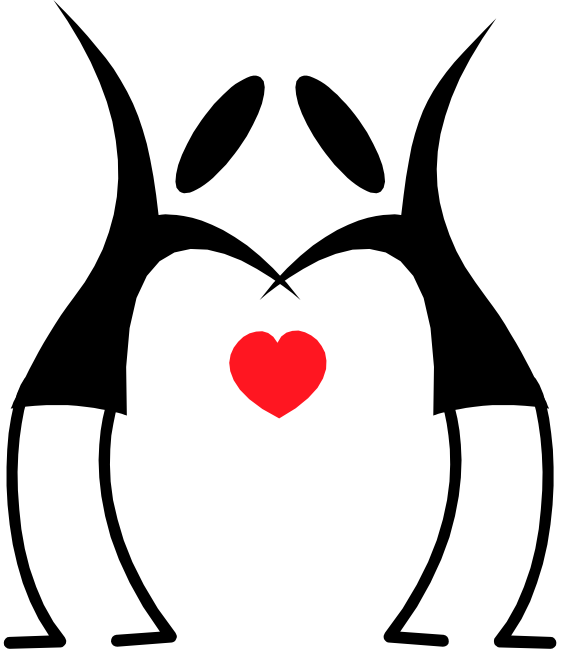
SHARE – Orlando, August 10th, 2011
Session 9616



CICS Performance and Capacity Management News and Best Practices

By Ivan Gelb

Think *Faster* with Gelb Information

Any questions? Email to: ivan@gelbis.com; Call: 732-303-1333

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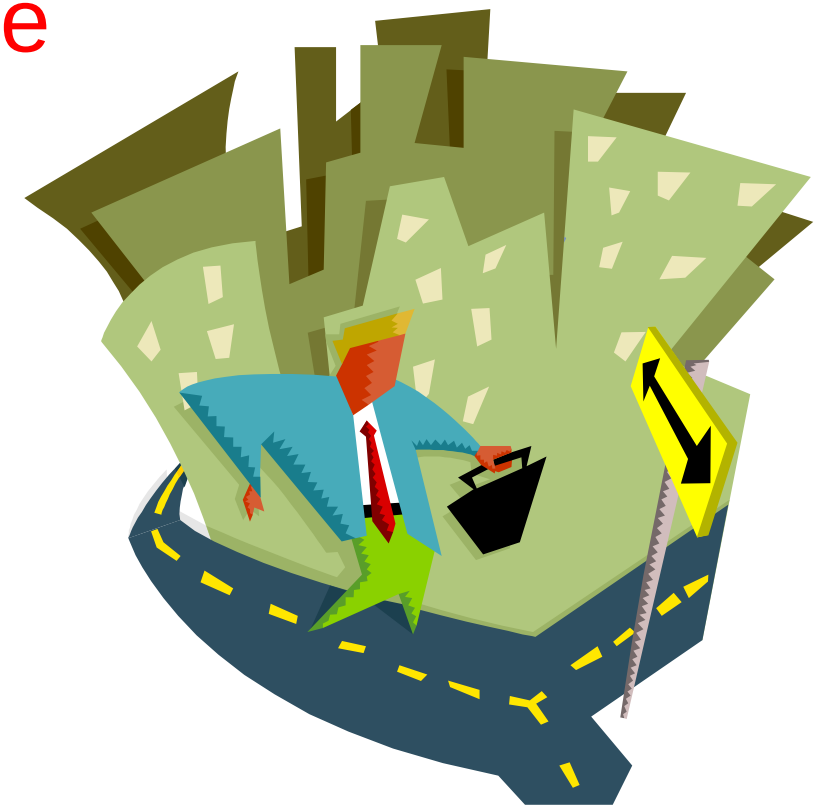
Agenda

- Your Questions @Anytime
- CICS V4.2 News
- Other News For CICS
- Performance Analysis
- Best Practices



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CICS V4.2 News

- Dig into the following sessions at this SHARE:
  - 9322, CICS TS V4.2 Technical Overview, Ian Mitchell
  - 9323 , CICS TS V4.2 Migration Update, Steve Zemblowski
  - 9324 , CICS TS V4.2 User Experience, Steve Ware, Charlie Wiese, and Gene Hudders
  - 9601, CICS TS V4.2 Scalability, John Tilling
  - 9605 , What's New in CICS V4.2 Systems Management Best Practices, Mathew Webster

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CICS V4.2 News (continued)

- CICS supplied mirror program is now threadsafe so TCB switching could be reduced.
- More 64-bit support
- Improvements to VSAM, HTTP connections, and workload management
- OSGi
  - Solves JAVA's JAR hell (Source: Wikipedia)
  - Speeds up JAVA applications' startup at often significantly reduced CPU cost
- Offload CICS Web Services CPU time to a zAAP process eligible JVM server.

