Db2 12 Migration

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November 2018
Session IK

Agenda

- Application Compatibility
- Pre-requisites and Incompatibilities
- Migration

Application Compatibility

APPLCOMPAT for Db2 12

- “Application Compatibility Level” controls the use of new and changed SQL capabilities that are introduced in function levels
  - First - you must activate the new Function Level (continuous delivery)
  - Then - you can enable the new Application Compatibility Level
- Set Application Compatibility Level at different levels
  - at the system level (with ZPARM DSN6SPRM.APPLCOMPAT)
  - at the application level (with Bind Parameter or SQL Register)
- Sets default for packages that do not explicitly specify it

APPLCOMPAT for Db2 12

- APPLCOMPAT format evolves for Db2 12
  - For Db2 10 & 11
    - VvvRr (V10R1 or V11R1)
  - For Db2 12
    - VvvRrMmmm (V12R1M100 , V12R1M500 etc…)

APPLCOMPAT and DDL

- Db2 12 DDL is now sensitive to APPLCOMPAT not Function Level
  - All DDL using new function must run under APPLCOMPAT V12R1M500 or above
  - Functions attempting to run below their function level will get either SQLCODE or revert to previous behaviour
  - E.g. ALTER TABLE ALTER COLUMN to run as a pending alter requires APPLCOMPAT V12R1M500 or above, otherwise will default to an immediate alter

Change in Strategy for APPLCOMPAT

- No need to force the rebind of all packages with a new, higher APPLCOMPAT level
- APPLCOMPAT will now have many more versions to support many Function Levels
- Must still rebind a package with a higher APPLCOMPAT level in order to exploit new SQL DML, SQL DDL, SQL DCL, and XML function
  - Applications can only use new SQL if the packages are bound with the necessary and required Application Compatibility (APPLCOMPAT)
    - Packages can only be bound with an APPLCOMPAT less or equal to the current FL

- Still recommended best practice to regularly rebind all packages to
  - Benefit from latest run time performance improvements
  - Gain exposure to new access path selection improvements
  - Benefit from defect fixes
  - Reduce exposure to latent issues seeded previously

Is APPLCOMPAT a ‘sticky’ Option on BIND/REBIND?

- BIND REPLACE does **not** reuse any bind option from the existing package if the option is not explicitly specified
- SQL statements can be totally different so BIND REPLACE is considered a new bind
- REBIND and BIND COPY are the only subcommands that reuse the existing/source package's options
  - APPLCOMPAT is only a sticky option if APPLCOMPAT column value in SYSPACKAGE is populated for the package
  - If not, the level-id value for system parameter APPLCOMPAT will be used
  - So be careful in advancing the level-id of the system parameter APPLCOMPAT
- This is true in all Db2 for z/OS releases and not just Db2 12 for z/OS

APPLCOMPAT Does Not Last for Ever

- APPLCOMPAT provides isolation for up to 2 Db2 versions
- Ultimately, you must change your applications to handle incompatibilities that are introduced in newer Db2 versions
  - Db2 12 still supports APPLCOMPAT V10R1
- IFCID 366 and 376, available in Db2 11 and 12, will capture SQL execution isolated by APPLCOMPAT and BIF_COMPATIBILITY and DISALLOW_SEL_INTO_UNION
- See Db2 12 Installation and Migration Guide for a list of incompatibilities that are isolated by APPLCOMPAT
  - 26 incompatibilities between Db2 10 and Db2 11
  - No application and SQL incompatibilities for migration from Db2 11 to Db2 12

Pre-requisites and Incompatibilities

Db2 12 HW and SW Requirements

- Minimum hardware prerequisite (all running in 64-bit mode)
  - z14, z13, zEC12, z196
- Processors must have enough real storage to satisfy the combined requirements of Db2 12 and z/OS
  - Up to 30% increase excluding buffer pools
- Minimum software prerequisites
  - z/OS V2 R1 (or higher) with
    - DFSMS V2 R1
    - Language Environment Base
    - Security Server V2 R1
  - IRLM (shipped with Db2 12 for z/OS)
- Generously provision enough zIIP capacity for total system workload

Pre-requisites for Migrating to Db2 12

- Understand new terminology
  - No more modes, now function levels
- Ensure catalog consistency
  - REPAIR DBD TEST/DIAGNOSE + CHECK DATA/LOB/INDEX + DSNTESQ + ….
- Run pre-migration check queries and act on the reported findings
  - DSNTIJPM (Db2 12 for z/OS) or DSNTIJPC (APAR PI58254 for Db2 11 for z/OS)

Pre-requisites for Migrating to Db2 12

- Apply the Fallback SPE APAR, PI33871 / II14794, and any prerequisite fixes
  - Your Db2 11 system MUST be at the proper service level
- Make sure Db2 11 for z/OS PTF level is reasonably current especially if exploiting mixed release coexistence with data sharing
- Non-Data Sharing
  - Db2 11 must be started with the SPE applied, or migration to Db2 12 will terminate
- Data Sharing
  - Before migrating a member to Db2 12 (V12R1M100), all other started Db2 11 members must have the fallback SPE applied

Important – Apply SPE to ALL Data Sharing Members Before Starting Migration!

