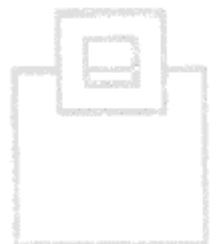


# **DB2 12 Continuous Delivery**

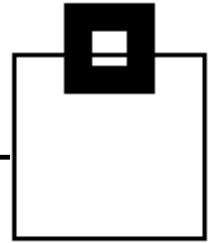
## **–**

# **New challenges for deployment.**

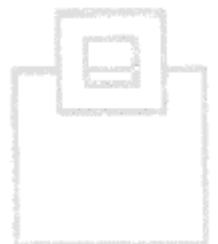
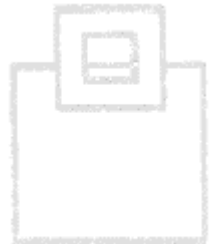


# Agenda

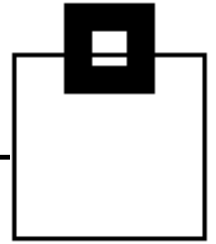
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- Agile, Continuous Delivery, DevOps
- DB2 Code, Catalog, Function and Application Levels
- Activation/Deactivation of new code and how to fallback and when you can't
- Different flavors of (pro-active) CD-screening and how it can be automated
  - Anomaly alerting based on Incompatibility Change Indicators (ICIs)
  - Dyn./Stat. access path change detection e.g. via Plan Management
  - Clone based code change pre-apply exploiting Backup System
  - Workload-KPI verification using SQL replay and KPI comparison
- Conclusion

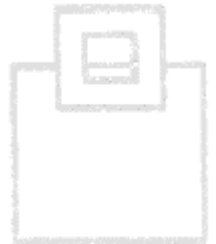


# Traditional vs Agile software development



- Traditional software development is a sequential process:
  - requirement definition – careful and complete
  - planning – visualization of the architecture
  - building – coding
  - testing – careful and complete
  - deployment – delivery and roll out

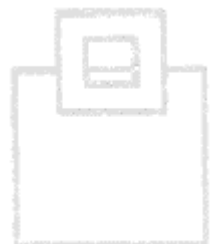
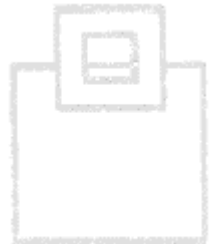
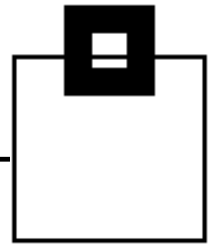
→ The key phases are the definition and planning, because it's a hierarchical process.
- Agile software development is a diversified dynamic evolution:
  - adoption
  - coding
  - (constant) compatibility testing



# Traditional vs Agile software development

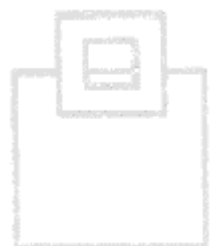
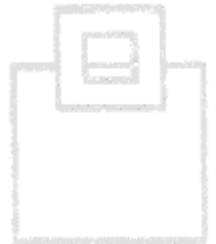
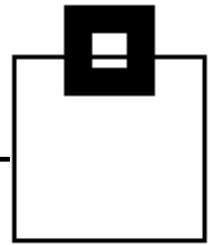
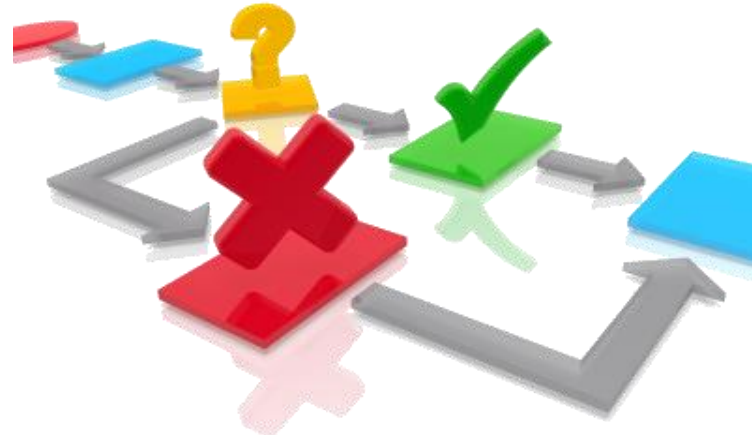
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- Both methodologies have their pro's and con's
- Traditional:
  - *Isolated*, serialized steps
  - Requires clear definition of requirements in advance
  - Less flexible when it comes to changes, fixes, enhancements
  - More solid with regards to quality
  - Stringent documentation and deployment



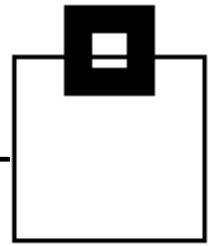
# Traditional vs Agile software development

- Both methodologies have their pro's and con's
- Agile:
  - Less rigorous process
  - Smaller chunks, but highly interacting pieces
  - More (iterative) phases of revision and improvement
  - Requires a close collaboration between user and developer
  - Problems and improvements can be addressed easier and less disruptively
  - Time to market is usually shorter, but the overall effort may increase

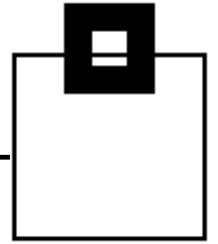


# Traditional vs Agile software development

- Both methodologies affect wide aspects of a business
  - User, Business Analyst and Developer have to collaborate differently depending on the chosen method
  - With Agile, the role of the developer changes due to the extensive interaction with the user
- Agile is a more granular approach leading to more flexibility, but increases demands for interaction/compatibility of the chunks
- The decision is *either or*  
Either go for the traditional way of software development that deals with bulkier, unilateral systems with better ease and forgo the other advantages, or compartmentalize the large system into smaller agile developed processes and play a compatibility gamble.



# Continuous Delivery and DevOps



Agile development requires near-time delivery

- Continuous Delivery (CD) is an approach to produce software in short cycles
- CD ensures that changes can be released at any time, considering building, testing and releasing faster and more frequent
- Key is a focus on more incremental updates
- CD requires a straightforward and repeatable deployment

Of course an enterprise can not just roll out a new code drop, but developers, operations, quality assurance, management and so forth have to work closer together.

DevOps (software **DE**velopment and information technology **OP**erations) aims to establish a culture and environment where building, testing, and releasing software can happen rapidly, frequently, and more reliably.



# Agile, CD and our role in DevOPs

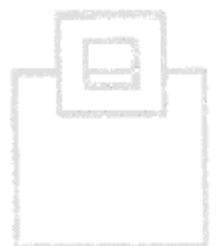
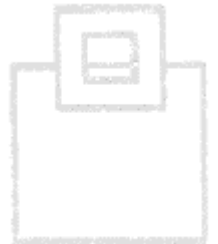
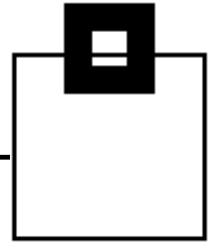
- Considering that Agile requires a close collaboration between development and the user, we are likely to be going closer to the labs – or are we already?  
Think about *IBMs vote for enhancements*, or *Sponsor Users*.
- Considering that Agile doesn't produce new versions, but an ongoing delivery stream, we are likely going to get new features, functions and fixes much quicker.
- Considering that Agile requires a total change in software development, we'll likely see "radical internal changes" at IBM
- Considering that Agile and CD requires a different deployment methodology as well, we'll very likely have to change our deployment.





