CICS Performance Series:

Blow the doors off CICS and DB2

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Summary of recent CICS TS enhancements to support DB2

- CICS-DB2 Attach exploits OTE to reduce TCB switching

- CICS-DB2 Attach supports group attach

- CICS TS support for enhanced restart-light function in DB2 V8 and above

- CICS-DB2 Attach supports the DB2 shipped JDBC drivers
  - Provides SQLJ and JBDC apis for CICS Java applications

- CICS-DB2 Attach exploits an RMI enhancement to allow purge across the RMI
  - New PURGEABLE keyword on ENABLE for TRUEs

OTE Exploitation

Recap of CICS Open Transaction Environment (OTE)

- Objectives
  - Enable applications on CICS TS use non CICS APIs
  - Open CICS TS to new types of client
  - Early support of new technology, eg Java Virtual Machine (JVM)

- Function
  - Access to POSIX functions, HLL functions, HFS, sockets
  - Improved performance for resource manager adapters eg. DB2, MQ

- Stage 1 (delivered in CICS TS 1.3)
  - CICS base infrastructure changed. OTE used for JVM and Java Hot Pooling

- Stage 2 (delivered in CICS TS 2.2)
  - Support for Task Related User Exits (TRUEs)

- Stage 3 (delivered in CICS TS 3.1)
  - Support for OPENAPI programs and C/C++ programs using XPLINK

Terminology

- Quasi-reentrant (QR) TCB
  - The main CICS TCB under which all application code runs prior to OTE
  - CICS dispatcher subdispatches work, so each CICS task has a slice of the action
  - A CICS task gives up control via a CICS dispatcher wait
  - Only one CICS user task is active at any one time

- Quasi-reentrant programs
  - Same program can be invoked by more than one CICS task
  - But only one CICS task is active at any one time
  - Quasi-reentrancy allows programs to share virtual storage e.g. CWA without the need to protect against concurrent update
  - CICS code took advantage of quasi-reentrancy, e.g. field CSACDTA in the CSA addressed the TCA of the currently dispatched CICS task.

Terminology

- Open TCBs
  - A new class of CICS TCB available for use by applications

  - Each TCB is for the sole use of the owning CICS task but can be reused by a later task.
  - No subdispatching under Open TCBs, blocking by applications allowed

  - There are several different types or modes of Open TCB.

  - CICS dispatcher domain manages a pool of TCBs for each mode

  - CICS will switch between an Open TCB and the QR TCB as required

  - Open TCBs are 'daughters' of QR TCB in the overall CICS TCB hierarchy

Terminology

- Threadsafe programs
  - Are capable of being invoked on multiple TCBs concurrently

  - Cannot rely on quasi-reentrancy to serialise access to resources and storage

  - A threadsafe program is one that does not modify any area of storage that can be modified by any other program at the same time and it does not depend on any area of shared storage remaining consistent between machine instrucutions.

  - Must use serialisation techniques such as compare and swap (CS) or enqueue/dequeue to access shared resources with integrity

  - All programs accessing a shared resource must be made threadsafe e.g. an existing program's reliance on quasi-reentrancy to serialise access to the CWA is made invalid if just one other program can run concurrently on another TCB and access the same CWA field

Terminology

- CICSAPI - services available today under QR TCB
    - CICS command level application programming interface
    - CICS system programming interface
    - CICS Resource Manager Interface (RMI)
    - CICS Exit Programming Interface (XPI) - for Global User exits
    - Systems Application Architecture (SAA) Common Programming Interfaces
        - CPI-C and CPI-RR
    - LE callable services

- OPENAPI - additional APIs possible under Open TCBs
    - Use of MVS services
    - Use of a specified set of POSIX services via MVS Unix System Services

- CONCURRENCY (QUASIRENT | THREADSAFE)
  - Applies to applications, TRUEs, GLUEs, URMs, PLT
    - QUASIRENT (the default) means the code must run under QR TCB
    - THREADSAFE means the code may run under QR or an open TCB
      - We say the program can 'float' between TCBs as required
  - Tells CICS if **application logic** is threadsafe or not
  - CICS handles threadsafe issues of its API.

- API (CICSAPI | OPENAPI) - implemented in CICS TS 3.1
  - Applies to applications, TRUEs, URMs, PLT (ignored for GLUEs)
  - CICSAPI (the default) means the program only uses CICS permitted apis
  - OPENAPI means the program requires an Open TCB to use other APIs
    - OPENAPI requires CONCURRENCY(THREADSAFE)

OTE Externals - COBOL Static and Dynamic Calls

- When a DB2 call is issued from a static or dynamically called routine, the CONCURRENCY definition of the program issuing the static/dynamic call determines the mode used after the DB2 call completes.

