Everything You Wanted to Know about DB2 Logs, but Were Afraid to Ask

Paul Pendle, Rocket Software

Session: 16906

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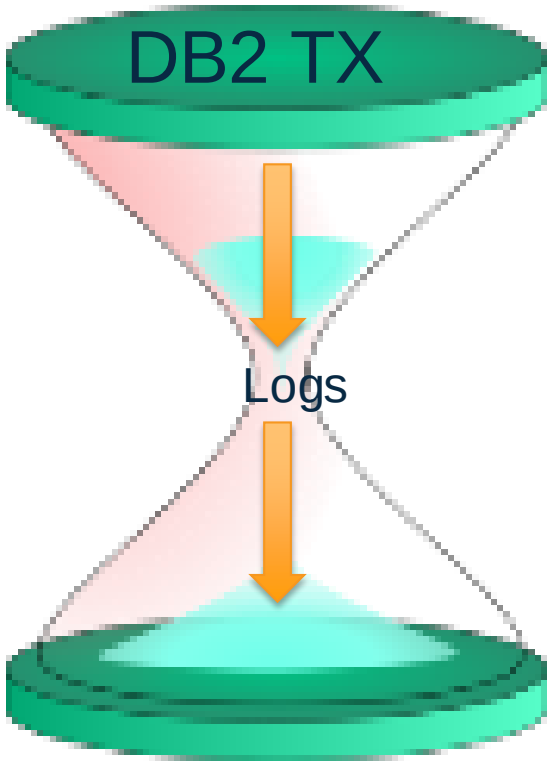
Agenda

- DB2 Logs Introduction
- DB2 Logging Components
- Log Performance
- How to Leverage the DB2 Log
- DIY Log Analysis
- DB2 Log Analysis Tool

DB2 Log Introduction

- Central to every updating transaction
- Key resource for DB2
  - Integrity
  - Recovery
- Bottleneck for transactional activity



What's in a Log?

- Unit of recovery
- Checkpoint data
- Database page set control records
- Other miscellaneous stuff!

Unit of Recovery Data

- Type of activity (Insert, Update, Delete)
- Before and after images of rows/columns
  - Redo and undo records
- Authid and plan name
- DBNAME and TSNAME
- DBID, PSID, OBID
- Compensatory log records
- RBA/LRSN (URID)

RBA and LRSN

- Changed from 6 bytes to 10 bytes with version 11
- RBA (non-data-sharing)
  - Ever increasing hexadecimal number
- LRSN (data sharing)
  - Based on timestamps from the Sysplex Timer
  - Starts with 0 when a new (non-data sharing) DB2 subsystem is started.
- Each log record is assigned a unique RBA/LRSN (URID)
- Increases with change activity
- Tracked in the BSDS

Checkpoint Log Record Triggers

- Elapsed time
- Number of log records
- CHECKPOINT FREQ
- Log switch
- End of successful restart
- Normal termination

