

CICS TS Resource Managers

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Agenda

- Anatomy of the CICS RMI
- Understanding how open TCBs are allocated and used
- CICS-DB2 use of OTE
- CICS-IMS use of OTE
- CICS-WMQ use of OTE
- IP CICS Sockets use of OTE
- Summary

Notes

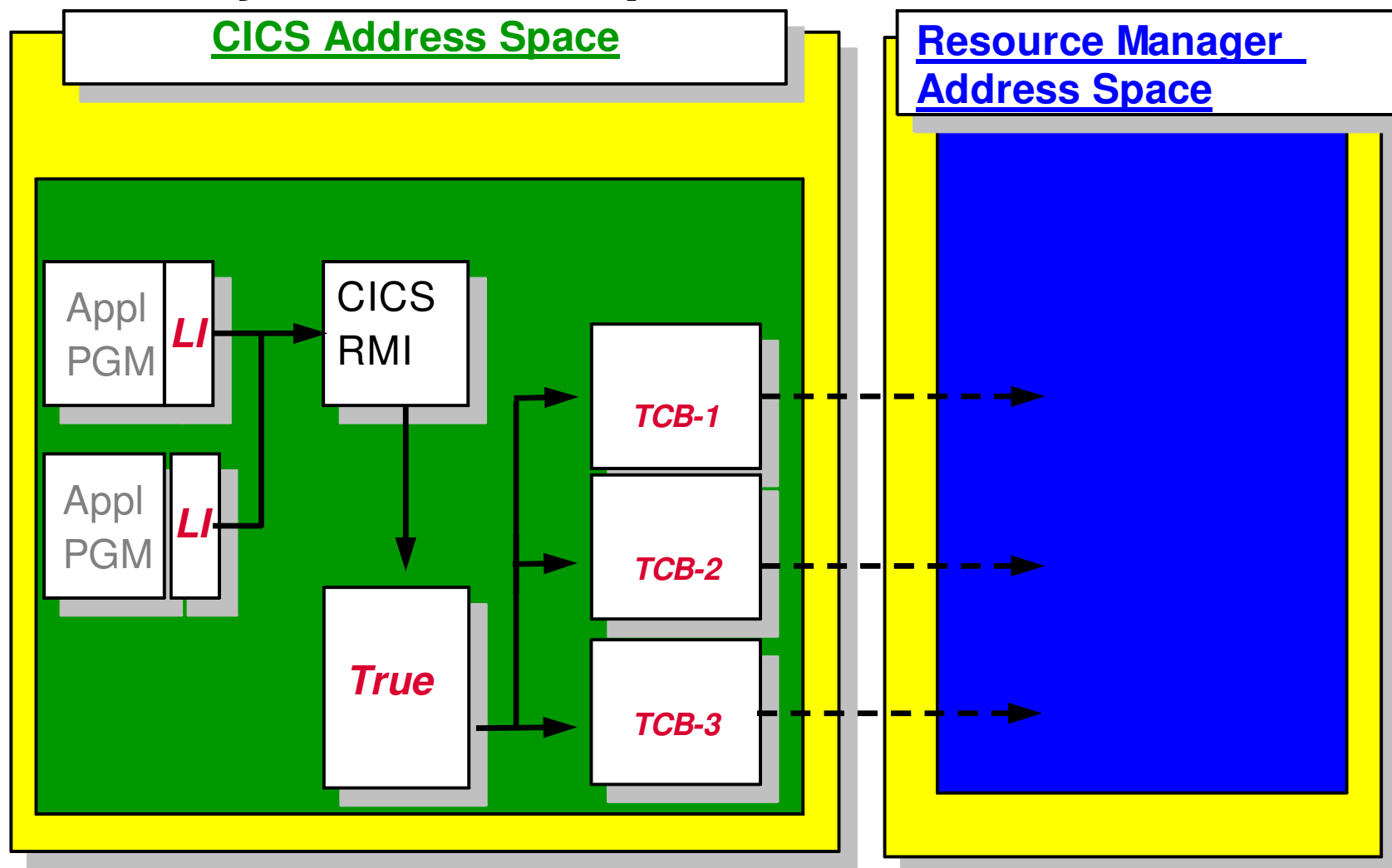
Enhancements introduced in CICS Transaction Server for z/OS V2.2 made it possible for Resource Managers to exploit the CICS Open Transaction Environment (OTE) through their supplied task-related user exits (TRUEs). The CICS DB2 adaptor supplied with this release was the first TRUE to utilize OTE and therefore enable threadsafe application programs to take advantage of the improved performance available with dispatching changes introduced with OTE.