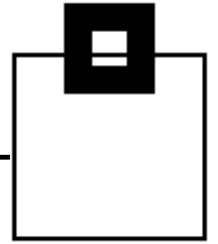
## DB2 levels

- Starting with DB2 12 GA, IBM is going forward to the CD model
- Only single phase migrations, no more CM, ENFM, NFM
- Enhancements may or may not require CATMAINT
- A new level is identified by
  - Version ID
  - Release number
  - Modification identifier
- New Enhancements and capabilities delivered as part of the maintenance stream as Function Levels
- Function Levels enabled via –ACTIVATE command

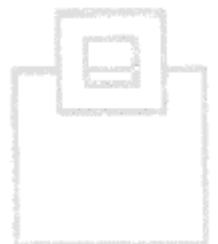
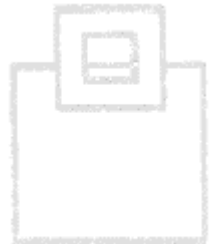


## DB2 levels

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- DB2 customers will see a significantly high volume of CD items in a single maintenance stream
- Entirely new releases, or versions will be very rare and only for major changes, like
  - Extending control structures
  - Enabling an architecture level set
  - Adopting a new compiler
- Recommended Service Upgrades (RSUs) are still available on a monthly/quarterly interval and may, or may not include new features
- Although a code drop may include fixes as well as new/changed features and functions, DB2 users keep control over what they activate – really?!?



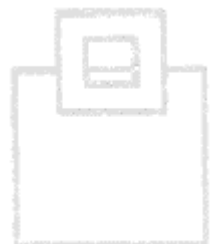
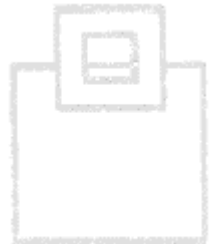
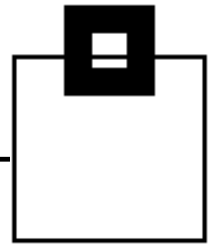
# DB2 levels

- To be able to separate fixes from new/changed features, applying maintenance now consists of up to four different, hierarchical levels:
  1. **DB2 code level** – DB2 libraries via SMP/E
  2. **DB2 Catalog level** – DB2 Catalog changes via CATMAINT
  3. **DB2 Function level** – general available functions via DB2 command (-ACTIVATE FUNCTION LEVEL )
    - Function levels may be skipped
  4. **Application level** – individual application functions via DB2 BIND/REBIND (default via ZPARM: SQLLEVEL APPLCOMPAT, or BIND with APPLCOMPAT VvvRrMmmm)
  5. **SQLLEVEL** – DSNHDECP for precompile or coprocessor (no more NEWFUN)
  6. **SET CURRENT APPLCOMPAT** may be used for prior levels
  7. **Client property** – clientApplCompat may be used for prior levels



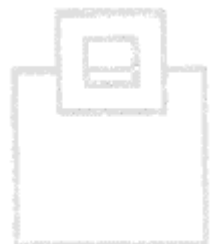
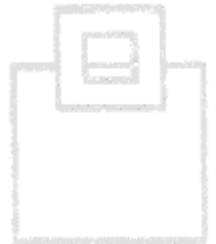
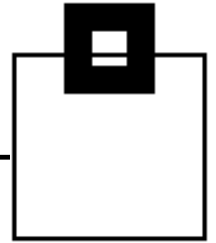
## DB2 levels

- DB2 comes with a variety of sources to determine the levels
  - The new DB2 Catalog table SYSIBM.SYSLEVELUPDATES maintains a history of the different levels
    - FUNCTION\_LVL
    - PREV\_FUNCTION\_LVL
    - HIGH\_FUNCTION\_LVL
    - CATALOG\_LVL
  - ...and additional columns:
    - OPERATION\_TYPE
      - “C” for catalog change – CATMAIN1
      - “F” for function level – ACTIVATE
      - “M” for maintenance update
    - Timestamps and LRSN/RBA



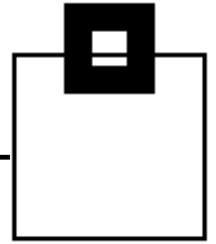
## DB2 levels

- DB2 comes with a variety of sources to determine the levels
  - Additional Catalog tables have a new column `FUNCTION_LVL`
    - `SYSIBM.SYSDYNQRY`
    - `SYSIBM.SYSPACKCOPY`
    - `SYSIBM.SYSPACKAGE`
    - `SYSIBM.SYSQUERY`

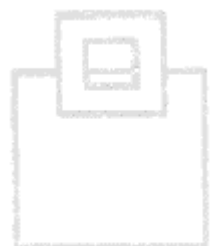


## DB2 levels

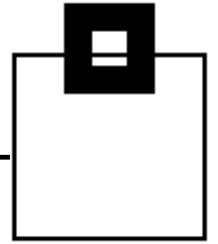
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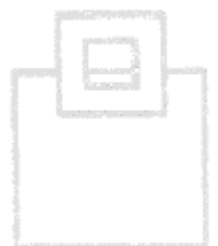
- DB2 comes with a variety of sources to determine the levels
  - New Global Variables deliver further insights into the current levels
    - SYSIBM.PRODUCTID\_EXT: pppvrrmmm
    - SYSIBM.CATALOG\_LEVEL: VvvRrMmmm
    - SYSIBM.DEFAULT\_SQLLEVEL (DECPSQLL): **VvvRrMmmm**
  - DB2 Command -DISPLAY GROUP shows the different levels
    - CATALOG LEVEL
    - CURRENT FUNCTION LEVEL
    - HIGHEST ACTIVATED FUNCTION LEVEL
    - HIGHEST POSSIBLE FUNCTION LEVEL
  - DB2 Command -DISPLAY LOCATION shows the Function Level of each connected system



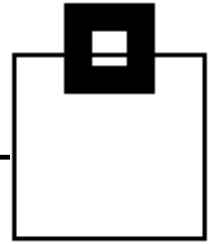
## DB2 levels



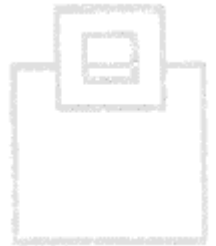
- DB2 comes with a variety of sources to determine the levels
  - RIBRELX – available via multiple interfaces after an applications “CONNECT”
    - The format was extended from VV.R.M to VV.R.MMM
  - SQLCA and GET DIAGNOSTIC do not include the levels
    - SQLERRP: pppvvrrm : Note the missing mm
  - CLI comes with a new infotype
    - SQLGetInfo API returns SQL\_DBMS\_FUNCTIONLVL showing the function level/buildlevel
  - JCC introduces
    - getDatabaseFunctionalLevel() API driver returning the function level/buildlevel
  - DDF Location Statistics shows the FL of connected system
  - DDF accounting header show the FL of connected system



# Activation of levels



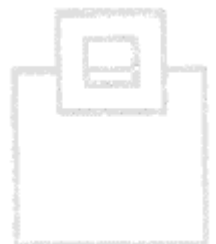
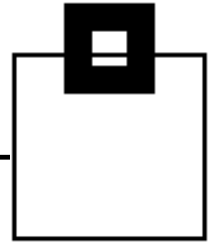
1. SMP/E apply of PTFs, or RSUs may increase the DB2 code level – on the member level of a DS group  
→ verify the system to be stable
2. CATMAINT (if needed) increases DB2 Catalog level  
→ Code level fallback is not possible after CATMAINT
3. ACTIVATE FUNCTION LEVEL (if needed/available) increases the DB2 Function Level – on the group level of a DS group  
→ new functions/behavior that aren't related to SQL, DML, DCL available  
→ REBINDs pick up DB2 Optimizer enhancements/changes  
→ dyn. SQL (non-stabilized) affected accordingly
4. BIND/REBIND APPLCOMPAT and/or ZPARM APPLCOMPAT (if needed/available) increases the DB2 Function Level of an individual package  
→ new functions/behavior related to SQL, DML, DCL available  
→ SET CURRENT APPLCOMPAT may be used for prior levels  
→ clientApplCompat may be used for prior levels