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CICS V4.2 News (continued)

- Increase the number of LSR pools from 8 to 255. Yey! See SIT parm CSDLSRNO=
- New data for JVM performance monitoring and capacity planning
- Increased Java applications capacity per CICS region via the CICS 64-bit JVM support
- Many enhancements related to threadsafe processing which can greatly improve a single CICS region's scalability

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Performance Analysis

Top 5 reasons for performance analysis:

1. **Meet** or exceed Service Level Agreements.
2. **Manage** and **control** costs.
3. **Assure** scalability of business systems.
4. **Insure** that computer resources are aligned with the business priorities.
5. **Reduce** total computer resource requirements per business unit of work.

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Performance Analysis (continued)

Top 5 performance tuning recommendations:

1. Insure that PR/SM and Workload Manager (WLM) Service Policy provide proper priority for processor access.
2. Minimize the number of production CICS regions.
3. Turn off all CICS traces.
4. Tune Temporary Storage and Transient Data to reduce/eliminate physical I/Os.
5. Tune file I/Os via data-in-memory techniques and use data tables (CICS or User maintained).

Note: For additional detailed recommendations, please see SHARE Proceedings for "CICS Performance Management Best Practices" and "Mining Performance Gold From CICS Statistics"

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Performance Analysis (continued)

An Ongoing Analysis Outline / Critical Success Factors:

- Service Level requirements are documented
- Short and long term performance data collected
- All system components (z/OS, CICS, MQ, DB2,…) are customized to maintain / protect performance of business critical applications
- Performance management and capacity management – are coordinated symbiotic functions

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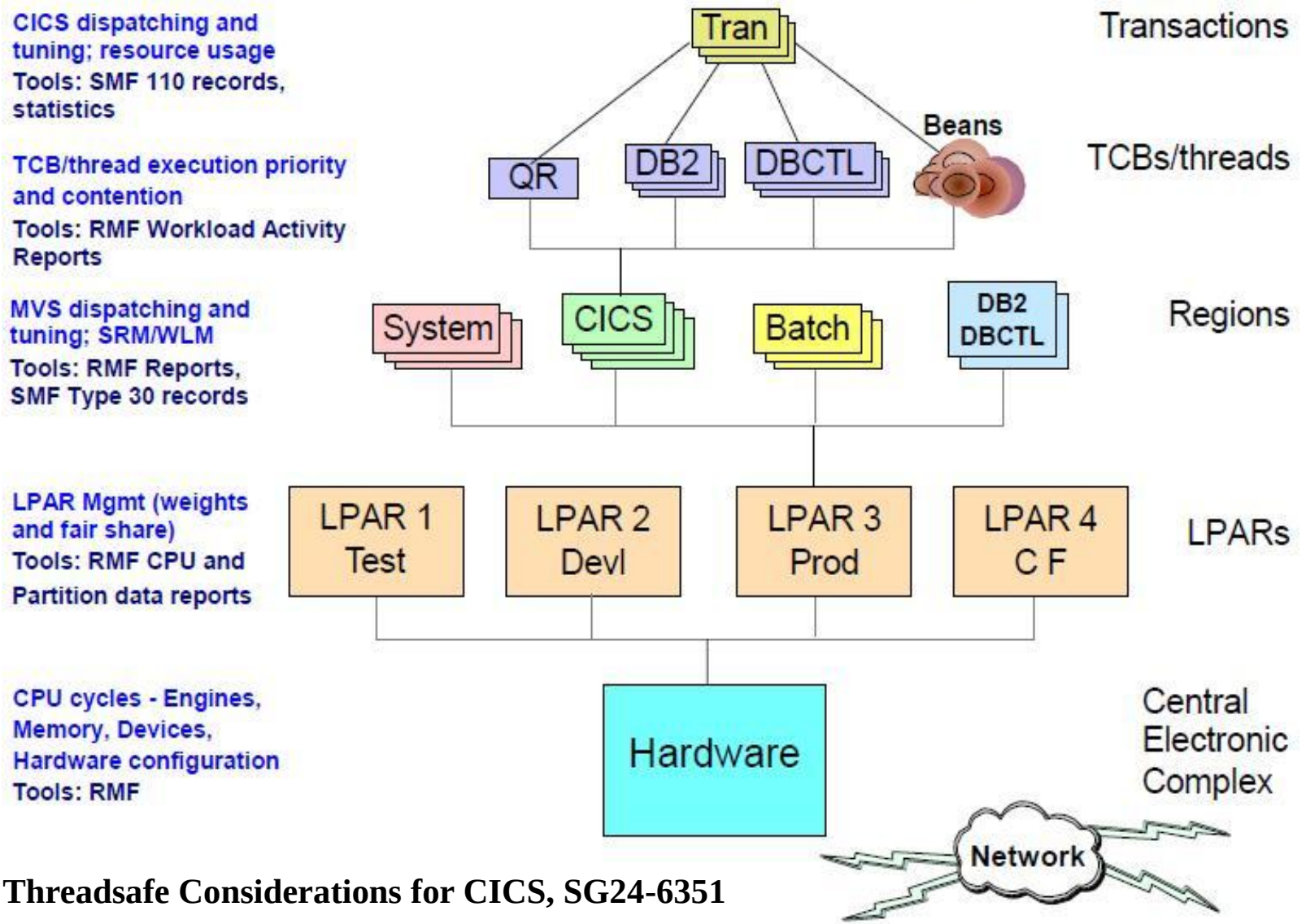
Performance Analysis (continued)