Other resource managers such as WebSphere MQ and IP Sockets Feature for CICS provide similar benefits for applications using their services. The speaker will discuss how a threadsafe resource manager exploits OTE, CICS and subsystem definitions required, and the interaction between threadsafe resource managers and other exits in your CICS system.

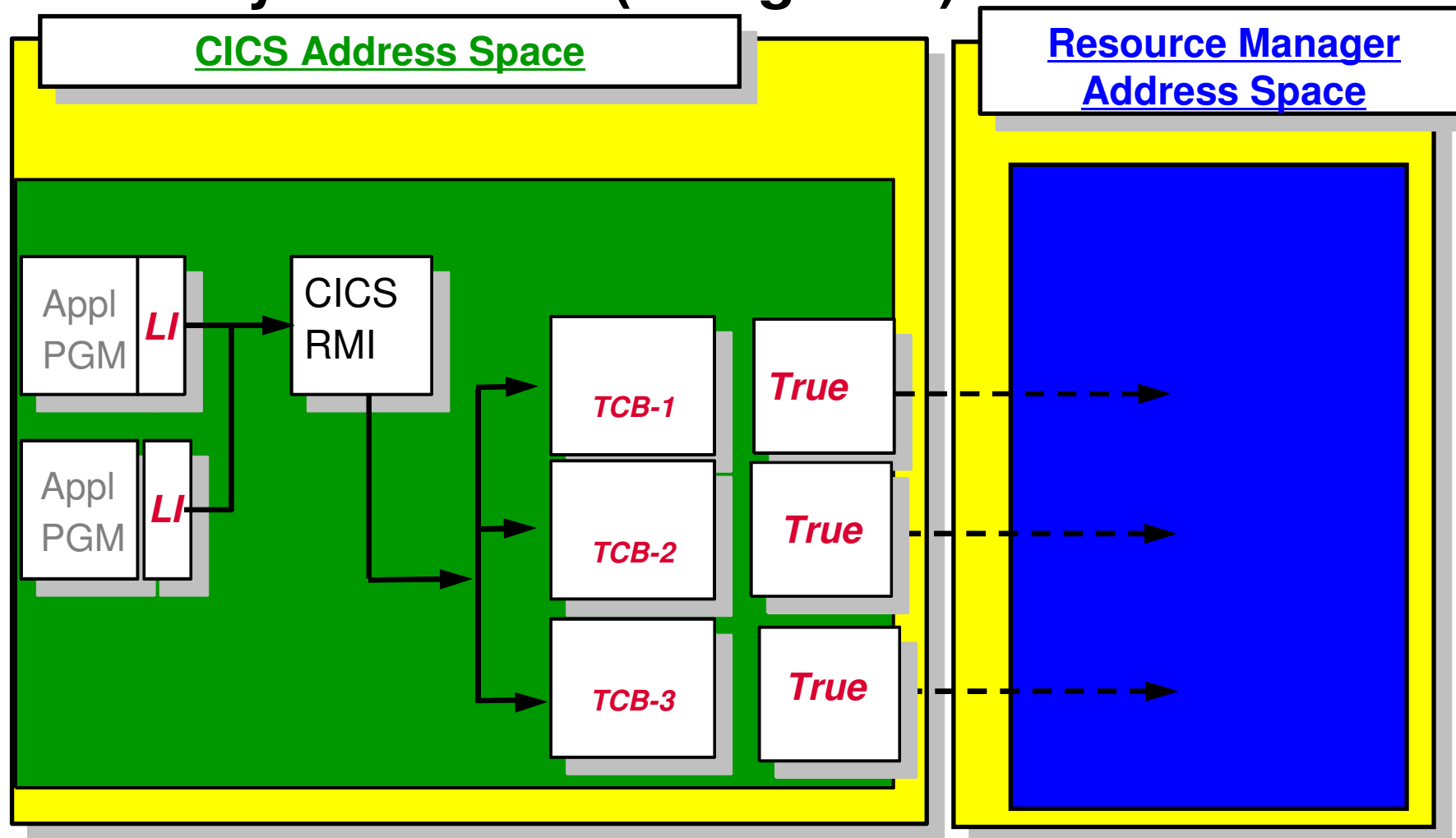
Resource Manager Interface (RMI)

- The RMI is the architected “way out” of CICS to invoke an external resource manager
- Also known as the Task Related User Exit (TRUE) interface as it invokes a TRUE
- IBM provides TRUEs to access DB2, IMS, MQ, ...
 - Third party vendors provide TRUEs to access their databases
- The TRUEs job is to invoke the resource manager
 - Typically using cross memory services
- Prior to OTE ...
 - the TRUE had to manage the issues of running on the QR TCB and obey CICS rules
 - TRUE had to switch TCBs to invoked the resource manager
 - It must not invoke the resource manager on the QR TCB
- With OTE ...
 - CICS can manage the TCBs and the TCB switching

