03	30	IFL	1.2	0.4	50	1.3	0.04	5.91
L1D4	04	14	IFL	1.3	0.5	10	0.3	0.02	2.52
L1E1	05	20	IFL	64.8	3.6	500	13.0	0.65	88.7
L1C1	**11**	**40**	**IFL**	**3228**	**80.5**	**200**	**5.2**	**0.13**	**17.7**
L1C2	12	31	IFL	11.1	0.7	10	0.3	0.01	1.14
L1C3	13	14	IFL	1.4	0.5	10	0.3	0.02	2.52
L1C4	14	14	IFL	1.0	0.4	10	0.3	0.02	2.52
L1A2	22	2	IFL	1.0	0.4	10	0.3	0.13	17.7
L1B1	25	20	IFL	310.7	7.1	300	7.8	0.39	53.2
L1B2	26	31	IFL	99.0	5.5	700	18.1	0.58	80.1
L1B3	27	30	IFL	1.2	0.4	50	1.3	0.04	5.91
L1B4	28	14	IFL	1.0	0.4	10	0.3	0.02	2.52

(5.2% of IFLs = 7.1)

VELOCITY SOFTWARE

LPAR Entitlement

Entitlement field added…

ESALPARS Logical Partition Summary

<-------Logical Partition------->				<%Assigned>		<-Assigned Shares---->				**Entitle**
		Virt CPU				<---LPAR-->		<VCPU Pct>		CPU Cnt
Name	Nbr	CPUs	Type	Total	Ovhd	Weight	Pct	/SYS	/CPU	
Totals:	00	387	IFL	4451	156	3860	100			
L1A1	21	4	IFL	2.6	0.4	50	1.3	0.32	44.3	1.77
L1D1	01	50	IFL	167.0	10.1	500	13.0	0.26	35.5	17.75
L1D2	02	40	IFL	490.8	38.7	900	23.3	0.58	79.9	31.94
L1D3	03	30	IFL	1.2	0.4	50	1.3	0.04	5.91	1.77
L1D4	04	14	IFL	1.3	0.5	10	0.3	0.02	2.52	0.35
L1E1	05	20	IFL	64.8	3.6	500	13.0	0.65	88.7	17.75
L1C1	11	**40**	IFL	3228	80.5	200	5.2	0.13	**17.7**	**7.10**
L1C2	12	31	IFL	11.1	0.7	10	0.3	0.01	1.14	0.35
L1C3	13	14	IFL	1.4	0.5	10	0.3	0.02	2.52	0.35
L1C4	14	14	IFL	1.0	0.4	10	0.3	0.02	2.52	0.35
L1A2	22	2	IFL	1.0	0.4	10	0.3	0.13	17.7	0.35
L1B1	25	20	IFL	310.7	7.1	300	7.8	0.39	53.2	10.65
L1B2	26	31	IFL	99.0	5.5	700	18.1	0.58	80.1	24.84
L1B3	27	30	IFL	1.2	0.4	50	1.3	0.04	5.91	1.77
L1B4	28	14	IFL	1.0	0.4	10	0.3	0.02	2.52	0.35
LN12	31	4	IFL	0	0	Ded	2.8	0	0	0
LOI3	32	14	IFL	64.0	4.7	500	13.0	0.93	127	17.75

VELOCITY SOFTWARE

Processor Summary

Processor efficiency has a price tag

- 100% is all you get

Performance options:

- LPAR Weights
- Virtual machine shares
- Capping
- Number and type of engines

z/OS engines about $1M fully loaded

vs IFLs $25K fully loaded….

- Big savings to move workload