Understanding IMS Locking

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IMS Locking White Paper

- "*IMS Locking with Program Isolation or the IRLM*"
  - Rich Lewis
  - Published in 2009
    - www-03.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101535
  - Contains detailed information about IMS locking

- This presentation is based on information in the white paper
  - The white paper should be used with this presentation

Agenda

- Lock managers
- Lock compatibility matrices
- Full function locks
- Fast Path locks
- Lock timeouts
- Deadlocks
- Design advice
- Space for lock control blocks
- PI vs. IRLM
- Locking Reports

Lock Managers

- IMS has three lock managers
  - Program Isolation (PI)
    - Does not support data sharing
    - Locks are managed by the IMS online system
  - IRLM
    - May be used with or without data sharing
    - IRLM is a separate address space
    - Multiple IRLMs are used with data sharing across LPARs
  - Fast Path lock manager
    - Used without data sharing
    - Fast Path also uses PI or IRLM
      - Required for deadlock detection

Lock Compatibility

- PI and FP lock compatibility matrix

Lock Level	1	2	3	4
1 – read	Y	Y	Y	N
2 – share	Y	Y	N	N
3 - update	Y	N	N	N
4 - exclusive	N	N	N	N

- IRLM lock compatibility matrix

Lock Level	2	3	4	6	8
2 – read	Y	Y	Y	Y	N
3 – erase	Y	Y	N	N	N
4 – share	Y	N	Y	N	N
6 – update	Y	N	N	N	N
8 - exclusive	N	N	N	N	N

- Lock level names are often confusing
  - Reads may require a read, share, update, or exclusive lock
  - Locks for updates sometimes use read locks

Full Function Locks

- Database Record Lock
  - Requested when a database record is accessed
    - HDAM and PHDAM lock the RAP
  - Used to serialize access to database records
  - Level depends on the PROCOPT
    - PROCOPT=G PI level 2 IRLM level 4
      - Readers may be positioned in a database record concurrently
    - PROCOPT=update PI level 3 (or 1) IRLM level 6
      - Updaters have exclusive access to database record
  - Released
    - If not update, when PCB position is moved to another database record
    - If update, held until sync point
      - PI demotes level 3 to level 1 when positioned is moved off the record and root is not updated

Full Function Locks

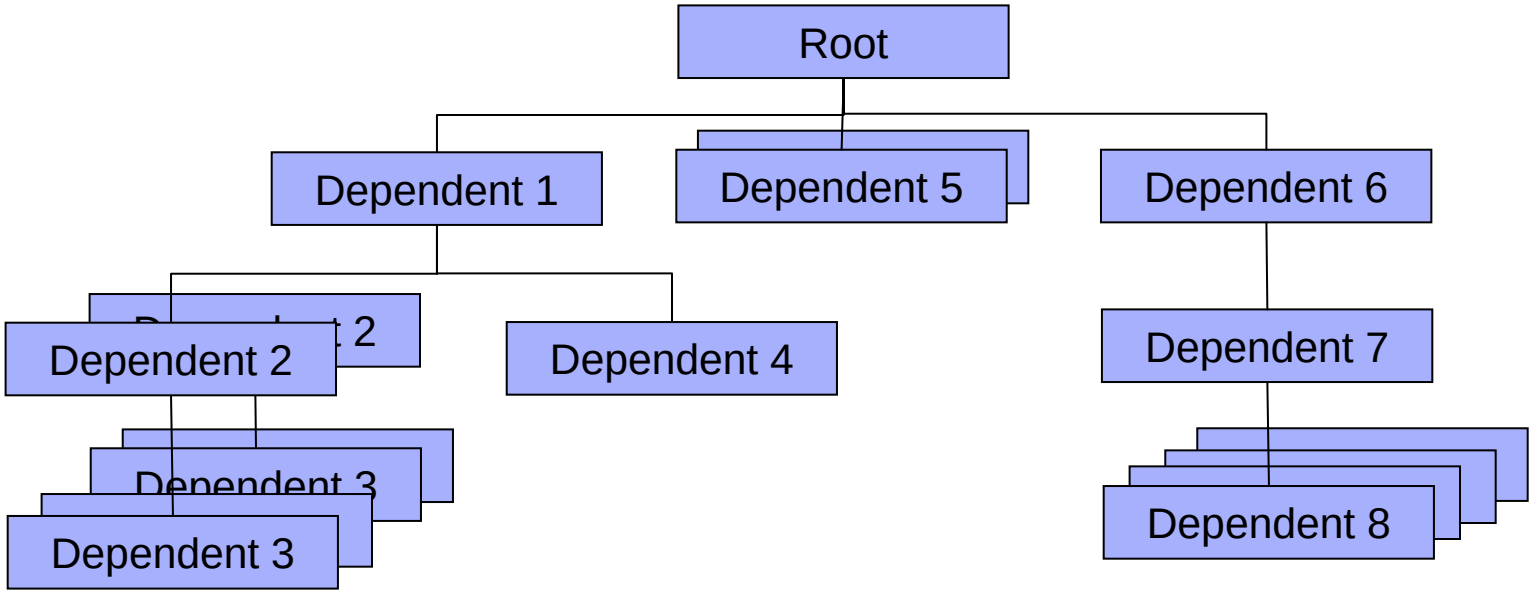
- Database Record Lock
  - HDAM and PHDAM
    - Lock is on the RAP
    - Another reason to have more RAPs than roots
      - Rule of thumb: # RAPs > 2 x # roots
  - Often, this is the most important lock
    - “Control” records often produce lock conflicts

Full Function Locks

- Segment Lock
  - Used only with PI
  - Segment lock is always requested for updates to dependent segments
    - Used to serialize access to updated dependent segments
    - Updates include updates to pointers in the segment (to other segments)
    - HISAM lock is for overflow logical records
  - Level: PI level 3
  - Released
    - At sync point
  - If database record lock is held at level 1 (by another program)
    - Some dependent segment is locked at level 3
    - Segment lock is tested when dependent segment is accessed
      - Test waits if lock is held but does not get the lock