Anatomy of the RMI (pre-OTE)



Anatomy of the RMI (using OTE)



Allocation of OPEN TCBs

- A TRUE defined as OPENAPI, or enabled as OPENAPI, is invoked on an L8 TCB instead of the QR TCB
- An L8 TCB is dedicated to one CICS task for the life of the task
 - No sub-dispatching
 - The same L8 TCB will be used to invoke other OPENAPI TRUEs used by this task
 - The same L8 TCB will run threadsafe CICS code
 - The same L8 TCB will run threadsafe application code
 - The same L8 TCB will run threadsafe global user exit code
- At CICS task termination, the L8 TCB is returned to the MAXOPENTCBS pool and is available for another task to use

Best performance for Threadsafe applications accessing Resource Managers

- Prior to CICS TS V4.2, assuming you run your CICS systems with Storage Protection (STGPROT=YES)
 - Threadsafe applications accessing Resource Managers are best defined as CONCURRENCY(THREADSAFE) API(CICSAPI)
 - CICSAPI means CICS supported APIs including calls via the RMI to DB2, IMS, MQ, ...
- Avoid API(OPENAPI)
 - Applications will typically be user key and invoked on an L9 TCB
 - However, TRUEs require an L8 TCB
 - OPENAPI gives you the ability to start on an open TCB, but also CICS assumes you might use “foreign API” requests. These “foreign APIs” require an L9 TCB.
- CICS TS V4.2 solves the problem ...
 - CONCURRENCY(REQUIRED) API(CICSAPI) indicates CICSAPI but start me on an open TCB. CICSAPI can always use an L8 TCB regardless of the execution key.

Do Not Neglect Global User Exits They Will Come Back To Bite You!



- GLUEs should be made THREADSAFE!
 - else excessive TCB switching will occur!
- CICS will switch to the QR TCB from an OPEN TCB to invoke a non-threadsafe GLUE and back again afterwards
- Particularly important global user exits that need to be threadsafe are **XRMIIN/XRMIOUT** on the RMI path, and **XEIIN/XEIOUT** called for all EXEC CICS commands
 - Check with vendors for threadsafe support
 - Use DFH0STAT to find out what user exits and user exit programs are in use and if they are defined as threadsafe
- Use XPI ENQUEUE and DEQUEUE to serialise access to shared areas like the Global Work Area (GWA)

Do Not Neglect Global User Exits They Will Come Back To Bite You!



Applid IYK2Z1V3 Sysid CJB3 Jobname CI07CJB3 Date 02/07/2012 Time 09:06:49 CICS 6.7.0 PAGE 3

User Exit Programs

Program Name	Entry Name	Entry Name	Length	Use Count	No. of Exits	Program Status	Exit Program Use Count	LIBRARY Name	LIBRARY Dataset Name
DFHEDP	DLI		0	0	0	Started	0	DFHRPL	BLDBSF.PEGXA.SDFHLOAD
DFHMQTRU	MQM	MQM	32	1	0	Started	9	DFHRPL	PUBPEG.MAIN.LOAD
RMIIN	RMIIN		0	0	1	Started	39	TESTLIB	CICSTS.TESTPROG.LOAD
RSINDI	RSINDI		0	0	1	Started	72	DFHRPL	UTL.CICSTS.LOAD
EZACIC01	EZACIC01	EZACIC01	468	1	0	Started	37	DFHRPL	PP.TCPIP.ZOS112.SEZATCP

Applid IYK2Z1V3 Sysid CJB3 Jobname CI07CJB3 Date 02/07/2012 Time 09:06:49 CICS 6.7.0 PAGE 4