Performance Hierarchy



Source: Threadsafe Considerations for CICS, SG24-6351

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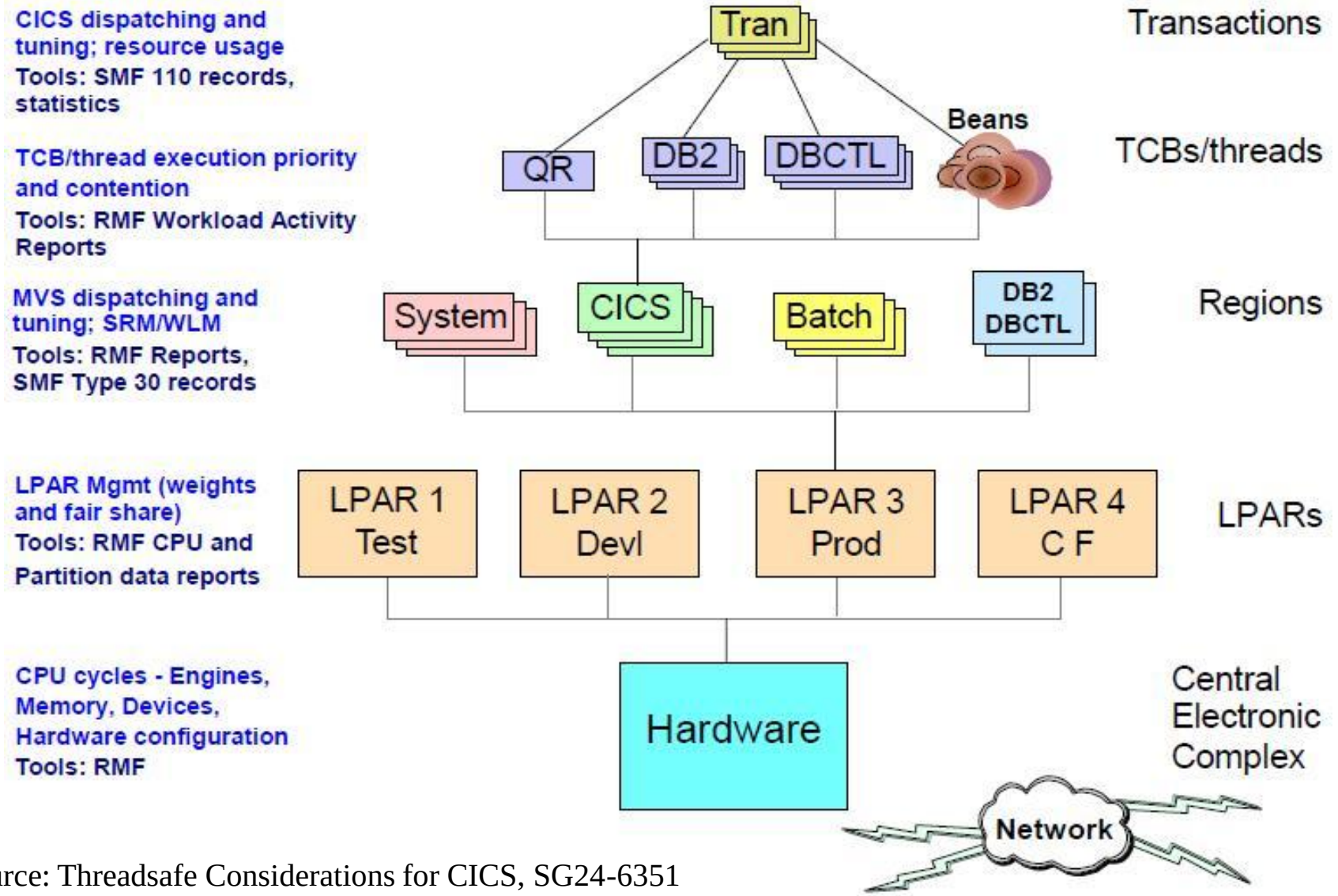
Performance Analysis – Holistic View

