

# Recovery Techniques For the New DBA

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# Abstract

- This session focuses on the procedures and utilities that a CA IDMS Database Administrator can use to identify and correct a database integrity problem. Attendees learn the recovery methods available and when they are appropriate to use. Also covered are techniques for preventing integrity problems. Attend this session if you are responsible for the integrity of your shop's database.

# Biography

- Laura Rochon  
Hera Evolution LLC
- Over 30 years experience with CA IDMS
- IUA Chair
- CQUI Chair
- Frequent presenter at IUA Conferences and CA World

# Agenda

- Types of Integrity Problems
- Causes of Integrity Problems
- How to detect Integrity Problems
- How to fix Integrity Problems
- How to avoid Integrity Problems
- Backup and Recovery Techniques
- Summary

# Types of Integrity Problems

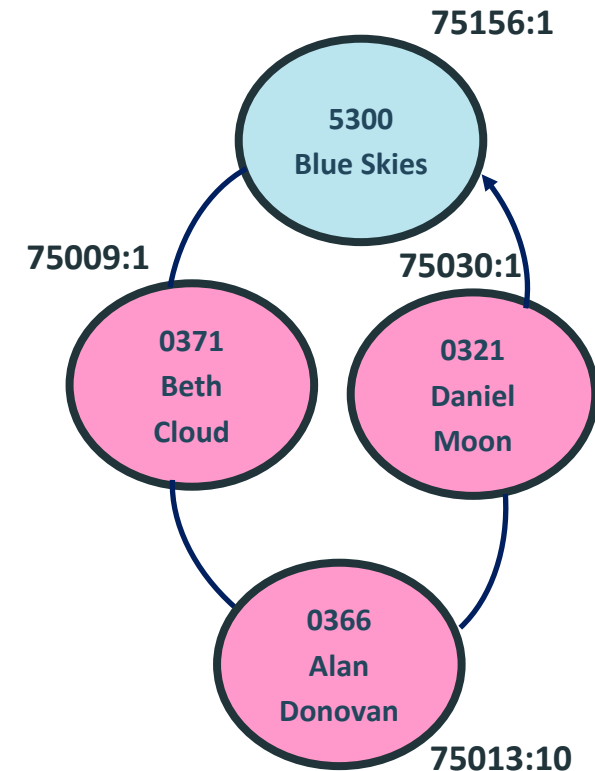
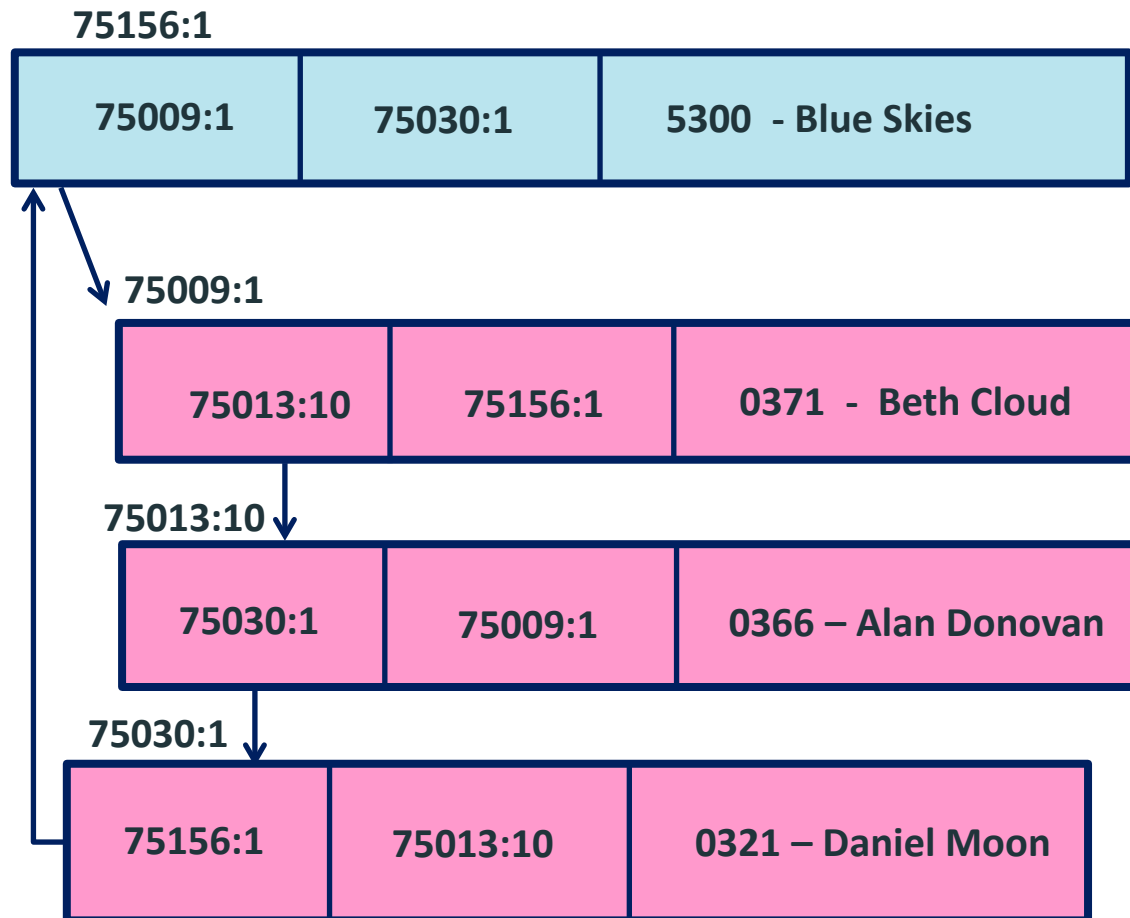
- Physical Database Integrity Problems
  - Record errors
    - Compressed record errors
    - Record in wrong area
    - Wrong record length
  - Broken chains
    - Pointer errors
    - Set errors
    - Integrated Index errors
    - Fragmented record errors
  - Page errors

# Types of Integrity Problems

- Logical Database Integrity Problems
  - Business rules not respected
    - Orphaned records with no owner
    - 1-n relationship not respected
  - Application program ran correctly with wrong input