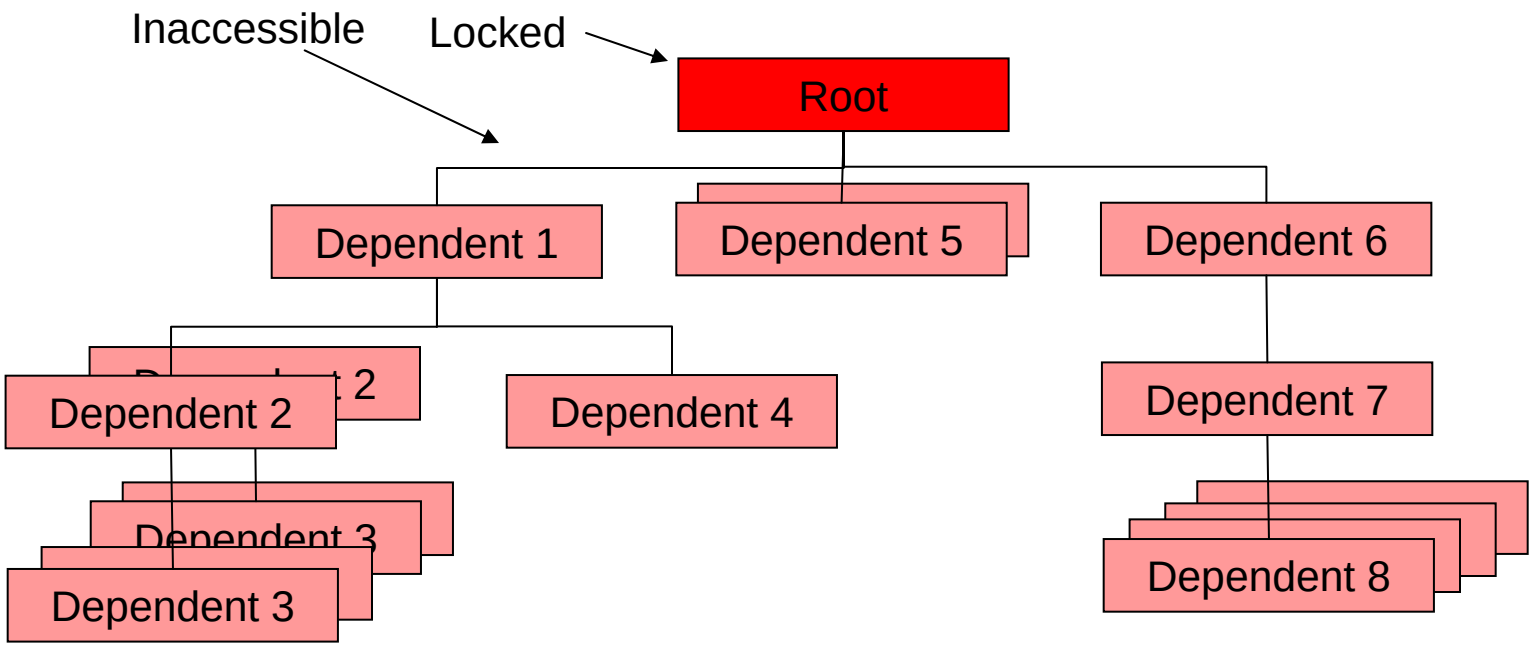
IRLM vs. PI

- PI may provide more concurrency
  - Allows accessed to non-updated segments in updated database record



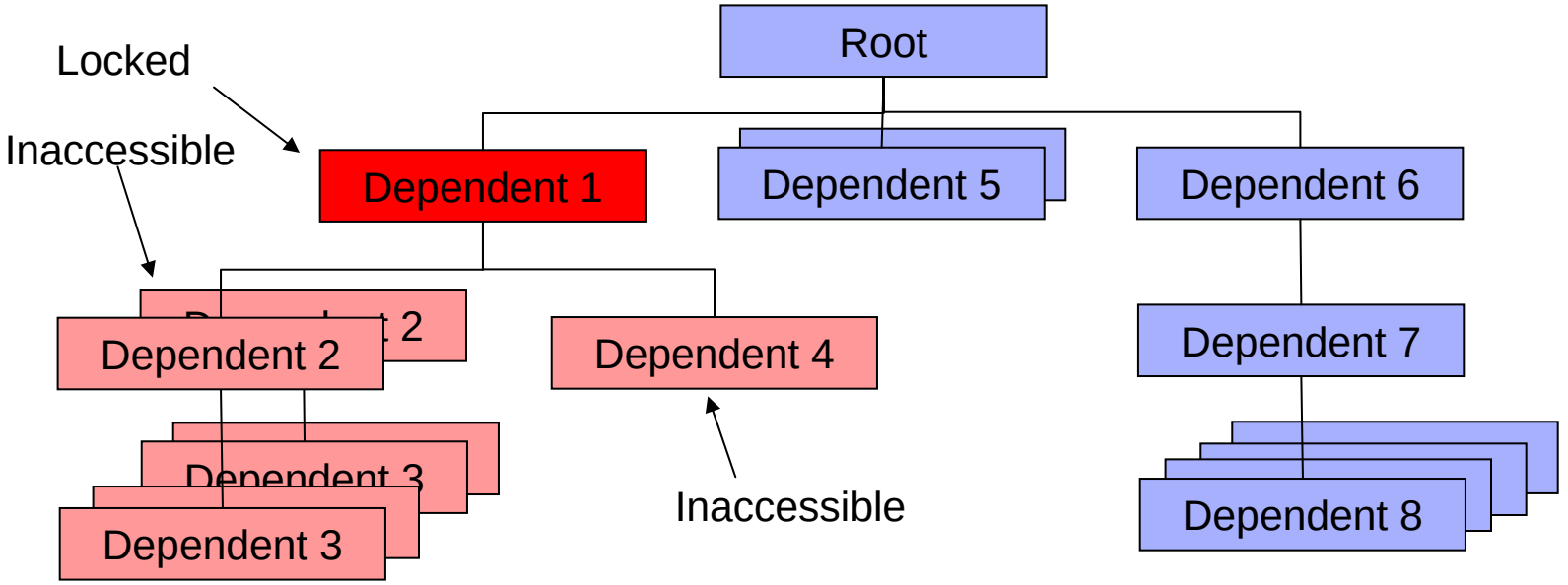
IRLM vs. PI

- PI may provide more concurrency
  - Non-shared lock of root makes the entire database record inaccessible



