CICS Threadsafe Resource Managers

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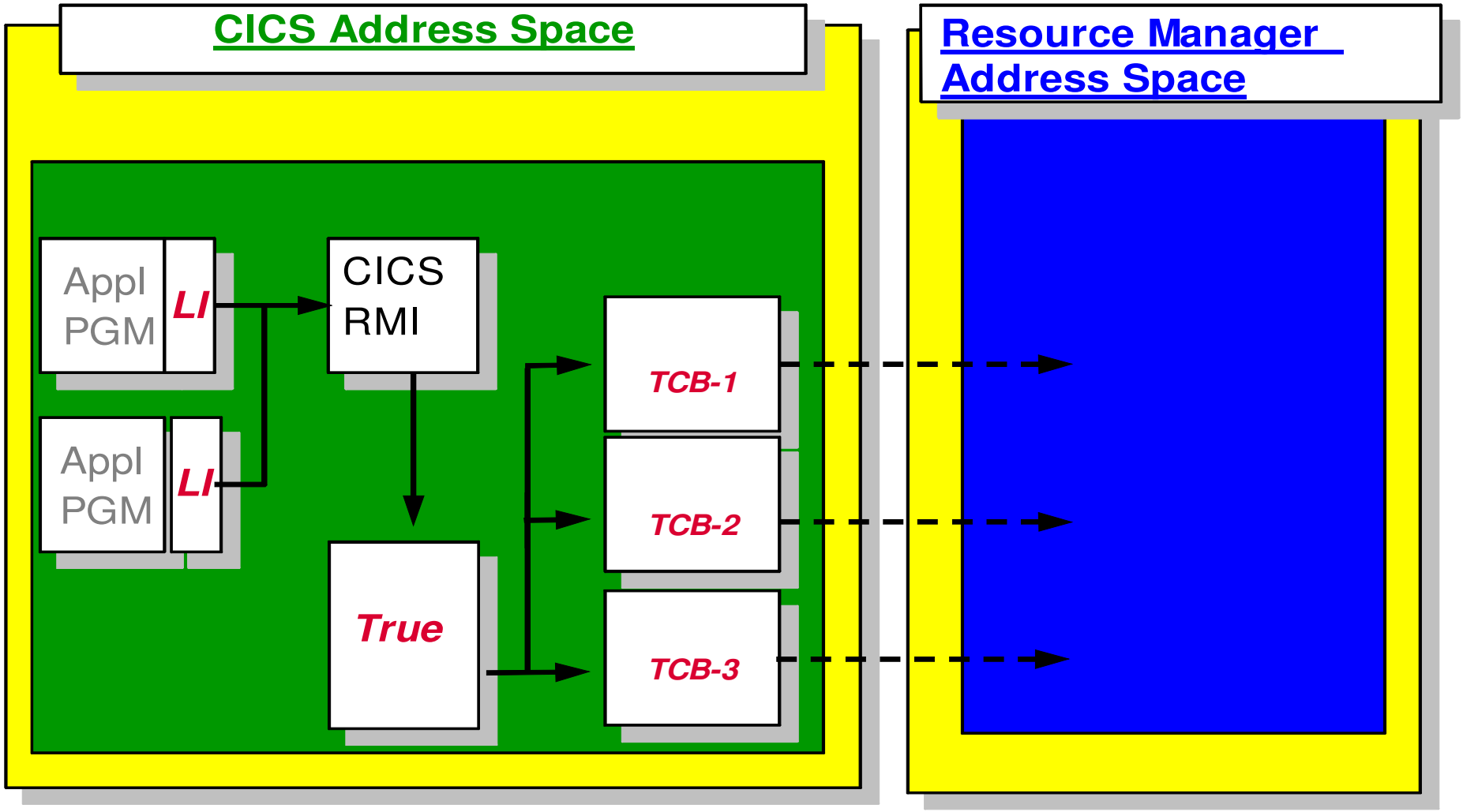
Agenda