CICS-DB2 Transactions in CICS TS 1.3
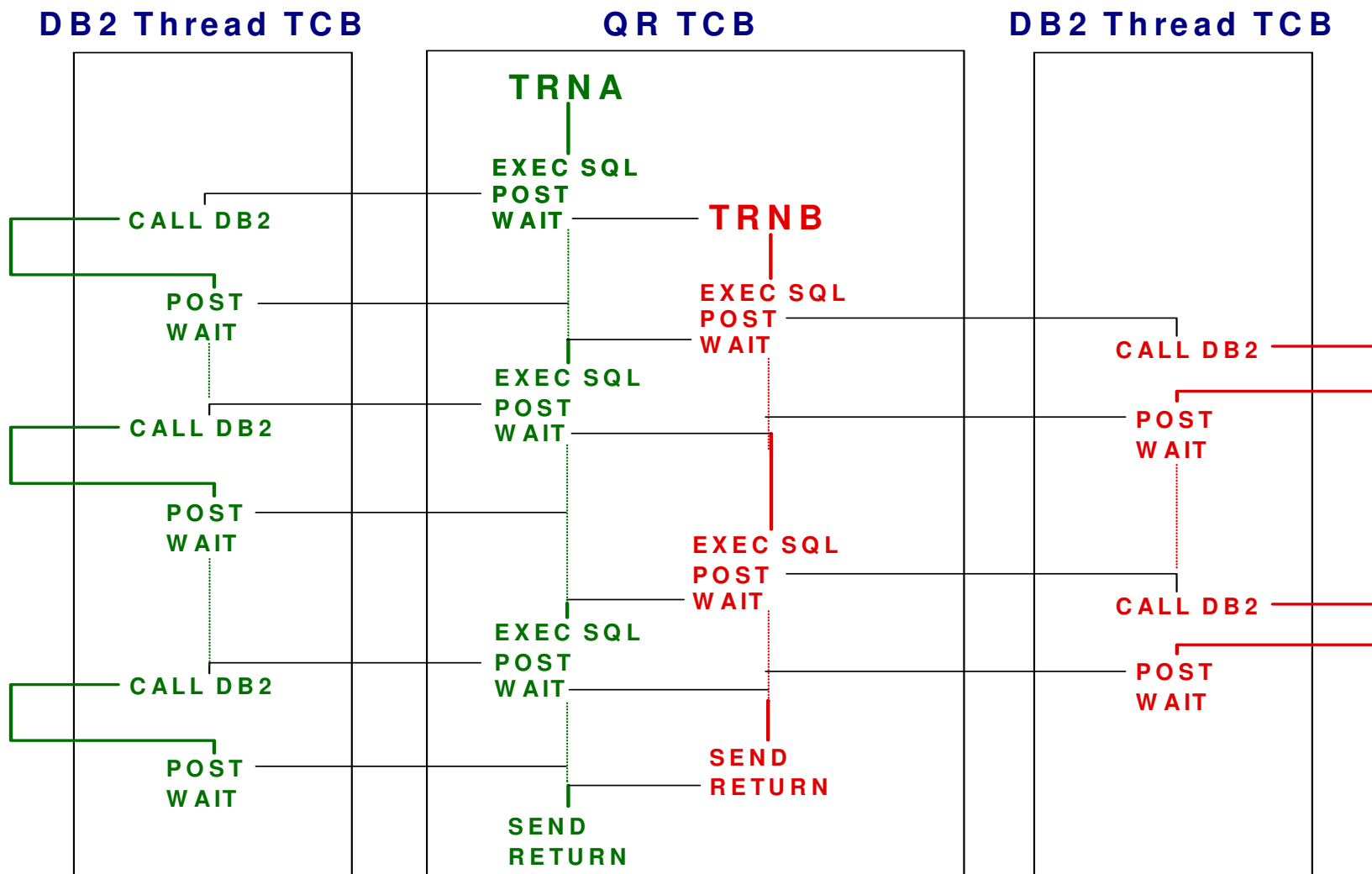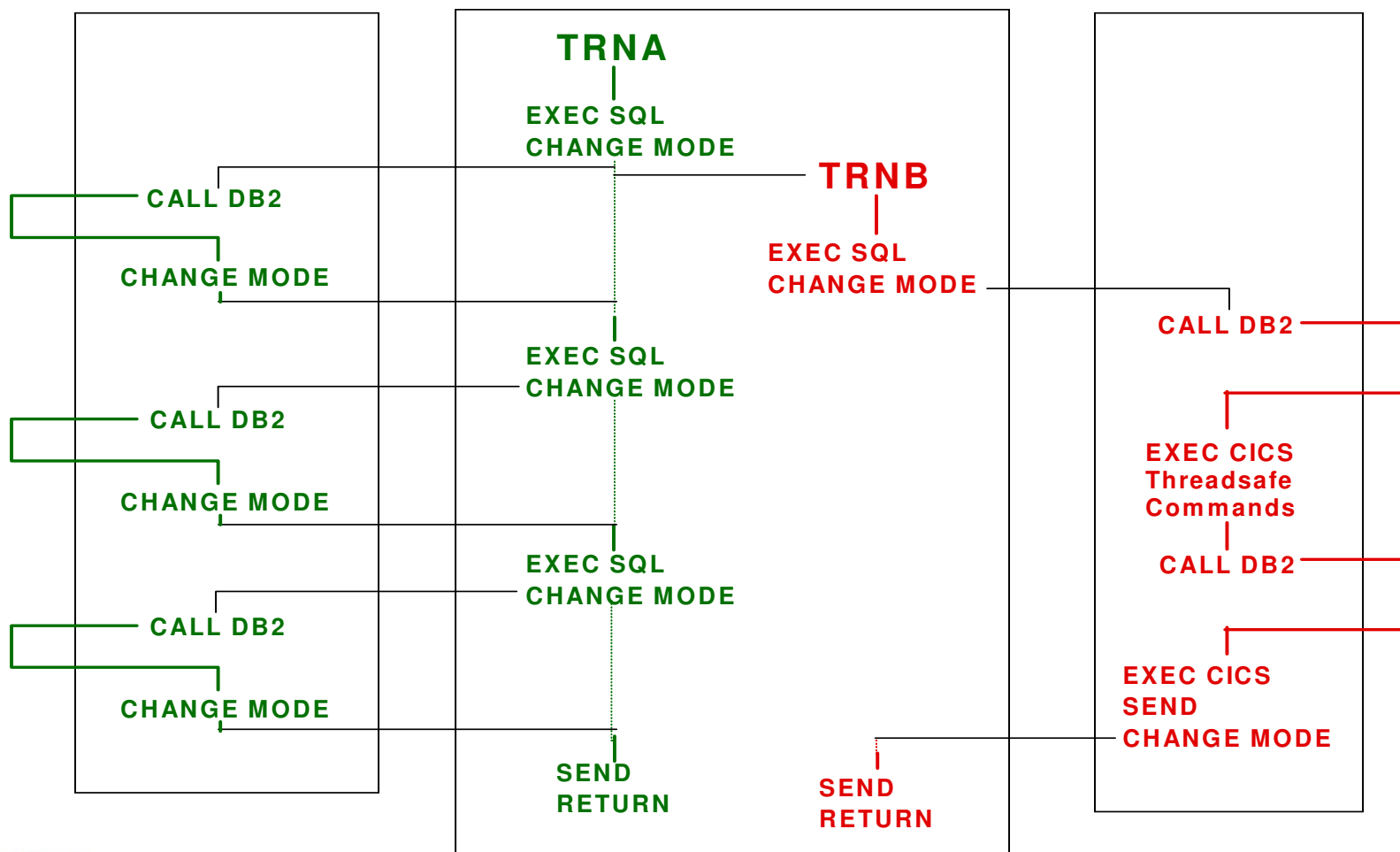
CICS-DB2 Transactions in using OTE