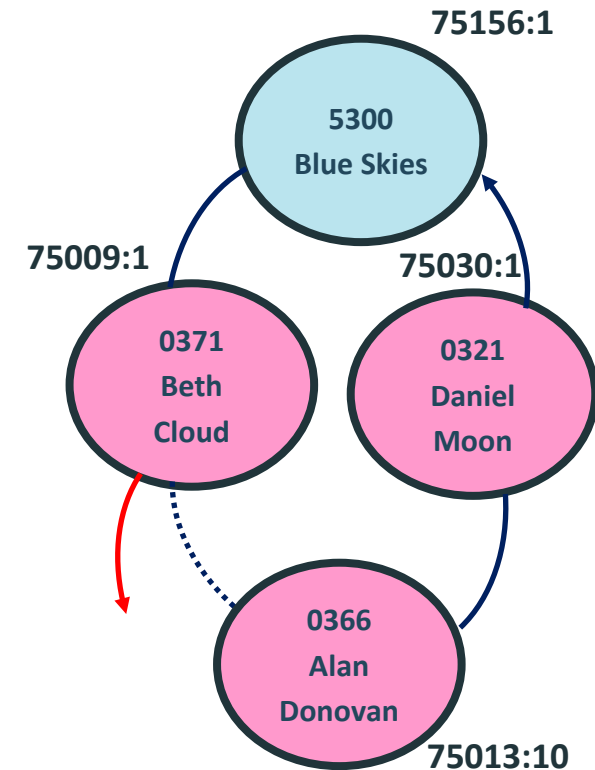
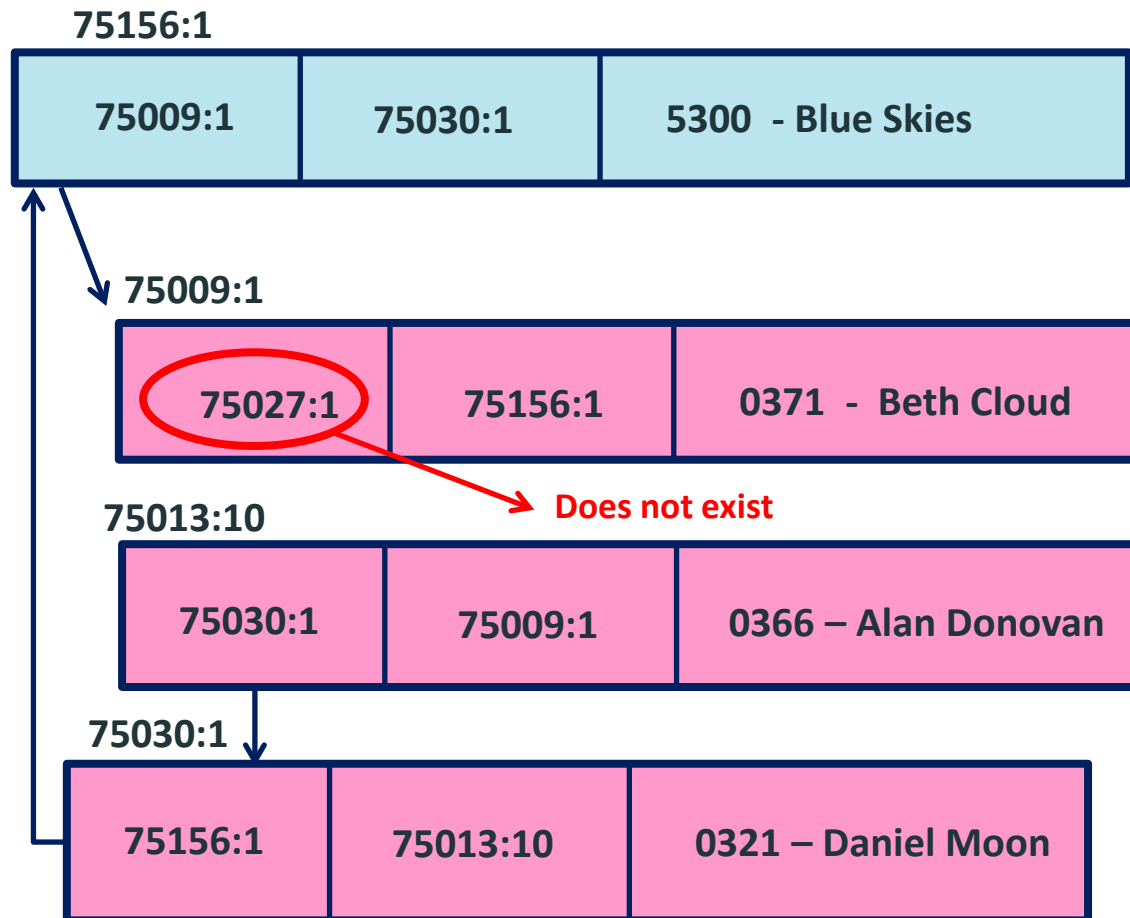
# Physical Database Integrity Problems