Performance Hierarchy



Source: Threadsafe Considerations for CICS, SG24-6351

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Performance Analysis Top 10

1. What is the complaint, and are any other older complaints **still** around/being reported and **unresolved**?
2. When did this problem **1st** occur and occur the **last** time?
3. What planned changes occurred during this time period?
4. Were any changes made to z/OS WLM service policy?
5. Did the total system workload composition change?
   A. Within all the LPARs (not just the affected CICS one)?
   B. Across all LPARs on this processor complex (CEC)?
6. Did the total load of all LPARs change, and/or is 95-100% physical CEC utilization hit when CICS service degrades?
7. Did any PR/SM LPAR weights or caps change, or switched from uncapped to **hard-capped** LPARs?
8. Was anything moved around (files, clients, regions,..)?
9. What were the most recent changes to the application?
10. How did transaction rates change within affected CICS region?

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Best Practices for CICS Performance and Capacity Management

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Best Practice (BP) 1 – WLM

- **Recommendation:** Use WLM Average or Percentile Response Time goals for best protection available for CICS performance.
  - Percentile response time – likely the easiest and requires the least monitoring and active management
  - Average response time – requires more active monitoring and management to maintain.
  - Let's dissect the WLM service class goal types…

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Percentile Response Time Goal

- The recommended way to manage loved CICS production work
- Goal example:
  - 90% of transactions with < 1 sec. Resp.
- Can address problems caused by long running or never ending transactions

Note: RMF Workload Activity Report is the easiest and least overhead way of working with and reporting of response time goals.

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Average Response Time Goal

- Can work acceptably for homogeneous CICS workloads
- Goal example:
  - ALL transactions < 1 sec. AVG. Resp.
- "Fooled" by long running transactions ending in the interval
- Once "fooled" it will **over-protect** CICS, and **hurt** all the other work in service classes with equal or lower WLM importance

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Velocity Goals

- "Execution velocity is an abstract mathematical description with no objectively measurable metric."
  --John Arwe, WLM Developer
- Velocity calculated from sampled states: CPU_Using_Time / (CPU_Using_Time + WLM_Managed_Delays)
  - WLM Managed delays: CPU, paging, swapping, MPL, IOs,…

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Velocity Goals (cont'd)

- Velocity goals NEVER work as tools for relative priority
- Velocity goals do not determine CPU dispatching priority
- CICS TOR velocities fluctuate severely
- CICS TORs performance can be hurt by WLM's efforts to manage them

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Velocity Goals – Consider When?

- Recommended for non-transactional work or work that “needs” a limiter
- Low importance + low velocity can control known “loopers”
- Consider use of WLM defined resource group maximum with velocity goals to impose an absolute limit on any work
- CICS test regions

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BP 2 – WLM CPU Critical Attribute

- **Recommendation:** Consider use of WLM service class option

  CPU Critical = YES

  – Defined for single period service classes with velocity or response time goals

  – CICS region's CPU dispatching priority will be kept higher than all less important work even if all of CICS' goals are being met.

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BP 3 – WLM Storage Critical Attribute

- **Recommendation:** Consider use of WLM service class option

  Storage Critical = YES

  – CICS protected from paging because region's working set is kept very close to its high water mark (HWM).
  Every other workload could be hurt a lot!

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BP 4 – WLM Batch Initiators Priority

- **Recommendation:** Use **INITIMP** parameter in IEAOPTxx; must be coded to keep initiators' CPU activity below service classes with CPU critical attribute for specified importance levels.
  Review current publication and OW55344, OA03581, and OA03870 for the complete story

- **Why?** During job selection, batch initiators run in SYSSTC service class – second highest priority just behind SYSTEM

- Initiators' activity degrades CICS because they will impair work at all importance levels, including importance 1s. Initiators' activity and their related exits often use a lot of CPU at the SYSSTC priority level before the job is classified.