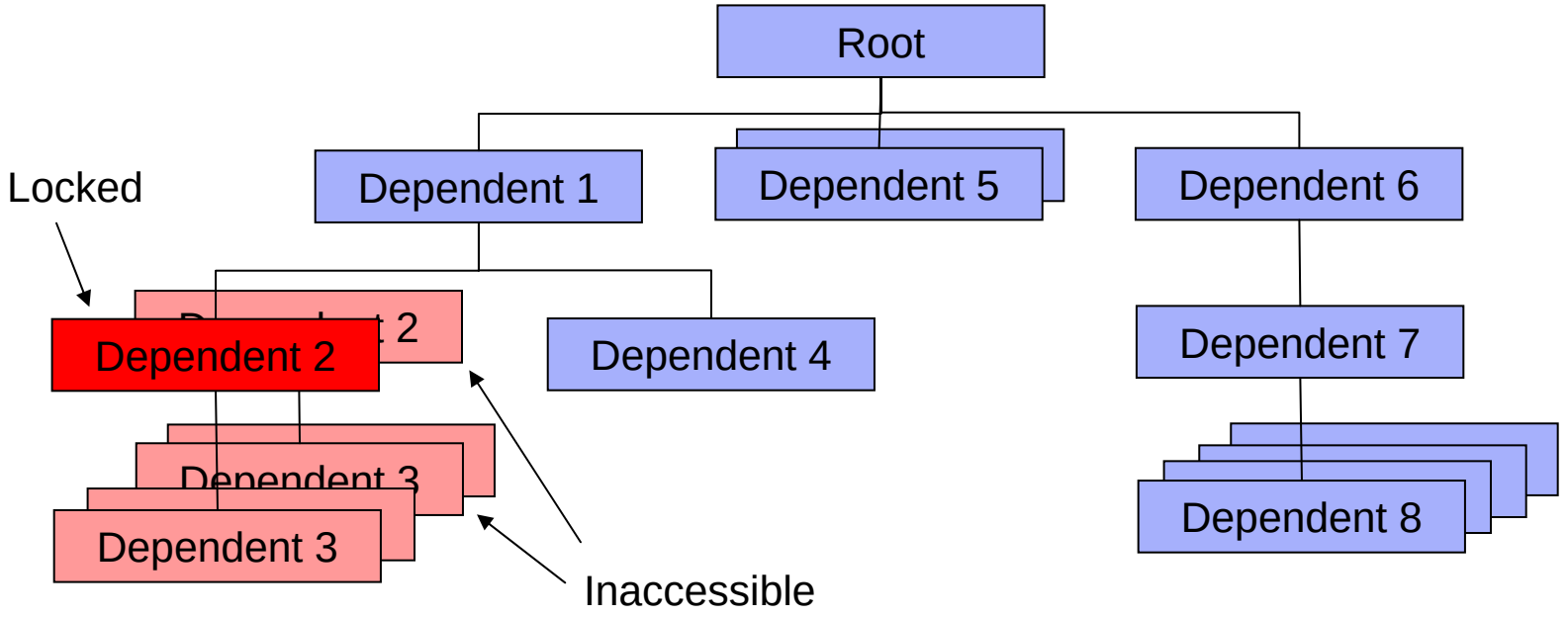
IRLM vs. PI

- PI may provide more concurrency
  - Non-shared lock of dependent makes all of its children inaccessible



