Journaling Forensics 101

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Today's Agenda

- Review of journaling concepts
- Tuning your journaling environment for forensics
- The old-fashioned, manual approach to dumping journal receivers
- The DMPJRN and CVTJRNDTA commands
- Practical example (time permitting…)

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Obligatory Brag Slide

- PC Richard & Son
  - Founded in 1909 as a hardware store in Bensonhurst, Brooklyn.
  - Began transition to appliances by selling the first electric iron, and later the first washing machines.
  - Currently own and operate 66 retail showrooms throughout NY, NJ, CT, & PA.
  - Family owned and operated – 5th Generation
- Steve Wolk
  - Joined PCR in 1986
  - Became company's first CTO in 2000.

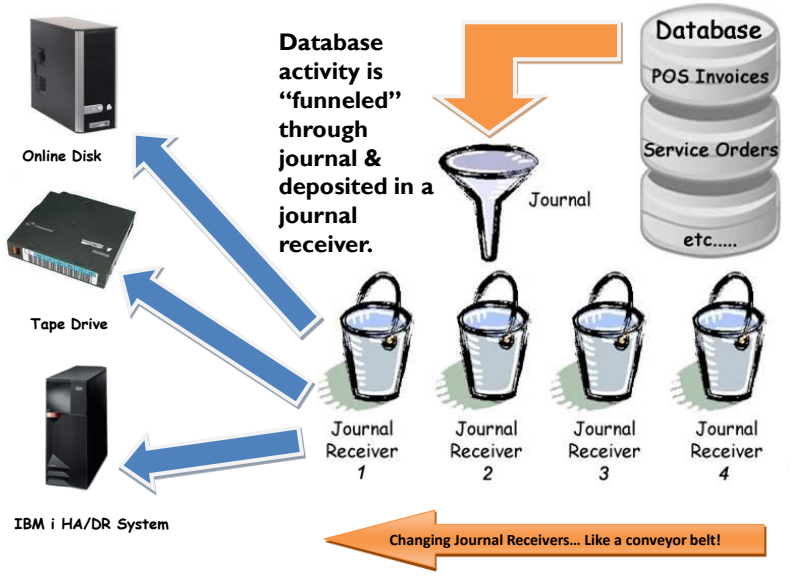
Most IBM i shops journal their DB files.

- Does yours?
- Why you should:
  - Enables use of Commitment Control
  - Recovery – APYJRNCHG, RMVJRNCHG
  - Replication to HA/DR system
  - Forensics

Objects involved in Journaling

- Journal
  - Attributes governing the what, where, when and how of journaling
  - Pointers to objects being journaled
  - Pointers to Journal Receivers
  - The Journal records the who, what, where, and when of what was done – along with what it looked like both before and after!
- Journal Receiver
  - Containers for the storage of journal entries, recording the journaled activity

Brief Review of Journaling Concepts



Optimal Journal Forensic Settings

- CRTJRN MINENTDTA(*NONE)
  - MINENTDTA (Minimize Entry Specific Data) is great in that it saves space in your journal receivers by only recording the changed bytes. However, by not recording the entire record, it makes forensics very difficult.
- STRJRNPF IMAGES(*BOTH)
  - This also takes more space in your journal receivers, but it's very useful to see both the before and after image when examining a changed record.

Journal Forensics…What's in it for me?

- You have bad data – what program did it?
- What else did that program do at that time?
- Replay events and transactions to understand a chain of events
- And of course … Find the bad guy

Dumping a Journal

- Step 1 – Gather Information
  - The file whose journal entries you need to dump
  - The journal used for this file – DSPFD
  - The journal receivers needed based on date/time range – WRKJRNA F15 to see the attach/detach date/time for each receiver.

Dumping a Journal

- Step 2 - DSPJRN to *OUTFILE
  - DSPJRN JRN(MYJRNLIB/MYJOURNAL)
    FILE((MYDBLIB/MYDBFILE MYMEMBER))
    RCVRNG(MYJRNLIB/STR_RCVR MYJRNLIB/END_RCVR)
    OUTPUT(*OUTFILE)
    OUTFILE(QTEMP/TMPJRNOUT)
    ENTDTALEN(*CALC)
  - This gives you an output file containing all the journal activity fields from record format QJORDJE along with a single field containing your database data. The length of this field is determined automatically by the ENTDTALEN(*CALC). This is known as the Entry Specific Data.