BP 5 – Combine CICS Regions

- **Recommendation:** Combine regions as you move up to faster single CPU speed processors or exploit CICS open TCBs via threadsafe work. Today's z114/z196 series have CPU speeds over 24x greater that those found in the mid-1990s!
- **Why?** Saves 5 – 25%+ CPU if 2-to-1

- Very likely that your production regions were split due to QR TCB saturation or "political" reasons in the region's lifetime.

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BP 6 – Customize CICS TRACE

- **Recommendation:** TRACE = NO for all production regions. Use trace in test regions as needed.
- **Why?** Saves 10 – 35% CPU!
  - If **needed** for problem determination in a production region, consider selective tracing by domain or transaction name or user ID, or… – over **30** options available for selective tracing!!!

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BP 7 – Monitor Wait for CPU

- **Recommendation:** Always monitor wait-for-CPU-dispatch as a component of the total CICS response time.
  Why? Best method of tracking CICS response time degradation caused by wait for CPU.
- CPU wait for dispatch related considerations:

1. Does the application have delays caused by higher priority work within CICS, and/or within MVS, and/or within the same or other PR/SM LPAR-s?

2. If answer to any part above is yes, CICS work may lack the proper PR/SM LPAR weight, z/OS WLM importance, CICS transaction priority, and/or not enough processor capacity is available to meet all the service level goals.

CICS Dispatcher Statistics – Time by TCB Mode

DISPATCHER STATISTICS (Note: Columns 2 – 5 deleted to improve legibility)

TCB Mode	MVS Waits	Total Time in MVS wait	Total Time Dispatched	Total CPU Time / TCB
QR	13051397	000-18:18:33.24	000-01:49:46.74	000-01:12:02.27
RO	48658	000-20:05:12.28	000-00:02:46.27	000-00:01:00.80
CO	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
SZ	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
RP	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
FO	800	000-19:00:52.61	000-00:00:44.05	000-00:00:06.50
SL	1	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
SO	2	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
S8	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
D2	2419	000-20:18:01.28	000-00:00:03.26	000-00:00:00.43
L8	16952578	007-03:07:31.31	000-05:36:18.48	000-01:13:35.37
H8	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00
J8	0	000-00:00:00.00	000-00:00:00.00	000-00:00:00.00

Recommendation: If QR TCB "Total Time Dispatched" is more than 1.25 times "Total CPU Time/TCB," determine response time degradation and seek increased importance in WLM Service Policy if degradation is significant.

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BP 8 – Avoid CICS Limit Conditions

- **Recommendation:** Avoid all CICS limit conditions being hit within CICS. Examples of limit conditions:
  - Max Tasks
  - Class Max Tasks
  - TCB-s
  - Threads
  - Buffers…etc…
  - SOS (short-of-storage anywhere in CICS region!)
- **Why?** The only good reason to hit any limit conditions: You **want** to cause delay and limit performance and capacity of a CICS application or an entire CICS region.

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BP 9 – MXT Settings

- **Recommendation:** Keep MXT as low as possible without turning it into a bottleneck unless you intend to cause PAIN!
- **Why?** Minimize z/OS Workload Manager (WLM) CPU overhead by tuning MXT for every CICS region.
  - **One PB created for each unit of MXT in every CICS!**
  - **If transaction management, Performance Blocks (PB) states sampled at 250 millisecond intervals**
  - **If region management: PBs are sampled every 10 intervals (10 * 250 ms = 2.5 sec)**
  - **Every PB is sampled every time even if it not in use**

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BP 10 - MROLRM

- **Recommendation:** MRO Long running mirrors: MROLRM = YES
- **Why?** Can save a lot of CPU time for transactions which use mirrors.
  - No reason not to do it in any region servicing MRO requests.
  - CPU savings achieved by reducing creation/destruction of mirror transactions. Just do it!

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BP 11 - MROBTCH

- **Recommendation:** Consider MRO Batching: MROBTCH = nn
- **Why?** Could save CPU in regions originating MRO requests. Carefully consider that batching:
  - Will increase response time of some trans.
  - CPU is saved because MRO requests are not sent until “nn” is reached or the system’s ICV value is reached (the maximum possible increase in response time)
  - Use it only if desperate for saving some CPU time, and the work can tolerate the response time increases this will cause.