Early code

- If Db2 11 system is at the prerequisite maintenance level, then early code is upwardly compatible
  - The Db2 12 early code is downward compatible with V11

- Activate the Db2 12 EARLY Code
  - IPL or
  - F LLA,REFRESH & -REFRESH,Db2 EARLY
    - Db2 must be down, but an IPL can be avoided

Migration / Fallback Maintenance

- No INFO APAR for migration/co-existence in Db2 12

- Use Fix Categories to check for migration fallback/co-existence maintenance
  - **IBM.Migrate-Fallback.Db2.V12**
    - Fixes that allow prior releases of Db2 to migrate to or fall back from Db2 for z/OS V12
  - **IBM.Coexistence.Db2.SYSPLEXDataSharing**
    - Fixes that enable Db2 releases to coexist when in data sharing mode.

- Fixcat external site
  - IBM Fix Category Values and Descriptions

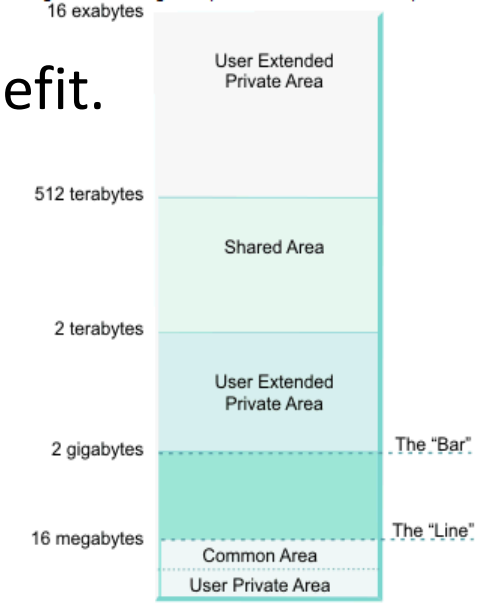
Prerequisite summary & planning …

- Data Sharing
  - Data Sharing requires the latest Coupling Facility (CF) level recommended for your processor at http://www.ibm.com/systems/z/advantages/pso/cftable.html
- Programming language requirements – minimum levels etc.
  - Enterprise COBOL for z/OS V3.4 (5655-G53) or later
  - VS Fortran 2.6 (5668-806, 5688-087, 5668-805). New data type and function are not supported since Db2 9.
  - Enterprise PL/I for z/OS V3.9 (5655-H31) or later
  - DSNHPC7 included in the base for older COBOL and PL/I
    - See the Program Directory

Prerequisite summary & planning …

- Configure a minimum of (IEASYSxx)
  - 1TB of contiguous shared private per Db2 – **HVSHARE**
    - Default is 510TB
    - Article on HVSHARE
  - 6GB of contiguous 64-bit (HVCOMMON) per Db2
    - Same as Db2 11, with a default of 66GB
  - Configure additional megabytes of 1MB LFAREA for maximum benefit.
    - Large Frame Area
    - See z/OS APAR OA34024 for LFAREA Sizing information
- PDSEs
  - Required for SDSNLOAD, SDSNLOD2, ADSNLOAD, ADSNLOD2 - Same as V11

Figure 3. Storage map for a 64-bit address space



Prerequisite summary & planning …

- Relief for buffer pool constraints
  - Max space for all buffer pools is now 16 TB (was 1 TB)
    - Max space refers to the sum of all VPSIZEs and SPSIZEs
  - Max buffers per 4 KB buffer pool is now 4,000,000,000 (was 250,000,000)
  - Max buffers per 8 KB buffer pool is now 2,000,000,000 (was 125,000,000)
  - Max buffers per 16 KB buffer pool is now 1,000,000,000 (was 62,500,000)
  - Max buffers per 32 KB buffer pool is now 500,000,000 (was 31,250,000)
  - The DBM1 address space proc created by DSNTIJMV now specifies a MEMLIMIT of 19 TB (was 4 TB)
- Migration: The new limits are available after migration to Db2 12
- Fallback: The new maximums (total and per buffer pool) are supported after fallback to Db2 11 as long as there is sufficient real storage

Check 4GB Log Data Sets

- Prior to Db2 12 logs need to be 4GB or less
  - Db2 11 will ignore extra space if >4GB
  - In Db2 12 either
    - Db2 will not start if log >4GB
    - -SET LOG will fail
- Recommendation
  - Ensure all log data sets <=4GB before moving to Db2 12
- Db2 12 has upper limit of 768GB
  - Logs need to have contiguous space
  - Remember Archive log data set space
  - Can use with V12R1M500 and above

New UNLOAD privilege

- SELECT privilege is no longer sufficient to execute UNLOAD
  - UNLOAD privilege introduced to control utility execution
  - Can be granted in V12R1M100 and becomes active after activating V12R1M500
- New ZPARM AUTH_COMPATIBILITY
  - Set to SELECT_FOR_UNLOAD to still check the SELECT privilege
- New IFCID 404 (V11 APAR PI55706) can be activated to audit the usage of the SELECT privilege for UNLOAD