What does the Journal tell me?

Description	Field	Type	Length	Dec
Length of entry	JOENTL	S	5	0
Sequence number	JOSEQN	S	10	0
Journal Code	JOCODE	A	1	
Entry Type	JOENTT	A	2	
Date of entry	JODATE	A	6	
Time of entry	JOTIME	S	6	0
Name of Job	JOJOB	A	10	
Name of User	JOUSER	A	10	
Number of Job	JONBR	S	6	0
Name of Program	JOPGM	A	10	
Name of Object	JOOBJ	A	10	
Objects Library	JOLIB	A	10	
Name of Member	JOMBR	A	10	
Count or relative record	JOCTRR	S	10	0
Flag: 1 or 0	JOFLAG	A	1	
Commit cycle identifier	JOCCID	S	10	0
Incomplete Data: 1 or 0	JOINCDAT	A	1	
Minimized Esd: 0, 1, or 2	JOMINESD	A	1	
Not used	JORES	A	6	
Entry Specific Data	JOESD	A	Varies	

What does the Journal tell me?

Description

Length of entry
Sequence number
Journal Code
Entry Type
Date of entry
Time of entry
Name of Job
Name of User
Number of Job
Name of Program
Name of Object
Objects Library
Name of Member
Count or relative record
Flag: 1 or 0
Commit cycle identifier
Incomplete Data: 1 or 0
Minimized Esd: 0, 1, or 2
Not used
Entry Specific Data

Journal Codes

A	System accounting entry
B	Integrated file system operation
C	Commitment control operation
D	Database file operation
E	Data area operation
F	Database file member operation
I	Internal operation
J	Journal or journal receiver operation
L	License management
M	Network management data
P	Performance tuning entry
Q	Data queue operation
R	**Record level operation** ★★★★
S	SNADS, network alerts, or MSF
T	Audit trail entry
U	User generated
Y	Library operation

What does the Journal tell me?

Description
Length of entry
Sequence number
Journal Code
Entry Type
Date of entry
Time of entry
Name of Job
Name of User
Number of Job
Name of Program
Name of Object
Objects Library
Name of Member
Count or relative record
Flag: 1 or 0
Commit cycle identifier
Incomplete Data: 1 or 0
Minimized Esd: 0, 1, or 2
Not used
Entry Specific Data

Entry types for journal code R

BR	Before-image of record updated for rollback
DL	Record deleted from physical file member
DR	Record deleted for rollback
IL	Increment record limit
PT	Record added to physical file member
PX	Record added directly to physical file member
UB	Before-image of record updated in physical file member
UP	After-image of record updated in physical file member
UR	After-image of record updated for rollback

- To view list of entry types for other journal codes:
  - DSPJRN
  - Position cursor on "Type" column
  - Press Help

What does the Journal tell me?

Description
Length of entry
Sequence number
Journal Code
Entry Type
Date of entry
Time of entry
Name of Job
Name of User
Number of Job
Name of Program
Name of Object
Objects Library
Name of Member
Count or relative record
Flag: 1 or 0
Commit cycle identifier
Incomplete Data: 1 or 0
Minimized Esd: 0, 1, or 2
Not used
Entry Specific Data

- YOUR DATA!
- Hex representation of your record format though.
- The ESD must be broken apart into discrete fields to be really useful.
- Can be a pain to do this.

Why do we need to break down the ESD into discrete fields?

```
            Entry specific data
Column      *...+....1....+....2....+....3....+....4....+....5
00001      'A ¬        TK  VHB655X                    ¬È     '
00051      '      r¤   å±   ø           ¤                ¬   '
00101      '          Y       Â¬   "       '
```

Ugly… Isn't It? Of course, we could always F11 for hex view…

```
            Entry specific data
Column      * . . . + . . . . 1 . . . . + . . . . 2 . . . . +
00001      'C1055F1214010F001F001FE3D2001FE5C8C2F6F5F5E7404040'
00026      '40404040404040404040404040404040404040285F740F080F00'
00051      '00172F000001999F000000478F000001700F000F0000000F00'
00076      '000F009F001F020F012F000F000F000F000F00000F055F0000'
00101      '0F00000F00000F404040E840000F000F4008625F4001037F07'
00126      '380F00000F'
```

Not much better…

Dumping a Journal

- Step 3 – Break ESD into discrete fields
  - Use DDS or SQL to create a new PF containing the journal activity fields and your database fields.
- Step 4 – Map the data
  - CPYF FMTOPT(*NOCHK).
  - This maps the ESD to your discrete database fields.