TRNA is non-threadsafe

L8001 TCB

QR TCB

TRNB is threadsafe

L8002 TCB

TRNA

EXEC SQL
CHANGE MODE

TRNB

CALL DB2

EXEC SQL
CHANGE MODE

CHANGE MODE

CALL DB2

EXEC SQL
CHANGE MODE

CALL DB2

CHANGE MODE

EXEC CICS
Threadsafe
Commands

CALL DB2

EXEC SQL
CHANGE MODE

CALL DB2

CHANGE MODE

EXEC CICS
SEND
CHANGE MODE

SEND
RETURN

SEND
RETURN

OTE Changes in CICS TS 3.1 : OPENAPI Programs

- New API Keyword on program definition
  - Attribute of program. Applies to applications, TRUEs, URMs, PLT (ignored for GLUEs)
  - CICSAPI (the default) means the program only uses CICS permitted interfaces
  - OPENAPI means the program requires an Open TCB to use other APIs (OPENAPI requires CONCURRENCY(THREADSAFE))

- New L9 TCB for running userkey OPENAPI programs
  - For OPENAPI programs TCB key must match PSW key for non-CICS apis to work (whereas CICS APIs run in either key irrespective of TCB key)
  - SIT parm MAXOPENTCBS now covers L8 and L9 TCBs

- New CICS uses of L8 TCBs
  - When accessing DOCTEMPLATEs or static HTTP responses held on HFS
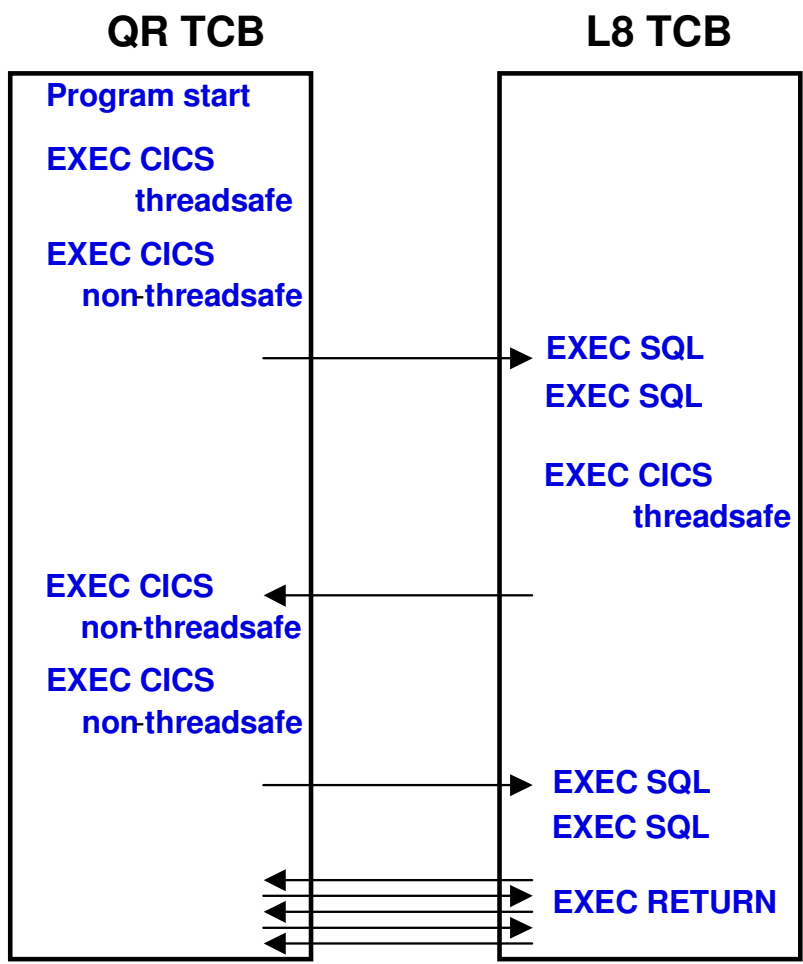 - WebServices and XML support implemented using cicskey OPENAPI programs