Activate utilities

- Ensure that IFAPRDxx member contains utility suite
  - PRODUCT OWNER('IBM CORP')
    NAME('Db2 UTIL SUITE') ID('5770-AF4')
    VERSION(12) RELEASE(1) MOD(*)

Quotes from Db2 Early Support Programs

Db2 12 – Exciting new capabilities

We love the "agile partition technology" that Db2 12 offers. This feature makes it easier for ITERGO to address "hot spots" where "new data" is inserted. This is particularly important when enterprises are looking for scale, speed and reduced costs .

Walter Janissen
Chief Architect
ITERGO

ITERGO

Db2 12 –Offering Advanced "in-memory" technology

We are looking forward to exploiting the ***advanced "in-memory" technology that Db2 12 offers*** (Index Fast Traverse Block) this gives us an opportunity to reduce CPU resource consumption and performance cost by using more real memory. It is very cost effective trade off for enterprises like us that run Db2 12 on z13 machines. During testing we have seen up to 23% CPU reductions in "specific" test cases.

Henrik Henriksen
Db2 DBA
Danske Bank

Danske Bank

Db2 12 rules the API Economy

The RESTful API is yet another way where Db2 is at the leading edge – and again cementing Db2's and the mainframes position as a full capable server in the IT infrastructure of today. Using these REST-services Mobile applications can both be built faster and run faster !

Frank Petersen
Chief Architect
BankData

bankdata

Db2 12 Availability & Security

*We are very pleased with many of the new Db2 12 features, especially with Transfer Ownership and Pending Alter Column feature this give our Enterprise **higher availability and security** which are "critical" in the banking industry.*

Jacek Surma
DII,Zespół Systemów Mainframe

Bank Polski

Db2 12 - The #1 Enterprise Server for Mission Critical Data !

We are really excited about Performance Enhancements in Db2 12 especially advance "in-memory" (Fast Traversal Blocks FTB) capabilities. During testing we have seen up to 5 % CPU reduction and this clearly relates to enormous potential cost savings and positions Db212 as a leader in Enterprise Database market.

İbrahim Parlak
IT Manager
Garanti Bank

GarantiBank

Popular Features

- Migration, Installation & Fallback
  - “…experience of migrating and falling back was flawless…”
- Performance
  - Average 15% improvement out of the box
  - Batch testing showed 25-20% after function level V12R1M500
  - FTB & Contiguous BP’s showed CPU savings
  - UNION ALL showed 22-39% CL2 CPU savings
- Insert Partition
  - "[our] senior application DBAs tested [it] and they were very impressed with the functionality…”
- Lifting Partition Limits
  - “…PBR RPN should improve our daily duties…"
- REORG Enhancements for PBG
- Piecewise DELETE
- SQL Pagination
- MERGE
- …… and more

Incompatibility – SQLCODE -109

- New ZPARM DISALLOW_SEL_INTO_UNION
  - Example: Wrong syntax

```
SELECT C1 INTO :hv1 FROM T1
UNION ALL
SELECT C2 FROM T2;
```

Correct syntax

```
SELECT C INTO :hv1 FROM
(SELECT C1 FROM T1
UNION ALL
SELECT C2 FROM T2);
```

  - Default setting
    - Db2 11: NO (PI55628)
    - Db2 12: YES (PI67611) | SQLCODE-109
      - **RECOMMENDATION SET TO NO INTIALLY, CHANGE AFTER FIXING**
    - Run IFCID 376 (as usual)
      - Function number 0011
    - APPLCOMPAT will not help here

Avoid Plan and Package Autobinds

- Avoid plan autobinds (DSNTIJPM/C will report autobinds)
  - REBIND plans last bound in Db2 V9 or earlier while in Db2 11
  - Autobind of plans can be MUCH more disruptive than packages, especially in the case of CICS
  - For online migration, autobind may fail if plan is in use by down level member
  - Autobind on Db2 12 would mean subsequent autobind on any co-existing Db2 11 member
  - Db2 11 cannot run Db2 12 plan

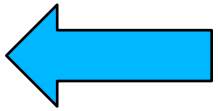
- Avoid package autobinds (DSNTIJPM/C will report autobinds)
  - REBIND packages last bound in Db2 V9 or earlier while in Db2 11
    - Opportunity to use PLANMGMT
  - Autobind destroys current package copy
    - No REBIND SWITCH Available
  - Fallback to Db2 11 and REBIND may still have same problem

- APAR PI87675 - Re-migration autobinds are disabled even with ABIND=YES

Deprecated in earlier releases

NOW removed

- Must convert BSDS to extended format 

  - Db2 V12 will not start – DSNJ157I
  - Use job DSNTIJCB to convert
  - Recommend convert during V11 NFM 
- Query I/O parallelism
  - Applications that used query I/O parallelism in Db2 11 are downgraded to use sequential access at run time in Db2 12
  - You can rebind the packages to enable Db2 to consider the use of CP parallelism instead in Db2 12
    - For data sharing – REBIND should occur after all members migrated to Db2 12 to avoid down level autobind