- Pointer errors



# Physical Database Integrity Problems

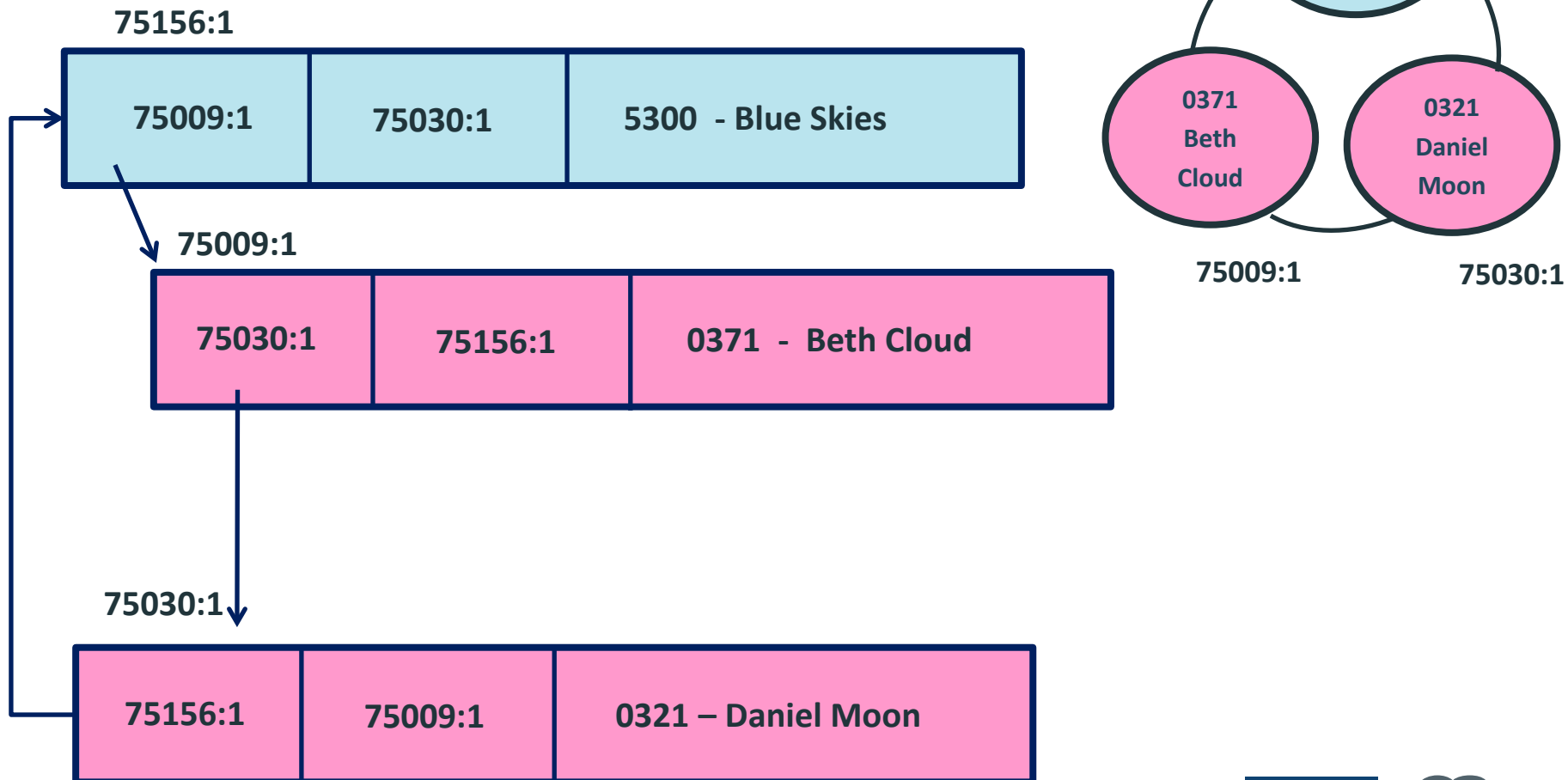
- Pointer errors





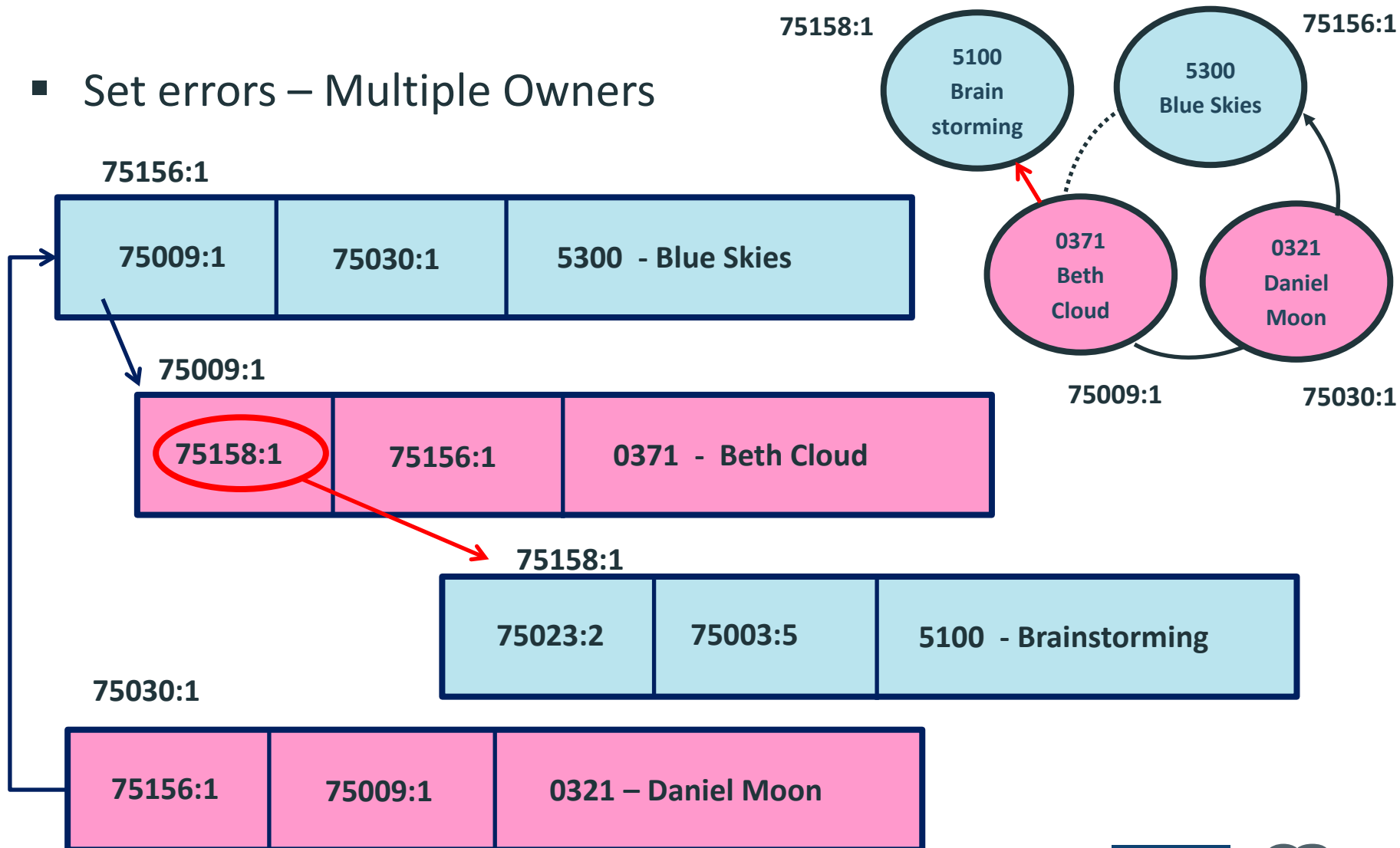
# Physical Database Integrity Problems

- Set errors – Multiple Owners



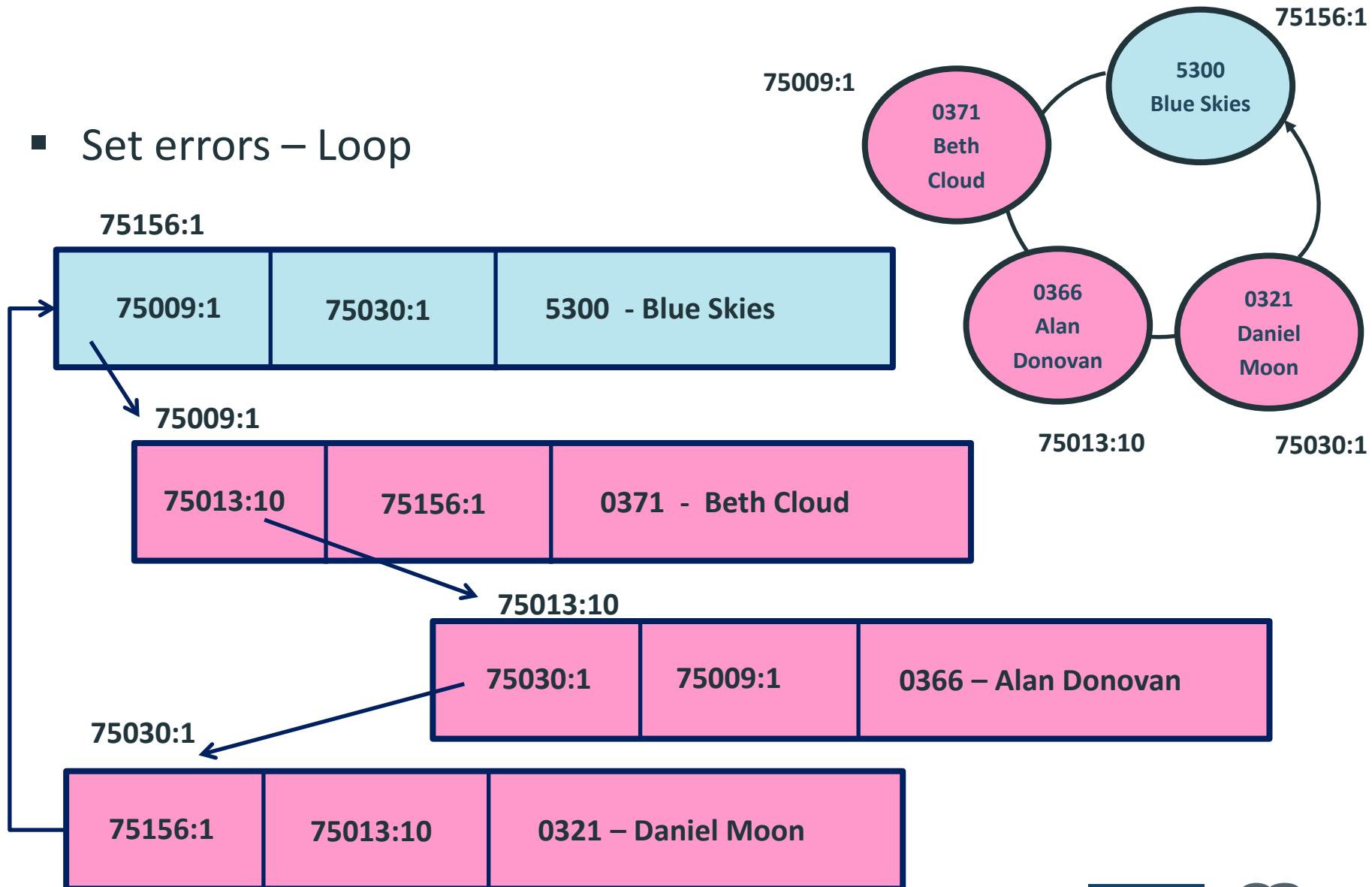
# Physical Database Integrity Problems

- Set errors – Multiple Owners



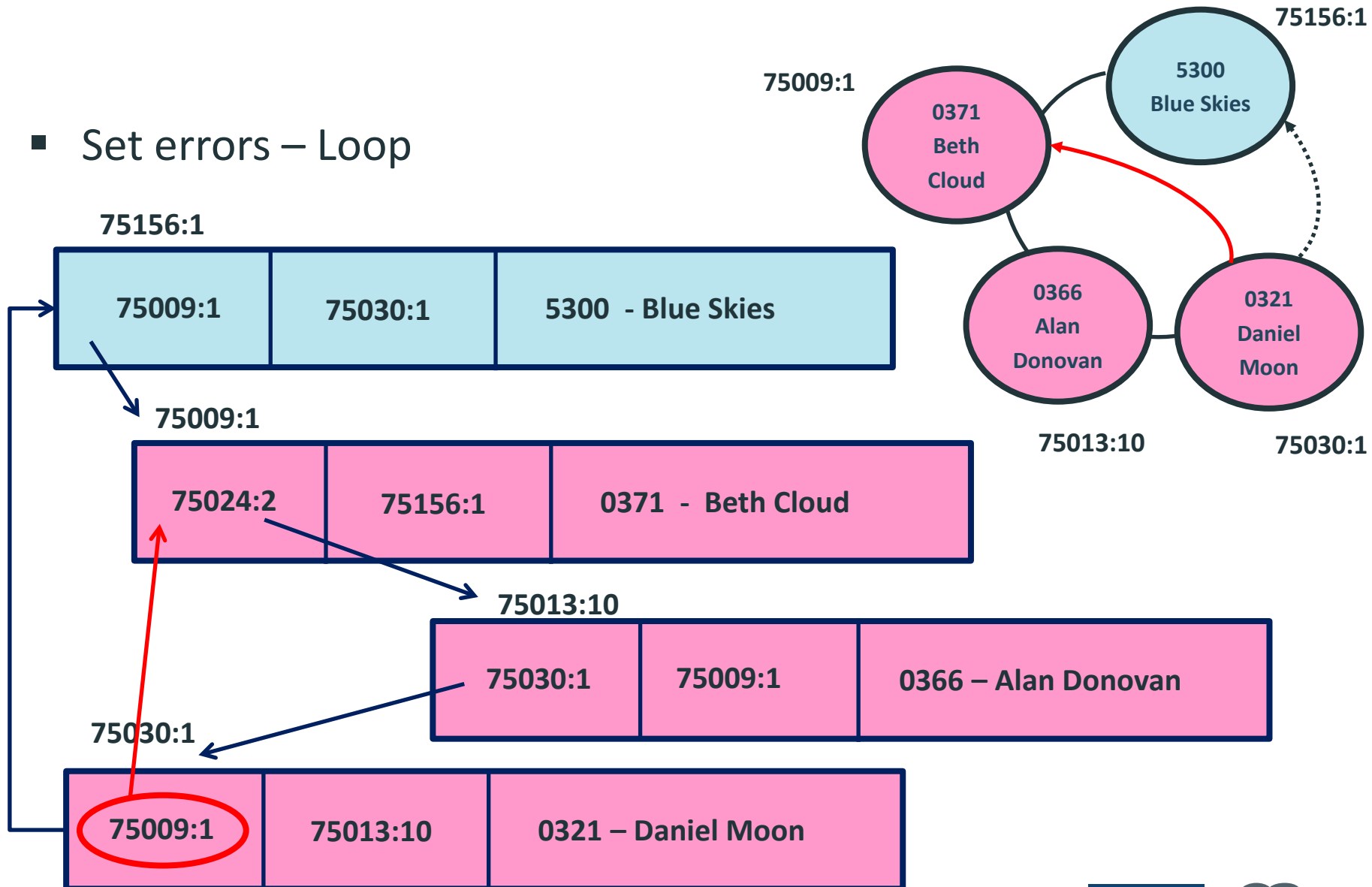
# Physical Database Integrity Problems

- Set errors – Loop



# Physical Database Integrity Problems

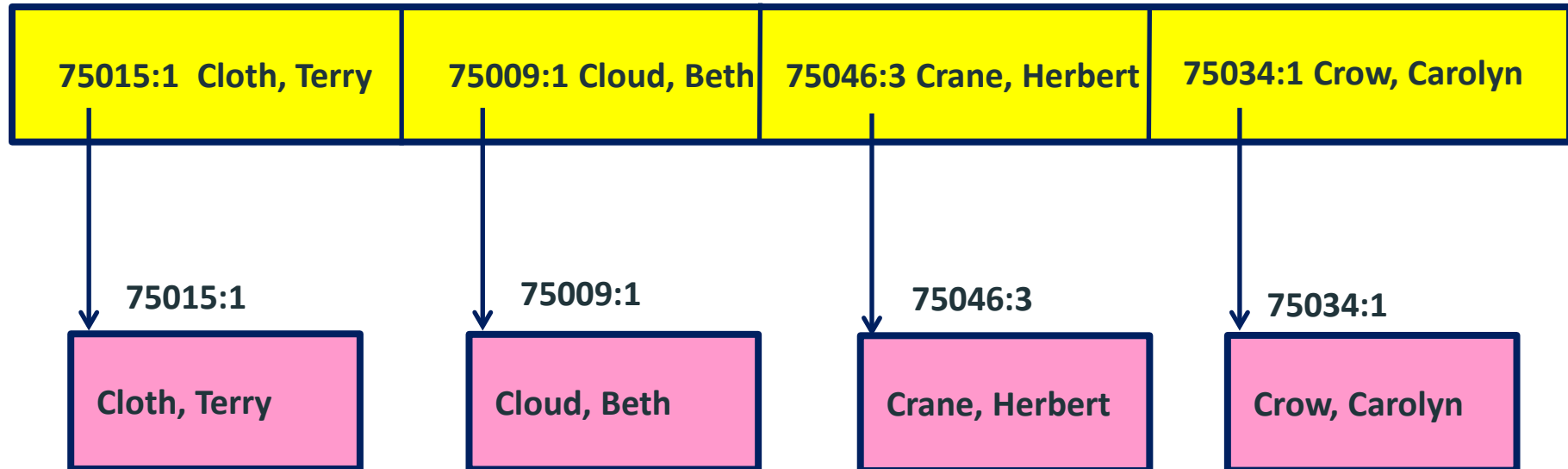
- Set errors – Loop



# Physical Database Integrity Problems

- Integrated Index Errors

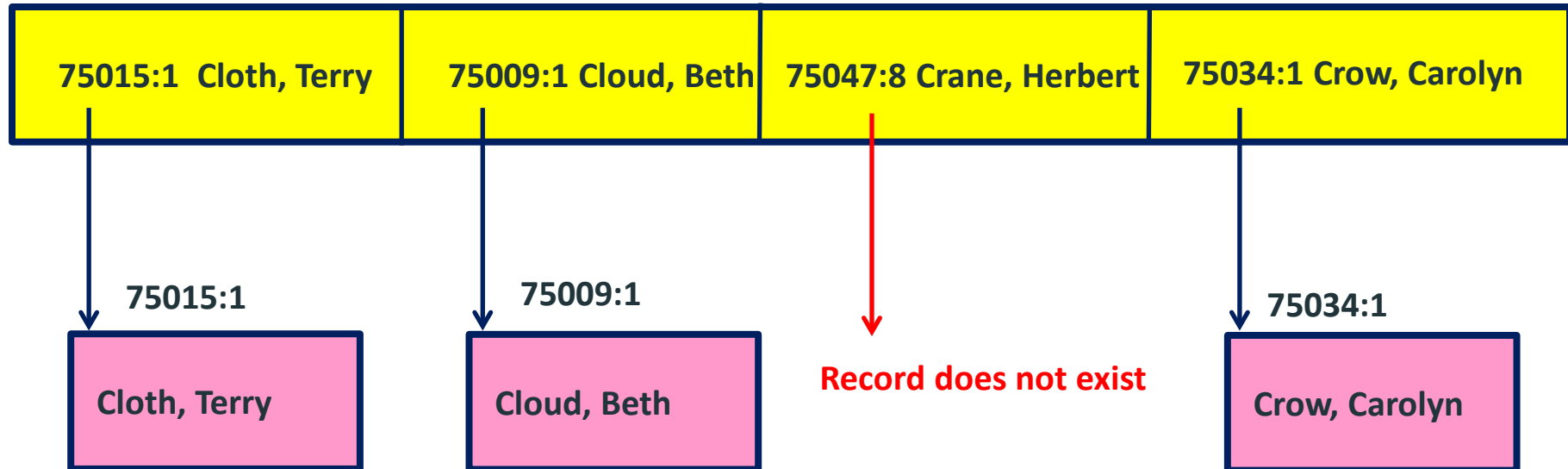
75002:4



# Physical Database Integrity Problems

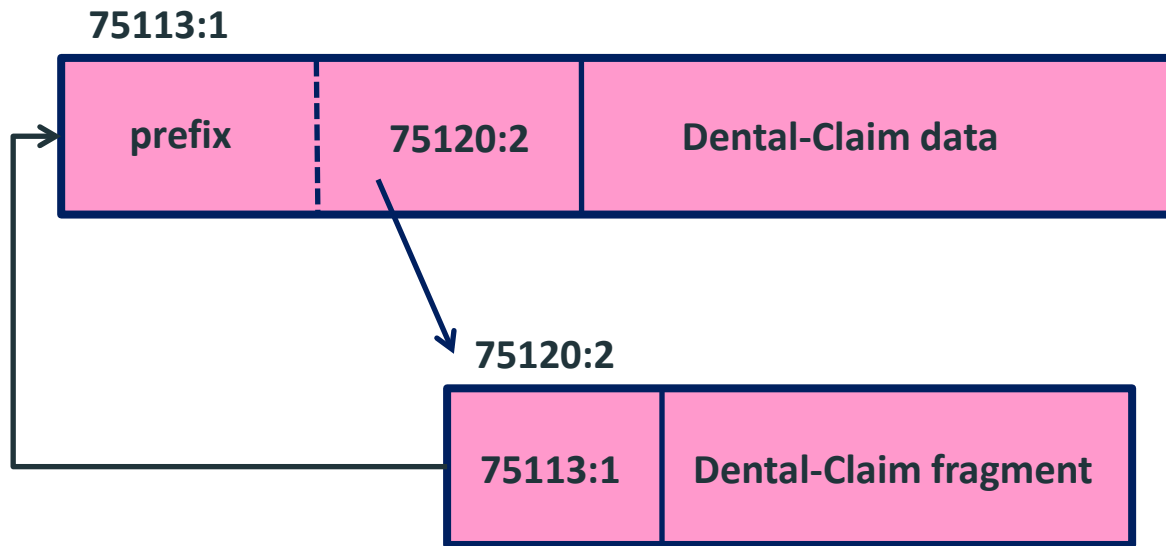
- Integrated Index Errors

75002:4



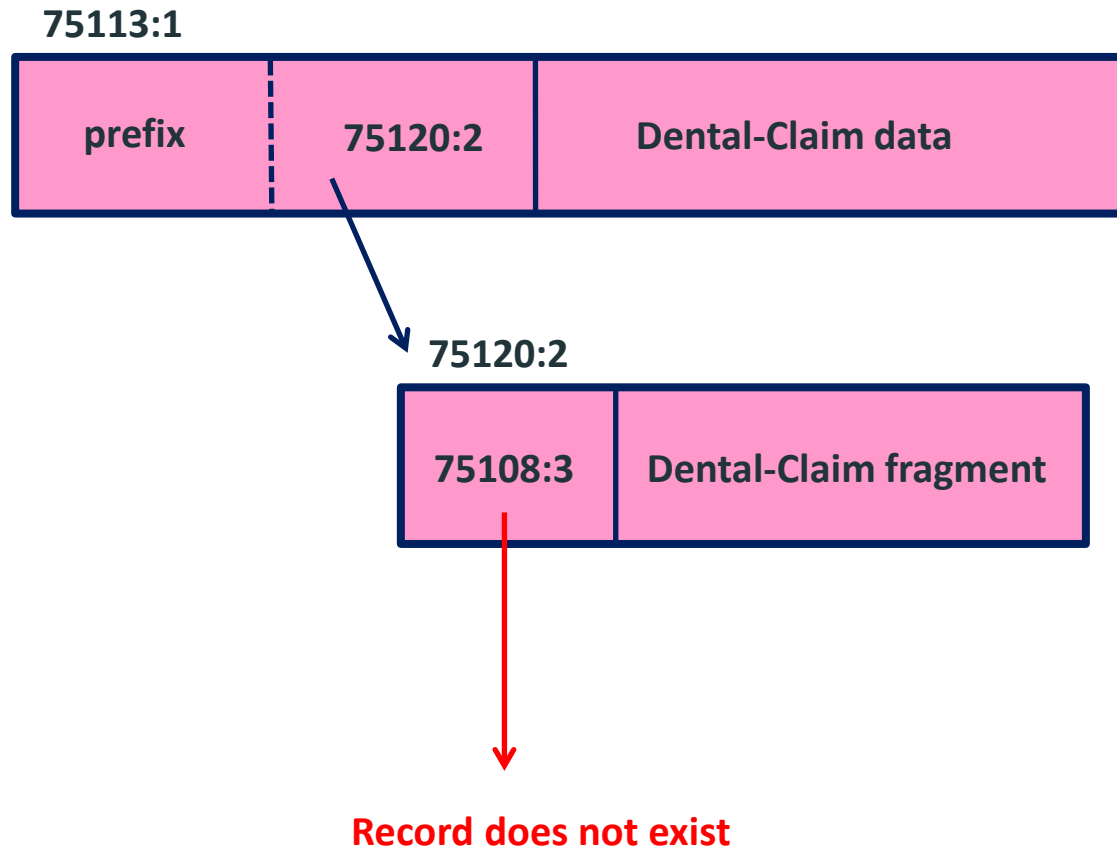
# Physical Database Integrity Problems

- Fragmented record errors



# Physical Database Integrity Problems

- Fragmented record errors

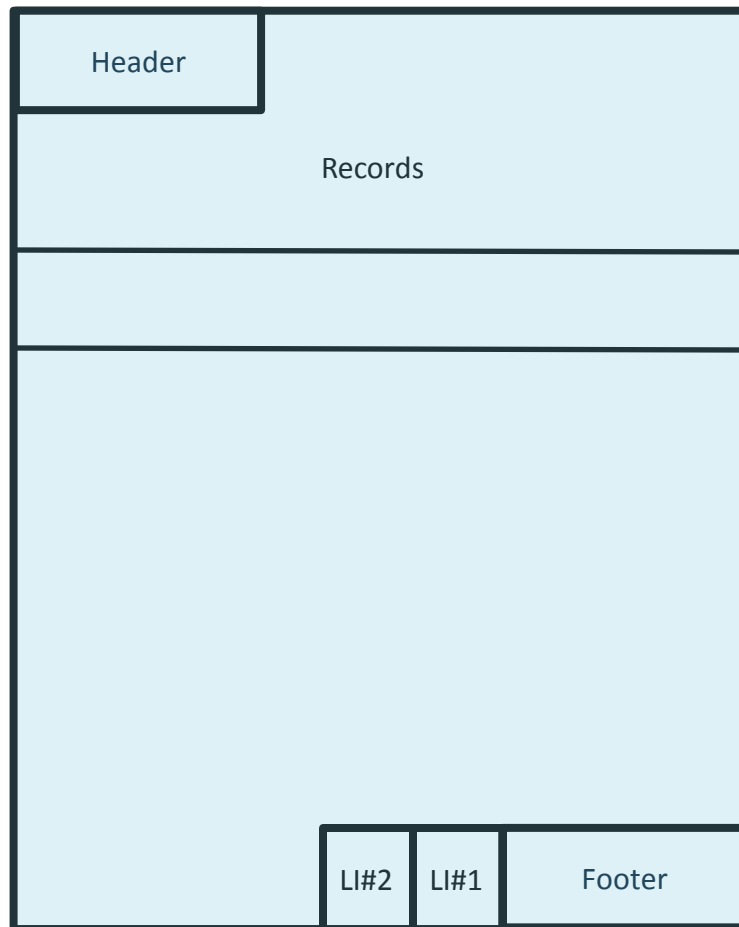