# Deactivation of levels

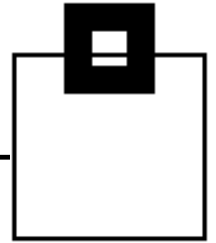
- DB2 Code Level fallback is only possible when no CATMAINT has been executed and the Function Level is still supported
- DB2 Catalog level fallback is impossible
- FUNCTION LEVEL fallback is possible via ACTIVATE FUNCTION LEVEL, but
  - the DB2 Code Level has to remain on the highest level
- BIND/REBIND APPLCOMPAT and/or ZPARM APPLCOMPAT can be used for DB2 Function Level fallback of an individual package
  - old functions/behavior related to SQL, DML, DCL
- SET CURRENT APPLCOMPAT may be used for prior levels
- clientApplCompat may be used for prior levels
- Unless you REBIND, packages bound with higher Function Levels remain functional...



# Skipping levels

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- DB2 Function Levels may be skipped, but always include all new/changed features/behavior of prior Function Levels



# CD Screening

- Now – is there a problem with Continuous Delivery?
- It depends ... it's a matter of control & verify  
→ Thus assure proper testing

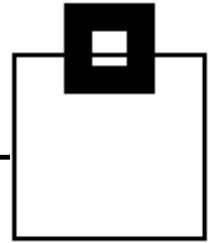


APPLCOMPAT results before continuous delivery:

- The way some of the most popular scalar BiFs worked started changing with DB2 10 for z/OS. For example, CHAR:

```
SELECT CHAR(DEC_COL) FROM SYSIBM.SYSDUMMY1;
```

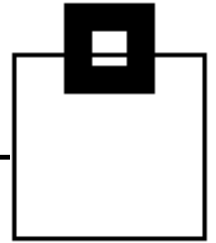
	CHAR(000.1)	CHAR(1000.)	CHAR(1.1)
V10+	'1'	'1000'	'1.1'
V9	' 000.1'	' 1000.'	' 1.1'



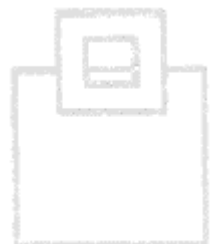
- Incompatible changes as of DB2 11:

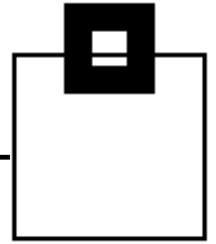
- 1: V9 version of CHAR(DEC) executed
- 2: V9 version of VARCHAR(DEC) executed
- 3: Unsupported character string representation of a TIMESTAMP
- 4: V10 default SQL path used instead of V11
- 7: SQLCODE -301 from a DB2 11 server
- 8: Stored procedure data types
- 9: TIMESTAMP TIMEZONE from DRDA
- 10: V9 version of LTRIM, RTRIM, STRIP executed
- 1101: INSERT into XML column w/o XMLDOCUMENT function
- 1102: XPATH evaluation resulted in error
- 1103: Dynamic SQL ASUTIME limit RLF issue
- 1104: CLIENT\_ACCTNG longer than supported length pre-V11
- 1105: CLIENT\_APPLNAME longer than supported length pre-V11
- 1106: CLIENT\_USERID longer than supported length pre-V11
- 1107: CLIENT\_WORKSTNNAME longer than supported length pre-V11
- 1108: CLIENT register longer than supported used for RLF
- 1109: CAST(String AS TIMESTAMP) using invalid string lengths as of V11
- 1110: Argument for SPACE function greater than 32764
- 1111: Optional integer argument of VARCHAR greater than 32764
- 1112: Empty XML element



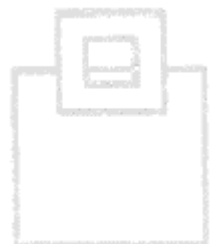


- ... and the first one announced for 12:
  - 1201: changed SQLCODE for POWER results out of range
  - Out-of-range result from POWER built-in function with DOUBLE arguments in DB2 12
    - *Starting in DB2 12, when the POWER built-in function is invoked with DOUBLE arguments, and the result is out of range, warning SQLCODE +802 is returned, instead of error SQLCODE -802*
    - *Actions to take:*
      - *In DB2 12, before function level 500 or higher is activated, identify applications with this incompatibility by starting a trace for IFCID 0376, and then running the applications. Review the trace output for incompatible changes with the identifier 1201. Adjust error processing to account for the change in the returned SQLCODE from an error to a warning*





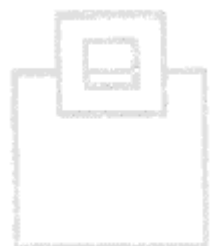
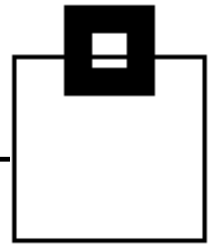
- The variations of levels and their dependencies/restrictions demand for an adjusted maintenance/migration
  - We need to be aware of applications being affected by changed behavior
    - Since DB2 10 we can use IFCIDs 366\* and 376 (DB2 11) to catch potential incompatibilities (Incompatibility Change Indicator – ICI)
  - We need to be able to prescreen access path changes resulting from code changes
    - Since DB2 9 we can use PLAN MANAGEMENT to fallback to prior runtime structures
    - Since DB2 12 we have stabilized dynamic queries to freeze runtime structures
    - Since DB2 collections we have the opportunity to REBIND (distributed) packages into a separate collection to compare and switch



\*deprecated

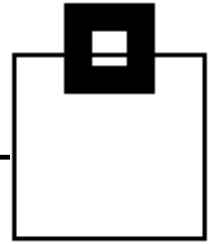
# CD-Screening

- The variations of levels and their dependencies/restrictions demand for an adjusted maintenance/migration strategy
  - We need a reliable, solid and automated way to test the different levels
  - The checks can't take longer than a couple of hours, or a few days, otherwise we'll never catch up
  - We need to be flexible in choosing the scope of testing
    - ICI Detection
    - Access Path Precheck and Protection
    - Instant Cloning
    - Workload Capture/Replay

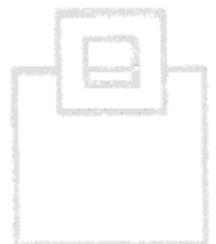
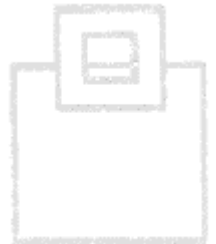


## ■ CDDC for DB2 z/OS

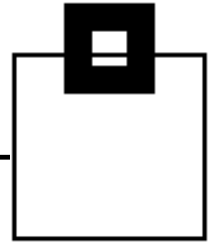
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- SOFTWARE ENGINEERING/SEGUS provides a powerful package that exploits years of experience in QA, AP Precheck, Cloning and DB2 Workload capturing
- ■ **Continuous Delivery Deployment Check for DB2 z/OS** provides four levels of automated alerting and testing:
  - ICI based anomaly alerting
  - Static & Dynamic SQL Access Path Pre- and/or Post-Check
  - Clone based code level checks exploiting Instant Copy (e.g. Flashcopy)
  - Workload Capture/Replay with KPI verification
- ■ CDDC for DB2 z/OS let's you decide the scope of testing, from incompatibility alerting up to a full system test including workload execution