Deprecated feature / function summary

- Resource limit table formats
  - DSNR**LMT**xx table formats earlier than the Version 11 format are deprecated in Version 12
    - When the deprecated version is detected during START RLIMIT, DSNT732I message is issued to inform the deprecation, but DSNRLMTxx is still used for RLF
  - DSNR**LST**xx table formats and related index formats earlier than the Version 8 format are not supported in Version 12 or later releases
    - DSNT731I issued during START RLIMIT to inform DSNRLSTxx not used for RLF
    - DSN9023I message issued, START RLIMIT command fails if supported DSNRLMTxx is not used
    - FYI - RLF can be started with LMT only, LST only, or both
    - Outmoded RSLTs are reported by the DSNTIJPM premigration job

Deprecated feature / function summary

- Support for table spaces using Basic Row Format is deprecated in Version 12. The RRF ZPARM is eliminated
  - All new table spaces are created in RRF
  - Partitions added by ALTER ADD PARTITION statements on existing PBG table spaces are RRF, unless the TS contains a table with an EDITPROC
  - Existing BRF table spaces are converted to RRF by running LOAD REPLACE or REORG TABLESPACE

- Subsystem parameters
  - MATERIALIZE_NODET_SQLTUDF
    - In later Db2 releases, user-defined SQL table functions that are defined with NOT DETERMINISTIC always behave as if MATERIALIZE_NODET_SQLTUDF is set to YES

