# Understanding IMS Locking

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SHARE in Boston

# 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

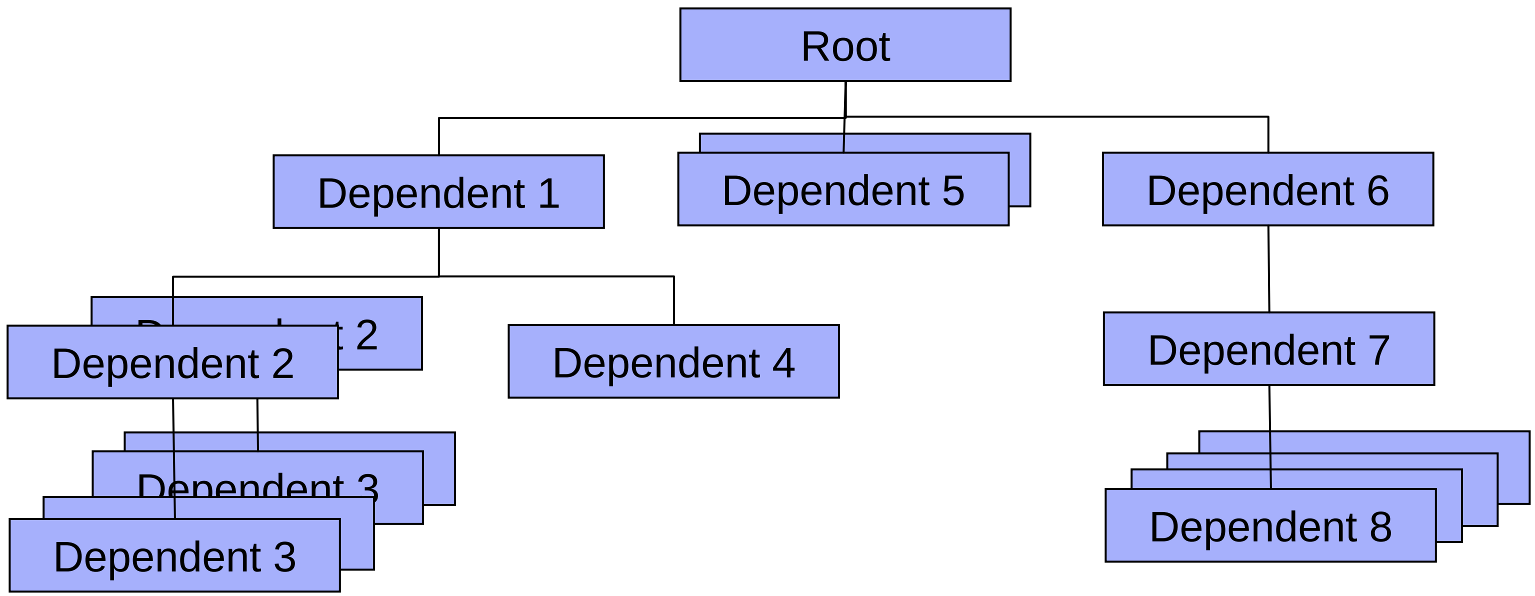
- Database Record Lock
  - HDAM and PHDAM
    - Lock is on the RAP
    - Another reason to have more RAPs than roots
      - Rule of thumb: # RAPs > 2 x # roots
  - Often, this is the most important lock
    - “Control” records often produce lock conflicts