# Physical Database Integrity Problems

## ■ Page Errors

Page 63014



**Header:** Page Number (4 bytes)

SR1 record (12 bytes):

- Next, Prior of CALC chain (8 bytes)
- Space Available on page (2 bytes)
- 00 (2 bytes)

**Footer:** Line Index 0 (8 bytes):

Record ID (2 bytes)

Offset (2 bytes)

Length of record (2 bytes)

Length of prefix (2 bytes)

Line Space Count (2 bytes)

00 (2 bytes)

Page Number (4 bytes)

# Causes of Integrity Problems

- Physical Integrity Problem:
  - Improper Recovery from
    - Program failure
    - System failure
    - Hardware failure
  - Hardware malfunction
  - Improper use of FIX PAGE, UNLOCK
  - Rare software problem
    - Fix RO88664(R18), RO88341 (R18.5), RO88672(R19), RO88798 (R18.5 DOS)

# Causes of Integrity Problems

- Logical Integrity Problem:
  - Application Program bug
  - Execution of program at wrong time

# How to Detect Integrity Problems – at runtime

- Loop
- Error-Status
  - 0226 ERASE
  - XX60 Inconsistent record in set
  - XX61 Invalid dbkey
- Abend Codes
  - 1117 Cannot adjust space available on page
  - 1123 Broken Fragment chain
  - 1164 Error trying to backout previous error while linking record in set
  - 1197 Error trying to delink a record from a set
  - 1198 Error trying to link a record into a set

# How to Detect Integrity Problems – at runtime

## ■ Messages

- DB002304 Invalid record in set
- DB002305 Dbkey in set not found
- DB002423 Dbkey not found
- DB002424 SR8 record not found
- DC598203 SR2 pointer no good
- UT003012 Possible broken chain/invalid SSC
- UT016018 SR8 orphan count

# How to Detect Integrity Problems - reporting

- IDMSDBAN
  - Report 2 – Area Report
    - Checks Page Integrity

```
IDMSDBAN - DATA BASE ANALYSIS                                REPORT 1:  MESSAGES
598601 - AREA PROCESSING BEGINNING: EMPDEMO.EMP-DEMO-REGION
598505 - PAGE           0/75002      PAGE CORNERS INCORRECT
```

# How to Detect Integrity Problems - reporting

- IDMSDBAN
  - Report 4 – Record report

```
IDMSDBAN - DATA BASE ANALYSIS                                REPORT 1:  MESSAGES

598601 - AREA PROCESSING BEGINNING: EMPDEMO.EMP-DEMO-REGION