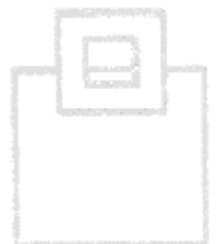
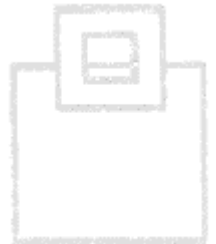


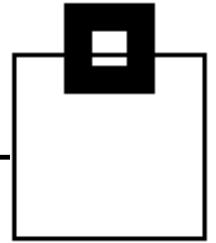
ICI Detection - ICI based anomaly alerting:

*REBIND application static packages with higher APPLCOMPAT to exploit DDL/DML new functions/**behaviors***

→ ICI Detection covers Function Level changes and pinpoints the origin of a statement (stmt id, program, package, collection, statement text)

- Incompatibility Change Indicators play a major role in Function/Application level handling
- DB2 itself tells us via IFCID 376 if potential incompatibilities exist, e.g.
  - Changes to the behavior of Built In Functions (BIFs)
  - Changes of SQLCODEs
  - Changes of SQL results
  - Deprecated support e.g. for TIMESTAMP formats
  - (...)



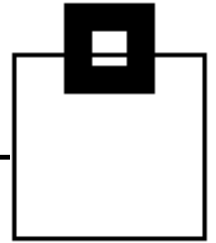


## ICI Detection - ICI based anomaly alerting :

BIF/ICI Detection-2017-03-02 16:14:17.846 DB2 for z/OS 1

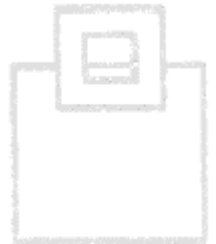
Package	Reason	WLX DB2 SSI...	Statement ID	Section number ...	Plan name	Statement Timestamp	Transaction name	End User ID	Workstation name ^
IQADBACP	DB2 9 VARCHAR Usage	DC10	180,221	114	IQAP0610	2016-08-30-10.15.04.581836			
IQADBACP	DB2 9 VARCHAR Usage	DC10	2,361	11	IQAP0610	2016-10-11-10.10.44.348841			
IQADBACP	DB2 9 VARCHAR Usage	DC10	180,221	114	IQAP0610	2016-08-30-10.15.04.581836			
IQADBACP	DB2 9 VARCHAR Usage	DC10	180,221	114	IQAP0610	2016-10-11-10.12.59.837638			
IQADBACP	DB2 9 VARCHAR Usage	DC10	180,722	114	IQAP0610	0001-01-01-00.00.00.000000	UNKNOWN	UNKNOWN	UNKNOWN
IQADBACP	DB2 9 VARCHAR Usage	DC10	1,260	11	IQAP0610	2017-01-25-09.42.51.340956	WLXPRVST	HOPPE	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	310	23	DISTSERV	2016-07-20-11.00.42.585936	INSERTRS	CHRISTO	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	310	9	DISTSERV	2016-07-20-11.00.42.585936	INSERTRS	CHRISTO	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	13,235	15	DISTSERV	2016-07-29-09.03.54.863931	EXECDDL	BOXWELL	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	13,239	18	DISTSERV	2016-07-29-09.04.15.676355	EXECDDL	BOXWELL	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	13,256	21	DISTSERV	2016-07-29-09.06.42.988871	EXECDDL	BOXWELL	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	13,262	36	DISTSERV	2016-07-29-09.12.39.004960	EXECDDL	BOXWELL	DB2CALL
SYSLH200	DB2 9 VARCHAR Usage	DC10	232	6	DISTSERV	2016-09-14-16.11.51.858847	DC10RS00	BOXWELL	UTILITY
SYSLH200	DB2 9 VARCHAR Usage	DC10	267	16	DISTSERV	2016-09-20-09.53.32.287974	DC10RS00	BOXWELL	UTILITY
SYSLH200	DB2 9 VARCHAR Usage	DC10	1,215	15	DISTSERV	2016-08-31-16.47.40.688532			
SYSLH200	DB2 9 VARCHAR Usage	DC10	1,215	15	DISTSERV	2016-09-29-13.09.25.096878	DC10RS00	BOXWELL	UTILITY
SYSLH200	DB2 9 VARCHAR Usage	DC10	2,321	176	DISTSERV	2016-10-10-09.32.49.278291			



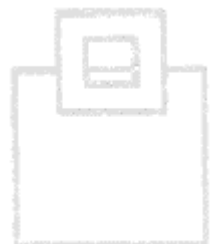


Access Path Check - Static & Dynamic SQL Access Path Pre- and/or Post-Check:

*REBIND of packages with any APPLCOMPAT would pick up optimizer enhancements. Non-stabilized dynamic SQL would pick up optimizer enhancements.*



- Access Path check covers Function Level Changes for both static AND dynamic SQL.
- Access Path check runs proactive (instead of PLANMGMT) and can be executed in your production environment (without harming applications), or in a virtualized test environment (simulates all optimizer relevant factors.)
- Access Path check clearly categorizes improvements and degradations (instead of PLAN STABILITY).
  - Access Path check opens up improvements and suppresses degradations.



