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CICS and Threadsafe

Exploiting the Open Transaction Environment

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Objectives

- Definitions
- Recommendations
- History of CICS Multitasking
- The Open Transaction Environment
- Making programs Threadsafe
- Exploiting the OTE
- OTE Performance Considerations
- Diagnosing Threadsafe Problems
- Addendums

Definitions

1. “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 does not depend on any area of shared storage remaining consistent between machine instructions.”
2. “A program **defined** as CONCURRENCY=THREADSAFE is one that will be allowed to run on an open TCB.”
3. “A threadsafe CICS **command** is one that is **allowed** to run under an open TCB. A non-threadsafe command is one that is **not allowed** to run under an open TCB”

Recommendations

- Consider Threadsafe implications now to:
  - Lower the Total Cost of Ownership (TCO) of CICS applications
  - Enable automatic exploitation of latest future hardware and software capabilities
- Target the Heavy CPU users to exploit multiprocessors
- Review “behavior” of purchased software packages
- Beware of COBOL calls (dynamic or static)

Recommendations

- OTE exploitation project maybe a waste unless we:
  - Convert XRMIIN/OUT and Dynamic Plan Selection exits **before** migrating to a threadsafe capable CICS release
  - Convert all frequently used exit programs to threadsafe **before** converting programs
  - Verify that required maintenance is on CICS and vendor products **before** converting programs to threadsafe
  - Study the IBM Redbook “Threadsafe Considerations for CICS”

History of CICS Multitasking

- CICS as a Single TCB exploiter:
  - Most efficient on fastest single processor
  - “Quasi-Reentrancy” is not = Reentrant code
  - Issues:
    - Region capacity limited by speed of one processor even though many CPUs may be available
    - Forces “cloning” of regions to gain capacity
    - Runaway tasks hang the entire CICS region
    - OS Waits in CICS applications, not a recommended practice, cause Wait of the entire Region
    - Many restricted OS and COBOL Commands

History of CICS Multitasking

- CICS Exploitation of Multiple Processors
  - Multiple TCBs available, but
  - Quasi-Reentrant (QR) is only one used for majority of transactions processing
  - Additional TCBs for:
    - VSAM
    - DB2
    - Program Loader
    - etc.
    - Except for the DB2 activity, most of these activities consume very small amounts of CPU

History of CICS Multitasking

- CICS and DB2
  - Separate TCB (‘thread’) for each DB2 Request
  - Task is switched from QR to DB2 TCB
  - DB2 code runs on DB2 TCB
  - Significant workload may be shifted from QR to DB2 TCBs, but added measurable overhead for TCB back and forth switching

Open Transaction Environment (OTE)

- Transaction runs under own TCB
- Introduced in TS 1.3 for Java
- DB2 Support added for TS 2.2
- Supports full OS function
- Allows true Multitasking in CICS
- Pseudo-reentrancy no longer **allowed**

OTE and DB2

Without Threadsafe

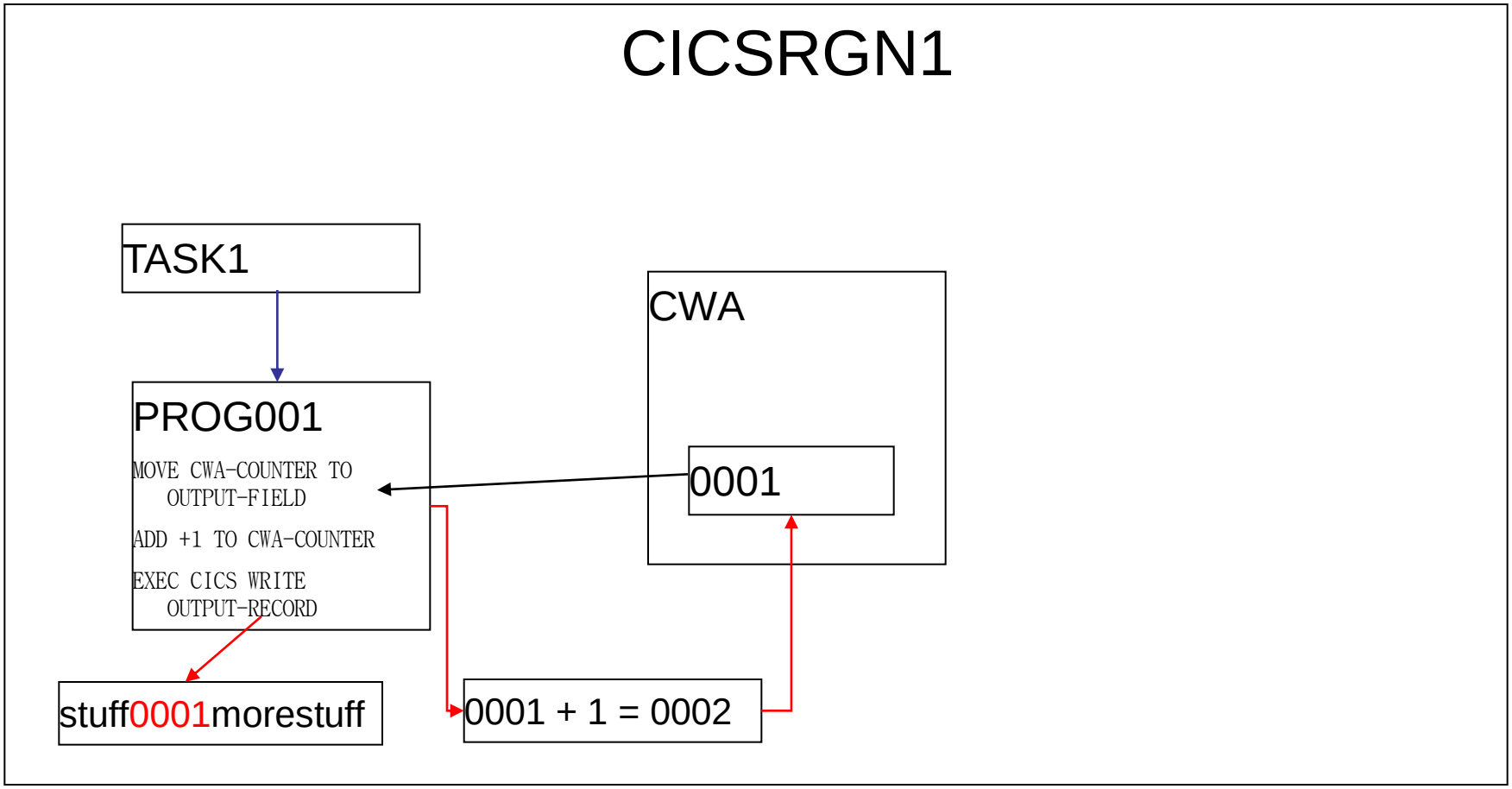
QR TCB		Open TCB
Task Starts		
EXEC CICS		
EXEC SQL	→	DB2 Code executes
Application Code	←	DB2 Code completes
EXEC SQL	→	DB2 Code executes
	←	DB2 Code completes