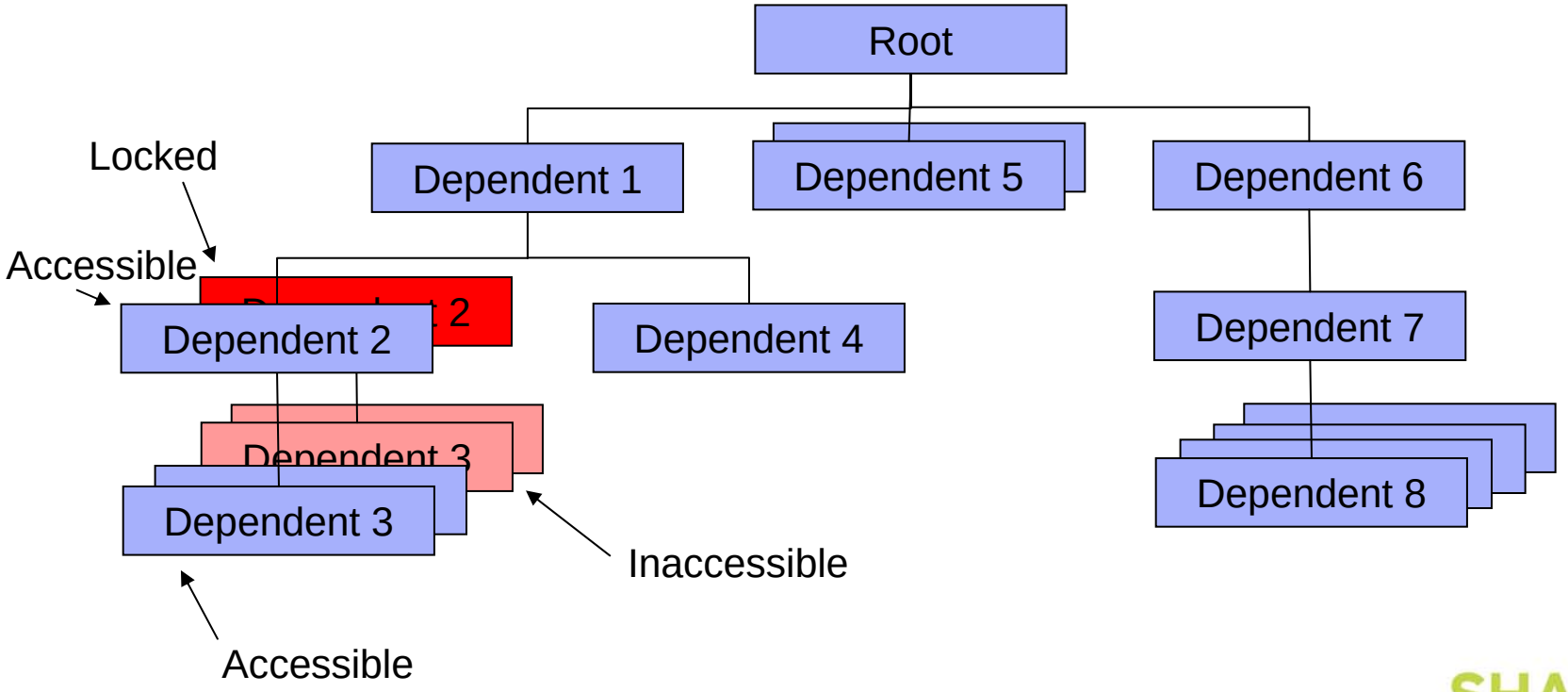
IRLM vs. PI

- PI may provide more concurrency
  - Non-shared lock of twin makes following twins inaccessible



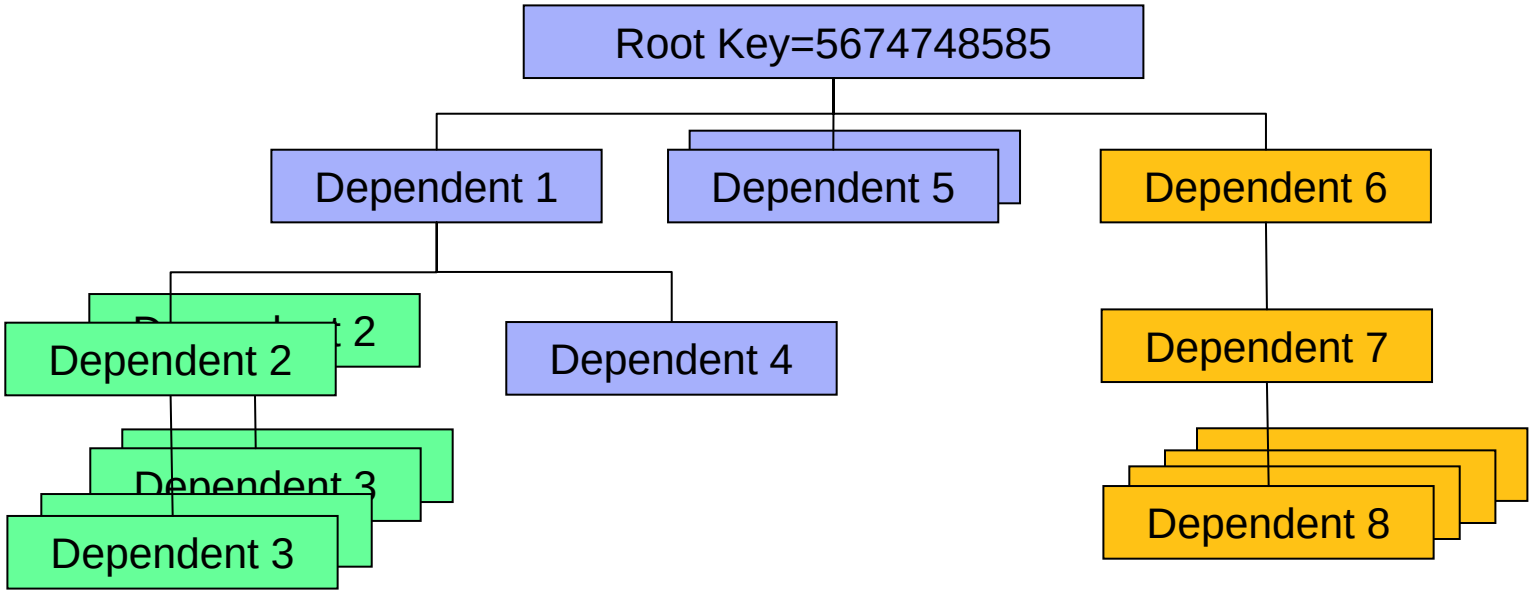
IRLM vs. PI

- PI may provide more concurrency
  - Non-shared lock of twin does not make preceding twins inaccessible



IRLM vs. PI

- PI may provide more concurrency
  - This effect may be small
    - What is the probability of two transactions or BMPs accessing different branches in the same database record at the same time?



Full Function Locks

- Block Lock
  - Used only with block level data sharing (SHARELVL=2 or 3)
  - Requested when a block is updated
  - Used to serialize updates from different IMS systems
    - Requested with private attribute
      - Cannot be shared across different IMS systems (no matter what level)
  - Level for OSAM and ESDS is always IRLM level 4
  - Level for KSDS (primary and secondary indexes)
    - Inserts and replaces IRLM level 4
    - Deletes IRLM level 3
    - CI/CA splits IRLM level 6
  - Released
    - At sync point

Block locks are only for updates!

(ISRT, DLET and REPL calls)

Full Function Locks

- Block Lock
  - Block locks are shared within an IMS system
    - Unless there is a delete with insert/replace of a KSDS record or a CI/CA split
  - Block lock conflicts typically occur for updates in a small database or small part of a database
    - Secondary index with high insert/delete activity to small range of records
      - Records in the same CI
      - Often due to keys based on current time
    - Small database with “control” records
      - Statistics maintenance, etc.