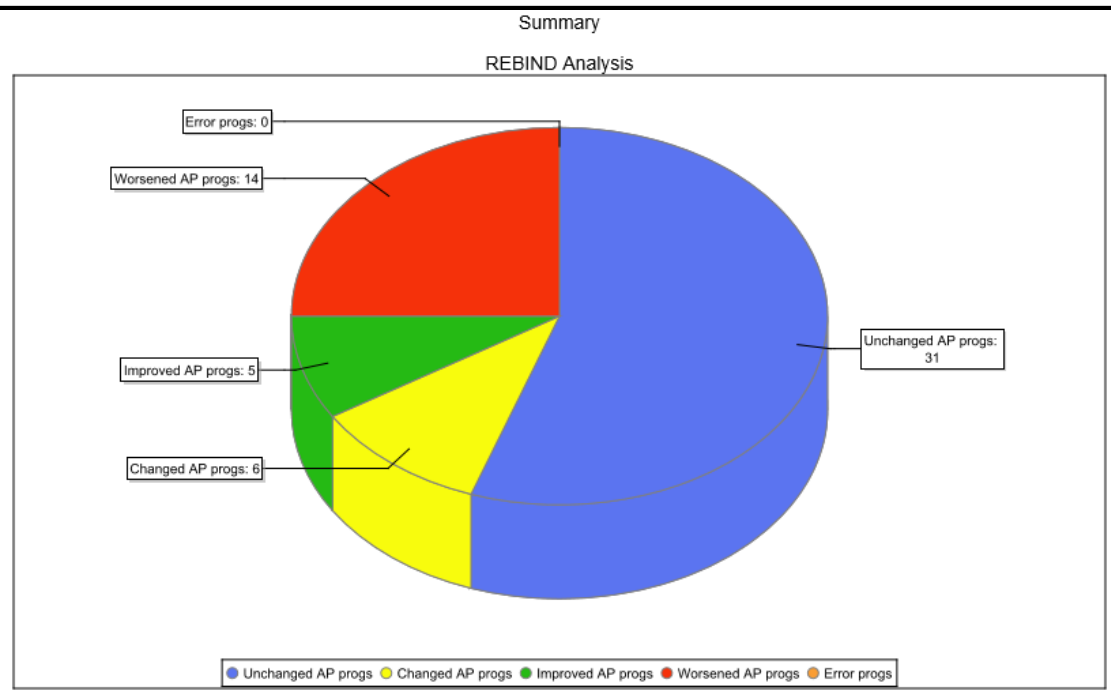


# CD-Screening

## Access Path Check - Static & Dynamic SQL Access Path Pre- and/or Post-Check:

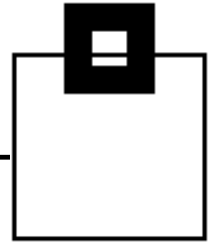


STMT No.	Section Number	DSC STMT ID	Impact ^	Si
2547	13	2547	DEGRADED	
796	2	796	DEGRADED	
804	3	804	DEGRADED	
812	4	812	DEGRADED	
820	5	820	DEGRADED	
671	2	671	DEGRADED	
679	3	679	DEGRADED	
687	4	687	DEGRADED	
695	5	695	DEGRADED	
3	3	3	DEGRADED	
4	4	4	DEGRADED	
5	5	5	DEGRADED	
6	6	6	DEGRADED	
968	7	968	IMPROVED	
1167	9	1167	IMPROVED	
235	1	235	IMPROVED	
1194	2	1194	IMPROVED	
2409	7	2409	IMPROVED	
1194	2	1194	IMPROVED	



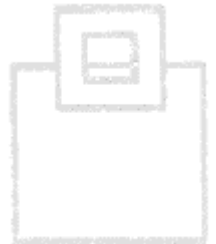
©Bind ImpactExpert™ for DB2 z/OS, © SOFTWARE ENGINEERING GmbH, 2004-2017  
Mar 2, 2017 3:54:04 PM

152	1	54	1	4	8
152	1	54	1	4	8
152	1	54	1	4	8
152	1	54	1	4	8
130	1	46	1	6	8
95	2	34	1	4	8
82	1	29	1	4	8
149	1	53	1	4	8
171	16	60	6	8	5
174	10	62	4	10	5
178	10	63	4	8	6
150	191	53	67	12	1
21	23	8	9	5	1
175	191	62	67	12	1



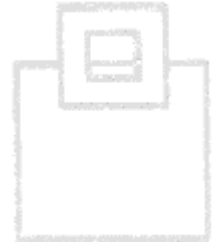
Instant Cloning - Clone based code level checks:

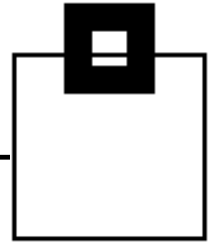
*PTFs (RSUs...) are applied that may increase the Code Level (CL) of a DB2 system. After system is stable on maintenance, execute (If Any) catmaint.*



→ Instant Cloning covers Code Level, Catalog Level and Function Level testing and allows the most comprehensive scope.

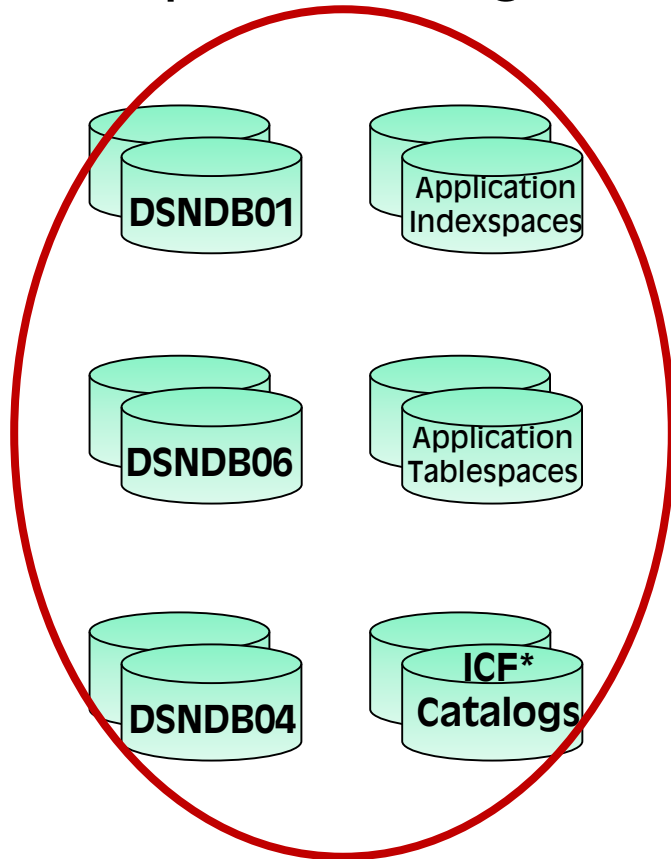
- For a full check, an entire DB2 system can be cloned in minutes. Object level cloning allows being more granular.
- FTP support transfers required data to different LPARs.
- Scheduling Environment and Routing support handles system setups with different environments.
- The entire process is guided and controlled.



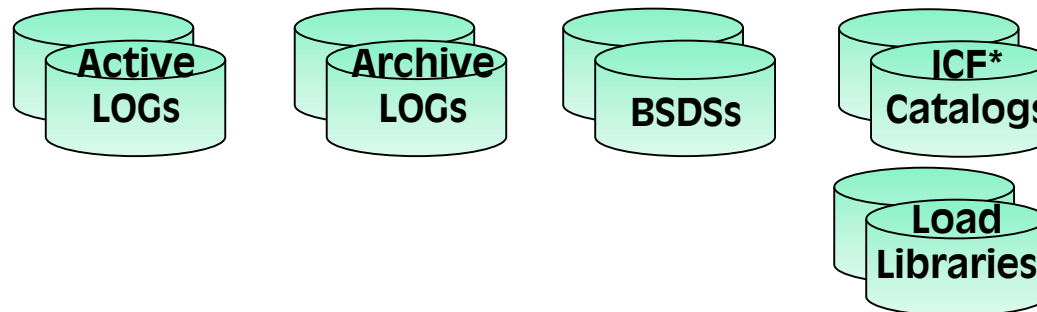


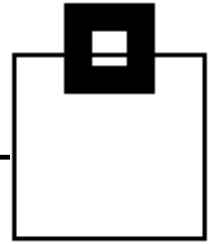
Instant Cloning - Clone based code level checks:

Scope of Cloning: Subsystem level



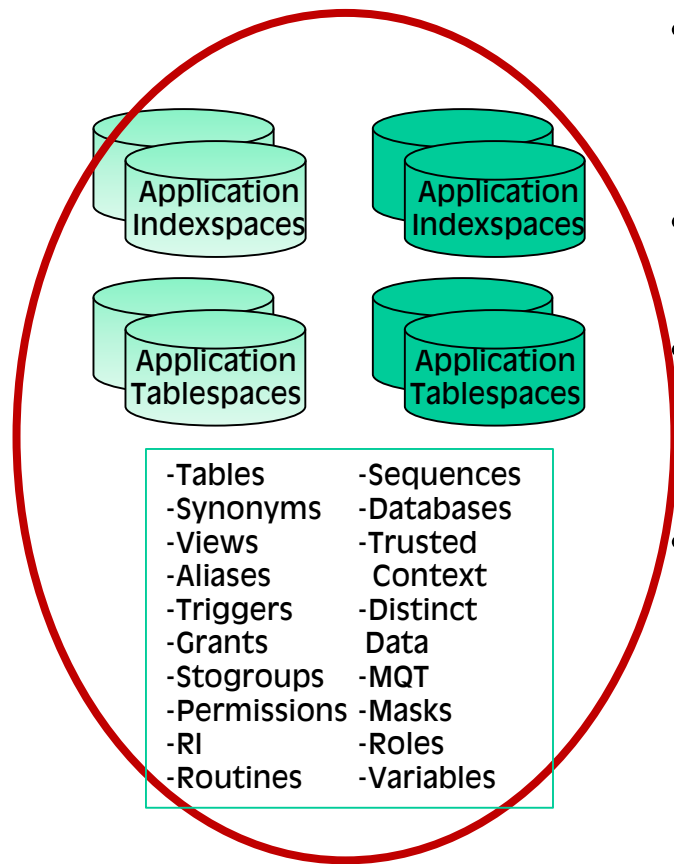
- Fully exploiting instant copy technology (e.g. Flashcopy)
- Supports  $DS \leftrightarrow NDS$ , as well as cross-version cloning
- Highly customizable and fully automated via XML scenario scheme