Other Quirky Log Content

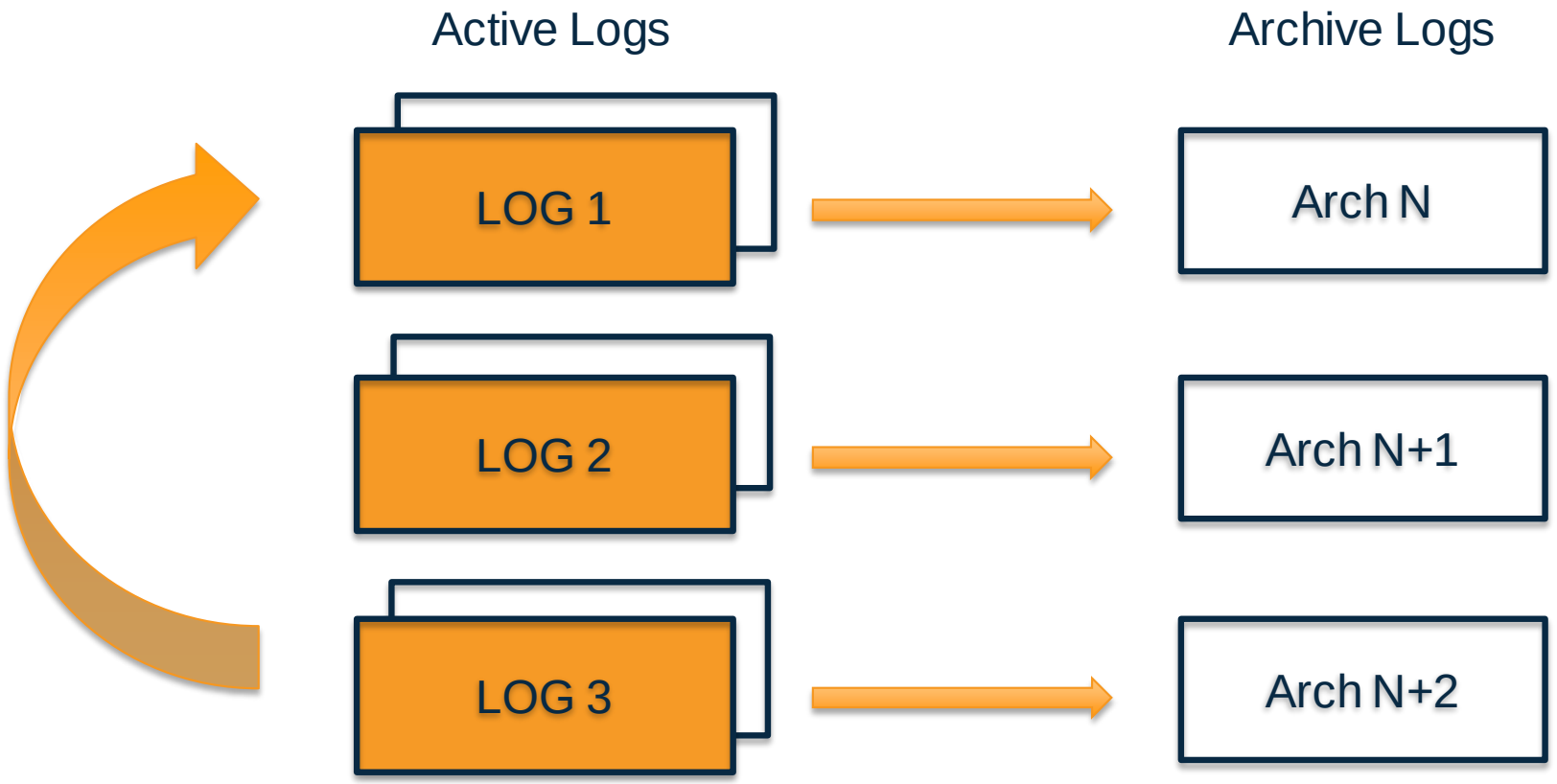
- Dataset creation and deletion
- Database Exception (DBET)
  - -DIS DATABASE(name) RESTRICT
- Compression dictionaries (v11)

Image Copies Registered in the Log

- DSNDB01.SYSUTILX
- DSNDB01.DBD01
- DSNDB06.SYSCOPY
- DSNDB01.SYSDBDXA

DB2 LOGGING COMPONENTS

DB2 Log Components



BSDS and the Logs

- Manages logs (active and archive)
- Tracks
  - Active Logs and RBA range
  - Archive Logs
  - Recent log point
  - Checkpoints

DSNJU003 (Change Log Inventory)

- Add or delete active or archive log data sets
- Add or delete checkpoint records
- Modify the value for the highest-written log RBA value or the highest-offloaded RBA value
- Other non-log stuff

DSNJU004 (Print Log Map)

- Log data set name, log RBA association, and log LRSN for both copy 1 and copy 2 of all active and archive log data sets
- Active log data sets that are available for new log data
- Contents of the checkpoint queue
- Archive log command history
- Other stuff …