OTE and DB2

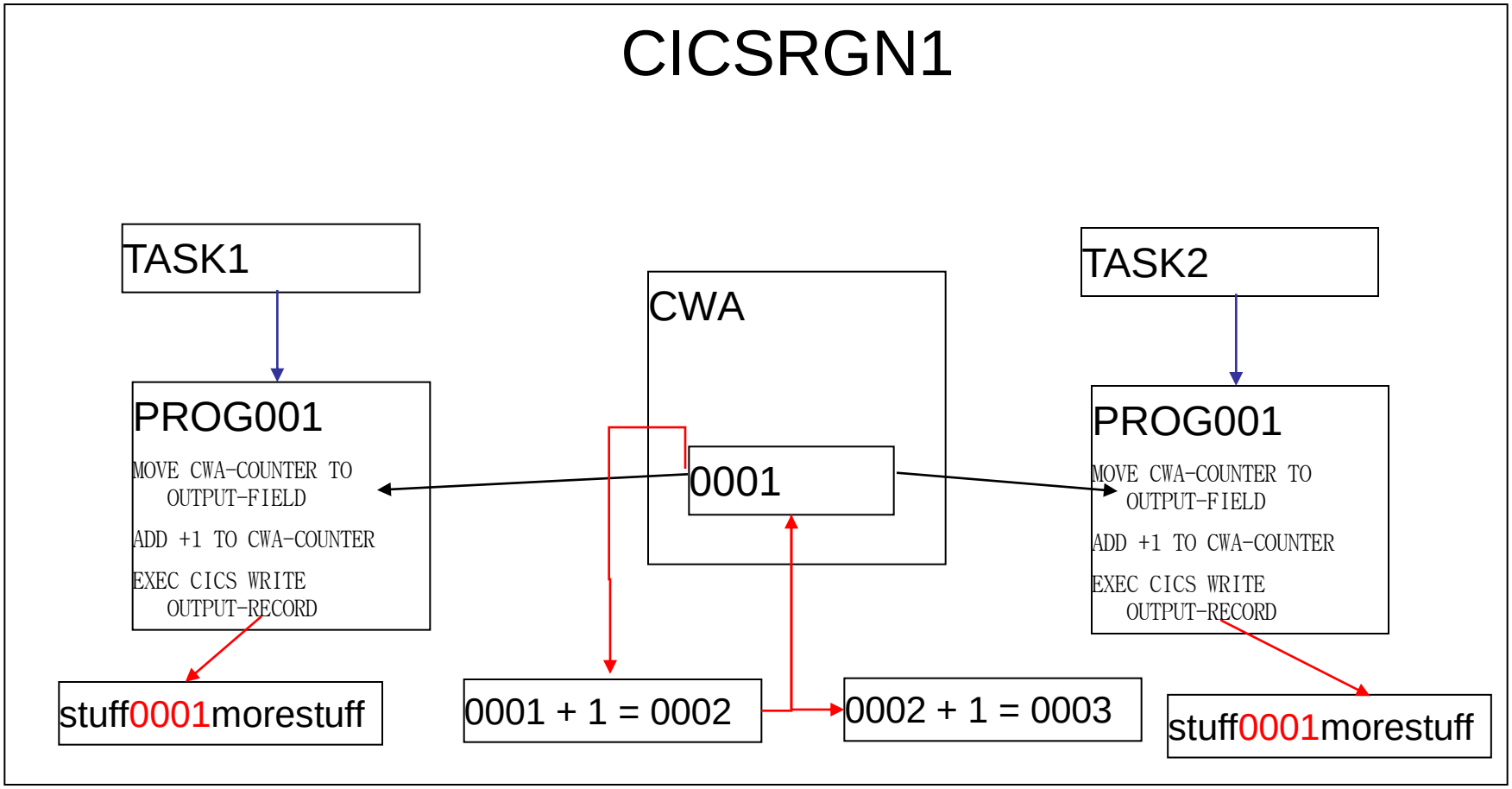
With Threadsafe

QR TCB		Open TCB
Task Starts		
EXEC CICS		
EXEC SQL	→	DB2 Code executes
		Application Code
		DB2 Code executes
Task Termination	←	Task completes

So, What's the Problem



So, What's the Problem



Controlling Threadsafe

- At the region level, new SIT parm - FORCEQR=YES/NO:
  - FORCEQR=YES All programs run on QR TCB
  - FORCEQR=NO Programs follow CONCURRENCY parm on program definition
- At the program level:

  New parameter on Program Definition
  - CONCURRENCY=QUASIRENT (Not Threadsafe)
  - CONCURRENCY=THREADSAFE
  - CONCURRENCY=REQUIRED

Identifying Threadsafe Programs

- CONCURRENCY parameter is a “promise” by Developer, not an order to CICS
- No automated method of identification
- IBM Tool helps: DFHEISUP will scan for CICS commands commonly used in non-threadsafe applications
- Rules of thumb:
  - COBOL and PL/1 must be LE
  - All programs must be re-entrant
  - Aps with no affinities are more likely to be threadsafe

Identifying Threadsafe Programs

Ensure programs are re-entrant:

- COBOL:
  - Compile with RENT
  - Link with RENT
- Assembler:
  - Code review, possible coding changes required
  - Assemble/Link with Rent
- CICS:
  - RENTPGM=PROTECT
  - Adjust RDSA/ERDSA sizes
  - Non-reentrant activity will generate DFHSR0622 message followed by S0C4/ASRA abend
  - Possible conflicts with debuggers

Identifying Threadsafe Programs

Continued...

IBM supplied tool available to help start…..

- Utility DFHEISUP will scan for CICS commands commonly used in non-threadsafe applications
- Use command table DFHEIDTH

Making Programs Threadsafe

After identifying non-Threadsafe code you have two choices (one requires applications changes):

1) Alter the code to serialize the shared storage access
   A) Use CICS to automatically ensure serialization
   B) Manually ensure serialization

2) Do nothing

Making Programs Threadsafe

continued...

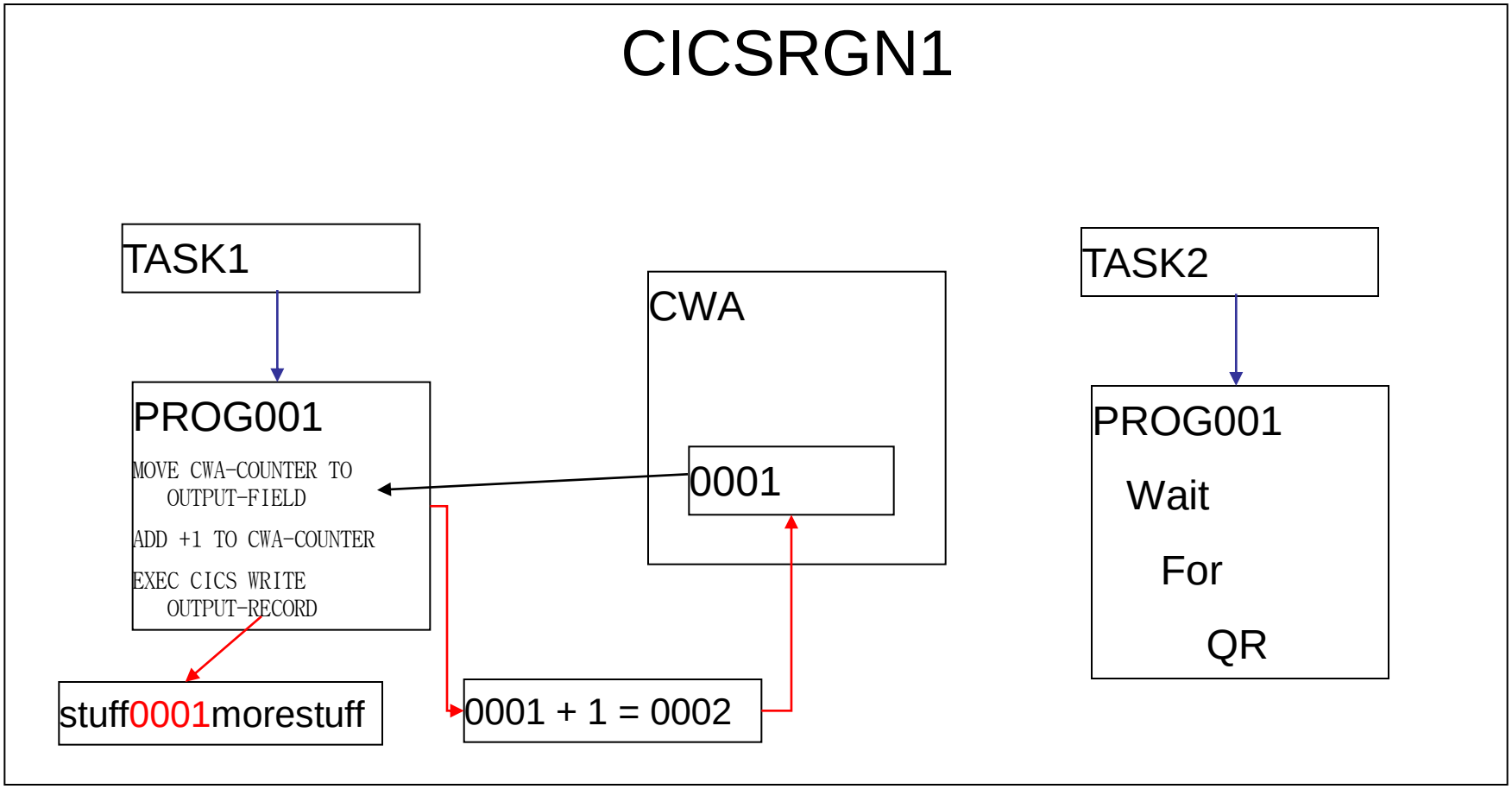
If shared storage use is limited to few programs:

- Leave non-threadsafe programs QUASIRENT
- CICS will switch to QR on LINK or XCTL (But…**not for CALL commands!**)
- Access to shared storage is automatically serialized by CICS

Making Programs Threadsafe

continued...

Leave Program CONCURRENCY(QUAISRENT)



Leave Program CONCURRENCY(QUAISRENT)

Advantages:

- No coding changes, so it can be a quick implementation

Disadvantages:

- Additional TCB switching overhead
- Maintenance issues
- All programs that access the shared storage areas **must** also remain QUASIRENT
- Applications mostly limited to process on QR TCB

Making Programs Threadsafe

continued...

