WYNTK About CICS Performance

Alison Lucas
IBM Hursley Park

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Agenda

- Performance improvements in CICS TS V5.3
- CICS TS V5.2 and V5.1 improvements you should know about
- What can you do to improve performance?
Agenda

• Performance improvements in CICS TS V5.3
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CICS TS V5 Vision

Service Agility
Enhanced support for Java and the WebSphere Liberty profile

Operational Efficiency
Performance optimizations, enhanced metrics and addition security

Cloud Enablement
New cloud and DevOps support to automate CICS deployments
Workload consolidation v5.3

• Run more work through less regions
  • Reduction in the CPU usage of CICS routing and data owning regions
  • HTTP enhancements
  • Threadsafe continuation
• Consolidating regions
  • Saves real storage
  • Can save MIPs
  • Saves operational costs
Core Performance Enhancements
Core Performance Enhancements

• CICS TS V5.3 pre-reqs:
  • Hardware pre-req of IBM System z9 or later
  • Software pre-req of IBM z/OS V1.13 + APAR OA38409

• Performance benefits from z9 hardware exploitation

• Improvements in trace
  • Use of faster hardware instructions
  • Some level 1 trace moved to level 2
Core Performance Enhancements

- Improvements in monitoring
  - Excluding fields is now less efficient than collecting all of them
  - Reduced lock contention
- Improvements for MRO connections with high session counts
  - Algorithm efficiency improved
  - Max improvement found when 999 sessions were in use (16% reduction in CPU)
- General performance improvements
  - Cache alignment of control blocks
  - Use of data pre-fetch
  - Tuning of other internal algorithms
Performance Comparison

Decrease of 8% average CPU per transaction
HTTP enhancements
HTTP Pre V5.3

HTTP Requests

CSOL
Long running task on its own TCB that listens for work.
Process next piece of work

CWXN
Determines the context of the user transaction that is started. This is known as the Web attach task.

User Transaction i.e. CWBA, CPIH
Application processing run under the context established by CWXN
HTTP in CICS TS V5.3

Long running task on its own TCB. It must not be blocked by an individual request.

If CICS SSL OR Web analyser program OR Static response OR Not enough data => CWXN

- Gets tran ID and user ID from URIMAP and/or AT-TLS
- Start the application transaction with the specific tranid and userid
- Process next piece of work

CWXN

Run when unable to establish context in SOLS

User Transaction i.e. CWBA, CPIH

Sync receive the body data and pass to the next step in application

Application processing run as before

Lower overhead results in lower CPU usage
Web Service optimization results

- 13% reduction in CPU for web-owning region
- 2.4GB/hr reduction in SMF 110 record volumes
**SSL in CICS TS V5.3**

HTTPS Requests

Long running task on its own TCB. It must not be blocked by an individual request.

If CICS SSL

Process next piece of work

CSOL

**CWXN**

The decryption of the request happens in this transaction.

Switching to and from S8 TCBs has been decreased reducing CPU usage.

User Transaction i.e. CWBA, CPIH

SSL Decryption

**TCPIPSERVICE**

**PORT(number)**

**SSL(CLIENTAUTH)**

Less TCB switching means lower CPU usage
AT-TLS Aware CICS TS V5.3

z/OS Communications Server

HTTPS Requests

SSL Decryption

AT-TLS Support

CICS TS V5.3

CSOL

Long running task on its own TCB. It must not be blocked by an individual request.

If CICS SSL OR
Web analyser program OR
Static response OR
Not enough data => CWXN

Can get user ID from AT-TLS

Start the application transaction with the specific tranid and userid

Process next piece of work

User Transaction i.e. CWBA, CPIH

EXTRACT CERTIFICATE commands still work

CWXN

Run when unable to establish context in SOLS

TCPIPSERVICE
PORT(number)
SSL(ATTLSAWARE)
Web Service optimization results

20% reduction in overall CPU when using AT-TLS and V5.3
HTTP performance tuning

- Protects CICS from unconstrained resource demand via HTTP(S) requests
- If CICS region is becoming overloaded
  - Initially CICS temporarily stops listening for new HTTP(S) connection requests
  - Allows feedback to TCP/IP port sharing and Sysplex distributor
HTTP performance tuning/2