But this all is a lot of effort, and we don't always have the time… so we create tools!

No time to dump journals the old fashioned way…

DMPJRN to the rescue…

The DMPJRN Command

```
                        Dump Journal Data (DMPJRN)

Type choices, press Enter.

Journal  . . . . . . . . . . . . JRN          _________
  Library  . . . . . . . . . . .               *LIBL
Range of journal receivers:      RCVRNG
  Starting journal receiver  . .              _________
    Library  . . . . . . . . . .               *LIBL
  Ending journal receiver  . . .              _________
    Library  . . . . . . . . . .               *LIBL
Journaled file:                  FILE

                                              _________
    Library  . . . . . . . . . .               *LIBL
  Member . . . . . . . . . . . .              *ALL
Converted Output file  . . . . . CVTOUTF      _________
  Library  . . . . . . . . . . .               *LIBL
Replace or add records . . . . . OUTOPT       *REPLACE
```

How does DMPJRN work?

- Reconstructs the DSPJRN command based on the DMPJRN parameters specified
- Passes the command to QCMDEXC
- Uses the CVTJRNDTA command to process the DMPJRN temporary output file

Tell me more about CVTJRNDTA!

```
                    Convert Journal Data (CVTJRNDTA)

Type choices, press Enter.

DSPJRN Output file . . . . . . . DSPJRNOUTF
  Library  . . . . . . . . . . .                  *LIBL
Converted Output file  . . . . . CVTOUTF
  Library  . . . . . . . . . . .                  *LIBL
Replace or add records . . . . . OUTOPT           *NONE
```

What CVTJRNDTA does…

- Creates the output file using an SQL join between the DSPJRN temporary output file and the original journaled PF.
- sqlcmd='create table ' + %trim(outlib) + '/' + %trim(outfil) +
  ' as (select joentl, joseqn, jocode, joentt, jodate, +
  jotime, jojob, jouser, jonbr, jopgm, joobj, jolib, +
  jombr, joctrr, joflag, joccid, joincdat, jominesd, +
  jores, ' + %trim(JrnFil) + '.* from ' +
  %trim(dsplib) + '/' + %trim(dspfil) + ', ' +
  %trim(jrnlib) + '/' + %trim(jrnfil) +
  ') with no data';

What CVTJRNDTA does…

- This new file contains the best of both worlds – the journal audit fields and your discrete database fields.
- Copies the data from the DSPJRN temporary output file to the newly created PF.

Duty calls…

- We use the DMPJRN command to check the security access file:

```
DMPJRN  JRN(WHITEHOUSE/JOURNAL)
        RCVRNG(*CURCHAIN)
        FILE(WHITEHOUSE/SECURITY)
        CVTOUTF(WHITEHOUSE/AUDIT)
```

- We view the results:

```
Select * from AUDIT
```

Surprising results

Jrn Seq #	Ent Type	Date	Time	Job	User	Job#	Program	Object	User	Clearance
13	UB	082412	221809	DEV1	JLYNCH	479286	SEC_CTRL	SECURITY	John Lynch	Minimal
14	UP	082412	221809	DEV1	JLYNCH	479286	SEC_CTRL	SECURITY	John Lynch	Presidential
15	BR	082412	221812	DEV1	JLYNCH	479286	SEC_CTRL	SECURITY	John Lynch	Presidential
16	UR	082412	221812	DEV1	JLYNCH	479286	SEC_CTRL	SECURITY	John Lynch	Minimal
19	UB	082412	221926	DEV1	JLYNCH	479286	QDZTD00001	SECURITY	John Lynch	Minimal
20	UP	082412	221926	DEV1	JLYNCH	479286	QDZTD00001	SECURITY	John Lynch	Presidential

- JLYNCH tried to raise his clearance from Minimal to Presidential using program SEC_CTRL – but this program had safeguards and, using commitment control, issued a rollback.
- The nefarious JLYNCH then used the ultimate weapon… DFU… and raised his clearance to Presidential.

The tools are free!

- Download the zip file containing a save file and instructions from the LISUG web site.
- Open the zip file and follow the instructions in the ReadMe.txt.
- For V5R3M0 and later only.

Thank you!

- Any questions?
- Please send any feedback on the DMPJRN & CVJRNDTA commands to:

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