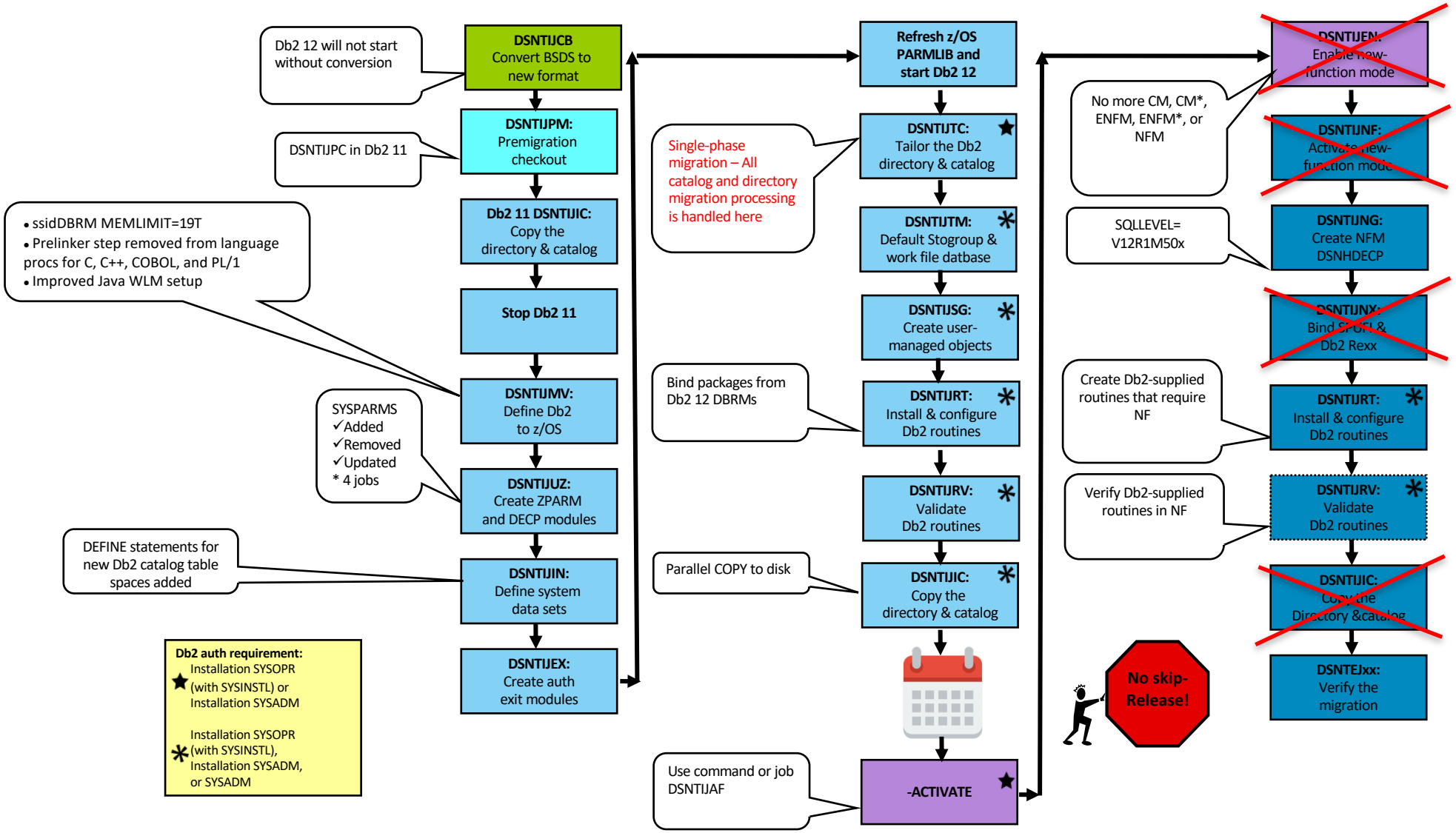
EXPLAIN: migrate explain tables

- Upgrade explain tables to version 12 format
  - V11 APAR PI52197 introduces V11 tolerance for V12 explain tables.
  - When all V11 is in NFM and all members have fallback SPE PTF applied, can upgrade explain tables to V12 form
- 2 ways are available to upgrade the explain tables
  - Use ADMIN_EXPLAIN_MAINT
  - Run batch job DSNTIJXA
- The statements or commands that invoke EXPLAIN processing will return SQLCODE
  - +20520: if the existing explain tables are in v11 format
  - -20008: if the explain tables are in pre-version 11 format