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

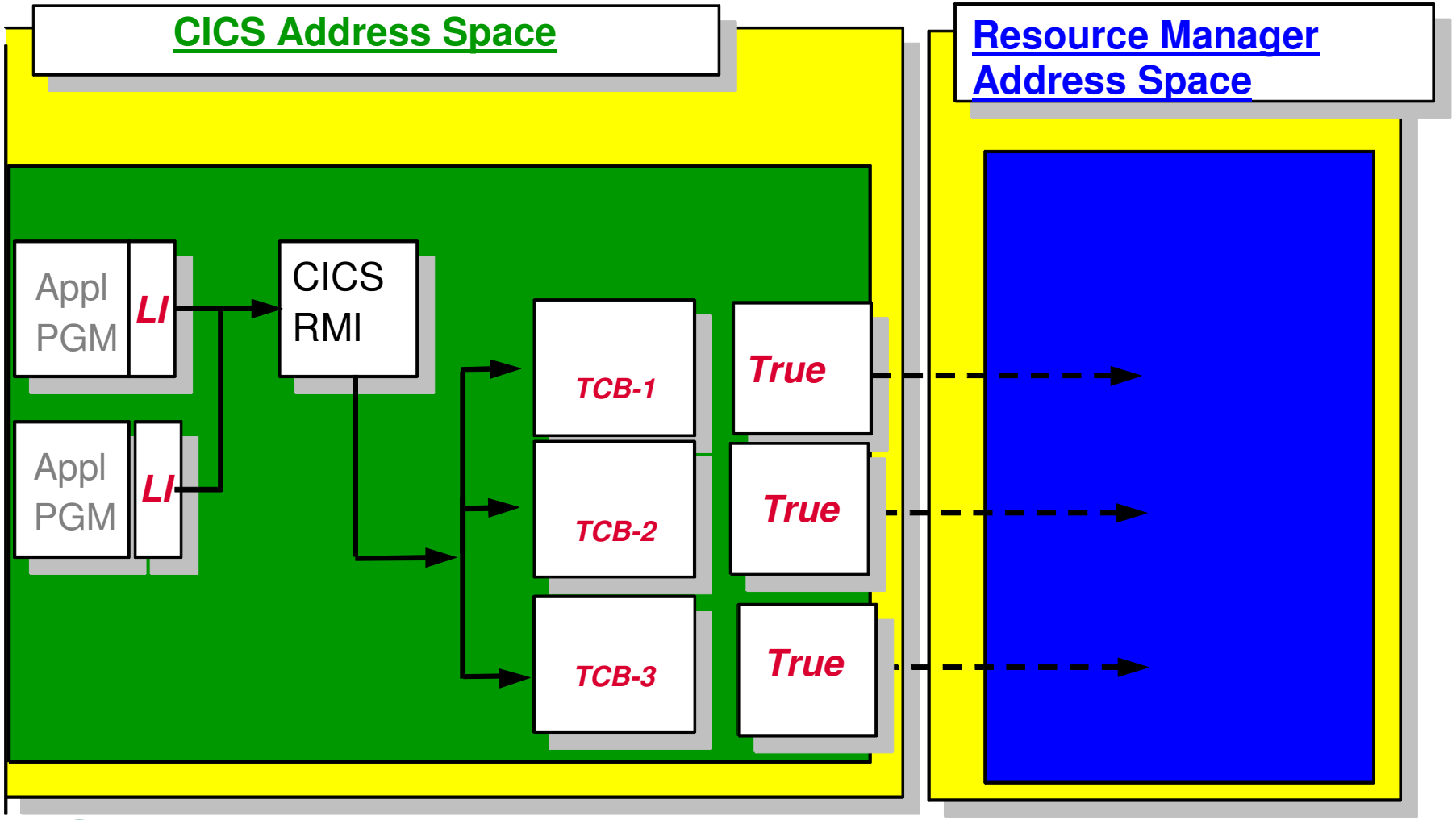
Resource Manager Interface (RMI)

- 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 TRUE’s 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 QR TCB and obey CICS rules
  - TRUE had to switch TCBs to invoke the resource manager – it must not invoke the resource manager on 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 QR TCB
- An L8 TCB is dedicated to one CICS task for the life of the task
  - No sub disptaching
  - The same L8 TCB will be used to invoke other OPENAPI trues used by this task
  - The same L8 will run threadsafe CICS code
  - The same L8 TCB will run threadsafe application code
  - The same L8 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