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BP 12 - CICS DPMODE for DB2

- **Recommendation:** Choose **DPMODE = Which one??**
- **Important Note**: All 3 will work **OK with little measurable difference** if non-CPU constrained in a multi-CP complex!
- **DPMODE=HIGH**
  - Works best for high volumes with little DB2 use as long as ample CPU capacity is available with multiple CPUs/complex
- **DPMODE=EQUAL (is/was CICS 2.2 default!)**
  - **May(!)** provide better performance for non-SQL transactions
- **DPMODE=LOW**
  - **Can** provide more **consistent** service in CPU constrained situations – otherwise only an experiment will tell which is best for a specific workload.

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BP 13 - CICS with DB2 and VSAM

- **Recommendation:** If you select DPMODE = HIGH or EQUAL, **then** separate CICS-DB2 from CICS-VSAM regions in unique WLM service classes.
- **Why**? Protects performance of CICS-VSAM QR TCB limited regions from DB2 application's CPU demands.

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BP 14 – RMF Performance Reports

- **Recommendation:** Utilize response time reports from RMF because they are available real-time and use less CPU than the collection of CMF transaction level records for later processing.
- **Why?** 4 – 12% CPU / CICS region can be saved if CMF based response time reporting is replaced with RMF reports of CICS response time. Critical CICS transactions can be isolated in RMF report service classes.
  Rather that full-time transaction level CMF data collection, selective collection during a few representative periods of activity is recommended.

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BP 14 - Performance Reports (cont'd)

- Please Note:
  - If goal = REGION, response times not reported to service class(es)
  - At least TORs must be managed with goal = TRANSACTION to get response time reports from RMF records.
  - **New in z/OS V1.13.** Service classes with velocity goals will also produce response time distribution.
    Recommendation: Consider the new reports a tool to assist migration from velocity to response time goals since only these can be associated with business driven CICS transaction specific service level agreements (SLA).

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RMF Workload Activity Report

```
REPORT BY: POLICY=HPTSPOL1  WORKLOAD=PRODWKLD  SERVICE CLASS=CICSHR   RESOURCE GROUP=*NONE   PERIOD=1
IMPORTANCE=HIGH

-TRANSACTIONS--  TRANSACTION TIME    HHH.MM.SS.TTT
AVG         0.00  ACTUAL              000.00.00.114
MPL         0.00  QUEUED              000.00.00.036
ENDED        216  EXECUTION           000.00.00.078
END/SEC     0.24  STANDARD DEVIATION 000.00.00.270
#SWAPS         0
EXECUTD      216
```

Response time

```
          -------------------------------RESPONSE TIME BREAKDOWN IN PERCENTAGE--------------------   ------STATE------
SUB    P  TOTAL ACTIVE READY  IDLE  -------------------------WAITING FOR--------------------------   SWITCHED TIME (%)
TYPE                                 LOCK   I/O  CONV  DIST  LOCAL  SYSPL  REMOT  TIMER  PROD  MISC   LOCAL SYSPL REMOT
CICS   BTE  93.4  10.2   0.0   0.0   0.0    0.0  83.3  0.0    0.0    0.0    0.0    0.0    0.0   0.0    83.3  0.0   0.0
CICS   EXE  67.0  13.2   7.1   0.0   0.0    0.0   0.0  0.0    0.0    0.0    0.0    0.0   46.7   0.0     0.0  0.0   0.0
```

Time in DB2 or IMS or MQ

This is a sample RMF post processor (ERBRMFPP) output with option SYSRPTS(WLMGL(SCPER))

Source: Chris Baker, IBM Hursley, UK

BP 15 – z/OS Log Manager

- **Recommendation:** Use fastest justifiable facility
  - Following are the three available performance levels:
    1. Highest Performer is a Nonvolatile Coupling Facility (CF) – uses CF and z/OS data space for backup
    2. Volatile CF – uses CF and disk file
    3. Lowest Performer is log defined to a disk file – actually uses disk file and a data space

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BP 16 – VSAM Recommendation

- **Recommendations:** For VSAM.
  1. Always focus on physical IO reduction via data in virtual techniques.
     This benefits CPU, response time, storage occupancy, IO subsystems performance.
  2. Track CICS VSAM file statistics as 1st indicator of tuning candidates. SMF 64 and 42 records are best sources of file performance data.
  3. Produce ongoing reports of total IO time by file and remember 80/20 rule.
  4. Track and minimize CI and CA split activity rates.
  5. Optimize LSR buffer pools (8 maximum until V4.2's increased to 255).