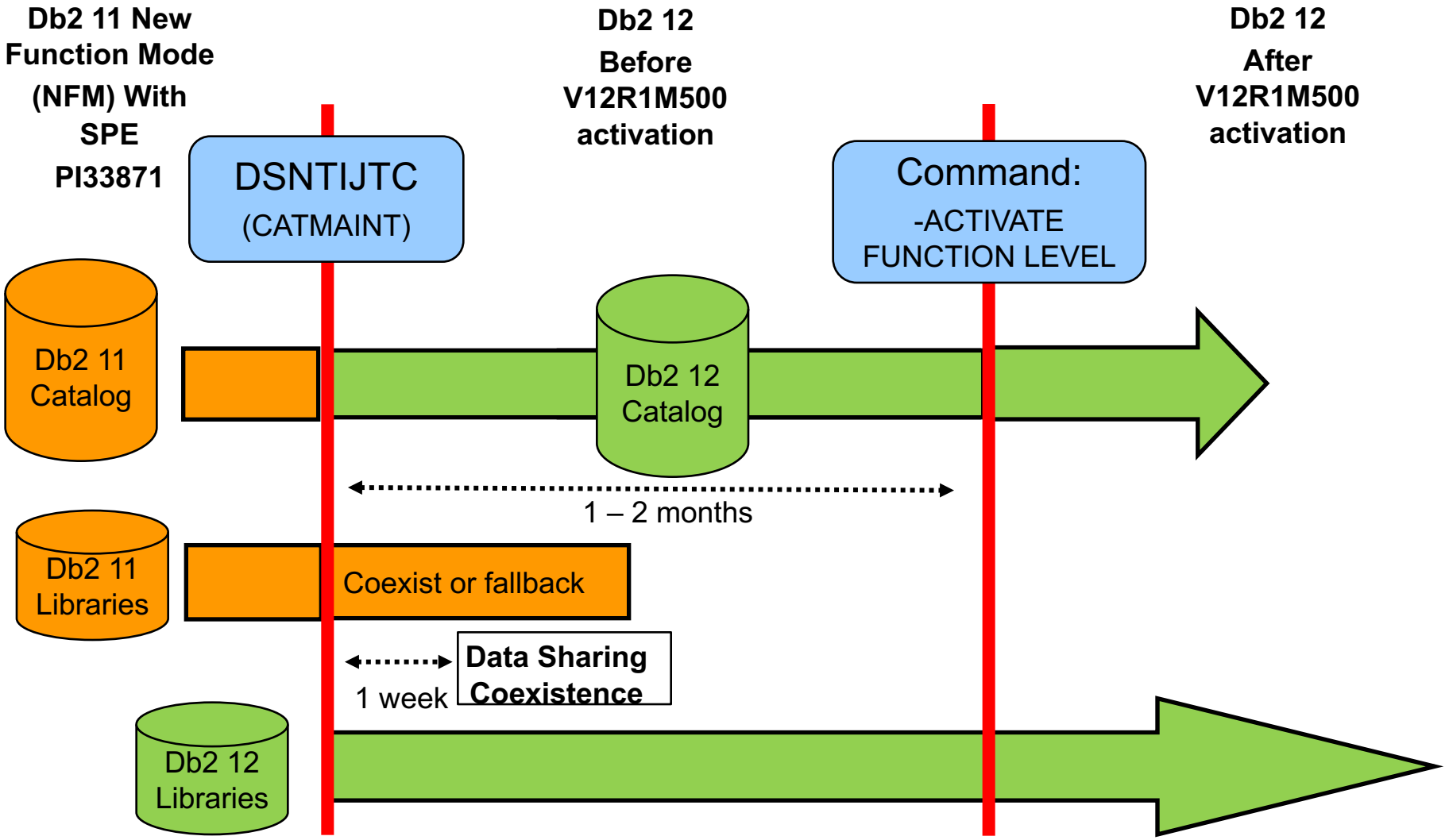
Migration

Db2 12 Migration Process Changes

At a Glance



Migration overview Db2 11 NFM - Db2 12



DSNTIJPM/DSNTIJPC

Pre-migration checkout

- Current list of reports

1. **Check for previous-release sample database:** Needed for verifying migration to pre-NF state
2. **Simple table spaces:** Supported but cannot be created so conversion to preferred format is recommended
3. **Explain tables that are not in current-release (Db2 11) format:** Fix now so they don't break after migration
4. **User-defined indexes on the Db2 catalog that are not in Db2 catalog space:** Drop and recreate recommended
5. **Package copies last bound prior to Db2 10:** Not supported after migration, so rebind or free before migration
6. **Packages last bound prior to Db2 10:** Same as 5
7. **Plans last bound prior to Db2 10:** Same as 5
8. **Packages on catalog and directory table spaces affected by DSNTIJTC/CATMAINT:** SQLCODE -908 if ABIND=NO
9. **Plans on catalog and directory table spaces affected by DSNTIJTC/CATMAINT:** SQLCODE -908 if ABIND=NO
10. **Catalog table space version errors:** Catalog table spaces with a current version < oldest version
11. **Catalog table version errors:** Catalog tables with inconsistent version numbers
12. **Orphaned rows in SYSCOPY and SYSOBDS:** Use REPAIR OBJECT to remove these in Db2 11
13. **Orphaned rows in SYSTABSTATS:** Use REPAIR OBJECT to remove these in Db2 11
14. **Orphaned rows in SYSCOLAUTH:** Use REPAIR OBJECT to remove these in Db2 11
15. **Extraneous text in SYSTRIGGERS TEXT columns:** Cannot be rebuilt; therefore drop and recreate in Db2 11
16. **Unicode columns in EBCDIC tables:** Alter to new format introduced in Db2 12 NF
17. **Indexes on Unicode columns in EBCDIC tables:** Drop to permit alter of table
18. **Obsolete RLSTs:** Alter to Db2 11 format before migrating
19. **Utilities mapping tables:** Alter to Db2 12 format after activation of new-function

- Shadow job DSNTIJPC added to Db2 11 for Db2 12 pre-migration checkout

DSNTIJUZ

Creates DSNZPxxx and DSNHDECP

- The APPLCOMPAT ZPARMs deserves special attention in migration
- Allowable Range
  - V10R1 / V11R1 / V12R1M100 / V12R1M50n Default V12R1M500
- Before new-function activation, specify V11R1
  - V11R1 is set automatically if you run the installation CLIST in MIGRATE mode
- Consequence of using APPLCOMPAT=V12R1M500 in V12R1M100 phase
  - BIND/REBIND failures
    - DSNT225I -DSN BIND ERROR FOR PACKAGE *location.collid.member*
      APPLCOMPAT(V12R1) OPTION IS NOT SUPPORTED

DSNTIJTC

Tailor the Db2 catalog and directory

- Single phase migration – all catalog migration processing is done here!
  - Migration modes – CM, CM*, ENFM, ENFM*, and NFM – are gone
  - Job DSNTIJTC/CATMAINT now performs *all* catalog tailoring for the new release and leaves Db2 in pre V12R1M500 state
    - Has group-wide scope in data sharing
    - Fallback and Db2 11 / Db2 12 data sharing coexistence are available
    - Application compatibility must be either V11R1 or V10R1
  - Jobs DSNTIJEN (ENFM), DSNTIJCS (CM*), DSNTIJES (ENFM*) and DSNTIJNF (NFM) have been eliminated
  - Job DSNTIJNG remains – for rebuilding the DSNHDECP module
  - A new command, -ACTIVATE FUNCTION LEVEL , is provided to get V12R1M500

DSNTIJRT

Creates Db2-supplied routines

- For Db2 12 migration, you must run DSNTIJRT before new function activation and again after new function activation
  - Before activation: To bind packages from Db2 12 DBRMs for existing Db2-supplied routines
  - After activation: To install and configure new Db2-supplied routines:
    - SYSPROC.DSNUTILV – Similar to DSNUTILU but supports a utility statement of up to 2 GB in length.
    - SYSIBMADM.CREATE_WRAPPED – For creating 'obfuscated' native SQL routines => SYSIBM.SYSROUTINES TEXT content …
      - Without obfuscation

```
CREATE PROCEDURE SYSTOOLS.REGSP          ( IN    SOURCE_STRING
```

      - With obfuscation

```
ablGWmdiWmtuTmtaTmJmTmteUntuUndaUotu1mZyWidaWmdaWmda
```

DSNTIJRV

Verifies Db2-supplied routines

- For Db2 12 migration, run DSNTIJRV in before NF activation and again after NF activation
  - Before activation: To verify migration of existing Db2-supplied routines
  - After activation: To verify installation and configuration of new Db2-supplied routines
    - SYSPROC.DSNUTILV
    - SYSIBMADM.CREATE_WRAPPED