DSNZPARMs for Logs

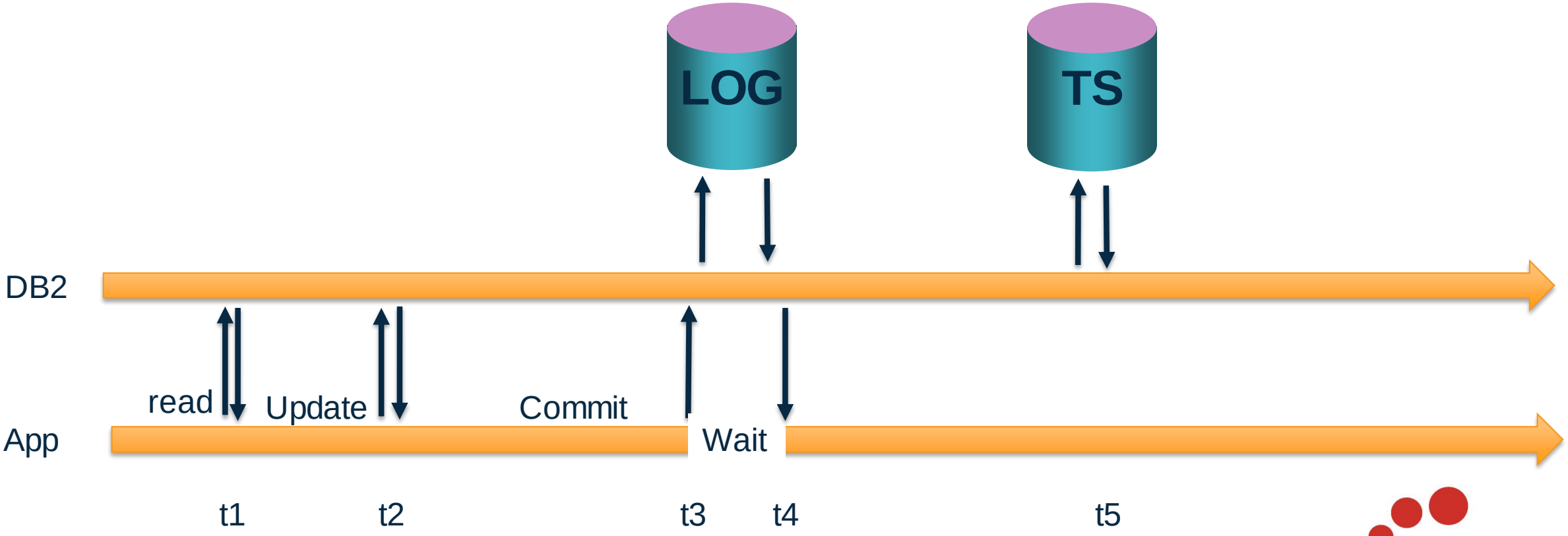
- DSN6LOGP DEALLCT=(0000),
  - MAXARCH=10000,
  - MAXRTU=2,
  - OUTBUFF=4000,
  - TWOACTV=YES,
  - TWOARCH=YES,
  - ARC2FRST=NO
- ARCHIVE LOG FREQ
- ARCHIVE LOG RACF
- MAXARCH