Full Function Locks

- Busy Lock
  - Requested to serialize activity to a data set
    - Update to KSDS with block level data sharing
      - Insert IRLM level 8
      - Non-insert IRLM level 2
    - Open and close of data set PI level 4 IRLM level 8
    - Creation of new block in data set PI level 4 IRLM level 8
  - Released
    - At end of operation (open, close, update, etc.)
- Lock waits are rarely a problem with busy locks
- The number of lock request may be important for data sharing
  - CF accesses for the lock structure for index updates

Fast Path Locks

- CI Lock
  - Similar to database record lock for full function
  - Requested when a CI is read into a buffer
  - Used to serialize access to segments in a CI
  - Level depends on the PROCOPT
    - PROCOPT=G FP level 1 IRLM level 2
    - PROCOPT=update FP level 4 IRLM level 8
  - Released
    - With update
      - By output thread (sync point with VSO)
    - Without update
      - By sync point or when buffer is stolen

No locks for SDEP CIs

Fast Path Locks

- UOW Lock
  - Only used when HSSP or High Speed Reorg (HSR) is active
    - Requested instead of a CI lock by HSSP and High Speed Reorg
    - Requested in addition to CI lock by others
  - Level depends on the PROCOPT
    - Non-HSSP or HSR request FP level 1 IRLM level 2
    - HSSP or HSR request FP level 4 IRLM level 8
  - Released
    - Non-HSSP, non-HSR request
      - When all locks on CIs in UOW are released
    - HSSP request
      - If update by output thread, if no update by sync point
    - HSR request
      - At end of reorg of UOW

Lock Time Outs

- PI and Fast Path lock managers never time out (i.e. end) a lock request
- IRLM has capability to time out a lock request
  - IRLM TIMEOUT parameter

    `F irlmproc,SET,TIMEOUT=seconds,imssubsystemname`
    - Controls the reporting of “long locks” for an IMS system using the IRLM
    - It does not time out a lock request
    - It drives an IMS LOCKTIME process to check on time outs
  - IMS LOCKTIME parameter controls time outs of locks with IRLM
    - DFSVSMxx or DFSVSAMP parameter
      - LOCKTIME=(mtime,maction,btime,baction)
    - May be changed with UPDATE IMS SET(LOCKTIME(…) command

      ```
      UPDATE IMS SET(LOCKTIME(MSG(mtime),MSGOPT(maction),
        BMP(btime),BMPOPT(baction),TELLIRLM(Y|N)
      ```

Lock Time Outs

- If wait exceeds IMS LOCKTIME value, the waiter's lock request ends
  - IMS "shoots the victim"
    - If ABEND is specified for '`maction`' or '`baction`'
      - U3310 abend and IMS TM input message is discarded
    - If STATUS is specified for '`maction`' or '`baction`'
      - 'BD' status code is returned for call which caused lock wait
  - The "bad guy" is probably the holder of the lock

Deadlock Detection

- Fast Path lock manager does not detect deadlocks
  - When a lock request waits, Fast Path passes information to the other lock manager (PI or IRLM)
    - Other lock manager does deadlock detection
- PI checks for deadlocks whenever a lock request waits
- IRLM checks for deadlocks on a timer basis
  - IRLM parameter: DEADLOK=(*local,global*)
    - *Local* is the time between deadlock detection cycles
    - *Global* value is ignored
      - Every local cycle is a global cycle
    - A wait must exist through two cycles before IRLM checks for a deadlock
      - With *local* value of 1 second, deadlock could last 2 seconds before detection
    - Reasonable values for *local* or 1 second or less

Deadlock Detection

- Deadlocks may be created with IMS and non-IMS resources
  - CICS applications with IMS and VSAM
  - IMS TM applications with IMS DB and DB2
  - DB2 stored procedures with IMS DB and DB2
  - Example:
    - Tran A holds IMS lock X
    - Tran B holds DB2 lock Y
    - Tran A requests DB2 lock Y and waits
    - Tran B requests IMS lock X and waits – DEADLOCK!
  - These deadlocks are only resolved by time outs
    - Usually, resolved by the “other” resource manager, not IMS
      - IMS only times out lock requests when LOCKTIME value for IMS is specified with IRLM

Handling Deadlock Victims

- Actions for deadlock victims
  - MPP, JMP, IFP, BMP, or JBP: Abend U0777
    - MPP, JMP, and IFP messages are rescheduled
  - APPC CPIC driven or modified standard application: Abend U0123
  - CICS task: CICS ADCD abend
  - ODBA thread: AIB “system failure” return code x’00000108’, reason code x’00000244’ and error extension code x’10000309’ and thread is terminated
- Exceptions of abend for deadlock ‘victim’
  - INIT STATUS GROUPB
    - Back out occurs and program receives a ‘BC’ status code
  - Non-message driven BMP or JBP with Fast Path PCB
    - Back out occurs and program receives an ‘FD’ status code
  - Deadlock during sync point processing with MSDBs
    - Back out and reprocessing occur

Design Advice

- Minimize PROCOPT values
  - PROCOPT=A produces “non-shared’ level locks
- Take frequent checkpoints
  - But don’t create a logging problem by checkpointing too much user data
    - Such as all of working storage
- Be wary of communications during a sync interval
  - OTMA commit mode 1 with synclevel=syncpoint or synclevel=confirm
  - APPC with synclevel=syncpoint or synclevel=confirm
  - Synchronous callout (ICAL)
    - Default timeout for ICAL is 10 seconds
    - Application may set any value
  - Communications delays will likely cause locking problems

Design Advice

- Try to limit high frequency updates to any record
  - "Control" records can be a problem
    - For example, "next invoice number"
    - Possible solutions:
      - Delay calls to the record until the end of the transaction
      - Use multiple records, one for each series of numbers
      - Use non-sequential numbers, such as choosing numbers at random
  - Databases with only a few database records are often problems
- Provide free space in (P)HIDAM with block level data sharing
  - Without free space all inserts go to end of data set causing block lock conflicts

Design Advice

- By wary of PROCOPT=E
  - PROCOPT=E on root
    - Schedules program exclusively for the database in an IMS subsystem
      - Does not affect scheduling or locking in other IMS subsystems
    - If not data sharing
      - No locks are used for the database
    - If data sharing
      - All locks for database are held until sync point
  - PROCOPT=E on a dependent segment
    - Schedules program exclusively for the segment in an IMS subsystem
    - Locks are used for the database records
    - No PI locks are used for the segment
  - PROCOPT=E on root is sometimes used to allow BMPs with infrequent checkpoints to run

Design Advice

- Tune the system and applications
  - Use lots of database buffers
  - *The faster an application runs, the shorter the time it holds locks!*

Space for Lock Control Blocks

- PI
  - Each locked resource uses 24 byte control block
  - Each holder of a resource lock uses 24 byte control block
  - Rule of thumb: Each lock requires 48 bytes
  - PI lock control block storage location:
    - With Fast Path: ECSA
    - Without Fast Path: Extended private of DLI SAS address space
    - Without Fast Path or DLI SAS: Extended private of control region
  - PI storage is limited by PIMAX execution parameter
    - If PIMAX is not specified, limited by second subparameter of CORE= on IMSCTF macro
    - PIINCR specifies the increments in which storage is acquired