598516 - DBKEY          0/75009:1    LI RECORD LENGTH NE SS RECORD LENGTH (FLR)
```

# How to Detect Integrity Problems - reporting

- IDMSDBAN
  - Report 5 – Set report

Invalid pointer:

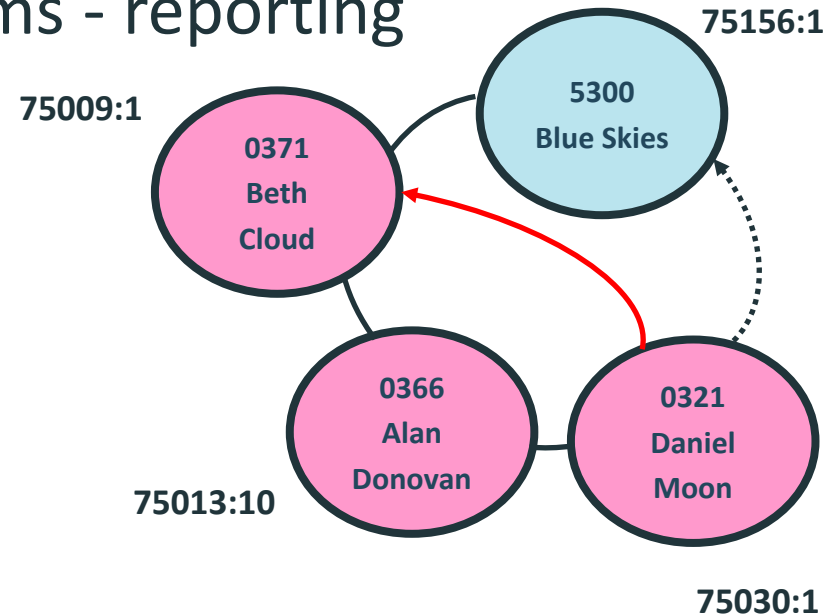
IDMSDBAN	PHASE II - SET ANALYSIS	REPORT 1A: MESSAGES	DATE	TIME	PAGE
599001	- PHASE II PROCESSING BEGUN		04/25/16	12464168	1
599803	- END PASS	0			
599801	- FROM-RECORDS WRITTEN TO SORT	65			
599802	- TO-RECORDS WRITTEN TO SORT	65			
599806	- INDEX SR8 DESCRIPTORS WRITTEN	0			
599807	- INDEX DOWN DESCRIPTORS WRITTEN	0			
599808	- INDEX UP DESCRIPTORS WRITTEN	0			
599809	- INDEX NO-UP MEM DESCRIPTORS WRITTEN	0			
599810	- INDEX NO-UP DOWN DESCRIPTORS WRITTEN	0			
599702	- NEXT LINK NOT FOUND	CHAIN START OF LINK	0/75030:1	OWNER IS AT	0/75156:1
	SET=DEPT-EMPLOYEE	LINK POINTS TO	0/75027:1	PRIOR IN PFX	0/75013:10
	CHAIN LENGTH 1				
599703	- PRIOR LINK NOT FOUND	CHAIN START OF LINK	0/75156:1	OWNER IS AT	0/75156:1
	SET=DEPT-EMPLOYEE	LINK POINTS TO	0/75009:1	PRIOR IN PFX	0/75030:1
	CHAIN LENGTH 1				