-ACTIVATE FUNCTION LEVEL

- Use this command to make new function in the release available
  - Issue the command – or use DSNTIJAF job
  - It marks the boundary between the ability to coexist with or fallback to Db2 11 and the availability of Db2 12 new function
- Successful completion of the command
  - Makes new function available
  - Application compatibility can be V12R1M100, V11R1, or V10R1
  - Eliminates coexistence with and fallback to Db2 11
    - Db2 11 will refuse to start
- Use -DISPLAY GROUP DETAIL to tell whether this command has been issued
- Afterwards, run job DSNTIJNG as usual to rebuild the DSNHDECP module with SQLLEVEL=V12R1M500

DSNTIJRT and DSNTIJRV

- Db2 12 after new function activation
- Rerun DSNTIJRT to add new Db2-supplied routines
- Rerun DSNTIJRV to verify operation of new and existing routines in NF

Recommendations

- Run V12 DSNTIJPM (DSNTIJPC in V11) as early as possible against all V11 subsystems
  - Take appropriate action as recommended
- Check maintenance for currency
- Avoid autobind on pre-V10 **plans** and packages under V12
  - Explicitly rebind under v11 NFM before moving on
  - Use plan management to keep a copy of access paths

Recommendations (cont'd)

- Convert BSDS and recovery log to 10 byte format before leaving v11 NFM
  - DSNJCNVT job
- Contact tools vendor to determine pre-reqs
- Consider staggering installation of Db2 12 across data sharing group
  - Practice in pre-production
- Create performance baseline on V11
  - Assists in quantifying performance across releases

CATMAINT Required?

- Check to see if CATMAINT required
  - CATMAINT required to get from V11 to M100
  - Check Knowledge Center to see if CATMAINT is required
  - Quick check chart

FROM	TO	CATMAINT
V11	V12R1M100	REQUIRED
V12R1M100	V12R1M500	NOT REQUIRED
V12R1M500	V12R1M501	NOT REQUIRED
V12R1M500	V12R1M502	REQUIRED
V12R1M501	V12R1M502	REQUIRED

Installation/migration Db2 without data access

- Traditionally, the installation and migration tasks that run under Db2 require SYSADM authorization
  - These authorities provide open access to user data

- Db2 12 allows these tasks to be performed using installation SYSOPR authority
  - This authority provides no access to user data

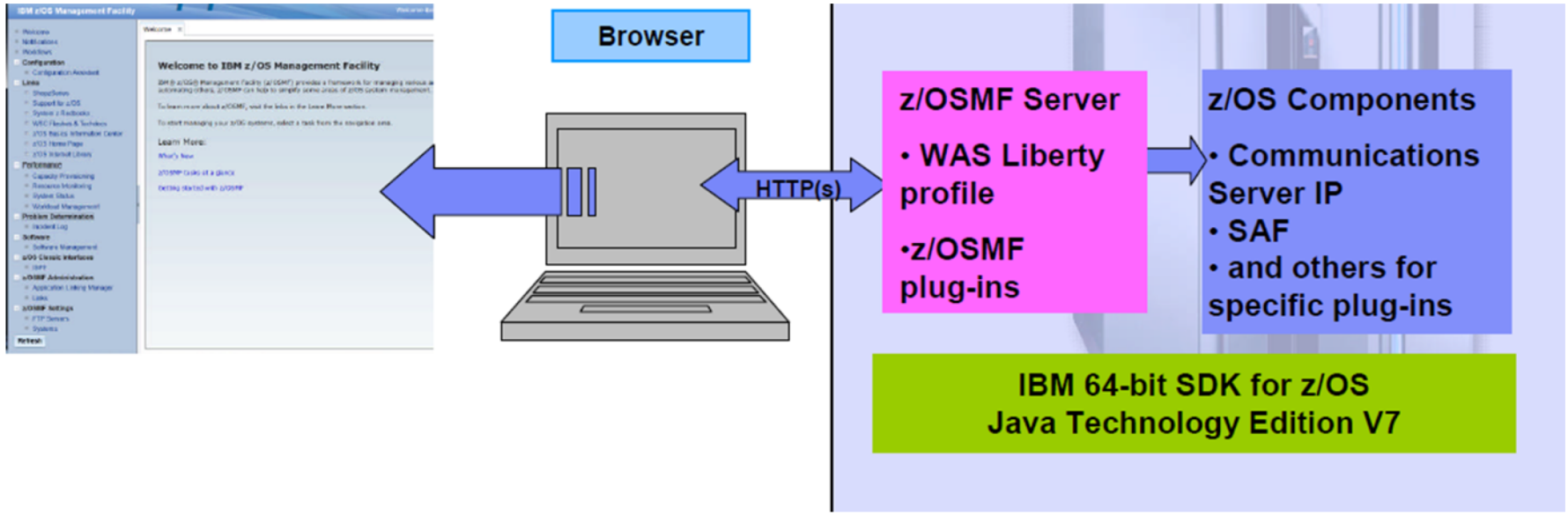
Installation/migration without data access (cont'd)