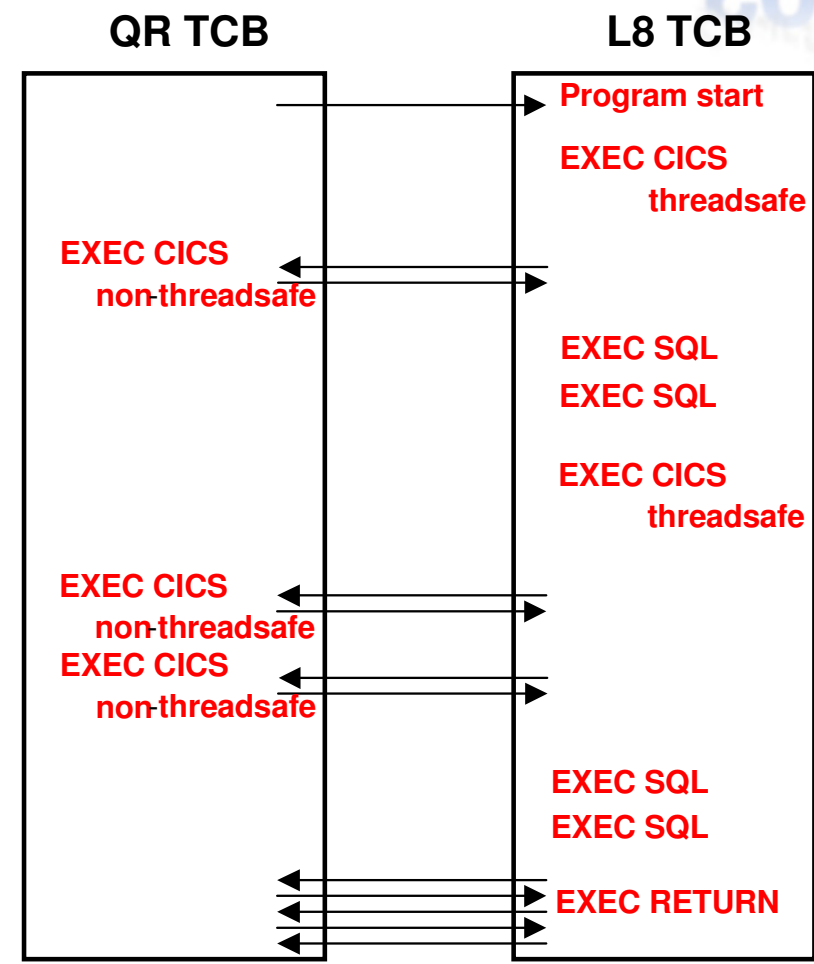# OTE Changes in CICS TS 3.1 : OPENAPI Programs

- OPENAPI programs - allows an application to specify it **must** run on an open TCB.
  - User key openapi programs run on an L9 TCB, CICS key openapi on an L8 TCB

  - Non threadsafe CICS requests switch to QR then back to the open tcb when returning to the application

  - Application logic must be threadsafe.

  - Primary purpose is to allow application workloads to be moved off QR TCB to provide better exploitation of machine resources and achieve better throughput.

  - Allows application to use non CICS APIs as well as CICS APIs
    - **Use of non CICS APIs within CICS is entirely at the risk of the user. No testing of non CICS APIs within CICS has been undertaken and is not supported by IBM service.**

Comparing threadsafe versus openapi - TCB switching

QR TCB	L8 TCB	QR TCB	L8 TCB
Program start			**Program start**
EXEC CICS threadsafe			**EXEC CICS** threadsafe
EXEC CICS non-threadsafe		**EXEC CICS** non-threadsafe	
	EXEC SQL **EXEC SQL**		**EXEC SQL** **EXEC SQL**
	EXEC CICS threadsafe		**EXEC CICS** threadsafe
EXEC CICS non-threadsafe		**EXEC CICS** non-threadsafe	
EXEC CICS non-threadsafe		**EXEC CICS** non-threadsafe	
	EXEC SQL **EXEC SQL**		**EXEC SQL** **EXEC SQL**
	EXEC RETURN		**EXEC RETURN**

The program for transaction BLUE is defined THREADSAFE , API= CICSAPI

The program for transaction RED is defined THREADSAFE, OPENAPI, EXECKEY=CICS

CICSAPI & THREADSAFE versus OPENAPI & THREADSAFE

- NB: OPENAPI TRUEs must run CICS key on an L8 TCB
  - A user key threadsafe OPENAPI program calling DB2 will switch from L9 to L8 then back to L9 for each DB2 request.
  - A user key threadsafe CICSAPI program running on an L8 TCB will remain on the L8 TCB to call DB2

- Candidates for CICSAPI with THREADSAFE
  - SQL programs with some non-threadsafe API
  - SQL programs with USER key

- Candidates for OPENAPI with THREADSAFE
  - programs with threadsafe APIs only
 - SQL programs with CICS key
  - CPU intensive programs

CICS Tools that can help – CICS IA

- Are my programs using shared resources?
  - CWA
  - Global user exit global work areas
  - Storage acquired explicitly by the application program with the GETMAIN SHARED option
  - Data only Load module

- Which non threadsafe CICS commands is my program using?

- Which TCB did my CICS commands run on ?