# How to Detect Integrity Problems - reporting

- IDMSDBAN
  - Report 5 – Set report

Loop in pointers:



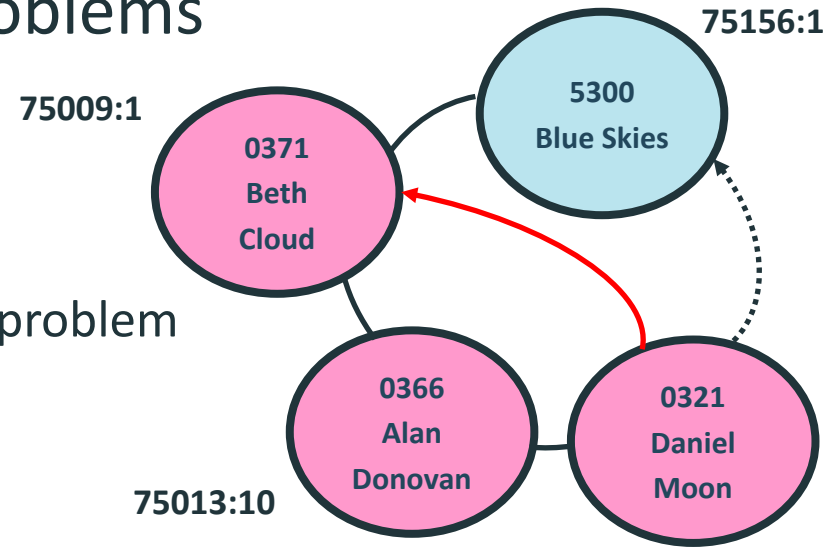
599701	- DUPLICATE TO-DBKEY	SET=DEPT-EMPLOYEE CHAIN LENGTH 1	CHAIN	START OF LINK LINK POINTS TO	0/75030:1 0/75009:1	OWNER IS AT PRIOR IN PFX	0/75156:1 0/75013:10
599701	DUPLICATE TO-DBKEY	SET=DEPT-EMPLOYEE CHAIN LENGTH 1	CHAIN	START OF LINK LINK POINTS TO	0/75156:1 0/75009:1	OWNER IS AT PRIOR IN PFX	0/75156:1 0/75030:1
599703	- PRIOR LINK NOT FOUND	SET=DEPT-EMPLOYEE CHAIN LENGTH 1	CHAIN	START OF LINK LINK POINTS TO	0/75009:1 0/75013:10	OWNER IS AT PRIOR IN PFX	0/75156:1 0/75156:1
599703	- PRIOR LINK NOT FOUND	SET=DEPT-EMPLOYEE CHAIN LENGTH 1	CHAIN	START OF LINK LINK POINTS TO	0/75156:1 0/75009:1	OWNER IS AT PRIOR IN PFX	0/75156:1 0/75030:1
599706	NO OWNER IN THIS CHAIN	SET=DEPT-EMPLOYEE CHAIN LENGTH 2	CHAIN	START OF LINK LINK POINTS TO	0/75013:10 0/75009:1	OWNER IS AT PRIOR IN PFX	0/75156:1 0/75009:1

- DB Audit Option
  - AUDIT : checks set integrity

26

# How to Fix Physical Integrity Problems

- DB Audit Option
  - FIX=SIMULATE : proposes how to fix problem

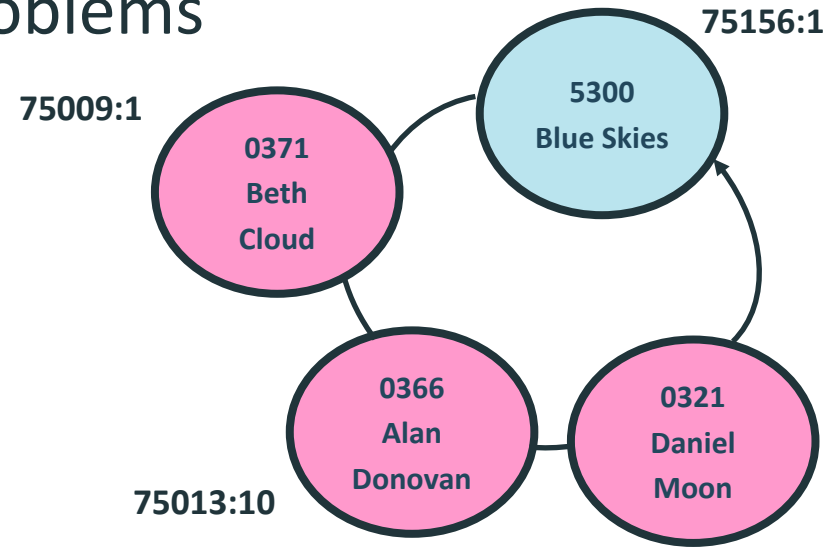


75030:1

[illegible]

# How to Fix Physical Integrity Problems

- DB Audit Option
  - FIX=UPDATE : fixes problem



**75030:1**

[illegible]

# How to Fix Physical Integrity Problems

- IDMSRPTS
  - Get record's set definition to correct broken chain

```
RECORD NAME..... EMPLOYEE
RECORD VERSION..... 0100
RECORD ID..... 0415
RECORD LENGTH..... FIXED
LOCATION MODE..... CALC USING EMP-ID-0415
WITHIN..... EMP-DEMO-REGION OFFSET
DBKEY POSITIONS.... SET..... TYPE..... NEXT 5 PGS FOR DUPLICATES NOT ALLOWED
                                           95 PGS
                                           PRIOR OWNER
CALC MEMBER 1 2
DEPT-EMPLOYEE MEMBER 3 4 5
EMP-NAME-NDX INDEX MEMBER 6
OFFICE-EMPLOYEE INDEX MEMBER 7 8
EMP-COVERAGE OWNER 9 10
EMP-EMPOSITION OWNER 11 12
EMP-EXPERTISE OWNER 13 14
MANAGES OWNER 15 16
REPORTS-TO OWNER 17 18
```