• If CICS region continues to become overloaded
  • Closes existing HTTP(S) persistent connections and marks all new HTTP(S) connections as non-persistent
  • Periodically close persistent HTTP connections to allow more efficient sharing of workload across regions that share IP endpoints.
HTTP performance tuning statistics

- Extra statistics to the global TCP/IP statistics

Performance tuning for HTTP connections . . . . . . . . . . . . . : Yes
Socket listener has paused listening for HTTP connections . . . : Yes
Number of times socket listener notified at task accept limit . . : 23852
Last time socket listener paused listening for HTTP connections : 13/10/2015 18:42:00.6662
Region stopping HTTP connection persistence . . . . . . . . . : No
Number of times region stopped HTTP connection persistence . . : 0
Last time stopped HTTP connection persistence . . . . . . . . . : --/--/-- ---- --:--:--:--:----
Number of persistent HTTP connections made non-persistent . . . : 0
Number of times disconnected an HTTP connection at max uses . . : 0
Threadsafe
New SPI commands made threadsafe

<table>
<thead>
<tr>
<th>INQUIRE commands</th>
<th>DISCARD commands</th>
<th>SET commands</th>
</tr>
</thead>
<tbody>
<tr>
<td>INQUIRE ENQMODEL</td>
<td>DISCARD ENQMODEL</td>
<td>SET ENQMODEL</td>
</tr>
<tr>
<td>INQUIRE JOURNALMODEL</td>
<td>DISCARD JOURNALMODEL</td>
<td>SET JOURNALNAME</td>
</tr>
<tr>
<td>INQUIRE JOURNALNAME</td>
<td>DISCARD JOURNALNAME</td>
<td>SET TCLASS</td>
</tr>
<tr>
<td>INQUIRE RRMS</td>
<td>DISCARD TCPIPSERVICE</td>
<td>SET TCPIP</td>
</tr>
<tr>
<td>INQUIRE STORAGE</td>
<td>DISCARD TDQUEUE</td>
<td>SET TCPIPSERVICE</td>
</tr>
<tr>
<td>INQUIRE STREAMNAME</td>
<td>DISCARD TRANCLASS</td>
<td>SET TDQUEUE</td>
</tr>
<tr>
<td>INQUIRE SUBPOOL</td>
<td>DISCARD TSMODEL</td>
<td>SET TRANCLASS</td>
</tr>
<tr>
<td>INQUIRE TASK LIST</td>
<td>PERFORM SECURITY REBUILD</td>
<td>SET TSQNAME</td>
</tr>
<tr>
<td>INQUIRE TCLASS</td>
<td>PERFORM SSL REBUILD</td>
<td>SET TSQUEUE</td>
</tr>
<tr>
<td>INQUIRE TDQUEUE</td>
<td>WRITE OPERATOR</td>
<td>SET UOW</td>
</tr>
<tr>
<td>INQUIRE TCPIP</td>
<td></td>
<td>SET WEB</td>
</tr>
<tr>
<td>INQUIRE TCPIPSERVICE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE TRANCLASS</td>
<td></td>
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<tr>
<td>INQUIRE TSMODEL</td>
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<tr>
<td>INQUIRE TSPOOL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE TSQNAME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE TSQUEUE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE UOW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE UOWENQ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INQUIRE WEB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Enhanced Metrics
Transaction tracking

• Transaction tracking identifies relationships between transactions as they flow across CICS systems, and can be visualized in CICS Explorer. This information can be used for problem determination, reporting, and auditing.