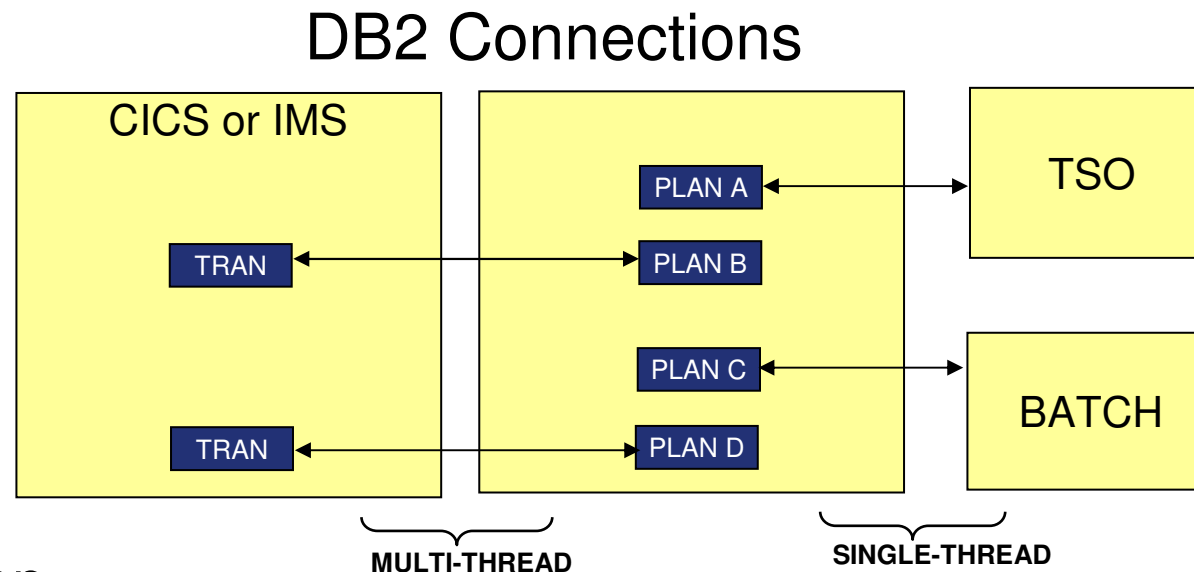
Program Name	Entry Name	API	Program Concurrency	Concurrency Status	Qualifier	Length	Taskstart	EDF	Shutdown	Indoubt	SPI	Purgeable
DFHEDP	DLI	Cics	Quasirent	Quasirent		284	No	No	No	No Wait	No	No
DFHMQTRU	MQM	Open	Threadsafe	Threadsafe	MQCD	224	No	No	Yes	Wait	Yes	No
RMIIN	RMIIN	Cics	Threadsafe	Threadsafe		0	No	No	No	No Wait	No	No
RSINDI	RSINDI	Cics	Threadsafe	Threadsafe		0	No	No	No	No Wait	No	No
EZACIC01	EZACIC01	Open	Quasirent	Threadsafe		788	No	No	Yes	No Wait	No	Yes

Applid IYK2Z1V3 Sysid CJB3 Jobname CI07CJB3 Date 02/07/2012 Time 09:06:49 CICS 6.7.0 PAGE 5

Global User Exits

Exit Name	Program Name	Entry Name	Global Area Entry Name	Length	Use Count	Number of Exits	Program Status	Program Concurrency	Concurrency Status
XRSINDI	RSINDI	RSINDI		0	0	1	Started	Threadsafe	Threadsafe
XRMIIN	RMIIN	RMIIN		0	0	1	Started	Threadsafe	Threadsafe

Connecting to DB2



- Connection
 - Address Space TCB identifies itself to DB2 for Services
- Thread
 - A Bi-directional path between a user TCB and DB2 resources
- Plan
 - SQL Access Strategy used by the thread

Understanding CICS-DB2 Attach: TCBs

- Prior to OTE support in CICS TS 2.2 ...
 - the CICS-DB2 Attach created/destroyed TCBs used to access DB2
 - TCBLIMIT on the DB2CONN controlled how many TCBs
 - A thread was built and permanently associated with a TCB
- From CICS TS 2.2 onwards ...
 - CICS open (L8) TCBs are used
 - Number of open TCBs governed by MAXOPENTCBS in the SIT
 - TCBLIMIT on the DB2CONN (really now it should be called CONNECTIONLIMIT) is a subset of MAXOPENTCBS
 - *How many connections into DB2*
 - Threads are plugged/unplugged to/from L8 TCBs

Understanding CICS-DB2 Attach: TCBs

- MAXOPENTCBS needs to be at least as large TCBLIMIT on DB2CONN
 - You cannot use a connection into DB2 without a TCB
- MAXOPENTCBS will normally be greater than TCBLIMIT
 - To cater for other use of L8/L9 TCBs ...
 - e.g. MQ, IMS, Sockets, CICS Webservice pipelines
- If you use Transaction Isolation (TRANISO) in production set MAXOPENTCBS to your MXT value
 - Avoids contention for TCBs in subspaces versus basespace
- CICS manages the open TCB pool and detaches TCBs that have not been used recently (30 minutes)