Using CICS Explorer and CICS IA

- Collector runs in a CICS region capturing CICS calls

- Dependencies
- MQ
- DB2
- Custom queries
- Prog/Tran
 - Which resources
- Resource
  - Which prog/tran
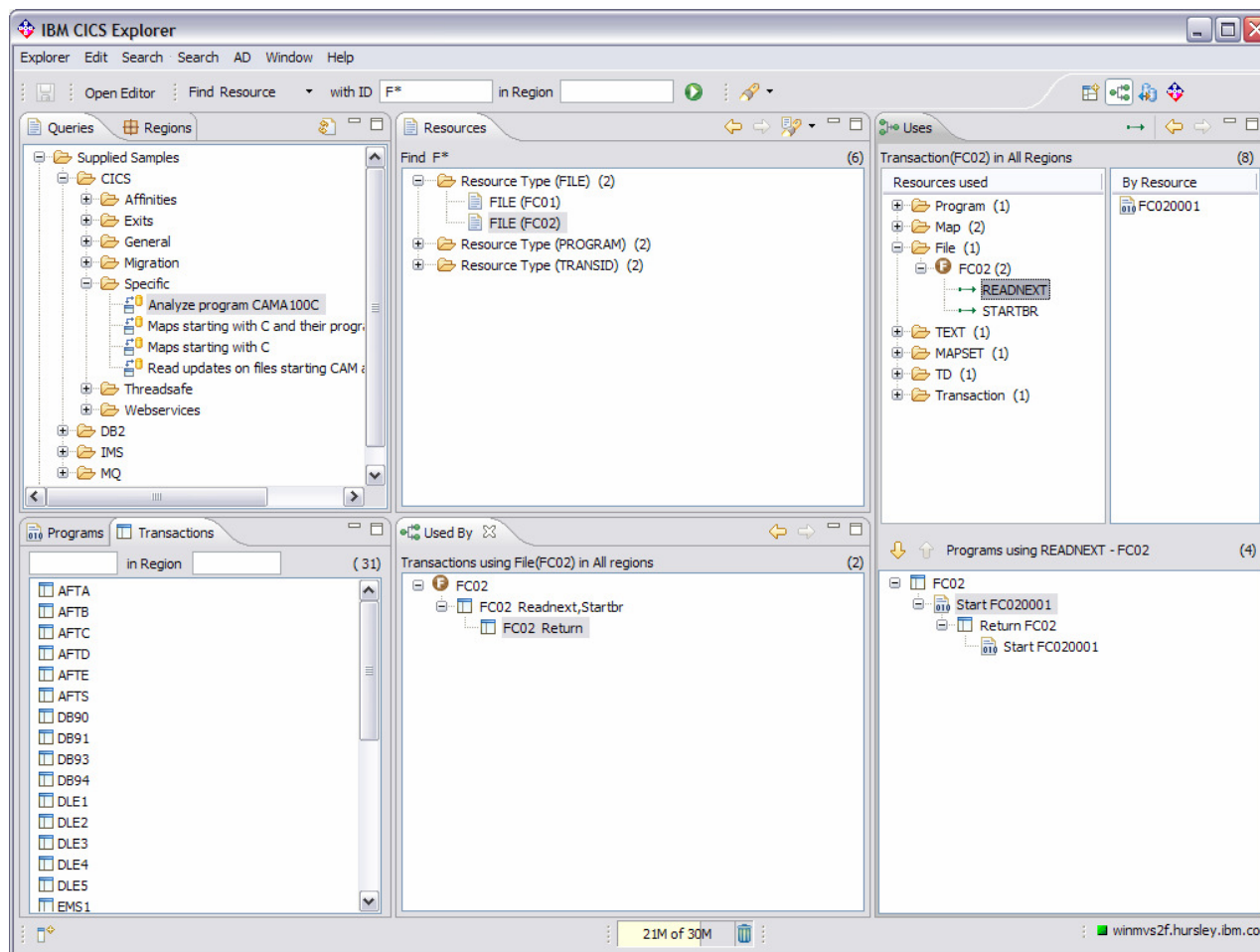
CICS Tools that can help – CICS PA

- Which TCBs did my transaction use?
    - How many TCB switches (change modes) occurred?
        - What was the Change Mode delay time?
    - How much Dispatch and CPU time did they use?
    - Performance Summary, List and List Extended Reports, …
    - Sample Report Forms …
        - CPU and TCB Usage, TCB Delays, Change Mode Delays, …