- Purpose
  - Support ability to install / migrate Db2 without access to user objects

- Support install/migration using INSTALL SYSOPR
  - Expand INSTALL SYSOPR to allow it to perform install / migration activities
    - Execute CATMAINT
    - -ACTIVATE FUNCTION LEVEL
    - BIND AGENT
    - Privilege to CREATE/DROP/ALTER system objects for SYSINSTL
    - Access to catalog, directory, system objects

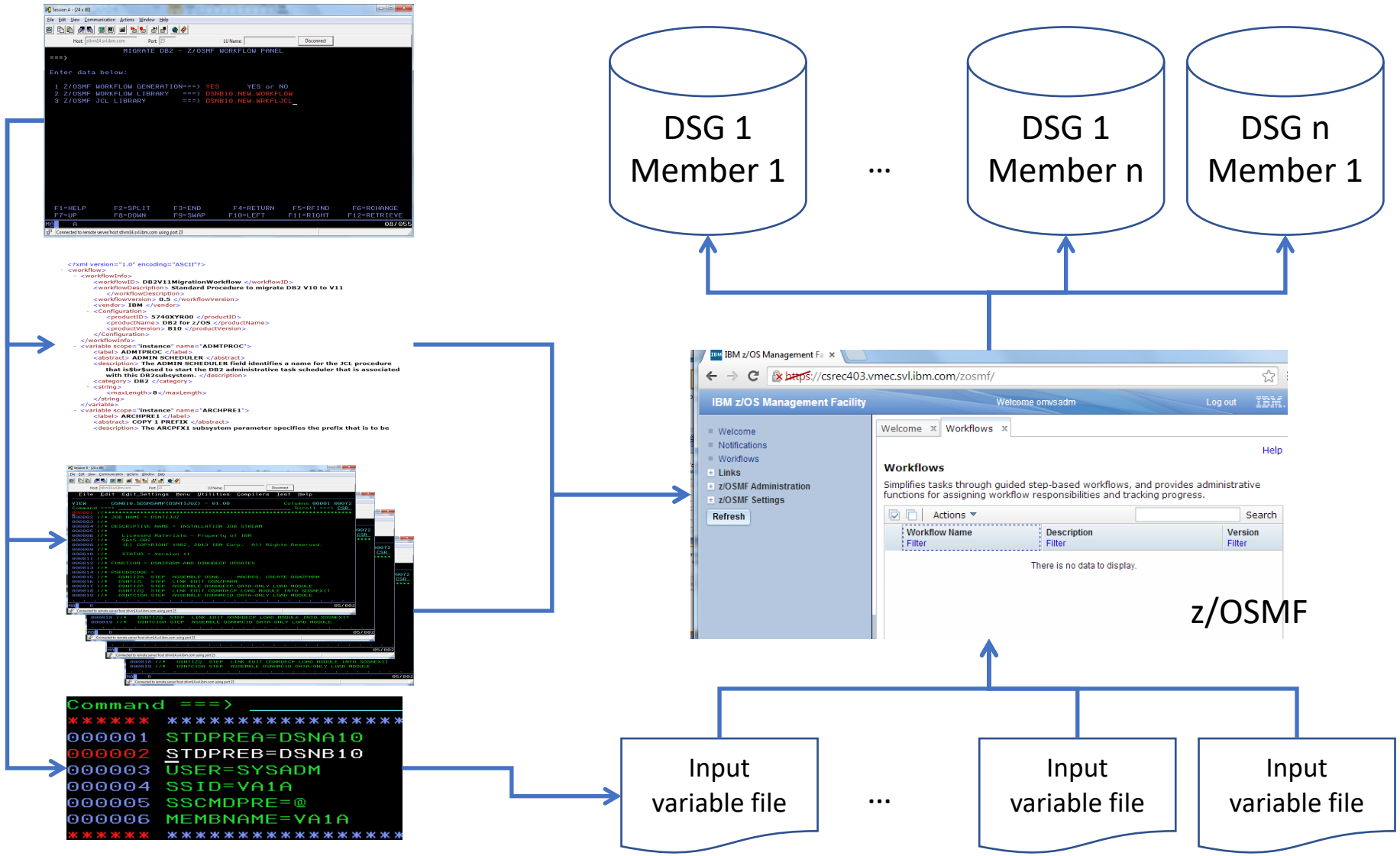
- Does not have access to non-system objects

IBM z/OS Management Facility - what is it?



- The z/OS Management Facility applications run on the z/OS enabling you to manage z/OS from a browser
  - Information is presented on a PC using a browser
- The z/OS Management Facility requires
  - z/OS Communications Server
  - Security definitions (SAF)
  - Other components are required for specific z/OSMF plug-ins
  - IBM 64-bit SDK for z/OS Java Technology Edition V7

The procedure to migrate a Db2 with z/OSMF



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  - http://conferences.gse.org.uk/2018/feedback/IK

- Paper feedback forms are also available from the Chair person

- This session is IK