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CICS VSAM File Control Statistics

File Name	Get Requests	Get Upd Requests	Browse Requests	Update Requests	Add Requests	Delete Requests	Brws Upd Requests	VSAM EXCP Requests Data	VSAM EXCP Requests Index	RLS req Timeouts	
AAAB2SP	34238	0	0	0	0	0	0	22	1	0	
BBBACTV	0	27	0	27	376636	0	0	382501	0	0	
CCCFNDD	65928	0	0	0	0	0	0	15089	6228	0	
DDDIAFD	4767	0	25159	0	0	0	0	12609	148	0	
EEEINTX	27088	0	8124	0	0	0	0	3	2	0	☺
FFFPNDD	17969	5310	0	5310	166	0	0	9905	799	0	
GGGSCRX	488	0	0	0	0	0	0	18	59	0	
HHHSEGH	33043	43	1712	43	43	0	0	1597	841	0	☺
IIISEG1	48931	6925	531	2810	6739	4115	0	15537	2862	0	
JJJSEG2	23634	745	0	205	745	540	0	1291	1	0	
KKKTBLS	537	0	75997	0	0	0	0	525	26	0	☺
LLLTEST	0	0	0	0	41741	0	0	43761	0	0	
MMMULHD	54891	43	0	43	0	0	0	806	453	0	☺
NNNUNLD	32679	1640	0	1586	53	0	0	7319	2670	0	
OOOPCFIL	37752	0	0	0	0	0	0	21	1	0	☺
TOTALS	427489	18626	155690	13864	459660	4655	0	536868	15546	0	

Notes & Recommendations:

1. Totals are greater than all files shown because many files deleted from sample.
2. Focus your tuning to minimize/eliminate VSAM EXCP Requests.
3. ☺ shown next to files with superior performance (least EXCP-s/Request).
4. BBB tuning options: faster IO service, application changes, file attributes,…
5. CCC, DDD, III, NNN appear to be good candidates for data in memory tuning.

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BP 17 – VSAM File Attributes - 1

1. Small CI & CA size
   - RAMOSt – random access mostly
2. Large CI & CA size
   - SAMOSt – sequential access mostly
3. FREESPACE allocation
   - Trades disk space to minimize CI and CA splits

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BP 17 – VSAM File Attributes - 2

1. **FREESPACE** allocation for reduced CI and CA splits

   NOTE: Loading the entire file with a high FREESPACE value can greatly reduce the effectiveness of “data in virtual” tuning efforts and increases physical I/O activity rate.

BP 17 – VSAM File Attributes - 3

- FREESPACE allocation ideas to consider:
  1. Load with 0, and then alter FREESPACE to any value that works for you.
     ☺ causes FREESPACE to be inserted exactly in key range where needed, but (!)
     ☹ guarantees one split for first insert.
  2. Load with low value, and then alter it to a higher value.
  3. If you know locality of insert activity, then load with low value, and later alter it to a high value for a specific key range only.

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BP 18 - LSR Buffer Pools - 1

Recommendations:

1. Use multiple LSR buffer pools (see next pg.)
2. Separate data from index within buffer pools
3. Use VSAM file statistics to set size of index buffer pools to equal amount of index data.
4. If faced with real or virtual storage constraint, separate business critical files' buffer pools from less important ones.
5. Eliminate or at least **Minimize** string waits.

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BP 18 - LSR Buffer Pools - 2

Recommended LSR buffer pool design:

1. Business critical high importance files with data buffers separated from index buffers
2. Medium importance files with data buffers separated from index buffers
3. Low importance files with data buffers separated from index buffers
4. Files with poor locality of reference with data buffers separated from index buffers
5. Pools 6, 7, 8 Use to isolate and measure a file's activity then move into one of 1 – 4
6. CICS TS V4.2 increases pools to 255! Use new pools for benefit of files requiring guaranteed performance level.

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BP 19 – CICS Temp. Storage

- **Recommendation:** Tune CICS Temporary Storage to minimize IO-s and activities that can waste CPU capacity.
  1. Minimize auxiliary storage requests by adding enough buffers and modifying applications that force TS activity to AUX.
  2. Avoid causing spanned TS records via proper CI size.
  3. Reduce/eliminate buffer and string waits.
  4. Avoid format writes with properly sized TS file.

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BP 20 – CICS Transient Data

- **Recommendation:** Tune CICS Transient Data to minimize IO-s and conditions causing waits.