- Why did my transaction take so long?
    - Wait Analysis Report, Performance List Reports, …
- Which Transaction(s) used GETMAIN SHARED?
- Where did my transaction go?
    - Cross-System Report, …
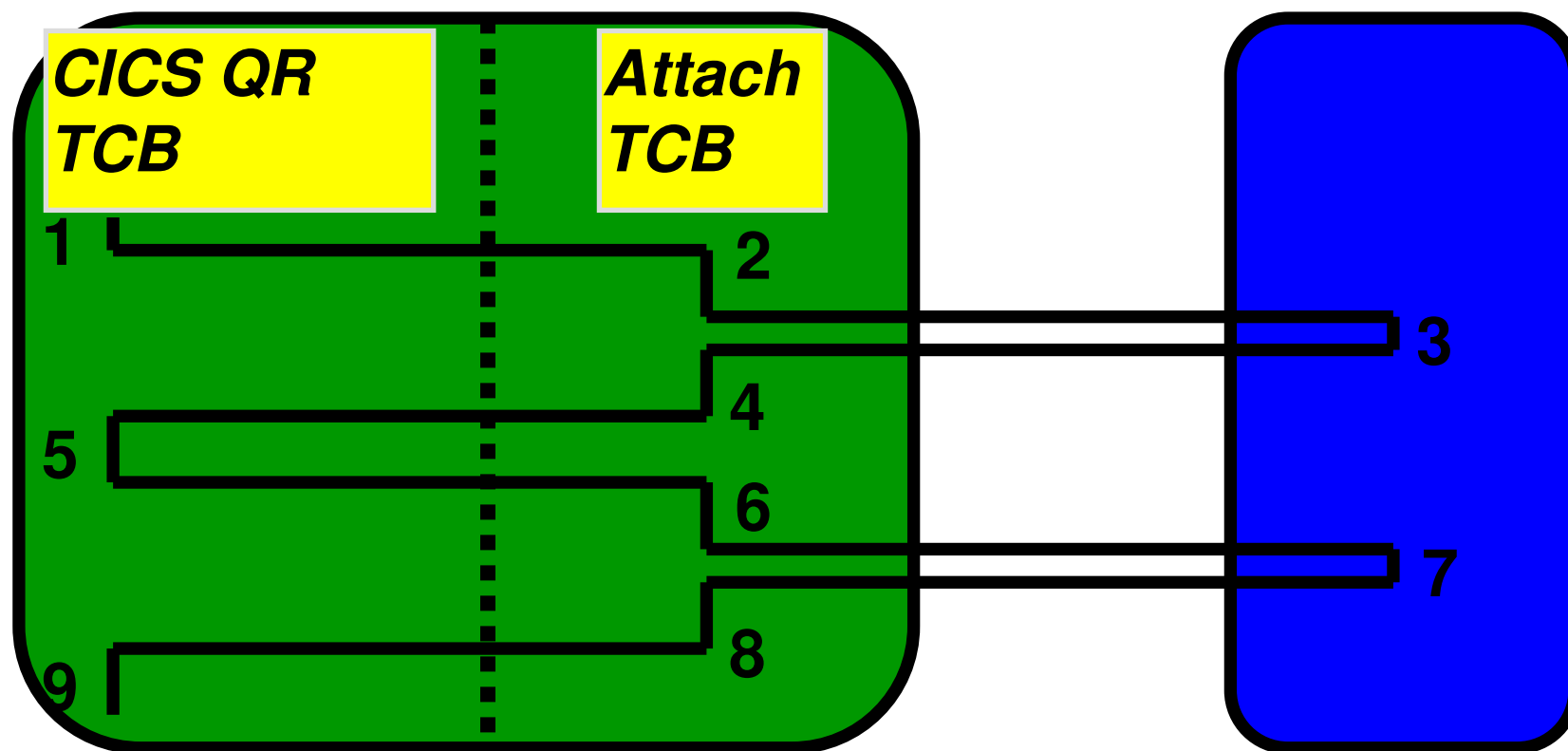   - Performance List, DB2 and WebSphere MQ Reports, …

Using CICS Explorer with CICS PA

- SMF to
- .csv extract
- Threadsafe
- CPU time
- Response wait
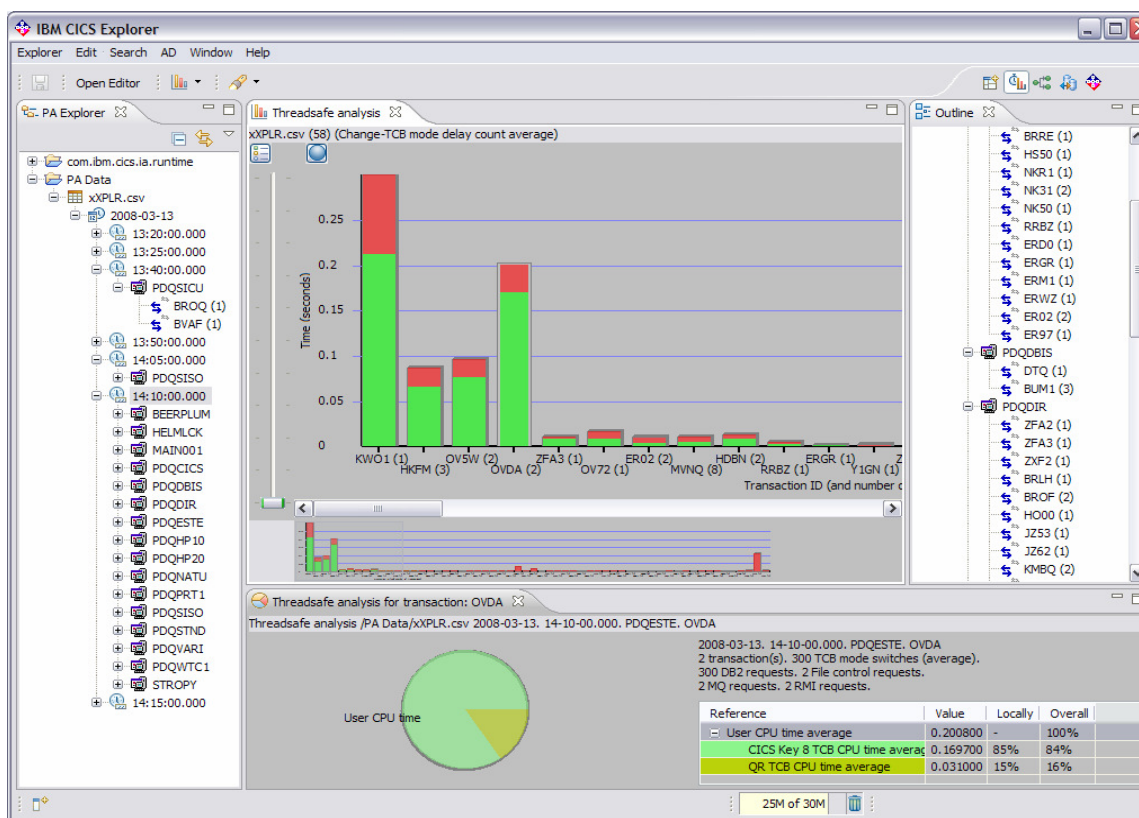
Accounting prior to use of OTE…