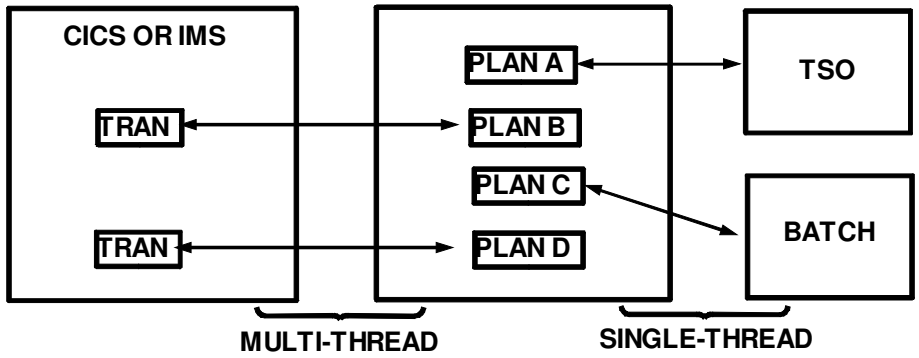
- Assuming you run your CICS systems with storage protection (STGPROT=YES) threadsafe applications accessing resource managers are best defined as CONCURRENCY(THREADSAFE) API(CICSAPI)
  - CICSAPI means CICS supported APIS including calls via the RMI to DB2, IMS, MQ…..
- Avoid API(OPENAPI)
  - Applications will be typically user key and will be invoked on an L9 TCB
  - TRUEs require an L8 TCB
- OPENAPI gives you the ability to start on an open TCB, but also CICS assumes you might issue ‘foreign api’ requests. These require an L9 TCB
- What we need in the future is an option to indicate CICSAPI but start me on an open TCB. CICSAPI can always use an L8 TCB regardless of the execution key as to CICS and the RMI the key of the TCB is irrelevant.
  - SHARE Requirement raised

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 QR TCB from an open TCB to invoke a non threadsafe GLUE and back again afterwards
- Particularly important exits that need to be threadsafe are XRMIIN and XRMIOUT on the RMI path, and XEIIN/XEIOUT called for all CICS commands.
  - Check with vendors for threadsafe support
  - Use DFH0STAT to find out whats exits in use and if they are defined threadsafe
- Use XPI ENQUEUE and DEQUEUE to serialise access to shared areas like the Global work area (GWA).

Connecting to DB2

DB2 Connections



- 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 was 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 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 eg MQ, sockets, CICS Webservice pipelines
- If you use transaction isolation in production set MAXOPENTCBs to your MXT value
  - Avoids contention for TCBs in subspaces versus basepsace
- 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 QR TCB
  - 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 is returned to the pool the priority is reset back to equal.
  - Other users of the L8 in the task – the application, other TRUEs use the L8 with that priority
- Other TRUEs do not set priority