LOG PERFORMANCE

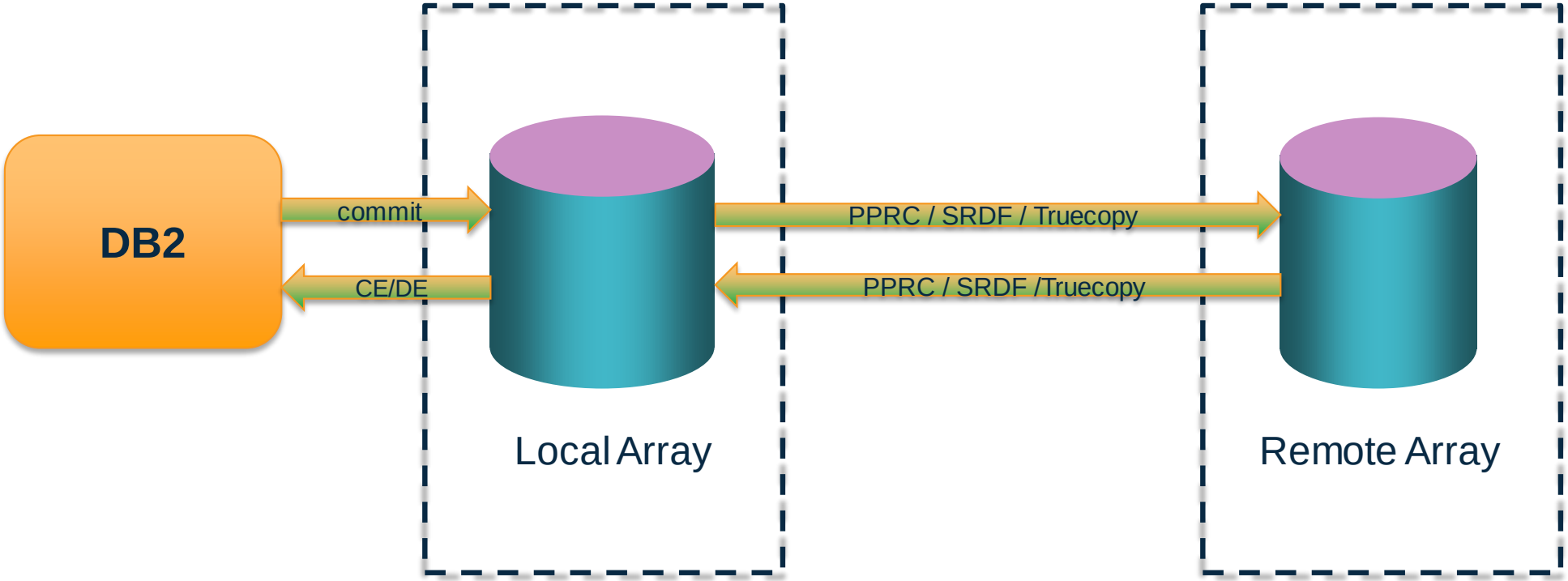
Improving Log Performance

- Separate Archive logs and Active logs
  - Separate volumes (physical disks if you can)
- Separate log copies (as above)
- Make log output buffers as large as feasible (OUTBUFF)
- VSAM stripe DB2 logs (or not!)
  - … “generally unnecessary with the latest devices”
- Remote replication considerations
  - Latency introduction by synchronous array replication

DB2 Commit Process



Synchronous Array Replication



zHyperWrite (Dec 2014)

- Reduces latency of synchronous replication
- New function provided by OA45662
  - (OA45125,OA44973,PI25747)
- IECIOSxx
  - HYPERWRITE=*yes/no*
- SETIOS HYPERWRITE={YES|NO}
- Pre-requisites
  - z/OS 2.1, Hyperswap/TPC-R Hyperswap/PPRC
  - DS8870 (w/specific MCL)

Data Capture Changes

- Logs more data into the log
  - Whole rows rather than single columns
- Provides an in-record context for an update

HOW TO LEVERAGE THE DB2 LOG

Log Data Use Cases

- Reporting of DB2 log activity
- Auditing of DB2 update, insert, delete activity
- Recovery of DB2 data
- Replication of DB2 activity

Reporting on DB2 Activity

- Change activity level and tracking
- Application RI reporting
- DDL tracking and reporting
- Report on non-Z change activity

Auditing Catalog Changes

- Report activity affecting DB2 catalog objects
- Display INSERT, UPDATE, and DELETE activity
- Translate the activity to
  - GRANT, REVOKE
  - CREATE, ALTER, DROP
- Display the timestamp when the action occurred