CICS Address Space

DB2

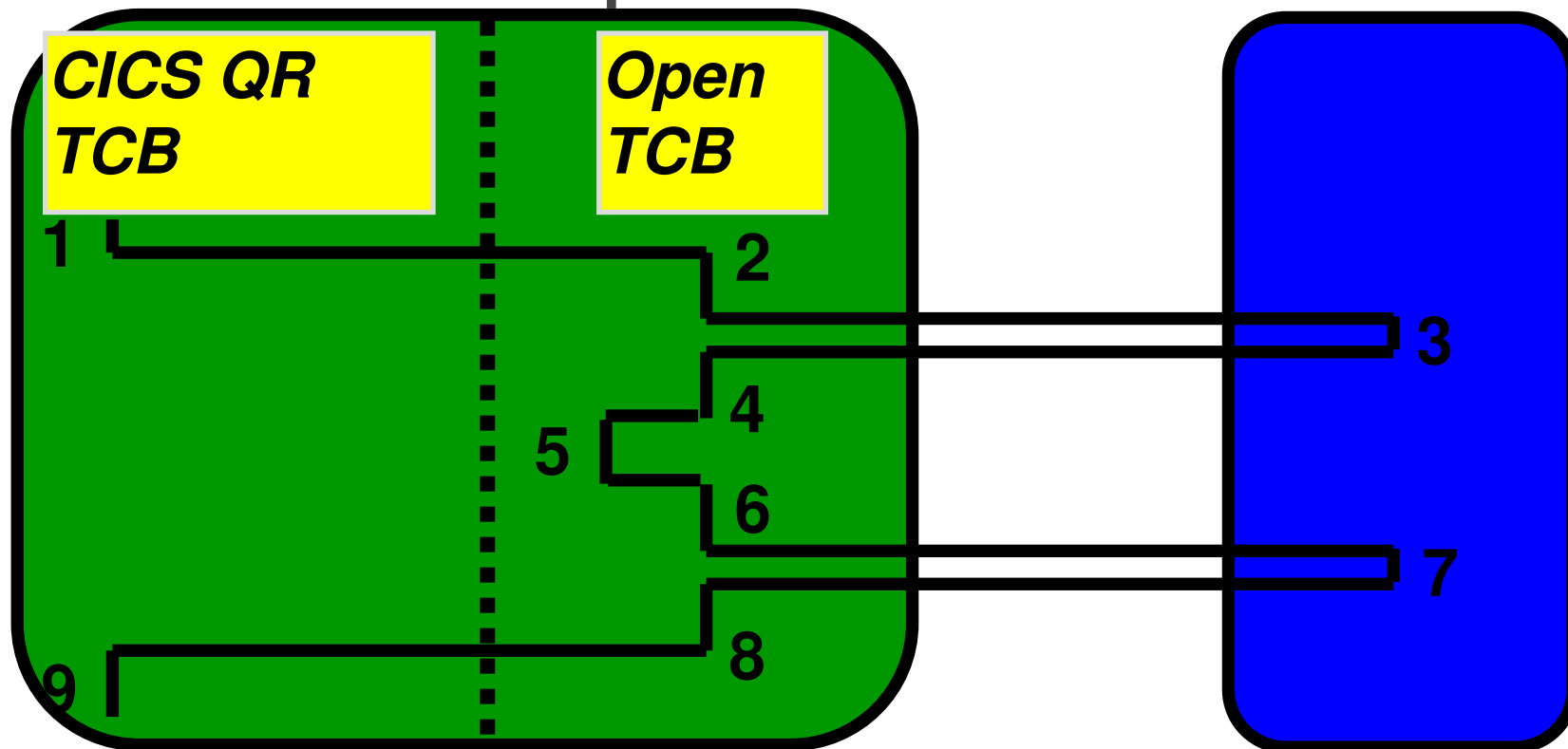**CICS QR TCB**

Attach TCB

1
2
3
4
5
6
7
8
9

CICS CMF CPU = 1+5+9

DB2   Class-1 CPU = 2+3+4+6+7+8

Class-2 CPU = 3+7

Accounting in an OTE environment

CICS Address Space

DB2

CICS QR TCB

Open TCB

1

2

3

4

5

6

7

8

9

CICS CMF CPU = 1+2+3+4+5+6+7+8+9

DB2   Class-1 CPU = 2+3+4+5+6+7+8

Class-2 CPU = 3+7

Support for Group Attach

Support for Group Attach

- DB2GROUPID parameter added to DB2CONN and INQUIRE/SET DB2CONN commands
  - ►Mutually exclusive to DB2ID parameter
  - ►CICS will connect to any member of the group
    - – DB2 searches list of subsystems defined to this MVS

- RESYNCMEMBER(YES¦NO) parameter added to DB2CONN
  - ►YES (default) means if CICS thinks indoubts are outstanding then ignore group attach and attach to the specific DB2 member last used

  - ►NO means use group attach regardless of indoubts
    - –CICS will nevertheless try a specific attach to the last used group member first. If that fails it will use group attach to connect to any group member.