Instant Cloning - Clone based code level checks:

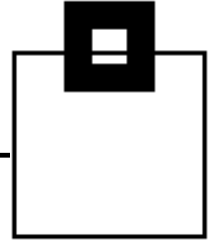
Scope of Cloning: Object level



- Fully exploiting instant copy technology (e.g. Flashcopy)
- Supports DDL and/or data cloning
- Flexible include/exclude of dependent objects
- Powerful renaming capabilities



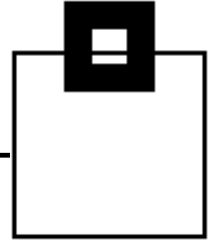




## Instant Cloning - Clone based code level checks:

```
<!-- JCL -->
<scenario opt0="" type="DEF" prod="HSC" name="DEFAFD3">
  <description short="DISCONN UCAT/Auto DB2 Start/Sys managed WKDB/Onl+Offl Copy">
    <p>This scenario is intended to build a DB2 clone of VOLUME BACKUPS (offline copy) or from an online copy (FlashCopy, e.g.). All DB2 data will be cloned (catalog, userobjects, BSDS, active logs, DB2-Files). Archive logs are ignored. It is necessary to pre
    <p>The configuration of the target system will remain the same after cloning, the only thing that may change is the DB2 version. If the source system is V9, e.g., the target system will be V9, too. </p>
    <p>In this scenario the start and stop of DB2 is automated by JCL.</p>
  </description>
  <menu>
    <menumenu>
      <name>Select DB2</name>
      <description>Select source</description>
    </menumenu>
    <menumenu>
      <name>Select DB2</name>
      <description>Select target</description>
    </menumenu>
    <menumenu>
      <name>Prepare</name>
      <description>Define datasets</description>
    </menumenu>
    <!-- ===== START OF SAMPLE CUSTOMIZATION FOR MENU HERE ===== -->
    <!-- ===== DELETE THE FOLLOWING CODE LINES UP TO END MARK TO ===== -->
    <!-- ===== AVOID DISPLAY OF "BUILD SAMPLES" IN MENU. ===== -->
    <menumenu>
      <name>Build samples</name>
      <description>Generate sample input for new DB2s</description>
    </menumenu>
    <!-- ===== END OF SAMPLE CUSTOMIZATION FOR MENU HERE ===== -->
    <!-- ===== -->
    <menumenu>
      <name>Set environment</name>
      <description>General cloning options and sources</description>
    </menumenu>
    <menumenu>
      <name>Validate variables</name>
      <description>Check customer variables</description>
    </menumenu>
    <menumenu>
      <name>Validate datasets</name>
      <description>Check installation specific datasets</description>
    </menumenu>
    <menumenu>
      <name>Gather information</name>
      <description>Get all needed information</description>
    </menumenu>
    <menumenu>
      <name>Stop DB2</name>
      <description>Stop target DB2</description>
    </menumenu>
    <menumenu>
      <name>Restore</name>
      <description>Restore volumes</description>
    </menumenu>
    <menumenu>
      <name>Rename</name>
      <description>Rename all datasets</description>
    </menumenu>
    <menumenu>
      <name>DSNZPARM+DSNHDECP</name>
      <description>Assemble and linkedit</description>
    </menumenu>
    <menumenu>
      <name>Start DB2/ACC MAINT</name>
      <description>Start DB2 AM/VCAT SWITCH/Work DB</description>
    </menumenu>
    <menumenu>
      <name>Final processing</name>
      <description>Start DB2/Bufferpools/WLM settings</description>
    </menumenu>
    <menumenu>
      <name>Cleanup</name>
      <description>Delete work files</description>
    </menumenu>
    <menumenu>
      <name>Finished</name>
      <description>Cloning completed</description>
    </menumenu>
  </menu>
  <flow>
    <showmenu override="Y"/>
    <getsource/>
    <!-- Get Source System -->
    <showmenu/>
    <gettarget/>
  </flow>
</scenario>
```



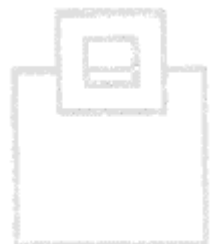
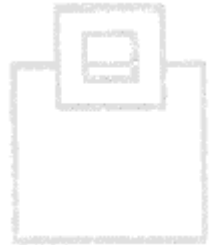


Workload Capture/Replay with KPI verification:

*After Function Level is considered stable – allow new application feature rollout.*

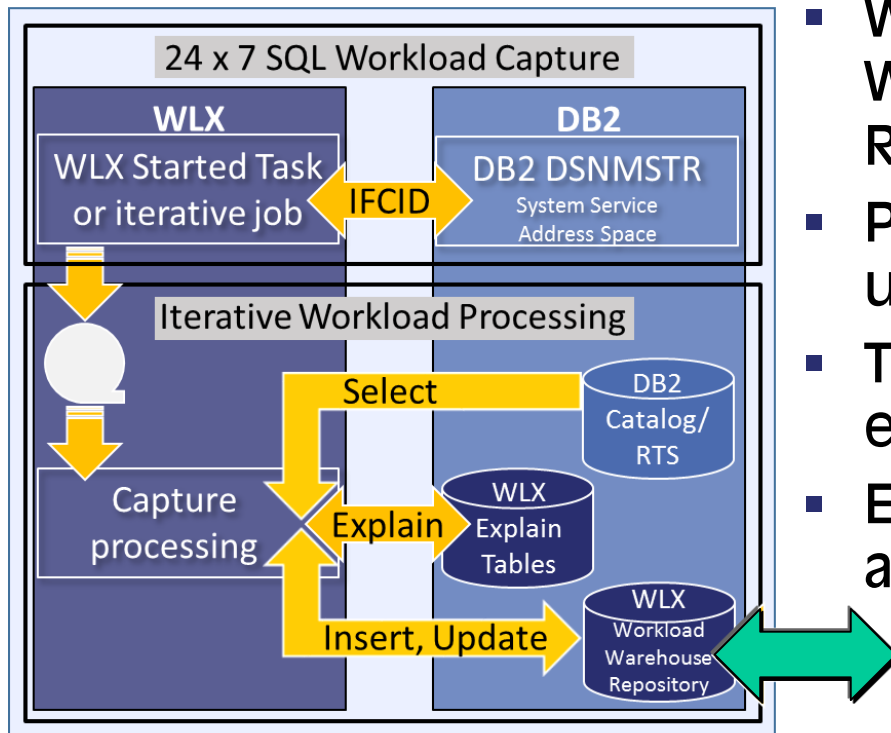
→ Workload Capture/Replay adds Application Level testing and completes the most comprehensive scope by executing sets of captured workload.