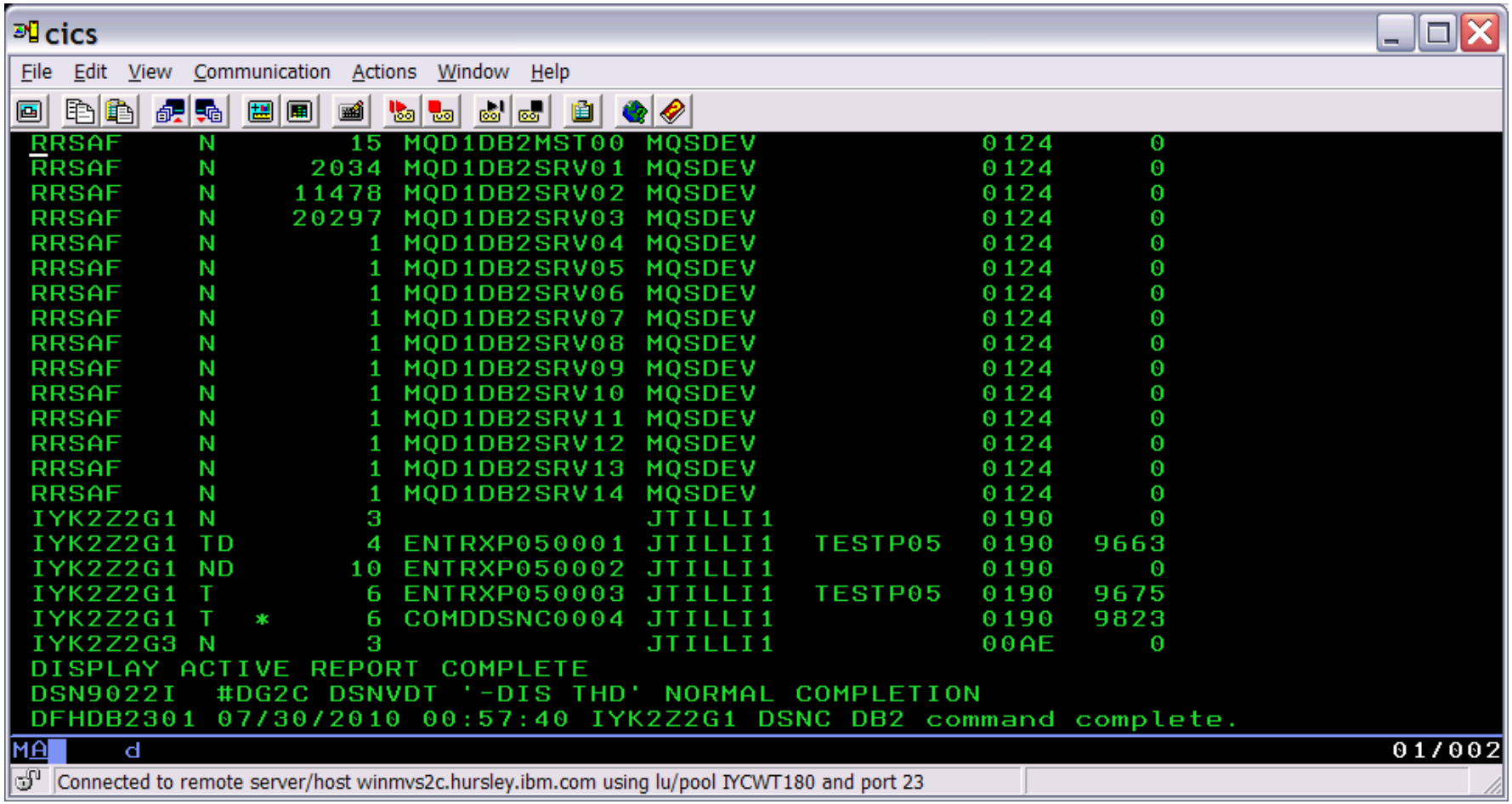
Understanding CICS-DB2 Attach: Threads

- 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 acquistion]
  - Plug a connection into a TCB
- THREAD TERMINATION [Deallocate Plan]
  - Frees storage

Understanding CICS-DB2 Attach: Threads



CICS-DB2 Exits

- If you use the dynamic plan exit, be aware:
  - The exit is driven from the CICS-DB2 TRUE DFHD2EX1 running on the L8 TCB
    - An exit defined as nonthreadsafe will switch to QR and then switch back to L8 afterwards. Sample DSNCUEXT is defined as non threadsafe
    - An exit defined as threadsafe will remain on the L8 TCB. Sample DFHD2PXT is defined as threadsafe
  - The exit can issue CICS commands, but a non threadsafe CICS command from DFHD2PXT will cause TCB switching. In the source it says:

```
*        This skeleton sample dynamic plan exit is the
*        same as DSNCUEXT, 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.
```

Connecting to WebSphere MQ

- CICS Transaction Server 3.2 & 4.1 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 8 private TCB
  - TCB used by a CICS task just for lifetime of MQ request
- With OTE - need enough L8 TCBs to cope with the peak WMQ workload