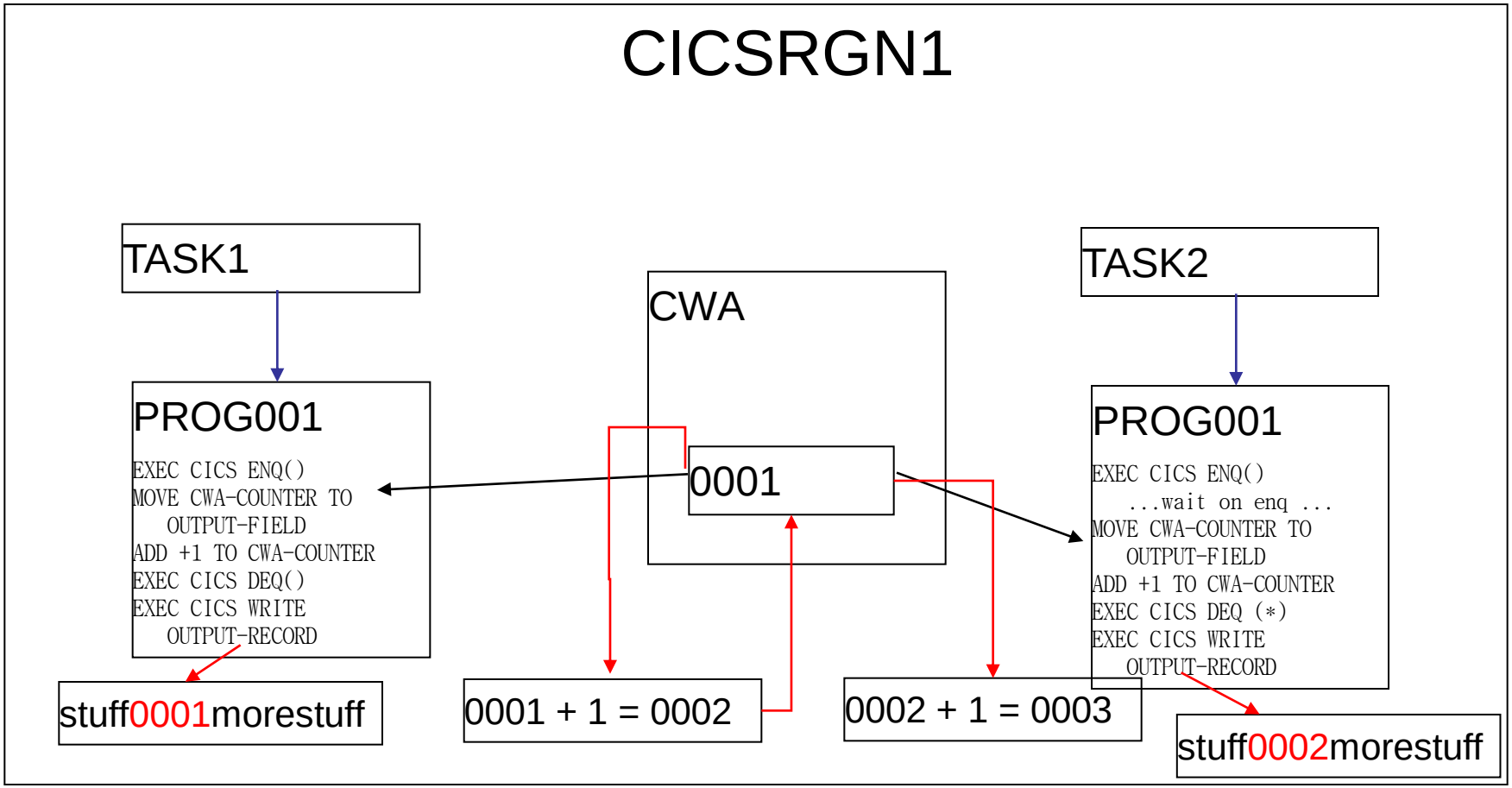
To serialize access to shared storage:

- “Wrap” access in CICS ENQ/DEQ – and measure / track response time elongation this will cause
- For Assembler, use CS/CDS instructions
- Move data to threadsafe but serialized facility like:
  - CICS Maintained Data Table
  - DB2 table
  - Coupling Facility

Making Programs Threadsafe

continued...

With ENQ / DEQ



Making Programs Threadsafe

continued...

ENQ Issues:

- CPU Cost relatively low but waits for ENQ can severely impact application response times as load increases
- Minimize the Potential bottleneck
  - Limit ENQ duration by issuing DEQ as soon as possible
  - Ensure deadly embrace prevention via strictly enforced application design.
    The “classic” safe design is preserved ENQ order in every program.
  - Prepare for deadly embraces with appropriate limiting parameter - DTIMEOUT

Making Programs Threadsafe

continued...

Regardless of which method, remember:

All programs that access the same shared storage areas in the same CICS region **must** be converted before **any** of these programs are marked as Threadsafe!

Accessing The OTE

Two supported methods of executing on OTE TCB

- Define program as API(OPENAPI)
- Define program as CONCURRENCY(REQUIRED)

Accessing The OTE via OPENAPI

For CICS 3.1 and higher, modify the PROGRAM definition on the application program to API=OPENAPI

- The program **must** be Threadsafe
- **All** application code runs in the OTE environment
- **All** application code runs on the same TCB instance on which the program was initialized.

Accessing The OTE via OPENAPI

API=OPENAPI Forces program to run on L8/9 TCB:

- Program is initialized on L8 TCB if CICS key
- Program is initialized on L9 TCB if USER key
- If program issues non-threadsafe command, task is switched to QR TCB
- Once non-threadsafe command completes, task is switched back to L8/9
- Use INQUIRE_CURRENT_PROGRAM and INQUIRE_PROGRAM to identify status

Accessing The OTE via OPENAPI

QR TCB		Open TCB
		Task Starts
		E.C. threadsafe
		E.C. threadsafe
Command Starts		E.C. non-threadsafe
Command Completes		
		Task Termination

Accessing The OTE via OPENAPI

There are performance implications for USER key OPENAPI programs that also access OPENAPI TRUEs (includes DB2)

- USER key Program is initialized on L9 TCB
- OPENAPI TRUE is initialized on L8 TCB
- When L9 program issues DFHRMCAL to OPENAPI TRUE:
  - Task is **switched** to L8 TCB for duration of TRUE
  - Task is **returned** to L9 following completion of TRUE
- L8 TCB instance held until task termination

Accessing The OTE via OPENAPI

There are performance issues for USER key OPENAPI programs that also access OPENAPI TRUEs (includes DB2)

- Review MAXOPENTCB for possible increase
- Review TCBLIMIT for possible increase
- Open TCB “stealing” performance issues
- Potential TCB deadly embrace

Accessing The OTE with CONCURRENCY(REQUIRED)

For CICS 4.2, modify the PROGRAM definition on the application program to API(CICSAPI) and CONCURRENCY(REQUIRED)

- The program **must** be Threadsafe
- **All** application code runs in the OTE environment
- **All** application code runs on the same TCB instance on which the program was initialized.
- **All** application code runs on an L8 TCB

Accessing The OTE with CONCURRENCY(REQUIRED)

Forces program to run on L8 TCB:

- Program is initialized on L8 TCB
- If program issues non-threadsafe command, task is spun to QR
- Once command has completed, task is spun to L8
- Use INQUIRE_CURRENT_PROGRAM and INQUIRE_PROGRAM to identify

Accessing The OTE with CONCURRENCY(REQUIRED)

QR TCB		Open TCB
		Task Starts
		E.C. threadsafe
		E.C. threadsafe
Command Starts		E.C. non-threadsafe
Command Completes		
		Task Termination

Accessing The OTE with CONCURRENCY(REQUIRED)

There are no additional performance issues / resource requirements for USER key CONCURRENCY(REQUIRED) programs that also access OPENAPI TRUEs (includes DB2)

- USER key Program is initialized on L8 TCB
- OPENAPI TRUE is initialized on L8 TCB
- Only one L8 TCB is acquired by the task
  - L8 is shared by user program and all OPENAPI TRUEs
- L8 TCB instance held until task termination

Accessing The OTE

So.....

Which

Way

Is

Best?