Understanding CICS-DB2 Attach: TCBs

- Prior to OTE
 - CICS-DB2 attach supported setting the priority of its TCBs
 - Higher, Equal, or Lower priority than the QR TCB priority
 - Set via the PRIORITY keyword on the DB2ENTRY or the DB2CONN for the pool
- With OTE
 - PRIORITY is still supported for DB2
 - Sets the priority of the L8 TCB used for the task
 - When the task completes and the L8 TCB is returned to the pool the TCB priority is reset back to equal
 - Other users of the L8 in the task ...
 - the application, other TRUEs use the L8 TCB with that priority
- Other Attachments do not set TCB priority

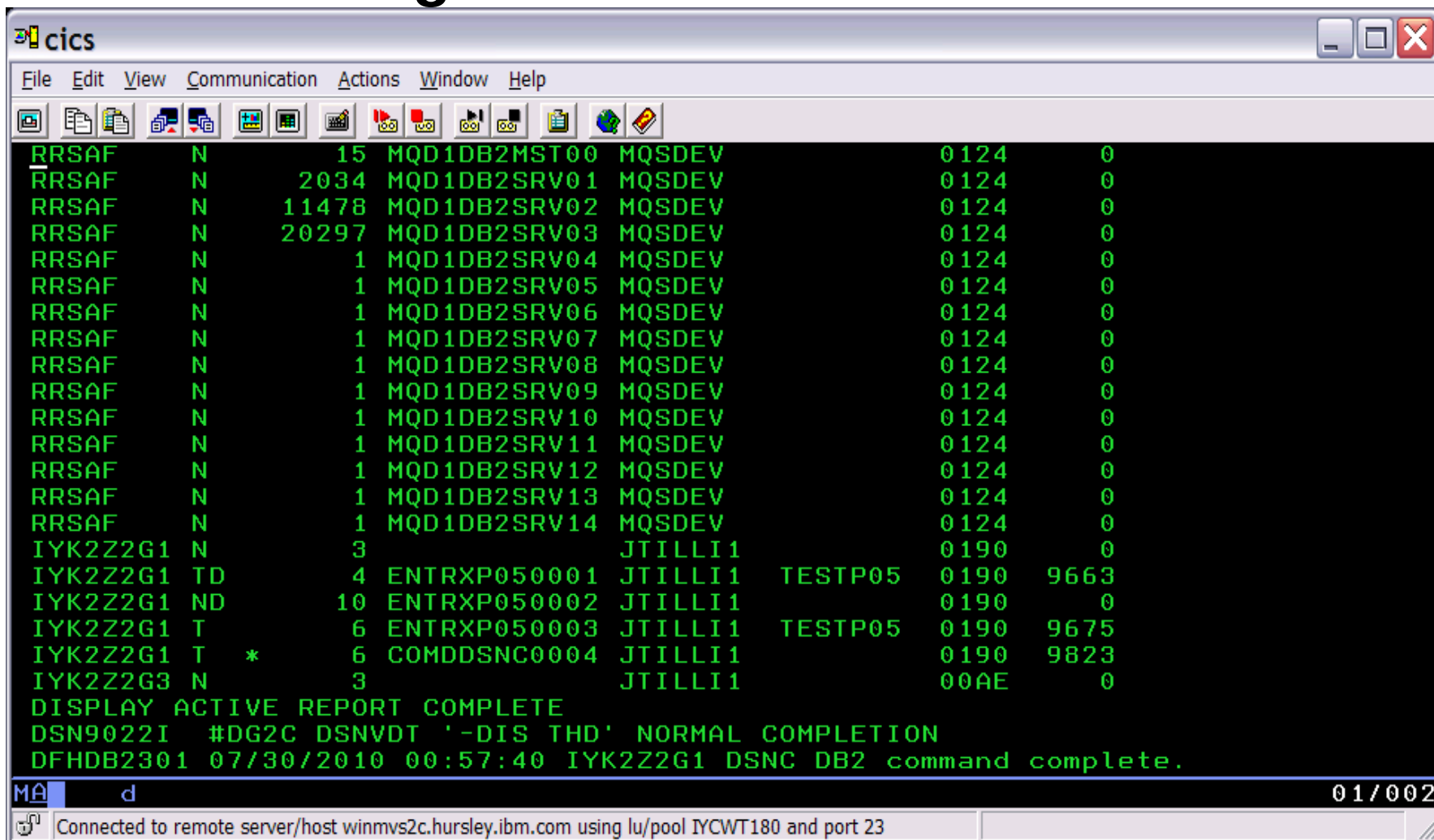
Understanding CICS-DB2 Attach: Threads

- A thread is required to execute a DB2 request
 - A thread is associated with a DB2 Plan
 - A thread requires a DB2 connection
 - A connection requires a TCB
- As well as limiting Connections, you can limit the number of threads in the pool and in individual DB2ENTRYs (THREADLIMIT)
 - The sum of all THREADLIMITs should not exceed TCBLIMIT!
 - You cannot use a thread without a DB2 connection