Change Activity Auditing

- Who changed what and when
  - Plan name
  - Package name
  - Table name
  - Activity (insert, update, delete)
  - Values (before and after)
- Show the sequence of the changes
- Valuable data for security-sensitive information
- Text alerts for unexpected changes

DB2 Log Auditing

- Monitor/Audit table activity
  - UPDATE/INSERT/DELETE
  - Who is changing data?
  - What is the sequence of the changes?
- Load reports into audit tables for review

Recovery Possibilities

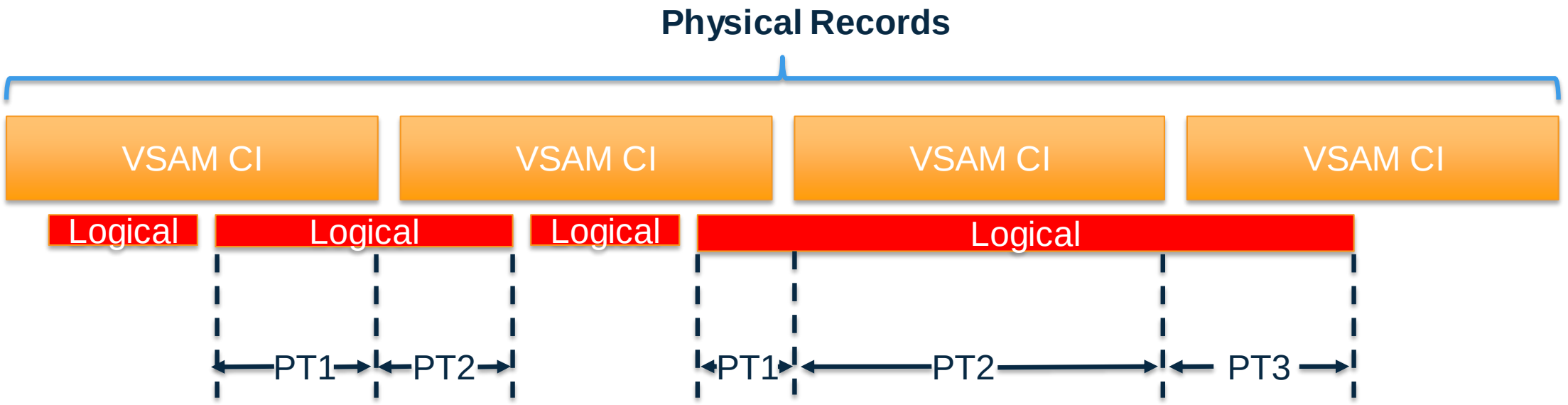
- Generate SQL to UNDO or REDO changes recorded in the log
- Support for dropped object recovery
  - Report on and recover data for dropped objects
  - After DDL is recreated, restore the data in the regenerated table back to its state prior to the table being dropped

Replication Possibilities

- Replay changes on another system / object
  - LOAD or REDO SQL
- Used for data warehousing / internal processes
- Used for setting up test systems
  - Use production data for authentic application testing

DIY LOG ANALYSIS

Log Record Structures



Log Record Types

Record Type	Event Type	#Sub Types
0002	Page set control	9
0004	SYSCOPY utility	
0010	System event	
0020	Unit of recovery control	11
0100	Checkpoint	2
0200	Unit of recovery undo	
0400	Unit of recovery redo	
0800	Archive log command	
2200	Savepoint	2
4200	End of rollback to savepoint	2
4400	Alter or modify recovery log record	1

sdsnmacs(dsndqj00)

Accessing the Log Data

- Using IFI
  - -START TRACE(P) CLASS(30) IFCID(126) DEST(OPX)
    - Real time access to log buffers in the online performance buffer
    - Synchronous
    - Asynchronous
- Log Capture Exit routine
  - Performance critical exit
  - DSNJL004

Image Copy Requirements

- Interrogate SYSCOPY
- Allocate the IMAGE COPY
- Reverse engineer the IMAGE COPY data pages
- Baseline the row content