Accessing The OTE

Via OPENAPI Parm

Advantages:

- No coding changes required
- All application code **guaranteed** to run in OTE
- No requirement to enable TRUE
- Can determine environment programmatically
- All user code on same TCB – no issues with “paired” z/OS macros

Accessing The OTE

Via OPENAPI Parm

Disadvantages:

- CPU overhead when accessing OPENAPI TRUE in USER key (DB2, etc.)
- CPU overhead for TCB switching when issuing non-threadsafe EXEC CICS commands
- **All** application logic **must** be threadsafe
- Can increase the number of open TCBs required.
- Overhead if TCB stolen to switch key

Accessing The OTE

Via CONCURRENCY(REQUIRED) Parm

Advantages:

- No coding changes required
- All application code **guaranteed** to run in OTE
- No requirement to enable TRUE
- Can determine environment programmatically
- All user code on same TCB – no issues with use of “paired” z/OS macros

Accessing The OTE

Via CONCURRENCY(REQUIRED) Parm

Disadvantages:

- CPU overhead when issuing non-threadsafe EXEC CICS commands
- **All** application logic **must** be threadsafe

Accessing The OTE

Via CONCURRENCY(REQUIRED)
with
API(OPENAPI)

Disadvantages:

- Can increase the number of open TCBs required.
- Overhead if TCB stolen to switch key

Accessing The OTE

Via CONCURRENCY(REQUIRED)
with
API(CICSAPI)

Disadvantages:

- Limited to using standard CICS services which is recommended practice anyway
- Potential for “unusual” and undocumented problems if unsupported z/OS services used

Accessing The OTE

One restriction in OPENAPI programs:

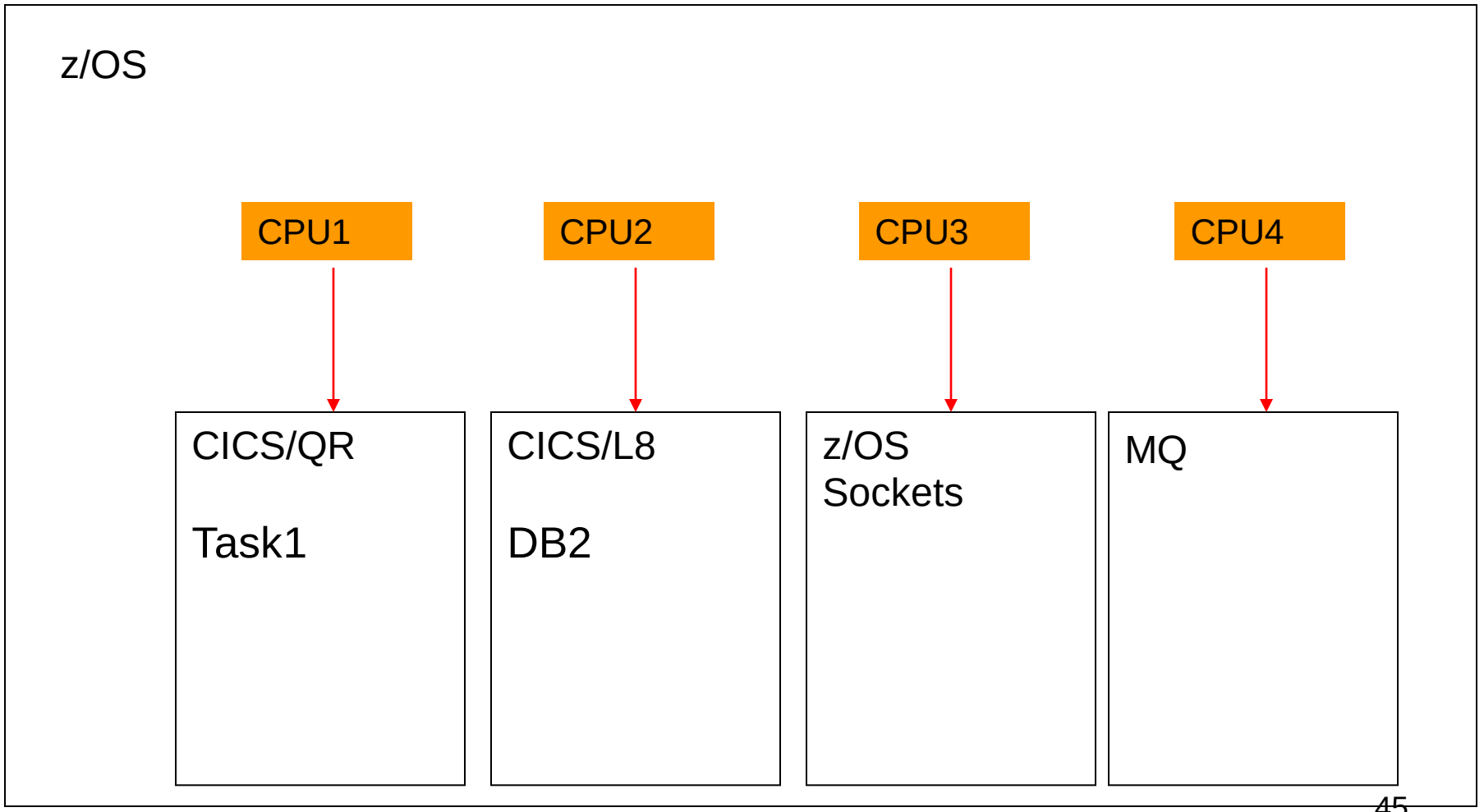
- **Do not attempt to initialize batch LE environment under CICS OPENAPI.**

Implications of New TCB Types

- Multiple TCB types
- Application code running in OTE
  - Application programs fighting for CPU
  - Poor coding only affects program user, not region
  - Resource hogs impact minimized
- CICS system code running in multiple TCBs
- IBM converting sub-products to use OTE
  - MQ
  - Sockets
  - XML parser

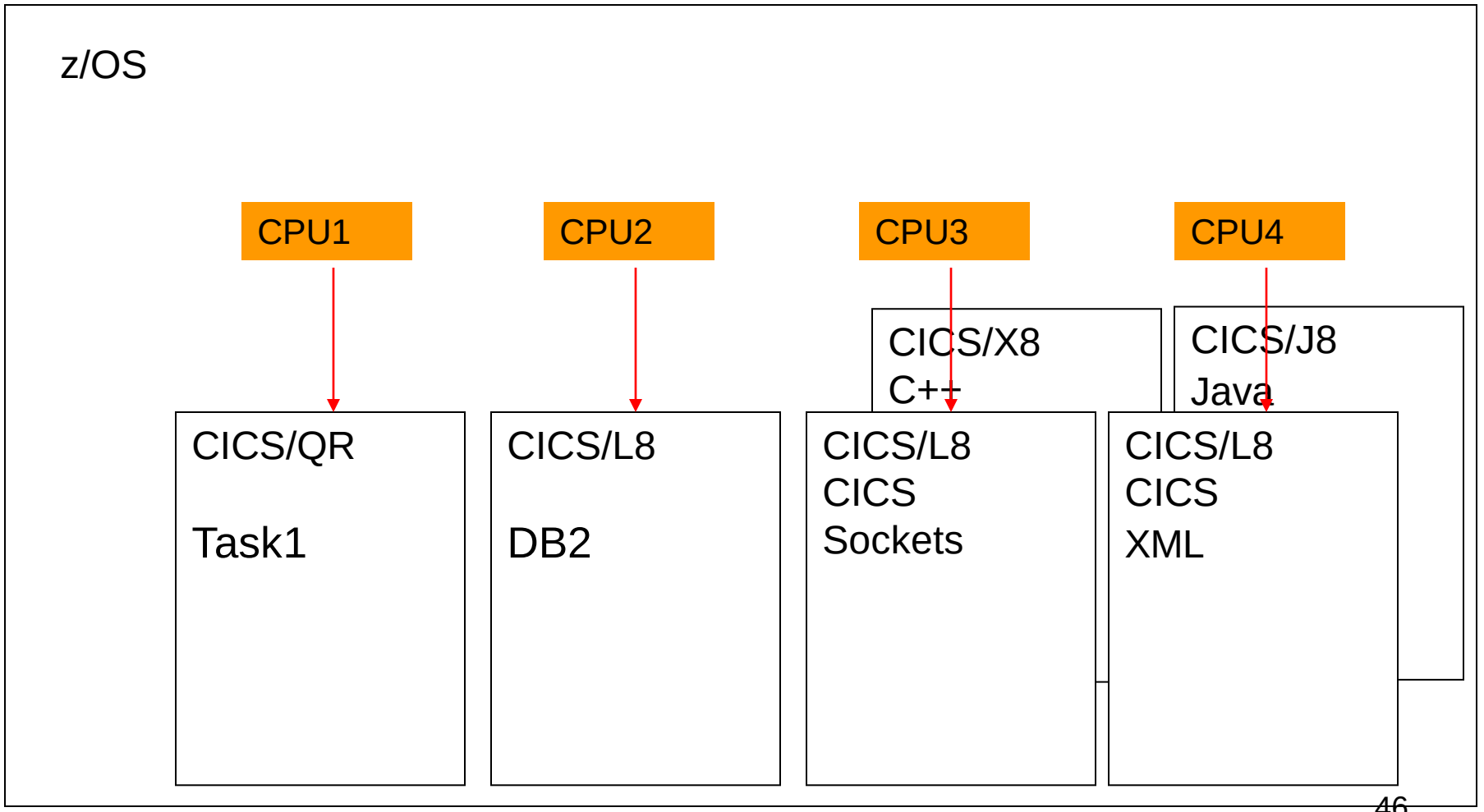
Multiple TCB Structure

Classic CICS



Multiple TCB Structure

Modern CICS



Why Bother?