# How to Fix Physical Integrity Problems

## ■ PRINT PAGE

- Preparation to manually fix broken chain

```

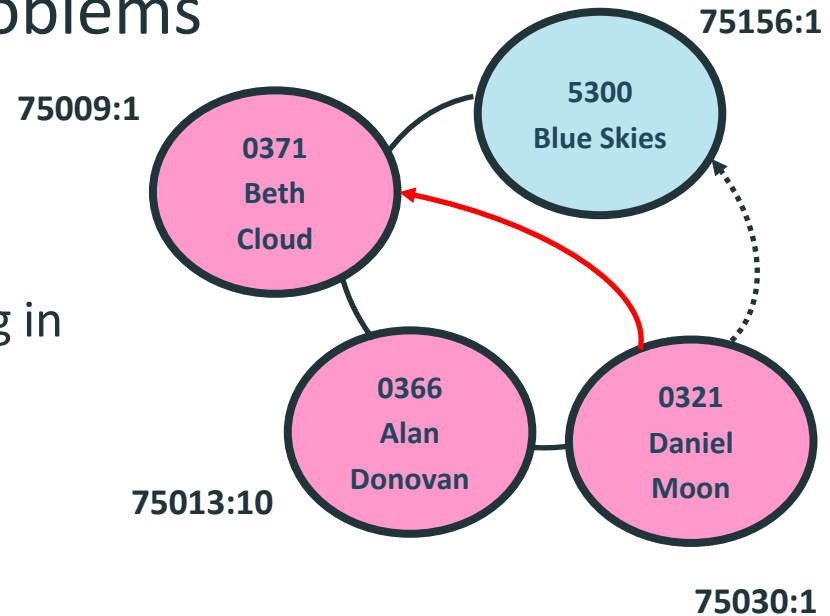
PAGE 75,030          PAGE GROUP 0          AVAILABLE SPACE 4,536
000000 00012516 01251601 01251601 11B80000 01251600 01251600 01250101 0125050A
000020 01259401 0124FA02 01259908 01259902 01256B05 01256B05 01251603 01251602
000040 01251604 01251605 01251607 01251606 0125120E 01251D0F F0F3F2F1 C4C1D5C9
000060 C5D34040 4040D4D6 D6D54040 40404040 40404040 40F1F640 E2D2E8C8 C9C7C840
000080 C4D94040 40404040 40E6C5E2 E3D6D540 40404040 40404040 D4C1F0F4 F3F7F140
0000A0 404040F6 F1F7F4F9 F2F1F4F1 F4F0F1F0 F2F3F4F8 F1F1F0F1 F1F9F7F8 F0F1F0F3
0000C0 F0F0F0F0 F0F0F0F0 F1F9F4F4 F0F3F2F4 01251601 01251603 01251601 01259D08
0000E0 0125050B 01259D08 F1F9F7F8 F0F1F0F3 F1F9F8F1 F1F0F0F9 F5F30055 00000C07
000100 0C000C00 0C000000 01251602 01251601 01251601 01259A06 01259A06 01259A06
000120 F1F9F8F1 F1F0F1F0 F0F0F0F0 F0F0F0F0 F7F10072 00000C01 0C000C00 0C000000
000140 01251605 01251601 01251601 0125A008 0125A004 F0F4F1F9 F6F5F0F5 F0F50000
000160 01251601 01251604 01251601 01259D09 01259D01 F0F3F1F9 F7F5F1F2 F1F50000
000180 01251601 01251607 01251601 0125050A 0125050A 0125050A C140F1F9 F8F1F1F1
0001A0 F1F00000 01251606 01251601 01251601 01250101 01250A0D 01250101 C140F1F9
0001C0 F8F1F1F1 F1F00000 00000000 00000000 00000000 00000000 00000000 00000000
0001E0 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
000200 --SAME--
001380 01CC01A4 00240018 01CC0180 00240018 01A90160 00200014 01A90140 00200014
0013A0 01A40108 00380018 01A400D0 00380018 019F0010 00C00048 00010004 000C0008
0013C0 00480007 00012516

1      4      0 0004      75,030-001      75,030-001      75,009-001      75,013-010      75,156-001      75,002-002
415    120    1 0010      75,030-000      75,030-000      75,115-005      75,115-005      75,030-003      75,030-002
                        75,161-008      75,161-002      75,030-007      75,030-006      75,026-014      75,037-015
                        75,030-004      75,030-005
*0321DANIEL      MOON      16 SKYHIGH DR      WESTON      MA04371      617492141401023*
*481101197801030000000019440324*

```

# How to Fix Physical Integrity Problems

- **FIX PAGE**
  - Manually fix broken chain by plugging in proper value



In our example, NEXT pointer of 75030:1 should be equal to 75156:1

```
IDMSBCF 18.5 CA IDMS Batch Command Facility

FIX PAGE 75030
VER 0018 0125,0101
REP 0018 0125,9401
```

# How to Fix Logical Integrity Problems

- Application program bug
  - Fix the bug
  - Might need one-time program to fix data
- Execution of program at wrong time or with wrong input
  - What do you do ?
  - Depends on when problem is discovered
    - If right after => Rollback
    - If not => one-time program to fix data



# How to Avoid Integrity Problems

- Proper backup and recovery procedures
- Never run UNLOCK on locked databases unless you are 150% certain there are no broken chains

**Database maintenance is done under the covers by DBMS if area opened in update mode**

- Apply HYPER apars regarding data integrity

# Backup and Recovery Techniques

- Frequently scheduled backups
  - Quiesced backups
    - CV down
    - CV up – Areas quiesced
      - DCMT VARY AREA RETRIEVAL or OFFLINE
      - DCMT VARY SEGMENT RETRIEVAL or OFFLINE
      - DCMT QUIESCE AREA
      - DCMT QUIESCE SEGMENT
      - DCMT QUIESCE DBNAME

# Backup and Recovery Techniques

- Frequently scheduled backups (cont'd)
  - Hot backups
    - Quiesce update activity on areas
    - Note date/time of quiesce point
    - Restart update activity on areas
    - Backup the areas
    - Optionally, get another quiesce point on areas

# Backup and Recovery Techniques

- Frequently scheduled backups
  - Local mode update jobs
    - Backup before job
    - Backup after job

# Backup and Recovery Techniques

- Recovery after warmstart failure
  - Offload all journal files
  - ROLLBACK ACTIVE
  - UNLOCK areas not affected by ROLLBACK
  - FORMAT journals

# Backup and Recovery Techniques

- Recovery from database I/O error
  - If transactions' recovery successfully
    - DCMT VARY AREA xxx OFFLINE
    - Fix problem
    - DCMT VARY AREA xxx ONLINE

# Backup and Recovery Techniques

- Recovery from database I/O error (cont'd)
  - If transactions' recovery unsuccessfully
    - DCMT VARY AREA xxx TRANSIENT RETRIEVAL/OFFLINE
    - DCMT VARY JOURNAL
    - DCMT VARY FILE DEALLOCATE
    - Restore backup
    - ROLLFORWARD FILE
    - Rename files
    - DCMT VARY FILE ALLOCATE
    - DCMT VARY FILE ACTIVE
    - DCMT VARY AREA ONLINE

# Backup and Recovery Techniques

- Recovery from journal I/O error (cont'd)
  - Quiesce update activity
  - If all update transactions finish normally
    - Backup areas
    - Format affected journal file
    - DCMT VARY AREA ONLINE



# Backup and Recovery Techniques

- Recovery from journal I/O error
  - If you get SUSPENDED TRANSACTIONS
    - Cancel the system
    - Restore backups of all areas in update mode
    - ROLLFORWARD COMPLETE for all those areas
    - FORMAT JOURNAL ALL
    - Backup areas
    - Restart system

# Backup and Recovery Techniques

- Recovery from local mode operations
  - Not journaling
    - Restore backup taken before job
  - Journaling to tape
    - ROLLBACK with local tape journal
  - Journaling to disk
    - Copy disk journal to tape
    - ROLLBACK with tape journal
  - If using incomplete journal file
    - FIX JOURNAL

# Backup and Recovery Techniques

- Mixed mode recovery
  - When database is updated by both CV and local mode job (at different times)
    - Will need CV and local journals
    - Can use MERGE ARCHIVE or
    - Can run separate ROLLFORWARD jobs

# Summary

- Important to have backup and recovery procedures (and to test them out!!!)
- Be VERY cautious when using UNLOCK and FIX PAGE

# Questions and Answers