Space for Lock Control Blocks

- IRLM
  - Each lock requires about 540 bytes in 64-bit storage of IRLM address space
  - Space may be limited by the z/OS MEMLIMIT parameter on the job or job step
- Coupling Facility Lock Structure
  - Each lock protecting an update uses an entry in the lock record list
    - All block locks
    - Level 6 database record locks
    - Level 8 Fast Path CI and UOW locks
    - Record list entries are about 250 bytes
  - Goal for lock table: 1000 entries per held lock
    - Provides false contention rate of 0.1%
    - Entries are typically 2 bytes
    - Therefore, about 2000 bytes per held lock

Space for Lock Control Blocks

- When lock space is exhausted
  - PI: U0775 abend of requestor
  - IRLM: U3300 abend of requestor
  - Lock structure record list: U3307 of requestor

- Excessive space for locks
  - Usually caused by BMPs
    - Usually a very small subset of BMPs

LOCKMAX Usage

- LOCKMAX parameter limits the number of locks held by a dependent region or batch job at any time
  - Specified in 1000s
  - Specified in PSBGEN statement of PSB
  - Specified as region parameter
    - Overrides PSB specification
- U3301 of program when LOCKMAX reached
- Log records contain the maximum number actually used
  - x'37' and x'5937' for online systems
  - x'41' for batch data sharing
- Recommendation:
  - Specify LOCKMAX in all dependent regions
  - Specify it in test systems

PI vs. IRLM

- IRLM required for block level data sharing
- PI has shorter path length
  - May not be significant in total application path length
- PI has maximum of 63 waiters
  - 64th waiter receives U2478 abend
    - MPP or JMP is rescheduled
  - IRLM has no limit on the number of waiters
- IRLM has “long locks” capability
  - Reports locks which wait for a long time
- Lock timeout capability requires IRLM

Locking Reports

IMS Monitor

- PROGRAM I/O Report

```
PSBNAME   PCB NAME    IWAITS      TOTAL      MEAN     MAXIMUM    DDN/FUNC  MODULE
AZLACL    RZCMA001         2       3419      1709        1991 PI RZCMA001.. 1
```

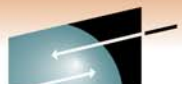
- REGION IWAIT Report

Database name

Segment code

```
                                        .........IWAIT TIME......
 **REGION     45 OCCURRENCES     TOTAL      MEAN    MAXIMUM      FUNCTION   MODULE
DL/I CALLS
                          16     20959      1309       4696  PI=SMWLJ001...1
                          19     48901      2573      26494  PI=RZCMA001...1
```

- Notes:
  - "PI" appears for both PI and IRLM
  - Segment code is "1" except for PI segment locks
- You can examine these reports to see if you have a lot of locks and to determine their average wait times



KBLA IRLM Lock Trace Analysis Utilities (DFSKLTx0)

- Report produced from IRLM lock trace
  - Excellent source of overall information on lock waits

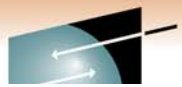
```
          Suspended IRLM Lock Requests Summary Report - Wait Time Order Page 001
Trace Date = 01/12/2005  Trace Start Time = 16:01:47 Trace End Time = 16:06:26
Trace Elapsed Time (secs) =     278
Trace Input DSN = IMS.ISA1.DFSTRA01

   Database DS    Lock Req     Wait   Not Int     Total     Average   Maximum
       Name Id       Count    Count     Count      Time        Time      Time

   BFLMSGY3 01        8628      115       110     9.198       0.079      2.76
   BFLMSGY7 01        8452      102        98     4.813       0.047      4.36
   BFLMSGP  01       15862      181       169     4.401       0.024      0.64
   BFLSUMP  01        3929       40        37     3.703       0.092      2.39
   BCMTLRD  09        1153        1         1     3.400       3.400      3.40
```

Not Int Count: Not including internal latch waits

Wait Count: Includes internal latch waits and lock waits



KBLA Lock Trace Detailed Print Program (DFSKLTC0)

- Report produced from IRLM lock trace
  - Detailed information about each wait
    - Voluminous!

```
 Suspended IRLM Lock Requests Report - Req Comp Order                  Page 0043
Trace Date = 01/12/2005 DSN = IMS.ISA1.DFSTRA01
Lock Request Lock Request ----Wait----- PST --Lock-- -------Resource------- Flag --IRLM--- --------Call---------Trace
Start Time     End Time    Elapsed Type Num Type Lvl    DB    DS RBA/HASH S      RCFB TRAC Type Num     Time Seq#
16:06:09.723 16:06:09.724     0.000  F  100 BIDP  4  BCICINY1 01 099DE001 P CPR  0000 08C0 ISRT 001 16:06:09.690 0975
16:06:09.727 16:06:09.727     0.004  F  100 BIDP  4  BCICINY1 01 099DE001 P CPKF 0000 08C0 ISRT 001 16:06:09.690 0C98
16:06:09.567 16:06:09.952     0.385  G  067 FPCI  8  BCMTRMD  08 00024CE0 F K    0440 08F0                      F073
16:06:10.170 16:06:10.170     0.004  G  067 BIDP  4  BAGTX1P  01 32117800 P CPKF 0840 08F0 ISRT 001 16:06:10.170 8B69
16:06:10.209 16:06:10.242     0.032  G  100 FPCI  8  BGLACAD  06 005203A0 F K    0440 08F0                      9A67
16:06:10.354 16:06:10.354     0.004  L  122 FPCI  8  BCMRDAD  10 00053AE0 F K    0440 2080                      D030
16:06:10.397 16:06:10.398     0.001  L  122 FPCI  8  BCMRDAD  11 00143820 F K    0440 2080                      DFDE
16:06:10.438 16:06:10.438     0.000  L  122 FPCI  8  BCMRDAD  13 0009E000 F K    0440 2080                      EB9D
16:06:10.959 16:06:10.992     0.032  L  038 BIDP  6  BCMTRPP  01 0412E804 P PKF  0000 2080 ISRT 001 16:06:10.959 BBD8
16:06:11.011 16:06:11.012     0.001  L  122 FPCI  8  BCMRDAD  11 00168360 F K    0440 2080                      D79D
```