Run tasks on an open TCB to:

- Reduce QR CPU constraint by running tasks concurrently on multiple TCB/multiple processors, and thus eliminate some clone AORs to save CPU and real storage use
- Segregate troublesome transactions to minimize their effects
- Use z/OS functionality forbidden on QR TCB (NOT a recommended practice for CICS applications) such as:
  - Activity generating z/OS waits
    - I/O
    - ENQ/DEQ
    - z/OS WAIT

Reducing QR CPU Constraint

QR TCB is limited to the speed of one processor

When QR hits CPU limit, region stalls

- Classic fixes
  - ➢Clone Region to offload CPU
- Modern fix = Exploit OTE to offload CPU
- Classic fix has higher CPU and real storage cost

Reducing QR CPU Blocking

QR TCB is single threaded

- Current task “owns” QR until next EXEC CICS (*)
- Heavy CPU routines don’t release QR
- Region appears to lock up
- While task runs, CICS workload backs up
  - VSAM, DB2 I/O Completes
  - New tasks ready for dispatch
  - .....

Reducing QR CPU Blocking

OTE is Multi-Threaded

- OTE task “owns” his TCB until next EXEC CICS (*)
- QR is available for other workload
- No region hold-up
- No extended response times
  - Other workload unaffected
  - Response time improves

Reducing QR CPU Constraint

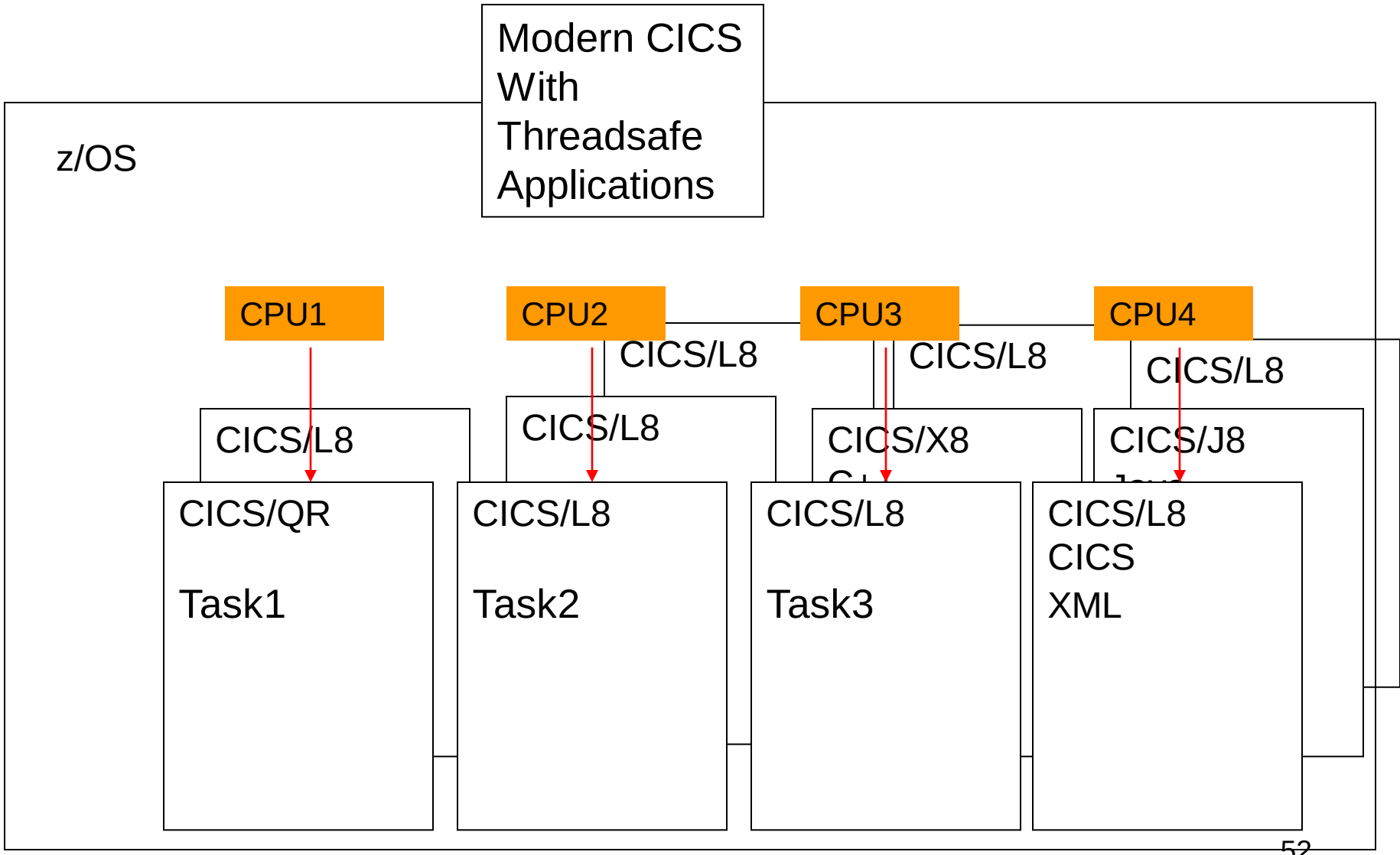
Warning: Consider LPAR CPU Implications when converting a QR constrained region to exploit open TCBs:

- Reduce QR constraint by moving tasks to other processors
- In MP environment, total CPU will increase until:

  1. CICS CPU requirements satisfied
  2. Box CPU capacity met

- Can negatively impact z/OS workload CICS may depend on

Multiple TCB Structure



Using Forbidden Functionality

Use almost any z/OS function (this is not a recommendations to do so):

- OTE provides insulation from demands of processor intensive transactions
  - CPU intensive tasks don't monopolize QR TCB
  - QR available for CEMT, etc.
- Communicate with operator via WTOR
- Make use of flexibility of STORAGE OBTAIN/RELEASE
- Issue I/O without CICS file control
- Use z/OS ENQ/DEQ to synchronize with batch jobs
- Etc..etc…….

OTE Performance Considerations

There are several performance issues that are unique to the OTE:

- Non-Threadsafe EXEC CICS commands
- Non-Threadsafe CICS Global User Exits
- Multi-TCB issues with OPENAPI programs

Non-Threadsafe CICS Commands

- Many commands not Threadsafe
- Use of non-Threadsafe commands *is **fully** supported* by CICS
- CICS detects non-threadsafe command and switches task to QR TCB
- Task's TCB status following command depends on API definition
- Potential performance issue for API=OPENAPI

Non-Threadsafe CICS Commands

A list of the commands that are threadsafe can be found in the *CICS Application Programming Reference Manual*, under **CICS threadsafe commands in the API.**

A list of the threadsafe SPI commands can be found in the *CICS System Programming Reference Manual*, in Appendix D, **Threadsafe SPI commands**

Non-Threadsafe CICS Exits

- Significant area of concern
- Task switched to QR for duration of exit, then back to Open TCB
- Infrequently referenced exits less of a problem
- Frequently referenced exits (eg., XEIIN) are a major performance problem
- XRMIIN/OUT and Dynamic Plan Selection most worrisome
- Worst case: significant (20%++?) increase in CPU utilization.
- Can cause CPU impact even if FORCEQR=YES

Non-Threadsafe CICS Exits

- Use DFH0STAT to identify exits in use
  - Select DB2, User Exit and Global User Exit options
  - Identifies all active exits by program name, CONCURRENCY option, exit point, and GWA usage
  - Shows Dynamic Plan exits
- Identify vendor exits and contact vendor
  - Do not mark threadsafe without vendor OK
  - Do not convert with heavily used QUASIRENT exits
- Review homegrown exit code to ensure threadsafe
- Use IBM supplied utility, DFH$MOLS, to analyze SMF 110 records

Minimizing CPU Overhead

- CPU overhead caused by task switching is incurred when a non-Threadsafe command is issued while the task is running on an Open TCB
- Overhead is zero if no non-Threadsafe commands are issued while the task is running on an Open TCB
- Overhead is minimized when non-Threadsafe commands can be clustered on the QR thus minimizing task switching

```
EXEC SQL OPEN CURSOR
PERFORM UNTIL ...
    EXEC SQL FETCH….
    EXEC CICS WRITEQ TD
END-PERFORM
```

Minimizing CPU Overhead

Once the command has been identified…..

- Replace: Replace Transient Data with CICS TempStor?

  OR

- Relocate: Move the command outside of the SQL loop?