Connecting to DB2

- IDENTIFY [TCB attached]
 - Checks connection protocol
 - Establishes connection – the execution environment
- (Re)SIGNON [1st SQL statement]
 - Establishes the primary authorization ID – Cuts accounting records
- CREATE [Allocate Plan]
 - Acquires resources (plan, allocation locks)
 - Checks plan authorization
- DISSOCIATE [Thread release]
 - Unplug connection from TCB
- ASSOCIATE [Thread acquisition]
 - Plug a connection into a TCB
- THREAD TERMINATION [Deallocate Plan]
 - Frees storage

Understanding CICS-DB2 Attach: Threads



```

cics
File Edit View Communication Actions Window Help
RRSAF      N      15 MQD1DB2MST00 MQSDEV      0124      0
RRSAF      N     2034 MQD1DB2SRV01 MQSDEV      0124      0
RRSAF      N    11478 MQD1DB2SRV02 MQSDEV      0124      0
RRSAF      N    20297 MQD1DB2SRV03 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV04 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV05 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV06 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV07 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV08 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV09 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV10 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV11 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV12 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV13 MQSDEV      0124      0
RRSAF      N       1 MQD1DB2SRV14 MQSDEV      0124      0
IYK2Z2G1   N       3              JTILLI1      0190      0
IYK2Z2G1   TD       4 ENTRXP050001 JTILLI1    TESTP05   0190   9663
IYK2Z2G1   ND      10 ENTRXP050002 JTILLI1      0190      0
IYK2Z2G1   T       6 ENTRXP050003 JTILLI1    TESTP05   0190   9675
IYK2Z2G1   T      *    6 COMDDSNC0004 JTILLI1      0190   9823
IYK2Z2G3   N       3              JTILLI1      00AE      0
DISPLAY ACTIVE REPORT COMPLETE
DSN9022I  #DG2C DSNVDT '-DIS THD' NORMAL COMPLETION
DFHDB2301 07/30/2010 00:57:40 IYK2Z2G1 DSNV DB2 command complete.
MA      d
01/002
Connected to remote server/host winmvs2c.hursley.ibm.com using lu/pool IYCWT180 and port 23
  
```

- * This skeleton sample dynamic plan exit is the
* same as DSNCEXT, but defined to CICS with
* program attribute CONCURRENCY(THREADSAFE). This
* means that DFHD2PXT will be invoked from the
* CICS-DB2 TRUE DFHD2EX1 running under an L8 open
* TCB. Any logic added to this skeleton must be
* threadsafe. Any non threadsafe CICS commands
* used in this exit will cause CICS to switch back
* to the QR TCB causing the application to incur
* the TCB switching overhead.

Threadsafe CICS-DBCTL

- CICS-DBCTL interface will use OTE when connected to IMS V12
 - At connect time ...
 - CICS and IMS determine if each other can support OTE
 - With IMS V10 and V11
 - CICS-DBCTL TRUE enabled as QUASIRENT
 - Toleration IMS V10 APAR PM31730 or IMS V11 APAR PM31729
 - With IMS V12
 - CICS-DBCTL TRUE enabled as OPENAPI
 - Apply CICS TS V4.2 fix PM42781
 - Exploitation APARs PM31420 + PM47327, PM5414 are required
 - For more information ...
 - Visit <http://www.ibm.com/software/data/ims/>

Threadsafe CICS-DBCTL

- TCB switching is controlled by the IMS Database Resource Adapter (DRA)
 - IMS V12 DRA will not switch TCBs and run the IMS request on the calling L8 TCB
 - < IMS V12 DRA will continue to be called on the QR TCB and will switch to a DRA thread TCB
- CICS code implementing CICS-DBCTL interface made threadsafe
- CALL DLI and EXEC DLI API are now threadsafe when run with IMS V12

Connecting to WebSphere MQ

- CICS Transaction Server V3.2, V4.1, V4.2 supply the following ...
 - CICS-MQ Adapter
 - MQ trigger monitor for CICS
 - MQ bridge (includes the DPL bridge and link 3270 bridge)
- CICS-MQ Adapter is enhanced to use OTE
 - The CICS-MQ TRUE is enabled as OPENAPI so uses L8 TCBs
 - MQ API commands from CICS applications are threadsafe
 - Reduced TCB switching for threadsafe applications – same as for DB2
- Prior to CICS TS 3.2 ...
 - WMQ provided the TRUE
 - TRUE created a set of 8 private TCBs
 - TCB used by a CICS task just for the lifetime of MQ request
- With OTE ...
 - Need enough L8 TCBs to cope with the peak WMQ workload!