Support for Group Attach

- When connected using group attach:

  ▶ DB2GROUPID shows the 4 character groupid

  ▶ DB2ID shows the 4 character SSID of the member connected to
    – DB2ID will be blanked out when CICS & DB2 disconnect

- When connected without group attach:

  ▶ DB2GROUPID will be blank

  ▶ DB2ID shows the 4 character SSID of the DB2 connected to
   – DB2ID is not blanked out when CICS & DB2 disconnect

JDBC/SQLJ Support

CICS/DB2 Operations

- DB2 JDBC driver sits between application & CICS
  - Converts calls into EXEC SQL... then calls CICS-DB2 Attach
  - CICS-DB2 Attach sees no difference from other languages

- DB2 JDBC driver manages the JDBC Connections
  - JDBC Connection is "thin layer" on top of existing threads

- CICS-DB2 Attach manages the threads (physical connections) into DB2
  - All existing thread allocation and reuse facilities apply
  - Converted calls visible to EDF

JDBC/SQLJ in a CICS environment
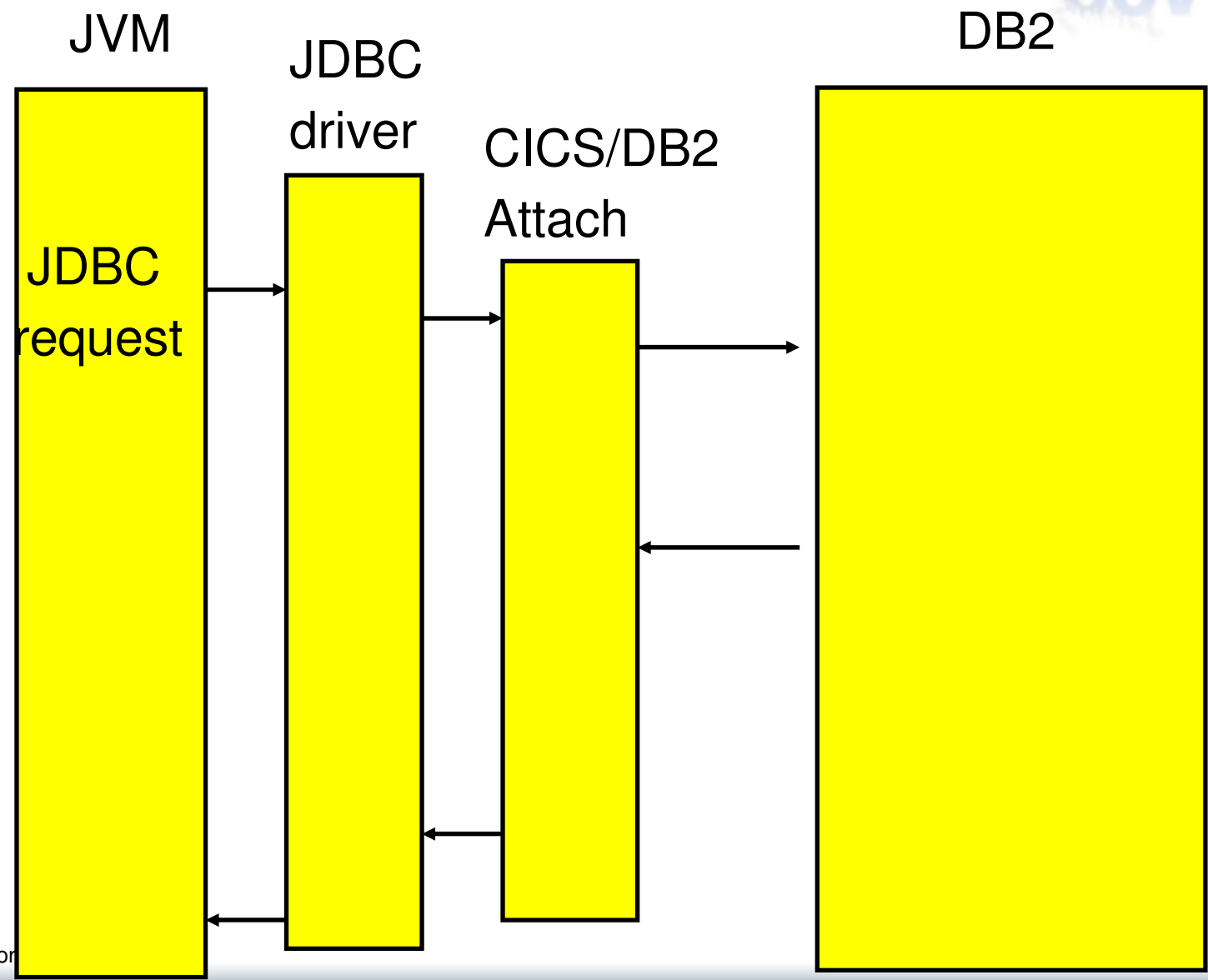
DB2 Restart-Light Support

Support for DB2 V8 enhanced Restart-Light

- Restart-Light was introduced in DB2 V7
  - Cutdown DB2 with reduced storage footprint
  - DB2 restarts to flush out in-flight UOWs (to minimise retained locks) then terminates

- DB2 V8 Restart light - subsystem remains active if indoubts outstanding
  - Flushes out in-flight UOWs
  - Awaits resynchronisation of indoubts

- CICS connects to DB2, DB2 informs CICS it is restart-light subsystem
  - CICS-DB2 Attach connection status remains as 'connecting'
    - stops any new work accessing DB2
  - CICS allows resynchronisation tasks (CRSY) to access DB2

- DB2 Restart-light system terminates when resync complete

CICS-DB2 Further information

- CICS TS 2.3/3.1/3.2 Information Centers
  - ►Refreshed regularly, can be downloaded from:
  - ►http://www.elink.ibmlink.ibm.com/public/applications/publications/cgibin/pbi.cgi

- Threadsafe redbook SG24-6351-02
  - ►http://www.ibm.com/redbooks

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