• CICS TS V5.3 open extends support to transactions started by the CICS-WebSphere MQ bridge

• This expands the scope of transactions that can use transaction tracking, to help with problem determination, reporting and auditing.
Transaction Tracking Example
Transaction Tracking Task Association

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Transaction ID</th>
<th>Region</th>
<th>Start Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000107</td>
<td>MQGM</td>
<td>IYK3ZAB4</td>
<td>14:33:27.2210</td>
</tr>
<tr>
<td>0000072</td>
<td>CSMI</td>
<td>IYK3ZAB5</td>
<td>14:33:27.2222</td>
</tr>
<tr>
<td>0000074</td>
<td>CSMI</td>
<td>IYK3ZAB3</td>
<td>14:33:27.2229</td>
</tr>
<tr>
<td>0000108</td>
<td>ECIP</td>
<td>IYK3ZAB4</td>
<td>14:33:27.2216</td>
</tr>
</tbody>
</table>
Transaction Tracking Information

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Odaptrdata 1</td>
<td>QMGR=MQD1</td>
</tr>
<tr>
<td>Odaptrdata 2</td>
<td>INITQ=ALIINIT1</td>
</tr>
<tr>
<td>Odaptrdata 3</td>
<td>QNAME=ALITRIG1</td>
</tr>
<tr>
<td>Odaptrid</td>
<td>ID=IBM WebSphere MQ for z/OS V7.0.1</td>
</tr>
<tr>
<td>Origin Appl ID</td>
<td>IYK3ZAB4</td>
</tr>
<tr>
<td>Origin Appl ID Net ID</td>
<td>GBIBM1A</td>
</tr>
<tr>
<td>Origin Facility Name</td>
<td></td>
</tr>
<tr>
<td>Origin Facility Type</td>
<td>START</td>
</tr>
<tr>
<td>Origin IP Address</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>Origin IP Address Format</td>
<td>NOTAPPLIC</td>
</tr>
<tr>
<td>Origin Net ID</td>
<td>GBIBM1A</td>
</tr>
</tbody>
</table>
New transaction CPU time statistics

- New fields added to monitoring domain statistics to show accumulated transaction CPU time for each completed transaction during the statistics interval

- Allows greater insight into CPU resource usage without the overhead of CICS monitoring

| User transactions ended . . . . . . : | 905747 |
| System transactions ended . . . . . . : | 31 |
| Time last user transaction attached . : | 09/11/2015 22:18:50.5082 | ...
| Time last user transaction ended. . . : | 09/11/2015 22:18:50.5087 | ...
| Average user transaction resp time . . : | 00:00:00.001793 |
| Peak user transaction resp time . . . : | 00:00:00.063212 |
| Peak user transaction resp time at. . . : | 09/11/2015 22:18:09.4275 |
| Total transaction CPU time . . . . . : | 00:00:25.256705 |
| Total transaction CPU time on CP . . . : | 00:00:25.256705 |
| Total transaction CPU offload on CP . : | 00:00:00.000000 |

- Also added peak depth of TD queues to TD queue statistics
z/OS Connect
z/OS Connect for CICS
Liberty z/OS Connect feature in CICS

- Liberty z/OS Connect feature is now supported in CICS
- It provides a way to have RESTful APIs with JSON payloads between CICS, mobile devices, and cloud environments
- Also available for CICS TS V5.2 via APAR
  - Liberty shipped performance improvements to z/OS Connect feature also available via APAR for CICS TS V5.2
Liberty z/OS Connect feature in CICS

- V5.3 offers the option of using a Java-based JSON parser or a non-Java equivalent, configurable in the pipeline config file:
  - Native (faster response time but not zAAP offload eligible)
  - Java (slower but zAAP offload eligible)
- Can have define a mixture of pipelines to give different qualities of service for different apps
Performance Comparison

Parser implementation

Native

Java

CPU cost per request (ms)

1.48

1.78

0.0

0.2

0.4

0.6

0.8

1.0

1.2

1.4

1.6

1.8

2.0

zIIP-eligible

non-eligible
Agenda

• Performance improvements in CICS TS V5.3
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• What can you do to improve performance?
Workload consolidation

- Run more work through less regions
  - Continual expansion of threadsafe support in V5
  - MXT limit doubled
  - Further VSCR
- Consolidating regions
  - Saves real storage
  - Can save MIPs
  - Saves operational costs
Threadsafe CICS
Threadsafe CICS

- Threadsafe APIs and SPIs
  - (V5.1) 7 existing + 3 new SPI
  - (V5.2) 2 new API + 16 existing SPI
  - (V5.3) 3 new API + WRITE OPERATOR + 38 existing SPI