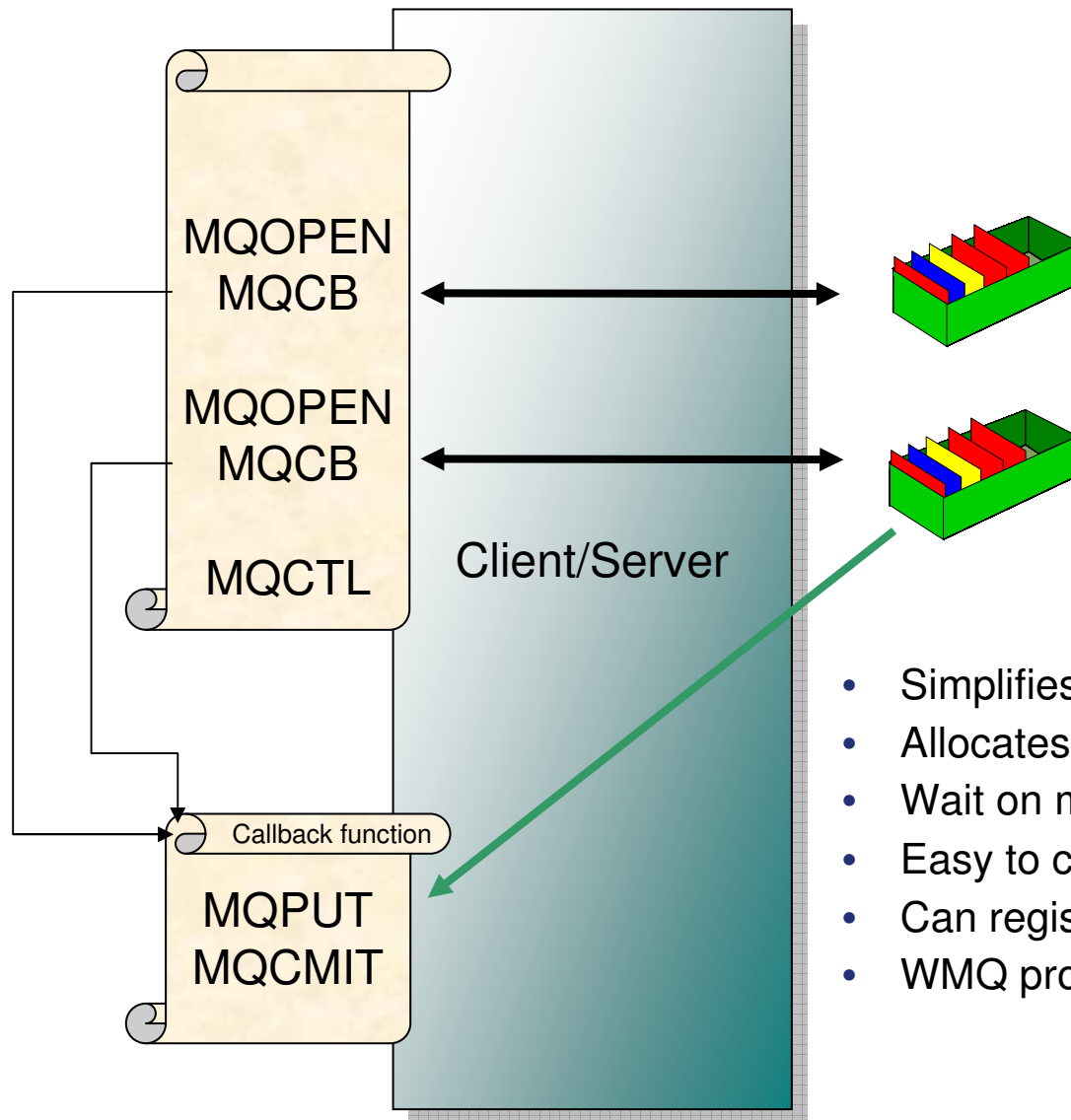
CICS-WebSphere MQ – Exits

- If you use the WebSphere MQ crossing exit be aware ...
 - The exit is driven from the CICS-DB2 TRUE DFHMQTRU on the L8 TCB
 - An exit defined as non threadsafe will switch to the QR TCB and then switch back to L8 TCB afterwards
 - An exit defined as threadsafe will remain on the L8 TCB
 - *Sample CSQCAPX is defined as threadsafe*
 - The exit can issue CICS commands, but a non threadsafe CICS command from CSQCAPX will cause TCB switching
 - Sample CSQCAPX issues multiple CICS commands. Although these commands are threadsafe it does have a performance impact. Keep processing to a minimum.