Minimizing CPU Overhead

Replace Transient Data with CICS Temporary Storage:

```
EXEC SQL OPEN CURSOR
PERFORM UNTIL ...
    EXEC SQL FETCH….
    EXEC CICS WRITEQ TS
END-PERFORM
```

Minimizing CPU Overhead

QR TCB		Open TCB
Task Starts		
FETCH	→	DB2 Code executes
		WRITEQ TS
		FETCH
		WRITEQ TS

Minimizing CPU Overhead

Relocate Transient Data Writes:

```
EXEC SQL OPEN CURSOR
PERFORM UNTIL ...
     PERFORM VARYING…
             EXEC SQL FETCH….
             MOVE RESULTS TO WS-RESULTS()
     END-PERFORM
     PERFORM VARYING…
             EXEC CICS WRITEQ TD FROM(WS-RESULTS())
      END-PERFORM
END-PERFORM
```

Minimize OTE Overhead: OPENAPI Program

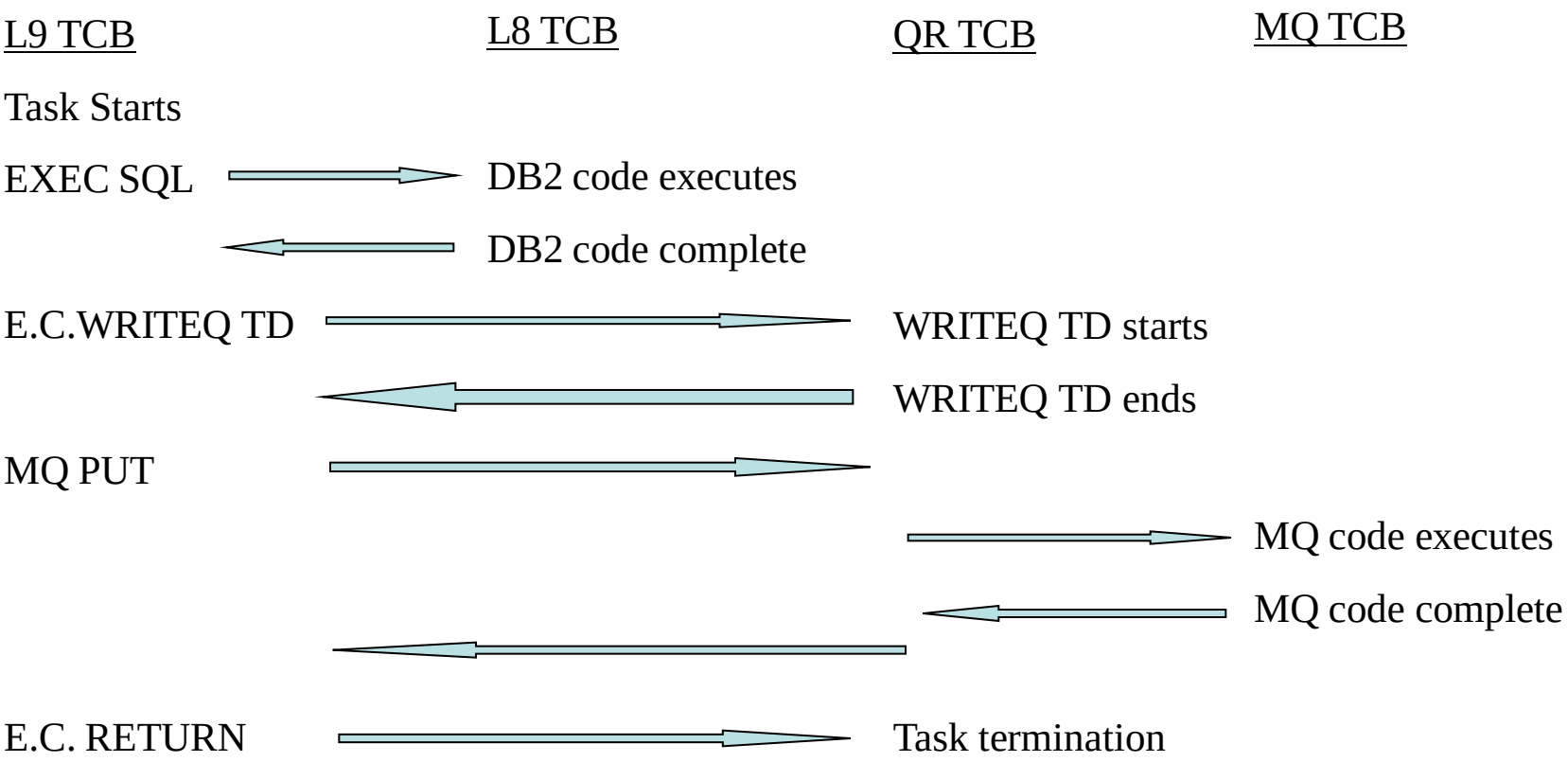
CPU overhead is minimized when:

1. Program does not issue Non-Threadsafe commands

2. If USER key, no DB2 or OPENAPI TRUE calls issued by the program

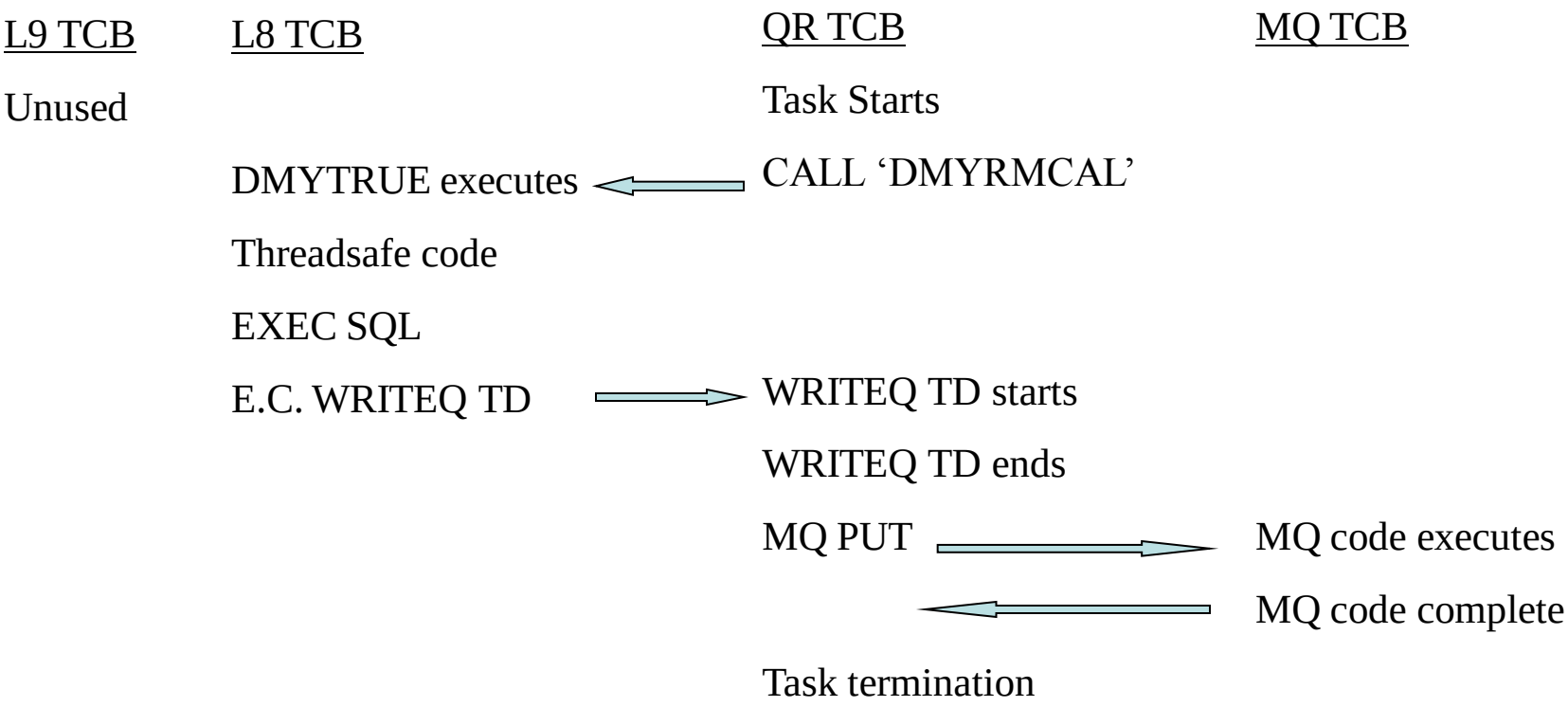
Minimize OTE Overhead: OPENAPI Program

MQ Series With OPENAPI program in USER key



Minimize OTE Overhead: OPENAPI Program

MQ Series With OPENAPI program in CICS key



Minimize OTE Overhead: OPENAPI Program

Relocation Ineffective for OPENAPI!

QR TCB

Open TCB

Task Starts
OTE user code

WRITEQ TS

Inner Loop


WRITEQ TD


WRITEQ TD


WRITEQ TD

Outer Loop

Minimize OTE Overhead: REQUIRED Program
with API(CICSAPI)

CPU overhead is minimized when:

1. Program does not issue Non-Threadsafe commands

Minimize OTE Overhead: REQUIRED Program

Relocation Ineffective for REQUIRED!

QR TCB

Open TCB

Task Starts
OTE user code

WRITEQ TS

Inner Loop


WRITEQ TD


WRITEQ TD


WRITEQ TD

Outer Loop

Reducing CPU Overhead

- Prior to CICS 4.2, IRC is not threadsafe.
  Threadsafe commands that are function shipped will be treated as if they are non-threadsafe.