Data Capture Changes

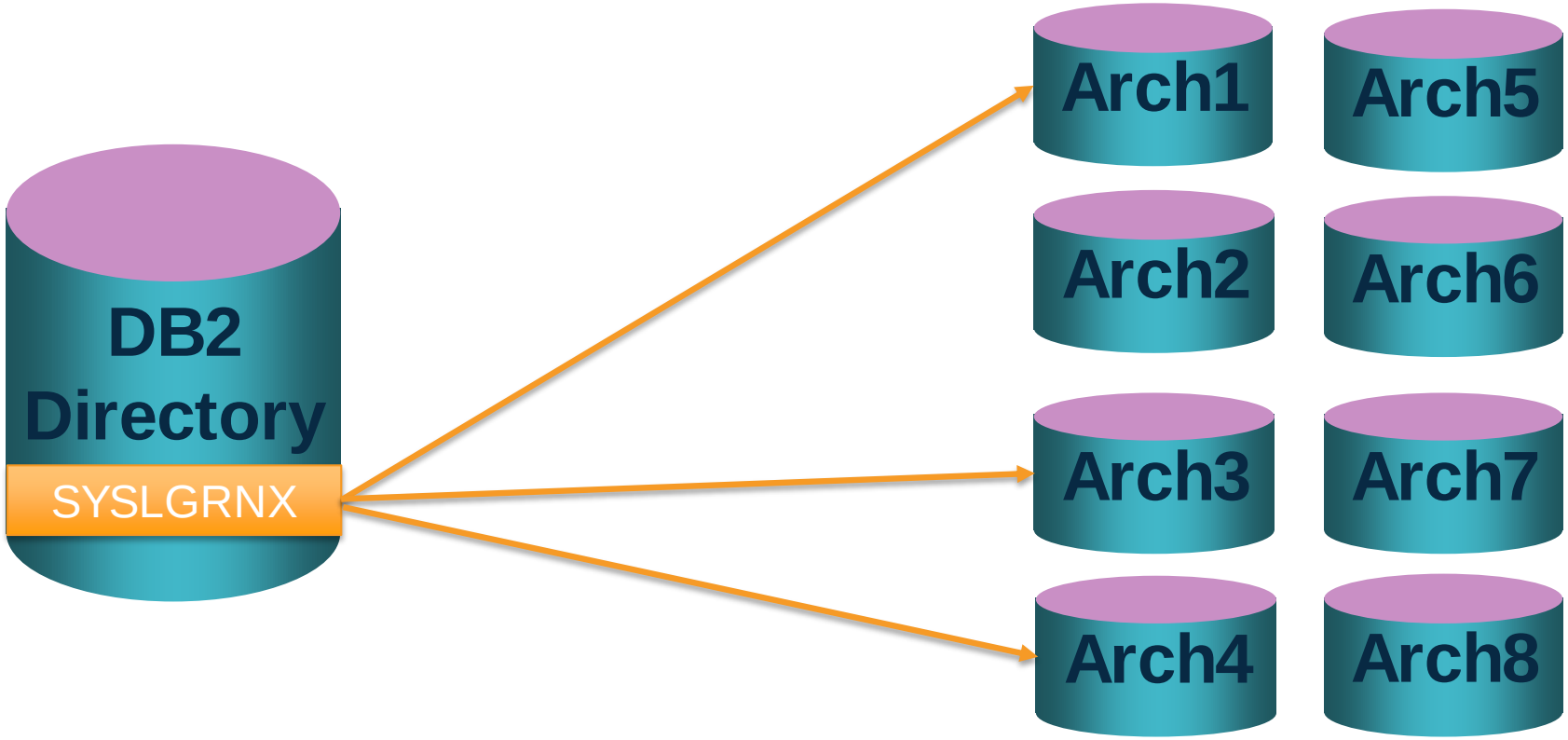
Managing “Odd” Log events

- REORGs
- Not logged activities
- Adding Columns
  - Table Versioning
- LOADs
- Compression dictionary rebuilds

Managing Compression

- Compressed rows require a compression dictionary to decompress
- Which compression dictionary?
- REORG kept/redefined CD?
- Understanding the CD layout
- How to reverse engineer the CD?
- How volatile is the structure?