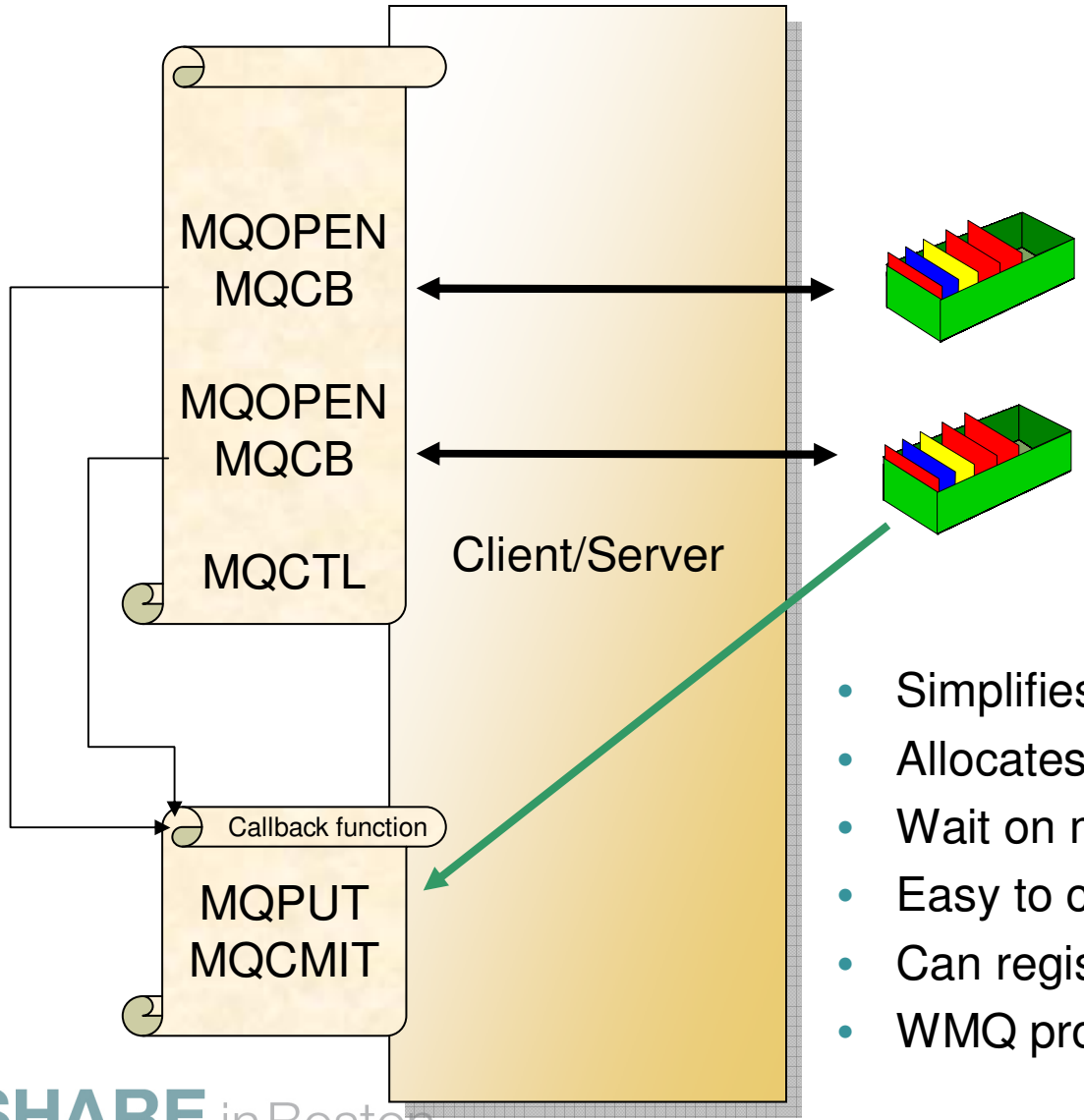
CICS-WMQ Exits

- If you use the WMQ crossing exit be aware:
  - The exit is driven from the CICS-DB2 TRUE DFHMQTRU on the L8 TCB
    - An exit defined as nonthreadsafe will switch to QR and then switch back to L8 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 DFHD2PXT 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 WMQ V7
  - Register multiple callbacks. Only have one long running task
- CICS shipped new function APARs in December 2009 to support new MQI verbs with WMQ V7.01 and above
- CICS TS 3.2 apar PK66866
- CICS TS 4.1 apar PK89844 plus CPSM 4.1 apars PK89845 & PM03697
- Recommended maintenance on WebSphere MQ V7.01
  - PK97364 & PK97972
- New V7 MQI support in CICS TS 3.2 and CICS TS 4.1 only
  - 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

- 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 DB2).
  - TCBLIM requires:
    - z/OS V1R11
    - z/OS V1R10 + APAR PK85446
    - z/OS V1R9 + APAR PK85446

CICS Sockets configuration file - EZAC transaction

```
EZAC,ALTer,CICS                                              APPLID = CICS1A

Overtype 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 CICS Sockets operator transaction EZAO has been enhanced to provide more information on the current 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 3.1/3.2/4.1 Information Centers
  - Refreshed regularly, can be downloaded from:
  - http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi
- Redbook: Threadsafe considerations for CICS SG24-6351-02
  - http://www.ibm.com/redbooks
  - Third edition (November 2007) incorporates CICS TS 3.2 enhancements