- Highly efficient IFCID (OPx) based capturing technology catches SQL for automated execution in the isolated cloned environment.
- Workload sets can be saved to represent quarters end, years end and other specific workload patterns.
- Tested workload is compared on a KPI level (e.g. # of getpages, rows returned, rows processed, ...) to report anomalies only.

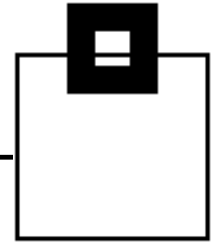


# CD-Screening

- Workload Capture/Replay with KPI verification:



- Workload sets stored in a Workload Warehouse Repository
- Pre-filtered to remove any unwanted/unsupported SQL
- Transferred to the clone environment
- Executed and KPI compared to automatically find anomalies



## ■ Workload Capture/Replay with KPI verification:

Selection 1					Selection 2				
Primary Authorization ID	Package	Collection ID	Number of Statements	Sum of CPU Time	Primary Authorization ID	Package	Collection ID	Number of Statements	Sum of CPU Time
n/a	CMEMAPP	PTFCOLL008	1	0	n/a	CMEMAPP	PTFCOLL008	1	0
n/a	COISEAR	PTFCOLL008	1	4	n/a	COISEAR	PTFCOLL008	1	4
n/a	COQAPTF	PTFCOLL008	1	0	n/a	COQAPTF	PTFCOLL008	1	0
n/a	DSN\$EP2L	DSNTEP2	3	0	n/a	DSN\$EP2L	DSNTEP2	3	0
n/a	DSNREXX	DSNREXX	1	0	n/a	DSNREXX	DSNREXX	1	0
n/a	DSNTIAP	DSNTIAP	2	0	n/a	DSNTIAP	DSNTIAP	2	0
n/a	FILLPROD	PTFCOLL008	1	0	n/a	FILLPROD	PTFCOLL008	1	0
n/a	IADMPTF	PTFCOLL008	1	0	n/a	IADMPTF	PTFCOLL008	1	0
n/a	IMEMB	PTFCOLL008	1	0	n/a	IMEMB	PTFCOLL008	1	0

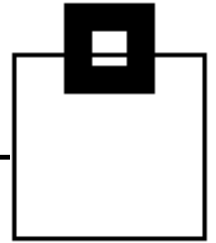
### Selection details

Column name	Selection value 1	Selection value 2
Highest CPU Time	0.062996	0.062996
Sum of Elapsed Time	0	0
Average Elapsed Time	0.002149	0.002149
Highest Elapsed Time	0.079543	0.079543
Sum of Executions	37	37
Sum of GETPAGES	74	74
Average GETPAGES	2	2
Highest GETPAGES	74	74
Sum of Synchronous Buffer Reads	2	2
Sum of Synchronous Buffer Writes	0	0

Value 1

Value 2



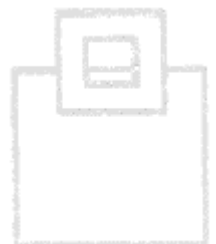


All tests can be combined and included in an automated execution stream to make the entire testing of a new DB2 code drop a standardized process.

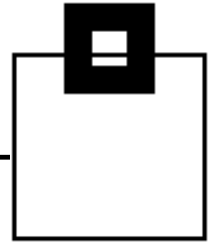


A typical setup is for example:

- Have ICI Detection continuously govern the production system (overhead minimal)
- Make Access Path Check a vital part of REBIND processing as well as DSC check to keep control of dynamic SQL
- Before PTF/RSU apply:
  1. Clone into an isolated environment for CD-screening
  2. Apply the PTF/RSU and if needed CATMAINT
  3. Run Workload Replay
  4. Check system behavior and KPI report for anomalies

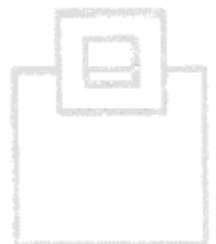
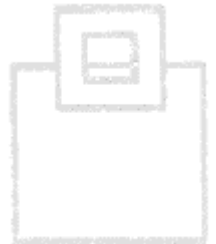


# CD-Screening



The scope and the environment can be chosen flexibly

	Code Level	Catalog Level	Function Level	Application Level
ICI Detection	X	X	Test and/or Production	Test and/or Production
AP Check	X	X	Test* and/or Production	Test* and/or Production
Instant Cloning	Test	Test	Test	Test
Capture/Replay	Test	Test	Test	Test

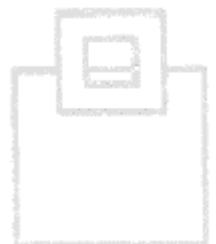
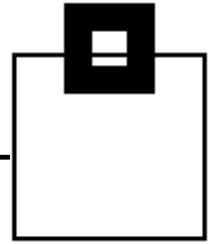


\* Access Path checks are accomplished in a virtual environment – no data needed!

# Conclusion

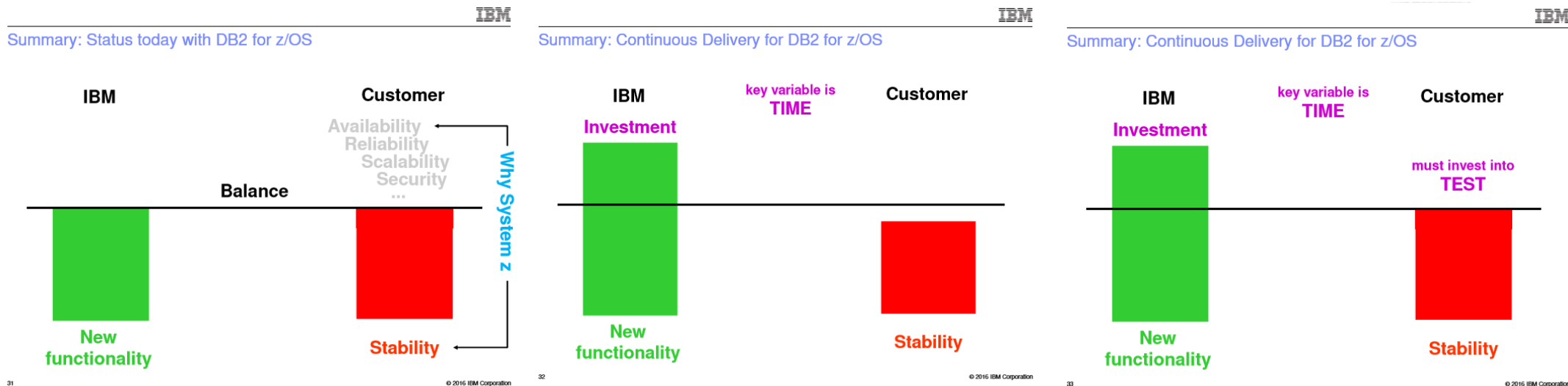
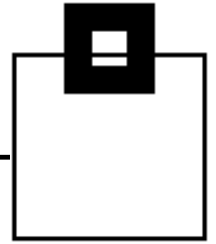
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- Compared to prior versions the path into the Agile world and their influence on existing behavior/compatibility started already in DB2 10 with BIF Compatibility
- APPLCOMPAT was first introduced in DB2 11
- The traditional three yearly release cycle doesn't fit to the technological development these days
- Retrofitting enhancements burns too many resources
- The idea of Function Levels should make the continuous delivery stream manageable



# Conclusion

IBM is investing in new functionality with the key variable TIME, we must invest in TEST if we want to keep our level of stability.