- As of CICS 4.2 IPIC connections support threadsafe mirror transactions

Ensuring Threadsafe Coding When Creating New Programs

Design is critical

- Design goal = Minimize number of TCB switches / transaction
- Ensure threadsafe coding standards are met

Ensure Threadsafe Coding Standards

- Eliminate updates to shared storage areas:
  - CWA
  - GWA
  - GETMAIN(SHARED)
  - OS GETMAIN
  - LOAD HOLD
- Require use of RENT on link-edit step
- Use RENTPGM=PROTECT in CICS

Minimize number of TCB switches

- Insures best possible performance
- Use only Threadsafe commands
- Design program flow to cluster OTE usage
- Issue non-Threadsafe commands before or after OTE activity complete

Diagnosing Threadsafe Problems

No way to prove threadsafe!

- Threadsafe problems most likely to occur during peak time.
- Stress testing must mimic production to bring out threadsafe problems.
- Best way to ensure success is strong application knowledge.
- Be thorough in your review.

Diagnosing Threadsafe Problems

How to tell when Testing is Complete?

Hint: 100% solution unavailable

- Errors based on probability
- Difficult to force simultaneous execution of code path
- Use stress testing
  - Set MAXTASK high
  - Set DSALIMITs high
  - Set SYSDUMPING on!
  - Use driver program to issue large number of STARTs

Diagnosing Threadsafe Problems

Unpredictable Results Means Just That!

- Difficult to identify root cause
- “Impossible/unpredictable” behavior likely to be threadsafe issue
- Use CICS Auxtrace – be selective or you will be overloaded with useless details
- Consider homegrown application trace analysis code
- Last resort: CICS system dumps

Paired MVS macros that need same TCB

- Macros such as ENQ and DEQ must run on same TCB
- Intervening user code can force TCB switch
- If switched, Second macro in pair fails
- Macros include:
  - ENQ/DEQ
  - ATTACH/DETACH

Diagnosing Threadsafe Problems

A Statically Called Assembler Program Isn't Threadsafe due to self contained register save area

COBPGM

CALL 'ASMPGM1'
USING PARM-LIST.

```
ASMPGM1  CSECT
         LA   R13,SAVEAREA
         STM  R14,R12,12(R13)
              .
              .
         LM   R14,R12,12(R13)
         BR   R14
              .
              .
SAVEAREA DS   18F
```

Diagnosing Threadsafe Problems

All Called Routines Run on TCB of the Caller

- Because ASMPGM1 issues no CICS commands, the code runs normally in a non-threadsafe environment
- CICS is not notified for calls
- Simultaneous access to SAVEAREA results in overlay
- Probable S0C4
- Identifiable in test via RENTPGM=PROTECT

Diagnosing Threadsafe Problems

All Called Routines Run on TCB of the Caller

Possible solutions:

1. Convert ASMPGM1 to Command Level
2. Alter COBPGM to pass address of RSA
3. Leave COBPGM non-Threadsafe
4. Convert ASMPGM1 to LE enabled Assembler

Threadsafe File Control

Threadsafe VSAM RLS available with CICS 3.2

Threadsafe **local** VSAM shipped in CICS 3.2 as disabled

New SIT parm:

FCQRONLY=[YES | NO]

- FCQRONLY=YES forces all file control to run on QR TCB
- FCQRONLY=NO allows threadsafe file control requests to run on L8/L9 TCB

Remote VSAM on non-IPIC connections remains non-threadsafe

Threadsafe File Control

Enable local VSAM threadsafe in CICS 3.2 with PTF UK37688

VSAM APARs OA20352 and OA24071 are required

NOTE: UK37688 changes the default on FCQRONLY from NO to YES. If you are running VSAM RLS threadsafe, and take the default on FCQRONLY, applying UK376688 will disable RLS threadsafe.

Futures

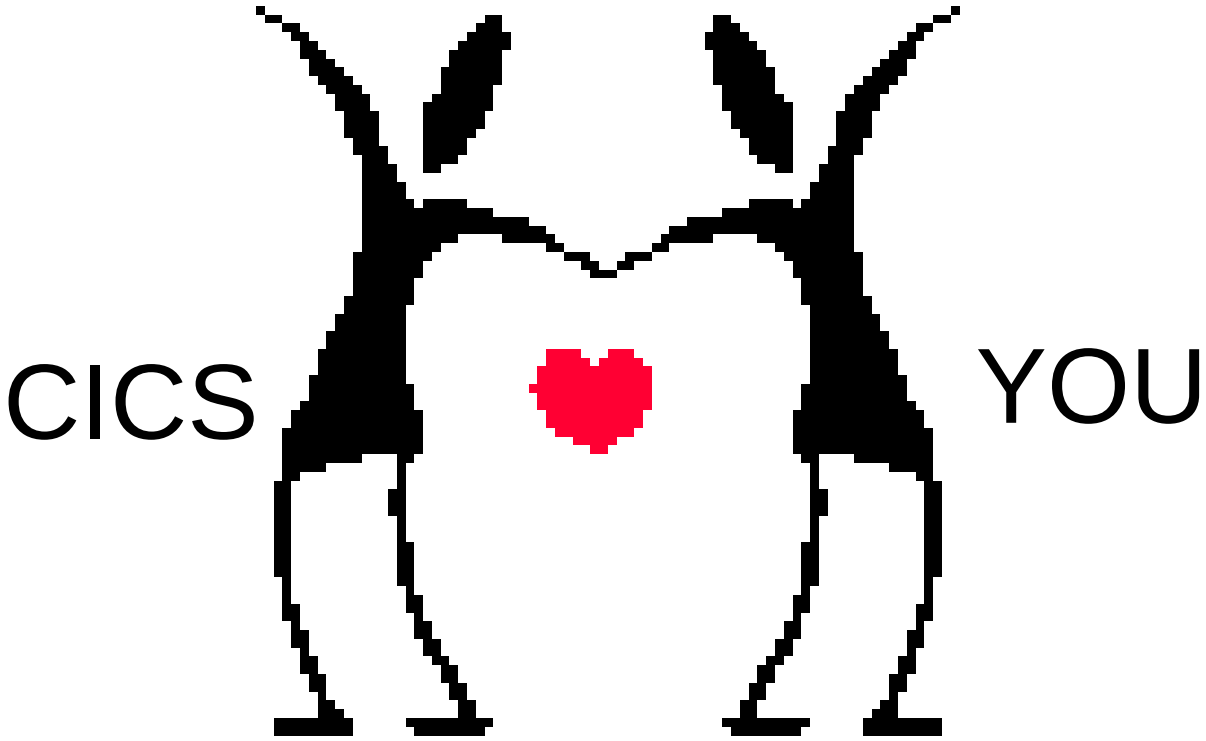
"It is the intention of IBM for future releases of CICS Transaction Server for z/OS to continue to enhance OTE support to enable the ongoing migration of CICS and application code from the QR to open TCBs."

Futures

- IBM committed to making more commands threadsafe
- IBM Announced additional threadsafe commands in every release since TS 2.2
- CICS 3.2 introduces threadsafe file control (local)
  Note: CICS TS 3.2 was shipped with threadsafe VSAM disabled. Apply PK45354 to activate it
- CICS 4.2 introduced threadsafe DBCTL for DLI
- Conversion to OPENAPI TRUEs for CICS Sockets, MQ
- Internal use of OPENAPI for CPU intensive processes

Be @Next SHARE / Any Questions?

Join us at the next SHARE in Pittsburgh, Summer of 2014



Addendums

- Using “Forbidden” Functionality
- DFH$MOLS
- Minimizing Overhead

Using Forbidden Functionality

Transaction initiated communication with operator via WTOR:

- OTE TCB waits, not entire region
- Synchronous waits on external events/requests
- CICS command input from master console
- Enable use of standard auto operation facility

Disadvantages:

- Task shows as “running”
- No way to track WTOR back to task

Using Forbidden Functionality

Use of z/OS STORAGE OBTAIN/RELEASE

- Powerful options not available from EXEC CICS GETMAIN
- Storage acquired outside of CICS subpools
- More efficient than CICS GETMAIN

Disadvantages:

- Storage invisible to CICS monitor
- No automatic cleanup at task termination
- Storage not displayed in dump, trace, etc.
- Problems with OS GETMAIN and USER key OPENAPI tasks

Using Forbidden Functionality

Error on STORAGE OBTAIN causes ASRB, not region failure:

DFHAP0001 CICSD225 An abend (code 878/AKEB) has occurred at offset X'FFFFFFFF' in module TEST.

```
00057 L9002 AP 00E1 EIP   EXIT  LOAD
00057 L9002 AP 1942 APLI  *EXC* Abend
00057 L9002 AP 0791 SRP   *EXC* MVS_ABEND
00057 L9002 DS 0010 DSBR  ENTRY INQUIRE_TASK
00057 L9002 DS 0011 DSBR  EXIT  INQUIRE_TASK/OK
00057 QR    PG 0500 PGIS  ENTRY INQUIRE_CURRENT_PROGRAM
00057 QR    PG 0501 PGIS  EXIT  INQUIRE_CURRENT_PROGRAM
00057 QR    AP 0782 SRP   *EXC* ABEND_ASRB
```

TCB is marked as unusable:

```
DSTCB QR    KE 0502 KEDS  ENTRY DETACH_TERMINATED_OWN_TCBS
DSTCB QR    KE 0503 KEDS  EXIT  DETACH_TERMINATED_OWN_TCBS/OK
```

Using Forbidden Functionality

Issue I/O without CICS file control:

- Bypass CICS file control
- “Batch-like” transactions segregated from normal CICS processing

Disadvantages:

- Cannot issue OPEN/CLOSE in COBOL program
- No backout or forward recovery
- Activity not in dump, trace, etc.