- Threadsafe TD (V5.1)
  - TD GLUEs must be threadsafe

- Threadsafe Program Load (V5.1)
  - If already on an open TCB and a CICS program load is requested (EXEC CICS LINK) no longer switches to RO TCB
  - Reduced contention on RO TCB
  - Reduced pathlength now TCB switch eliminated
Threadsafe Program Load

![Graph showing response time vs. program LOADs per second for CICS TS V4.2 and V5.1.](image)
MAXTASKS
Maxtasks

- MXT limit increased to 2000 in V5.1
  - Now defaults to 250
  - Was 500 in V5.1

- Not advisable to run with default MXT value
  - Should be tuned for your environment
    - 10-20% above expected levels is a good starting point
  - Excessive MXT values can:
    - Waste LSQA storage for MVS performance blocks
    - Consume CPU cycles during MVS WLM scans

It’s OK to hit MXT
Virtual Storage Constraint Relief
24-bit VSCR

• To reduce pressure on below the line storage, 24 bit storage use significantly reduced (V5.1)
  • All CICS supplied transactions now TASKDATALOC(ANY)
  • Many internal control blocks moved

• User Exit Global Work Area (V5.1)
  • New GALLOCATION parameter on the ENABLE PROGRAM command
    • LOC24 – Global work area is in 24-bit storage (default)
    • LOC31 – Global work area is in 31-bit storage
31-bit VSCR

• Domains exploiting 64 bit
  • (V5.1) Storage Manager, Loader, Console Queue, new domains such as managed platform and application context
  • (V5.2) Pipeline, new domains
Further 31-bit VSCR – web services

- 31-bit storage used reduced (V5.2)
  - Reduced number of TCB switches
    - Small performance gain
Amode(64) application support

• 64 bit application storage via assembler (V5.1)
  • Non-LE assembler only
• Provides application support to access large data objects
• Cache large amounts of data above the bar
  • EXEC CICS GETMAIN64 and FREEMAIN64
• Applications can pass data in 64-bit storage using channels
  • EXEC CICS PUT64 CONTAINER and GET64 CONTAINER
  • CICS keeps the container data in 64-bit storage
• AMODE(64) Assembler Programs are NOT supported as
  • Global or Task User Exit Programs (GLUEs or TRUEs)
  • User Replaceable Programs (URMs)
Java Performance Enhancements

- Improved defaults for some system configuration parameters
- Java Trace (V5.2)
  - Content of default trace changed
  - Better performance for JCICS
CICS Java Hello World Sample

Transaction cost (CPU ms)

- V5.1 No trace
- V5.1 Default trace
- V5.2 Default trace
JCICS File Read

Transaction cost (CPU ms)

- V5.1 No trace
- V5.1 Default trace
- V5.2 Default trace
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• What can you do to improve performance?
What can you do to improve performance?

- Analyse your systems
- Make appropriate programs threadsafe
- Recompile with newer compiler versions
- Exploit zIIP offload
- Education – CICS Performance Redpaper series
- Upgrade machine
- Add accelerator cards
- Consolidate regions
- Change settings to be appropriate for workload
- Use policies to protect regions
- Get help from IBM
CICS Operational Insights

• Cloud based Service to identify opportunities to tune your CICS
  • Part of z Operational Insights
    • Helps you understand your operational characteristics to target improvements
• Upload a snapshot of operational data and get
  • CICS Threadsafe Analysis
CICS OI threadsafe assessment example
CICS Operational Insights

- CICS OI also offers
  - CICS Region CPU Constraint Analysis
  - CICS Java Offload Analysis
  - CICS Abend Analysis
Where to find more information

A wide variety of CICS performance resources are available from the CICS Developer Center – see https://developer.ibm.com/cics/cics-performance-resources/

- Videos from the CICS performance 101 series
- Links to RedPapers/RedBooks/RedPieces
- Blog posts etc
New look CICS Performance Report

Look out for the new CICS Performance Report Redbook

- CICS TS V5.3 Benchmark on IBM z13
  - 227,000 transactions per second
- Web Services Performance in CICS TS V5.3
- CICS Type 2 and type 4 JDBC Driver Performance
- IBM CICS Interdependency Analyzer
  - Updated for CICS IA V5.3
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Summary

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Questions?

Any questions?
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