F – false contention
G – global contention
L – local contention

RMF II - IRLM Long Lock Detection Report

- Shows lock waits greater than IRLM LOCKTIME value
  - Also shows holders of lock and other waiters for lock

```
                    RMF - ILOCK IRLM Long Lock Detection          Line 1 of 15
 Command ===>                                                  Scroll ===> HALF
                    CPU= 37/ 35 UIC=2540 PR=   0               System= RMF5
Total
 State    Type    Lock_Name                          PSB_Name  Elap_Time  CICS_ID
          IMS_ID  Recovery_Token              PST#   Trx/Job   Wait_Time  DB/Area
 ------------------------------------------------------------------------------
  CF Structure ACOXLOCK          at 07/28/2006 13:02:10 Deadlock Cycle 00002EC7
 ------------------------------------------------------------------------------
 TOP      BMP     09C943CFA7800101D700000000000000 DFSSAMB1  00:06:04
 BLOCKER  ACO3    ACO3    0000000300000000   0006  IRLMTOPZ
 ------------------------------------------------------------------------------
 TOP      BMP     09C3614505800101D700000000000000 DFSSAMB1  00:06:09
 BLOCKER  ACO1    ACO1    0000000600000000   0006  IRLMTOPA
 ------------------------------------------------------------------------------
 WAITER   BMP     09C3614505800101D700000000000000 DFSSAMB2
          ACO2    ACO2    0000000800000000   0007  IRLMWTA1  00:05:52  DI21PART
 ------------------------------------------------------------------------------
 WAITER   BMP     09C943CFA7800101D700000000000000 DFSSAMB7
          ACO2    ACO2    0000000900000000   0008  IRLMWTZ2  00:05:42  DI21PART
 ------------------------------------------------------------------------------
```

DFSERA30 Deadlock Report

- Provides detailed information about each deadlock

```
*******************************************************************************
DEADLOCK ANALYSIS REPORT - LOCK MANAGER IS IRLM
.......................................................................
RESOURCE DMB-NAME LOCK-LEN LOCK-NAME     - WAITER FOR THIS RESOURCE IS VICTIM
01 OF 02 CMLDDCDB    08    7EB22000843A01D7
KEY FOR RESOURCE IS FROM DELETE WORK AREA
KEY=(200414913326180)
         IMS-NAME TRAN/JOB PSB-NAME PCB--DBD  PST# RGN  CALL LOCK  LOCKFUNC STATE
WAITER   IMS2     TRLDDC1  CMLDDCDB CMLDDCDB 00003 MPP  DLET GBIDP 22400318  04-P
HOLDER   IMS1     USMEED2  CMLDDCDB -------- 00007 MPP  ---- ----- --------  04-P
.......................................................................
RESOURCE DMB-NAME LOCK-LEN LOCK-NAME
02 OF 02 CMLDDCDB    08    7EB22B3E843A01D7
KEY IS ROOT KEY OF DATA BASE RECORD ASSOCIATED WITH LOCK
KEY=(200414913326180)
         IMS-NAME TRAN/JOB PSB-NAME PCB--DBD  PST# RGN  CALL LOCK  LOCKFUNC STATE
WAITER   IMS1     USMEED2  CMLDDCDB CMLDDCDB 00007 MPP  GET  GRIDX 30400358  06-P
HOLDER   IMS2     TRLDDC1  CMLDDCDB -------- 00003 MPP  ---- ----- --------  06-P

DEADLOCK ANALYSIS REPORT - END OF REPORT
*******************************************************************************
```

RMF Coupling Facility Reports

- Coupling Facility Usage Summary – Structure Summary

```
                                C O U P L I N G   F A C I L I T Y   A C T I V I T Y
                                                                                                                                PAGE   2
     z/OS V1R10             SYSPLEX SYSPLEXA            START 01/18/2010-11.00.00        INTERVAL 000.20.00
                            RPT VERSION V1R10 RMF       END   01/18/2010-11.20.00        CYCLE 05.000 SECONDS

------------------------------------------------------------------------------------------------------------------------------
 COUPLING FACILITY NAME = CF01
 TOTAL SAMPLES(AVG) =   240  (MAX) =   240  (MIN) =   240
------------------------------------------------------------------------------------------------------------------------------
                                          COUPLING  FACILITY  USAGE  SUMMARY
------------------------------------------------------------------------------------------------------------------------------

------------------------------------------------------------------------------------------------------------------------------
     STRUCTURE SUMMARY
------------------------------------------------------------------------------------------------------------------------------
                                          % OF           % OF    % OF    AVG     LST/DIR  DATA      LOCK      DIR REC/
       STRUCTURE                 ALLOC    CF       #     ALL     CF      REQ/    ENTRIES  ELEMENTS  ENTRIES   DIR REC
 TYPE  NAME           STATUS CHG  SIZE     STOR    REQ   REQ     UTIL    SEC     TOT/CUR  TOT/CUR   TOT/CUR   XI'S


 LOCK  MMHL_IMSIRLM   ACTIVE      34M      0.2  71551    0.1     0.1   59.63       62K       0      8389K       N/A
                                                                                   28       0       170       N/A
```

RMF Coupling Facility Reports

- Coupling Facility Usage Summary – Structure Summary

```
                    C O U P L I N G   F A C I L I T Y   A C T I V I T Y
                                                                                PAGE   2
   z/OS V1R10            SYSPLEX SYSPLEXA         START 01/18/2010-11.00.00      INTERVAL 000.20.00
                         RPT VERSION V1R10 RMF    END   01/18/2010-11.20.00      CYCLE 05.000 SECONDS

-----------------------------------------------------------------------------------------------
 COUPLING FACILITY NAME = CF01
 TOTAL SAMPLES(AVG) =   240   (MAX) =   240   (MIN) =   240
-----------------------------------------------------------------------------------------------
                              COUPLING  FACILITY  USAGE  SUMMARY
-----------------------------------------------------------------------------------------------

-----------------------------------------------------------------------------------------------
   STRUCTURE SUMMARY
-----------------------------------------------------------------------------------------------
                                       % OF          % OF    % OF    AVG   LST/DIR  DATA      LOCK     DIR REC/
      STRUCTURE                 ALLOC  CF                                  ENTRIES  ELEMENTS  ENTRIES  DIR REC
 TYPE NA                ATUS CHG SIZE  S

 LOCK MM                TIVE     34M
```