# 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

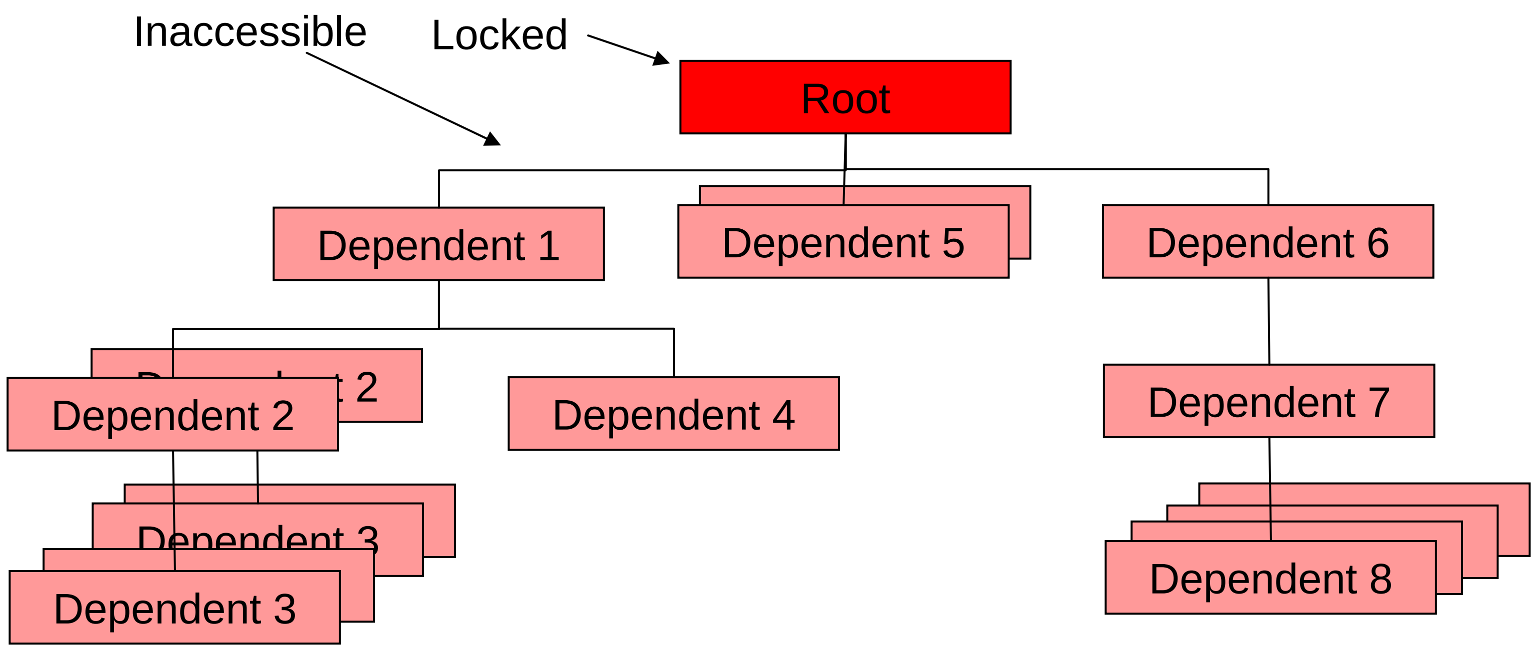
# IRLM vs. PI

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



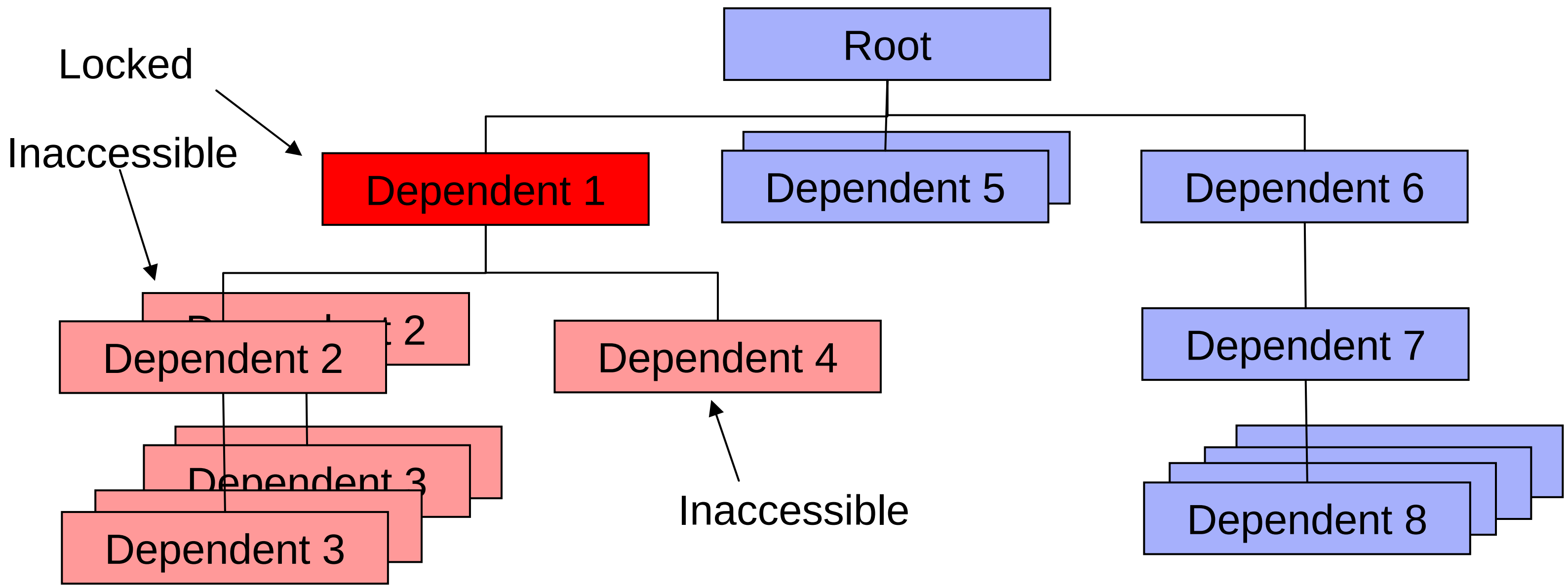
## IRLM vs. PI

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



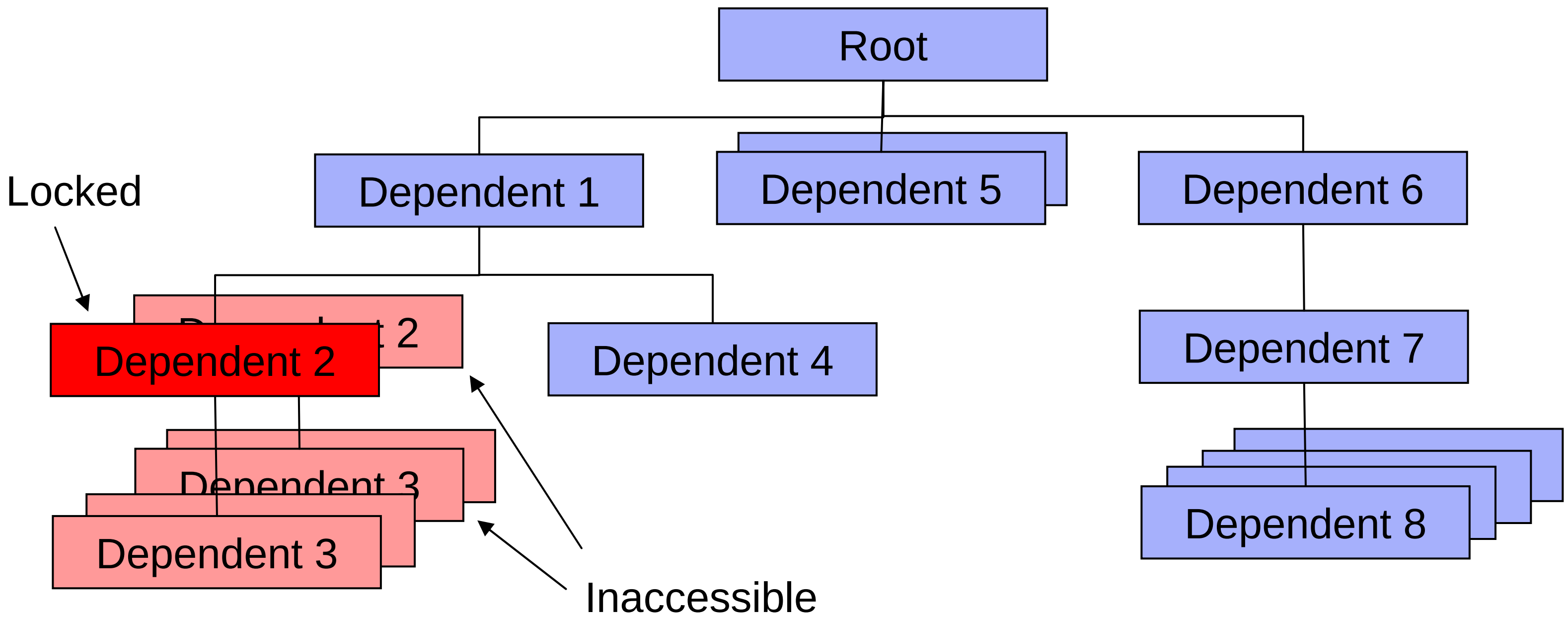
# IRLM vs. PI

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



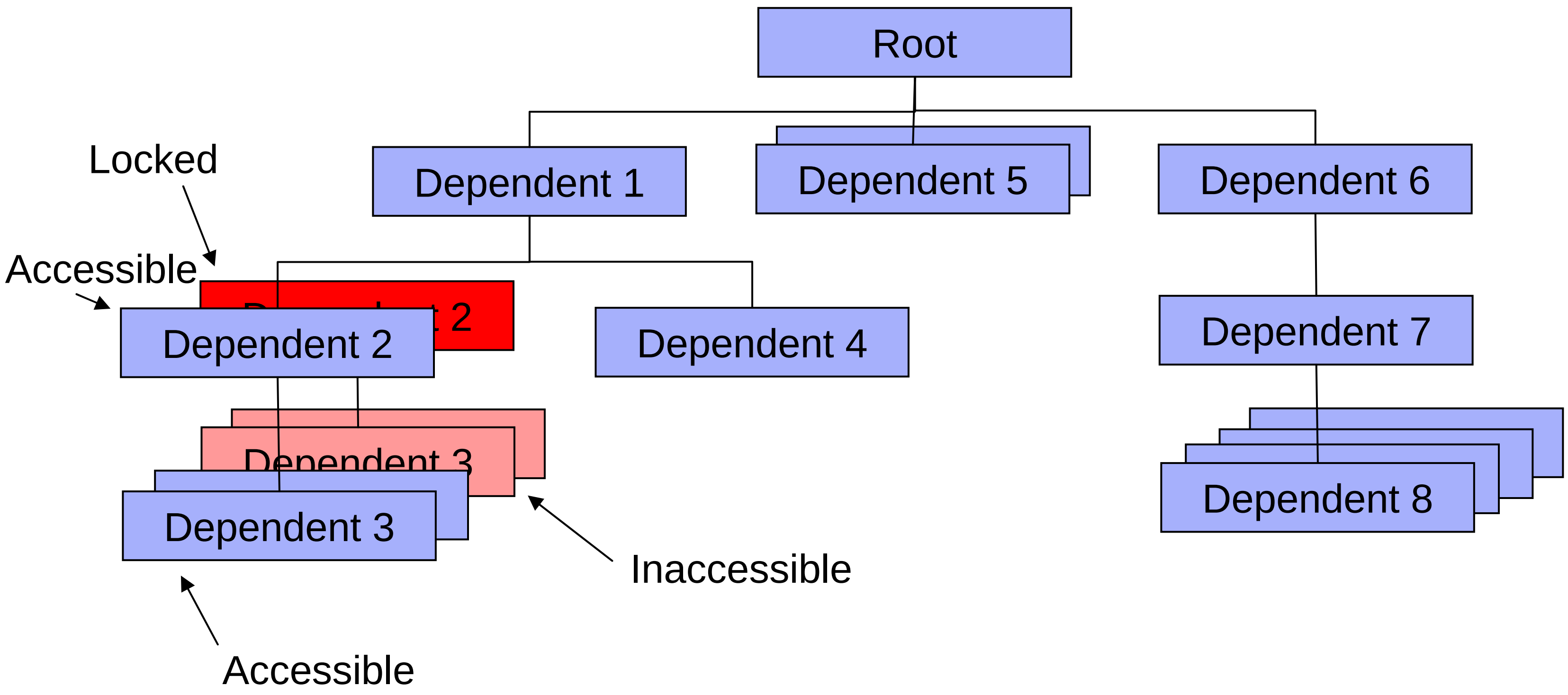
# IRLM vs. PI

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



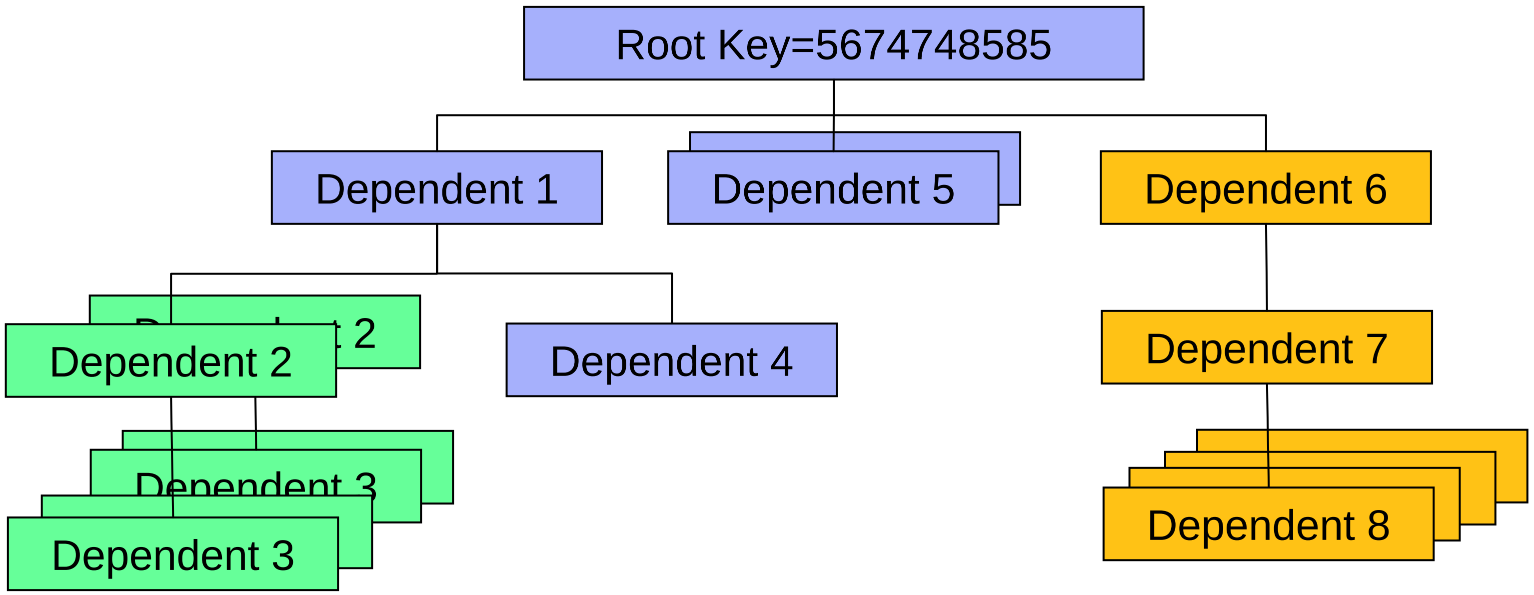
# IRLM vs. PI

- 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 <u>protecting an update</u> uses an entry in the lock <u>record list</u>
    - 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 Name | DS Id | Lock Req Count | Wait Count | Not Int Count | Total Time | Average Time | Maximum 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         #       ALL     CF       REQ/    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
              # 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      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

```
----------------------------------------------------------------------------------------------------------------------
                                          COUPLING  FACILITY  STRUCUTRE ACTIVITY
----------------------------------------------------------------------------------------------------------------------
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.                                             9
                   CHNGD     0    0.0  INCLUDED IN ASYNC  PR CMP    0   0.                                             9
                                                                                                                 1

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.                                            18
                   CHNGD     0    0.0  INCLUDED IN ASYNC  PR CMP    0   0.                                            18
                                                                                                                 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                                  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