Using Forbidden Functionality

Reminder: the OTE only supports CICS LE service routines:

- COBOL display becomes a WRITEQ TD (not threadsafe!)
- COBOL dynamic call modified for CICS
- OPEN/CLOSE unavailable
- Storage obtained via EXEC CICS GETMAIN

Using IBM Utility DFH$MOLS

- IBM supplied utility, DFH$MOLS to analyze SMF 110 records
- Provides detailed report
  - One page / task
  - Storage utilization
  - CPU utilization
    - By TCB type
  - Response time
- Can use pre-generated MCT A$
- Activate monitoring with CEMT
  - SET MON ON PER
- Flush buffers with CEMT
  - SET MON ON NOP

Using IBM Utility DFH$MOLS

Use IFASMFDP to extract the 110 records

INDDx points to your SMF datasets. You can use either active datasets or archives

```
//*******************************************************************
//*  Step 1: Unload data from the SMF data sets
//*******************************************************************
//SMFDUMP  EXEC PGM=IFASMFDP
//INDD1     DD DSN=SYS1.D002.MAN11,DISP=SHR,AMP=('BUFSP=65536')
//INDD2     DD DSN=SYS1.D002.MAN12,DISP=SHR
//INDD3     DD DSN=SYS1.D002.MAN13,DISP=SHR
//OUTDD1    DD DSN=?????.SMF.DATA1,DISP=(NEW,CATLG),
//             SPACE=(CYL,(50,10)),UNIT=SYSDA
//SYSPRINT  DD SYSOUT=A
//SYSIN     DD *
       INDD(INDD1,OPTIONS(DUMP))
       INDD(INDD2,OPTIONS(DUMP))
       INDD(INDD3,OPTIONS(DUMP))
       OUTDD(OUTDD1,TYPE(110(1)))
```

OUTDD1 points to the output dataset that holds the extracted 110 records

Use an INDD control statement to describe each SMF file used as input.

The OUTDD control statement describes your output file and the record types to be extracted. We're using 110 subtype 1 records

Using IBM Utility DFH$MOLS

Use DFH$MOLS to format the extracted records

INPUT DD points to OUTDD dataset from previous step.

The report is written to SYSPRINT

Use the DATE START card to limit your report

```
//PRNT     EXEC PGM=DFH$MOLS
//STEPLIB  DD DSN=SYS2.CICSTS31.CICS.SDFHLOAD,DISP=SHR
//INPUT    DD DSN=?????.SMF.DATA1,DISP=OLD
//SORTWK01 DD SPACE=(CYL,(5,1)),UNIT=SYSDA
//SORTWK02 DD SPACE=(CYL,(5,1)),UNIT=SYSDA
//SORTWK03 DD SPACE=(CYL,(5,1)),UNIT=SYSDA
//SORTWK04 DD SPACE=(CYL,(5,1)),UNIT=SYSDA
//SORTWK05 DD SPACE=(CYL,(5,1)),UNIT=SYSDA
//SORTDIAG DD SYSOUT=A
//SYSOUT   DD SYSOUT=A
//SYSPRINT DD SYSOUT=A
//SYSABEND DD SYSOUT=A
//SYSUDUMP DD SYSOUT=A
//SYSIN    DD *
SELECT TRANID=trn1,trn2
DATE START=03/23/2006
/*
```

Use the SELECT TRANID cards to limit your report.

Using IBM Utility DFH$MOLS

```
----------FIELD-NAME-----------------------UNINTERPRETED-------------------------------INTERPRETED--------------
        DFHTASK C001      TRAN             C5E2C3F1                                      ESC1
        DFHTERM C002      TERM             C3D7F8F4                                      CP84
        DFHCICS C089      USERID           C3C9C3E2 C4F2F2F4                             CICSD224
        DFHTASK C004      TTYPE            E3D60000                                      TO
        DFHCICS T005      START            BED82B7ADC91D761                    2006/05/23 10:53:46.968349
        DFHCICS T006      STOP             BED82B7ADD3A7B40                    2006/05/23 10:53:46.971047
        DFHTASK P031      TRANNUM          0000513C                                    513
        DFHTASK A109      TRANPRI          00000001                                      1
           ...
        DFHTERM C111      LUNAME           E2F0F1E3 C3D7F8F4                             S01TCP84
        DFHPROG C071      PGMNAME          C5E2D7E4 E2C5C3F1                             ESPUSEC1
        DFHTASK C097      NETUOWPX         C2C8C4D5 C5E34BE2 F0F1E3C3 D7F8F400 00000000  BHDNET.S01TCP84
        DFHTASK C098      NETUOWSX         D82B7ADC9D100001
        DFHCICS A131      PERRECNT         00000001                                      1
        DFHTASK T132      RMUOWID          BED82B7ADC9D1021                    2006/05/23 10:53:46.968529
        DFHCICS C167      SRVCLSNM         C3C9C3E2 40404040                             CICS
           ...
        DFHTASK C163      FCTYNAME         C3D7F8F4                                      CP84
        DFHTASK A164      TRANFLAG         4000800002000000
        DFHTERM A165      TERMINFO         01000191
           ...
        DFHTASK C082      TRNGRPID         180FC2C8C4D5C5E3...
        DFHTERM C197      NETID            C2C8C4D5 C5E34040                             BHDNET
        DFHTERM C198      RLUNAME          E2F0F1E3 C3D7F8F4                             S01TCP84
```

Non-Threadsafe CICS Exits

DFH$MOLS report of non-threadsafe program:

DB2REQCT		14879
USRCPUT	00:00:01.11961	29763
SUSPTIME	00:00:01.79190	29763
DISPWTT	00:00:01.69950	29762
QRDISPT	00:00:00.37627	14882
QRCPUT	00:00:00.01568	14882
KY8DISPT	00:00:03.67361	14880
KY8CPUT	00:00:01.10212	14880
L8CPUT	00:00:01.10212	14880
RMITIME	00:00:03.37489	14880

Non-Threadsafe CICS Exits

DFH$MOLS report of non-threadsafe EXIT:

DB2REQCT		14879
USRCPUT	00:00:01.15467	59519
SUSPTIME	00:00:02.71036	59519
DISPWTT	00:00:02.41534	59518
QRDISPT	00:00:00.63364	29760
QRCPUT	00:00:00.01456	29760
KY8DISPT	00:00:03.35622	29759
KY8CPUT	00:00:01.14011	29759
L8CPUT	00:00:01.14011	29759
RMITIME	00:00:02.92852	14880

Minimizing CPU Overhead

DFH$MOLS of modified program running Threadsafe in test:

EXEC CICS WRITEQ TD replaced with WRITEQ TS

DB2REQCT	00004E20	20000	
USRDISPT	00066339000001E3	00:00:06.69787	483
USRCPUT	0003A4D3000001E3	00:00:03.82084	483
SUSPTIME	00002570000001E3	00:00:00.15334	483
DISPWTT	000003CE000001E2	00:00:00.01558	482
QRDISPT	0000065400000141	00:00:00.02592	321
QRCPUT	000002B100000141	00:00:00.01102	321
KY8DISPT	000659D3000000A1	00:00:06.65937	161
KY8CPUT	0003A1F7000000A1	00:00:03.80913	161
L8CPUT	0003A1F7000000A1	00:00:03.80913	161
QRMODDLY	0000032D00000140	00:00:00.01300	320
DSCHMDLY	0000033C00000144	00:00:00.01324	324

Minimizing CPU Overhead - Example

DFH$MOLS of modified program running Threadsafe in test

Results of 10 SQL FETCH placed in Working Storage, then issue 10 EXEC CICS WRITEQ TD at once

DB2REQCT	00004E20	20000	
USRDISPT	00066339000001E3	00:00:06.69787	2612
USRCPUT	0003A4D3000001E3	00:00:03.82084	2612
SUSPTIME	00002570000001E3	00:00:00.15334	2612
DISPWTT	000003CE000001E2	00:00:00.01558	2611
QRDISPT	0000065400000141	00:00:00.02592	1052
QRCPUT	000002B100000141	00:00:00.01102	1052
KY8DISPT	000659D3000000A1	00:00:06.65937	526
KY8CPUT	0003A1F7000000A1	00:00:03.80913	526
L8CPUT	0003A1F7000000A1	00:00:03.80913	526
QRMODDLY	0000032D00000140	00:00:00.01300	1050
DSCHMDLY	0000033C00000144	00:00:00.01324	1055