ALLOC SIZE
34M

Structure Size

AVG REQ/ SEC	LST/DIR ENTRIES TOT/CUR	DATA ELEMENTS TOT/CUR	LOCK ENTRIES TOT/CUR	DIR DIR REC XI'S
59.63	62K	0	8389K	N/A
	28	0	170	N/A

Record List

Lock Table

RMF Coupling Facility Reports

- Coupling Facility Structure Activity

COUPLING FACILITY STRUCUTRE ACTIVITY

STRUCTURE NAME = MMHL_IMSIRLM TYPE = LOCK STATUS = ACTIVE

SYSTEM NAME	# REQ TOTAL AVG/SEC		REQUESTS # REQ	% OF ALL	-SERV TIME(MIC)- AVG	STD_DEV	REASON	DELAYED REQUESTS # REQ	% OF REQ	AVG TIME(MIC) /DEL	STD_DEV	/ALL	EXTERNAL REQUEST CONTENTIONS	
SYSL	584	SYNC	584	0.8	18.3	8.2	NO SCH	0	0.0	0.0	0.0	0.0	REQ TOTAL	723
	0.49	ASYNC	0	0.0	0.0	0.0	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	7
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	7
													-FALSE CONT	0
SYSM	69547	SYNC	69K	97.1	15.7	7.4	NO SCH	3	0.0	9.3	5.1	0.0	REQ TOTAL	79K
	57.96	ASYNC	103	0.1	108.6	387.3	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	54
		CHNGD	1	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	53
													-FALSE CONT	15
SYSN	406	SYNC	394	0.6	21.2	7.5	NO SCH	0	0.0	0.0	0.0	0.0	REQ TOTAL	520
	0.34	ASYNC	12	0.0	51.1	9.3	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	9
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	9
													-FALSE CONT	1
SYSO	1014	SYNC	1014	1.4	18.0	7.8	NO SCH	0	0.0	0.0	0.0	0.0	REQ TOTAL	1236
	0.84	ASYNC	0	0.0	0.0	0.0	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	18
		CHNGD	0	0.0	INCLUDED IN ASYNC		PR CMP	0	0.0	0.0	0.0	0.0	-CONT	18
													-FALSE CONT	0
TOTAL	71551	SYNC	71K	100	15.7	7.4	NO SCH	3	0.0	9.3	5.1	0.0	REQ TOTAL	82K
	59.63	ASYNC	115	0.2	102.6	366.8	PR WT	0	0.0	0.0	0.0	0.0	REQ DEFERRED	88
		CHNGD	1	0.0			PR CMP	0	0.0	0.0	0.0	0.0	-CONT	87
													-FALSE CONT	16

RMF Coupling Facility Reports

- Coupling Facility Structure Activity

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                                        COUPLING  FACILITY  STRUCUTRE ACTIVITY
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STRUCTURE NAME = MMHL_IMSIRLM      TYPE = LOCK   STATUS = ACTIVE
             # REQ    ------------- REQUESTS -------------   ------------ DELAYED REQUESTS ------------
SYSTEM  TOTAL            #    % OF -SERV TIME(MIC)-  REASON    #  % OF  ---- AVG TIME(MIC) --  EXTERNAL REQUEST
NAME    AVG/SEC          REQ   ALL    AVG   STD_DEV            REQ   REQ   /DEL  STD_DEV   /ALL  CONTENTIONS

SYSL     584    SYNC     584    0.8    18.3                    0.0     0.0    0.0   REQ TOTAL      723
        0.49    ASYNC      0    0.0     0.0                    0.0     0.0    0.0   REQ DEFERRED     7
                CHNGD      0    0.0  INCLUDE                   0.0     0.0    0.0   -CONT            7
                                                                                    -FALSE CONT      0

SYSM   69547    SYNC      69K  97.1    15.7      7.4   NO SCH    3   0.0    9.3     5.1    0.0   REQ TOTAL       79K
       57.96    ASYNC    103    0.1   108.6    387.3   PR WT     0   0.0    0.0     0.0    0.0   REQ DEFERRED    54
                CHNGD      1    0.0  INCLUDED IN ASYNC  PR CMP    0   0.0    0.0     0.0    0.0   -CONT           53
                                                                                    -FALSE CONT     15

SYSN     406    SYNC     394    0.6    21.2      7.5   NO SCH    0   0.0    0.0     0.0    0.0   REQ TOTAL      520
        0.34    ASYNC     12    0.0    51.1      9.3   PR WT     0   0.
                CHNGD      0    0.0  INCLUDED IN ASYNC  PR CMP    0   0.

SYSO    1014    SYNC    1014    1.4    18.0      7.8   NO SCH    0   0.                                        1236
        0.84    ASYNC      0    0.0     0.0      0.0   PR WT     0   0.
                CHNGD      0    0.0  INCLUDED IN ASYNC  PR CMP    0   0.
------------------------------------------------------------------------------------------------------------------------
TOTAL  71551    SYNC      71K  100     15.7      7.4   NO SCH    3   0.0    9.3     5.1    0.0   REQ TOTAL       82K
       59.63    ASYNC    115    0.2   102                        0.0    0.0     0.0    0.0   REQ DEFERRED    88
                CHNGD      1    0.0                              0.0    0.0     0.0    0.0   -CONT           87
                                                                                    -FALSE CONT     16
```

-SERV TIME(MIC)-
AVG STD_DEV

REQ TOTAL 82K
REQ DEFFERRED 88
-CONT 87
-FALSE CONT 16

15.7 7.4

Summary

- Locking affects IMS performance
- Locking is influenced by
  - Database design
  - Application program design
  - Syncpoint frequencies
- There are multiple sources of information about locking
  - These may be used to discover and address locking problems