Typically customers spent months to test new code, but that won't fit the continuous delivery stream.

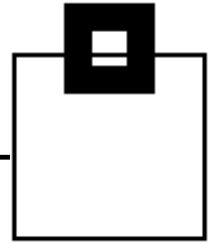
A multilevel, highly automated test framework is a reliable, robust solution to exploit and benefit from the new directions.



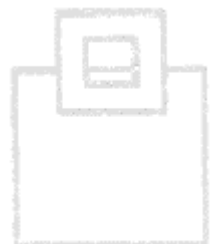


# Recommendations

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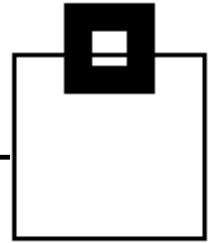


- Understand Continuous Delivery
  - Get familiar with the various levels and what they affect
  - Verify and adjust your migration procedures
  - Check the changes that affect a migration
  - Resolve application incompatibilities before setting APPLCOMPAT to a new level
  - Use the TEST option before activating a new level
- Further information:
  - Redbook: IBM DB2 12 for z/OS Technical Overview
  - IBM Knowledge Center



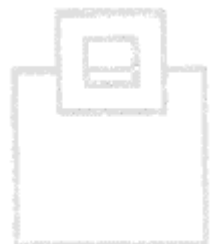
# Conclusion

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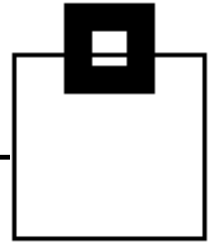
## ■ **Continuous Delivery Deployment Check for DB2 z/OS**

- Comes with multicomponent quality assurance
- Depending on the importance of the system to maintain, tests can be extended, or reduced
- A focus on automation helps to test complex DB2 applications
- Exploiting efficient storage technology keep costs low
- Automated cloning scenarios clone an entire production system in minutes, ready for testing
- Workload Capture/Replay combined with KPI comparison assures that changes in DB2 behavior are detected quickly and efficiently

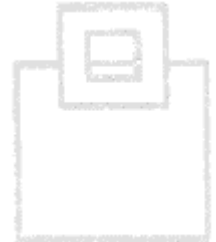
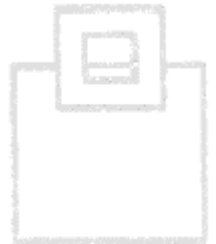


## BIF/ICI HealthCheck for DB2 z/OS

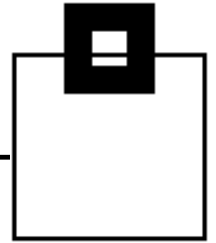
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- A handy batch job, or started task that reports BIF incompatibilities in DB2 10, DB2 11, or DB2 12
- Both IFCID 366 and 376 can be captured as long as desired
- At the end of the capture process, or during -if desired- a report shows any affected dynamic, or static statement along with it's
  - PLAN
  - COLLECTION
  - PACKAGE
  - Number of occurrences (366)



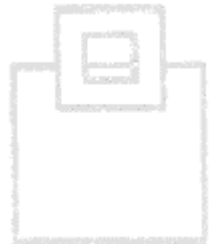
# BIF/ICI HealthCheck for DB2 z/OS



SQL WorkloadExpert for DB2 z/OS Version 2.2 2015-09-24 at 15:15:58 Page 1  
(C) 2013-2015 - SOFTWARE ENGINEERING GmbH

BIF Health Report for group GSA12A13 started at 2015-09-24 15:15:58.48

Type	Plan	Collection	Package	ICI	Count
Dyn	DSNESPUR	DSNESPUR	DSNESM68	1	5
Dyn	DSNESPUR	DSNESPUR	DSNESM68	5	4
Stat	BIFTEST	BIFTEST_TEST	O2TESTB	1	2



SQL WorkloadExpert for DB2 z/OS Version 2.2 2015-09-25 at 10:48:17 Page 1  
(C) 2013-2015 - SOFTWARE ENGINEERING GmbH

BIF Health Report for subsystem DB10 started at 2015-09-25 10:48:17.23

Type	Plan	Collection	Package	ICI	Count
Dyn	DSNESPUR	DSNESPUR	DSNESM68	1	2
Stat	BIFTEST	BIFTEST_TEST	O2TESTB	1	2

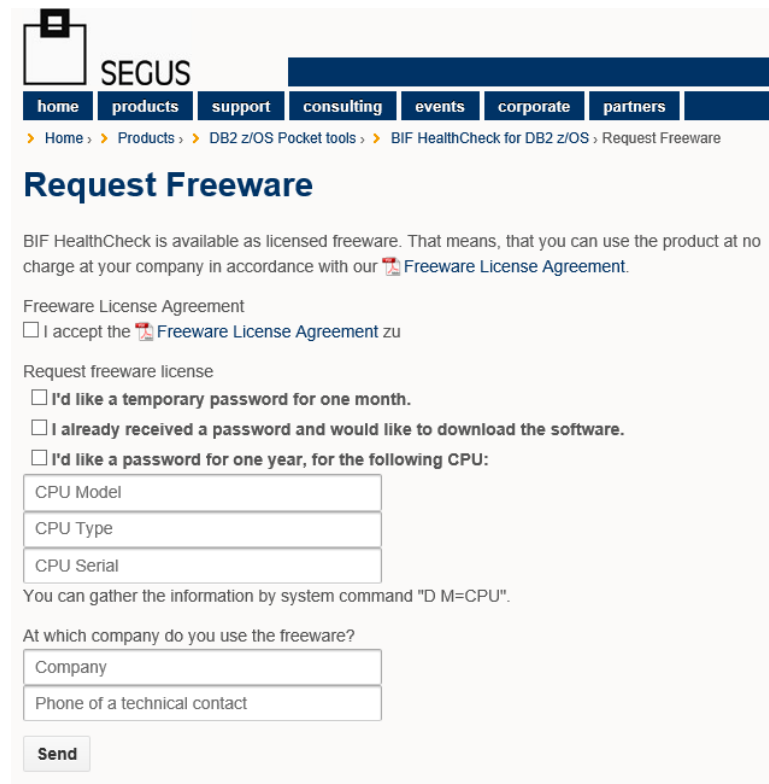


Freeware

# BIF/ICI HealthCheck for DB2 z/OS

- Download\* the Freeware at

<https://www.segus.com/bif>



The screenshot shows the SEGUS website's 'Request Freeware' page. The header includes the SEGUS logo and a navigation menu with links: home, products, support, consulting, events, corporate, and partners. Below the header is a breadcrumb trail: Home > Products > DB2 z/OS Pocket tools > BIF HealthCheck for DB2 z/OS > Request Freeware. The main heading is 'Request Freeware'. The text explains that BIF HealthCheck is available as licensed freeware and that users can use the product at no charge at their company in accordance with the Freeware License Agreement. There is a checkbox for 'I accept the Freeware License Agreement zu'. Below this, there is a section for 'Request freeware license' with three options: 'I'd like a temporary password for one month.', 'I already received a password and would like to download the software.', and 'I'd like a password for one year, for the following CPU:'. The third option has three input fields for 'CPU Model', 'CPU Type', and 'CPU Serial'. Below these fields, there is a note: 'You can gather the information by system command "D M=CPU".'. There is also a question 'At which company do you use the freeware?' with two input fields for 'Company' and 'Phone of a technical contact'. At the bottom of the form is a 'Send' button.

\*requires a free account at segus.com

# Questions???

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Many thanks for your attention and now....