Long Running CICS-MQ Tasks

- Each long running CICS-MQ task sitting in a GETWAIT will hold an L8 TCB for its lifetime. An alternative is the new async consume function with WebSphere MQ V7
 - Register multiple callbacks – Only have one long running task
- CICS shipped new function APARs in December 2009 to support new MQI verbs with WebSphere MQ V7.01 and above
 - CICS TS V3.2 apar PK66866
 - CICS TS V4.1 apar PK89844 plus CPSM V4.1 apars PK89845 and PM03697
- Recommended maintenance on WebSphere MQ V7.01
 - PK97364 and PK97972
- New V7 MQI support in CICS TS V3.2, V4.1, and V4.2
 - No support for older CICS TS releases in the MQ shipped adapter

Asynchronous Consumption of Messages



- Simplifies programming
- Allocates message buffers
- Wait on multiple queues
- Easy to cancel
- Can register an Event handler
- WMQ provided samples for CICS users

IP CICS Sockets component of Communications Server for z/OS



- Since z/OS 1.7, you can optionally configure IP CICS Sockets to use OTE
 - By default, it will run with a quasirent TRUE and its own set of TCBs
 - Setting OTE=YES in the config file means the TRUE will be enabled as OPENAPI
- In later releases, TCBLIM introduced ...
 - TCBLIM – How many of MAXOPENTCBS can be used for sockets
 - like TCBLIMIT on the DB2CONN for CICS-DB2
 - TCBLIM requires ...
 - z/OS V1R11
 - z/OS V1R10 + APAR PK85446
 - z/OS V1R9 + APAR PK85446

IP CICS Sockets configuration file EZAC transaction



EZAC,ALTer,CICS

APPLID = CICS1A

Overtime to Enter

APPLID	====>	CICS1A	APPLID of CICS System
TCPADDR	====>	TCPCS	Name of TCP Address Space
NTASKS	====>	100	Number of Reusable Tasks
DPRTY	====>	010	DPRTY Value for ATTACH
CACHMIN	====>	010	Minimum Refresh Time for Cache
CACHMAX	====>	020	Maximum Refresh Time for Cache
CACHRES	====>	005	Maximum Number of Resolvers
ERRORTD	====>	CSMT	TD Queue for Error Messages
SMSGSUP	====>	NO	Suppress Task Started Messages
TERMLIM	====>	000	Subtask Termination Limit
TRACE	====>	YES	Trace CICS Sockets
OTE	====>	NO	Open Transaction Environment
TCBLIM	====>	00000	Number of Open API TCBs
PLTSDI	====>	NO	CICS PLT Shutdown Immediately
APPLDAT	====>	YES	Register Application Data

PF 3 END

12 CNCL

IP CICS Sockets – Use of OTE

- The IP CICS Sockets operator transaction EZAO has been enhanced to provide more information on the current IP CICS Sockets environment ...

EZAO, INQUIRE, CICS		APPLID = CICS1A	
TRACE	====> NO	Trace CICS Sockets	
MAXOPENTCBS	====> 00260	CICS Open API, L8, TCB Limit	
ACTOPENTCBS	====> 00000	Active CICS Open API, L8, TCBs	
TCBLIM	====> 00000	Open API TCB Limit	
ACTTCBS	====> 00000	Number of Active Open API TCBs	
QUEUEDEPTH	====> 00000	Number of Suspended Tasks	
SUSPENDHWM	====> 00000	Suspended Tasks HWM	
PF 3 END		12 CNCL	

Further Information

- CICS TS V3.2/V4.1/V4.2 Information Centers
 - Refreshed regularly, can be downloaded from ...
<http://www.elink.ibm.link.ibm.com/public/applications/publications/cgibin/pbi.cgi>
- z/OS V1R12 Communications Server
 - IP CICS Sockets Guide, SC31-8807
- Redbook: Threadsafe considerations for CICS SG24-6351-03
<http://www.ibm.com/redbooks>
 - Fourth edition (November 2010) ...
 - Does not include CICS TS V4.2 changes

Summary

- Anatomy of the CICS RMI
- Understanding how open TCBs are allocated and used
- CICS-DB2 use of OTE
- CICS-IMS use of OTE
- CICS-WMQ use of OTE
- IP CICS Sockets use of OTE