SYSIBM.SYSLGRNX



Can DSN1LOGP help?

- Prints log records from active or archive logs
- Breaks up the physical records into logical records
  - Still unformatted
- Useful for debugging your DYI code

DB2 LOG ANALYSIS TOOL

IBM DB2 Log Analysis Tool (LAT)

- Provides robust:
  - Reporting/Auditing
  - Recovery
  - Replication
- Always day one support for new DB2 versions
  - Even DB2 11 with the RBA size change
- Extensive use of ZIIP processors

LAT Reporting

- General report and detail report
- Custom reports by filter:
  - Authid
  - Plan
  - Table owner/name
  - Database, table space
  - ID (OBID, PSID, DBID)
  - Time range
  - URID
  - Activity (U/I/D)

General Report (1)

```
V3.5.0 ---------- Generate database activity report (general) ---- SC01/SS1A
COMMAND ===>
                                                                More:     +

*DB2 subsystem name..... SS1A     (SSID)
*Action................. E        (E - Edit, S - Submit)
 Job Identifier.........
*Generate details....... Y        (Y/N)
*Data Sharing Mode...... Y        (Y/N)
*Specify logs........... N        (Y/N)
*LOAD options........... N        (Y/N)
 Misc flags.............          (X - Bypass SYSLGRNX,
                                  P - Include partial recovery points,
                                  H - High speed mode)
*Output flags........... GS       (B - Bypass reports, G - General, S - Summary,
                                  X - Extended, T - Transaction,
                                  Q - Quiet time, I - Impact,
                                  J - Impact by row, F - Commit Frequency,
                                  C - Continuous mode file)
Log range:
 Start/End Date-Time.... 2014/01/11 - 00:00:00 / 2014/09/01 - 00:00:00
 Start/End RBA (URID)...                       /
 Start/End LRSNs........                       /
 Continuous mode file...
```

General Report (2)

```
V3.5.0 ---------- Generate database activity report (general) ---- SC01/SS1A
COMMAND ===>
                                                                More:    -
 Start/End Date-Time.... 2014/01/11 - 00:00:00 / 2014/09/01 - 00:00:00
 Start/End RBA (URID)...                       /
 Start/End LRSNs........                       /
 Continuous mode file...
*Resolve started UOWs... N       (Y/N)
*Override GMT offset.... N       (Y/N)
  with this GMT offset.. +00:00

Filters for log data:
*Show UPDATEs........... Y       (Y/N)
*Show DELETEs........... Y       (Y - Yes, N - No,
                                  X - Yes, but exclude mass deletes)
*Show INSERTs........... Y       (Y - Yes, N - No, X - Yes, but exclude loads)
*Show rollbacks......... N       (Y - Yes, N - No, O - Only)
*Compensation recs...... N       (Y/N)
*Include LOB/XML data... N       (Y/N)
*Show uncommitted....... N       (Y/N)
*Include catalog data... N       (Y/N)
*Misc filters........... Y       (Y/N)
*Object filters......... A       (N - None, M - By Name,
                                  I - By IDs, A - Advanced)
*Filter file usage...... N       (N - None, S - Save, E - Edit, U - Use)
 Filter file name.......
```

LAT Recovery

- Dropped object
  - Support this effort though DML
- Surgical transaction removal
  - Through SQL engine
- Recovery to earlier state using SQL engine
  - Backwards or forwards

Replication

- Create load files for other DB2 systems
- Create CSV, EBCDIC files
- Create fixed column output files (v3.5)

Summary

- The DB2 LOG contains a wealth of data that can be used for:
  - Auditing
  - Replication
  - Recovery
- It can be processed by home-grown programs
- IBM DB2 Log Analysis Tool is a good alternative

References

- http://www-03.ibm.com/software/products/en/db2lat
- DB2 Admin Guide (Chapter 14)

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