  Employ same principles as tuning any single VSAM file's activity plus minimize waits for buffers and strings.

BP 21 – TRANISO & STGPROT

- **Recommendation:** If no storage violations in your CICS region, TRANISO = NO
  and STGPROT = YES

  If TRANISO=YES required:
  - May cause SOS in DSA due to .25 MB alignment
  - May increase working set size and paging rate.
  - Transaction isolation is NOT FREE! Do not just use it if you do not need it.

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BP 22 – CMF Data Collection

- **Recommendation:** MN = ON
- Why? CPU cost less than 2% to produce CICS statistics records.
  Why would you collect data that is never used for anything by CICS area staff? Because:
  - May need to determine what caused a problem
  - May need to figure out if anything changed in a transaction's resource requirements
  - Performance management and tuning data requirements
  - Capacity planning data requirements
  - Audit requirements
  - If you do not use the data for any of the above reasons, or you must reduce CPU capacity requirements, then you may **consider** MN = OFF

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BP 23 - PRTYAGE

- PRTYAGE=nnnnn
  - If you made a transaction low priority, does it become more important if it lingers longer? We think NOT!
  - **Recommendation:** Don't use PRTYAGE. Use just transaction priority instead if some transactions are higher importance than others.

BP 24 – Consider THREADSAFE

- Best possible performance if:
  - All applications are written and defined threadsafe
  - All exits within the task-related user exit (TRUE) path are written and defined threadsafe
  - Use on non-threadsafe CICS commands is minimized
  - Intermingling of non-threadsafe CICS commands with SQL or IP Sockets calls is minimized
- Learn more about threadsafe from:
  - Redbook: Threadsafe considerations for CICS, SG24-6351
  - SHARE Proceedings of CICS project presentations

Any questions? Email to: ivan@gelbis.com; Call: 732-303-1333

BP 25+ Also Consider . . .

- AKPFREQ= **4000** | # between 200 and 65,535 Affects performance, CPU and restarts duration. Requires tuning.
- FORCEQR= **NO** | YES
  Recommendation: NO honors CONCURRENCY(THREADSAFE)
- HPO= **NO**| YES
  Recommendation: YES allows use VTAM auth. path feature of HPO
- LPA= **NO** | YES
  Recommendation: YES enables use of LPA-ELPA resident modules and reduces real storage requirements and paging
- SUBTSKS= **0** | 1
  Recommendation: 1 enables CO mode TCB for VSAM and TS use

  NOTE= **Bold** underlined values are the defaults.

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BP 25+ Also Consider . . .(continued)

- FCQRONLY={YES|NO}
  - For CICS V4.1 or older, FCQRONLY=YES for best performance of all FORs
  - For CICS V4.2
    - specify FCQRONLY=YES for MRO and ISC connections so FC request uses only QR TCB and avoids locking overhead
    - Specify FCQRONLY=NO for IPIC connections so FC requests stay on L8 TCB which avoids potential for switching overhead and increases parallelism of FC requests

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- Consider for CICS TS V4.2
  - New TSMAINLIMIT={64M|amount}
  - Automatic TS cleanup with use of EXPIRYINT specified on a TSMODEL definition. Non-zero value causes system clean up task to run every 30 minutes. Defaults to zero value.

Summary of Recommendations by Use

- **Transaction response time tuning**: 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 17, 18, 19, 20, 22, 23, 24
- **CPU**: 4, 5, 6, 8, 9, 10, 11, 14, 19, 20, 21, 22, 24, 25
- **I/O rate and performance**: 9, 12, 16, 17, 18, 19, 20, 24
- **Real and virtual storage demand**: 5, 8, 18, 19, 24, 25
- **Performance management and capacity planning:** 1, 4, 5, 22, 24, 25

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References

- CICS Information Center – IBM CICS Transaction Server for z/OS
  https://publib.boulder.ibm.com/infocenter/cicsts/v4r2/index.jsp
- CICS Performance Guide
- CICS Performance Management Guide
- Videos On YouTube (Follow CICSfluff):
  - Performance comparison between CICS TS V3.2 and CICS TS V4.1 and CICS TS V4.1 with WLM
  - Threadsafe Analysis with the CICS Explorer and CICS Tools

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@Next SHARE

Join us at next SHARE in Atlanta, March 11 – 16, 2012 and attend

"CICS Performance Update – 2012"

Besides the expected CICS Version 4.2 performance related details, this session will dig into recommended performance and capacity analysis reports produced from metrics found in RMF, SMF, and CICS statistics.

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