IBM

DB2 12 — The ultimate enterprise database for business-critical transactions and analytics

DB2 for z/OS: Continuous Delivery of New Features (part 2)
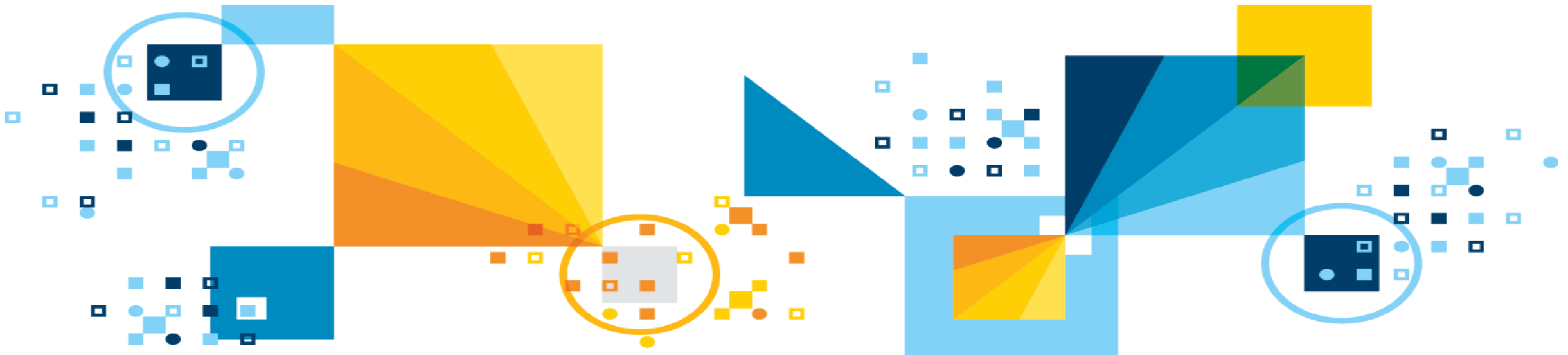
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Presented by Mark Rader

WSC: DB2 for z/OS

DB2 12

Applications

Static SQL, DDL, and DCL

- In DB2 11, Static SQL is controlled by APPLCOMPAT BIND option

- In DB2 11, DDL and DCL is controlled by CM/NFM

- DB2 12 needs to take into account function levels changing more often and the need to control applications' use of new function across one or more function levels

    - In DB2 12, the APPLCOMPAT BIND option is extended to support function levels (e.g. V12R1M501)

    - In DB2 12, the APPLCOMPAT BIND option is extended to support DDL and DCL, in addition to DML

Dynamic SQL, DDL, and DCL

- In DB2 11, by default, Dynamic SQL executed under the APPLCOMPAT Bind Option
  - Could be V10R1 or V11R1
    - SET CURRENT APPLICATION COMPATIBLITY could be used to SET to V11R1 if in NFM
- DB2 12 needs to take into account function levels changing more often and the need to control applications use of new function across one or more function levels
  - In DB2 12 the APPLCOMPAT BIND option is extended to support function levels (e.g. V12R1M501) for both STATIC and DYNAMIC SQL, DDL and DCL
  - The APPLCOMPAT BIND OPTION controls the MAX value that can be specified in SET CURRENT APPLICATION COMPATIBILITY
  - An APPLCOMPAT level will remain active even if the FL is lowered to a * mode (e.g. M501->M500*)

    - REBIND of the current APPLCOMPAT value is allowed even if the value exceeds the current *mode FL

    - SET CURRENT APPLICATION COMPATIBILITY continues to be allowed up to the value specified on BIND/REBIND for APPLCOMPAT

New Global Variables

- PRODUCTID_EXT
  - Contains the extended product identifier of the database manager that invoked the function.
  - The format of the extended product identifier values is pppvvrrmmm, where ppp is a 3- letter product code (such as DSN for DB2®), vv is the version, rr is the release, and mmm is the modification level (such as '100', '500', '501'). For example, DSN1201500 identifies DB2 12 after the activation of DB2 12 new function (function level 500 or higher).

- CATALOG_LEVEL
  - Contains the level of the current catalog level.
  - The format of the catalog level values is VvvRrMmmm, where vv is the version, r is the release, and mmm is the modification level (such as '100', '500', '501'). For example, V12R1M500 identifies DB2 12 after the activation of DB2 12 new function (function level 500 or higher).

- DEFAULT_SQLLEVEL
  - Contains the value of the default value of the SQLLEVEL SQL processing option (DECPSQLLV).
  - The format of the default SQL level values is V10R1, V11R1, or VvvRrMmmm, where vv is the version, r is the release, and mmm is the modification level (such as '100', '500', '501'). For example, V12R1M500 identifies DB2 12 after the activation of DB2 12 new function.

- DB2 V11 can query the new built-in global variables. Their values will be:
  - SYSIBM.PRODUCTID_EXT: DSN111500
  - SYSIBM.CATALOGLEVEL: V12R1M500
  - SYSIBM.DEFAULT_SQLLEVEL: NULL

IBM Data Server Drivers
- ODBC/CLI
- JDBC
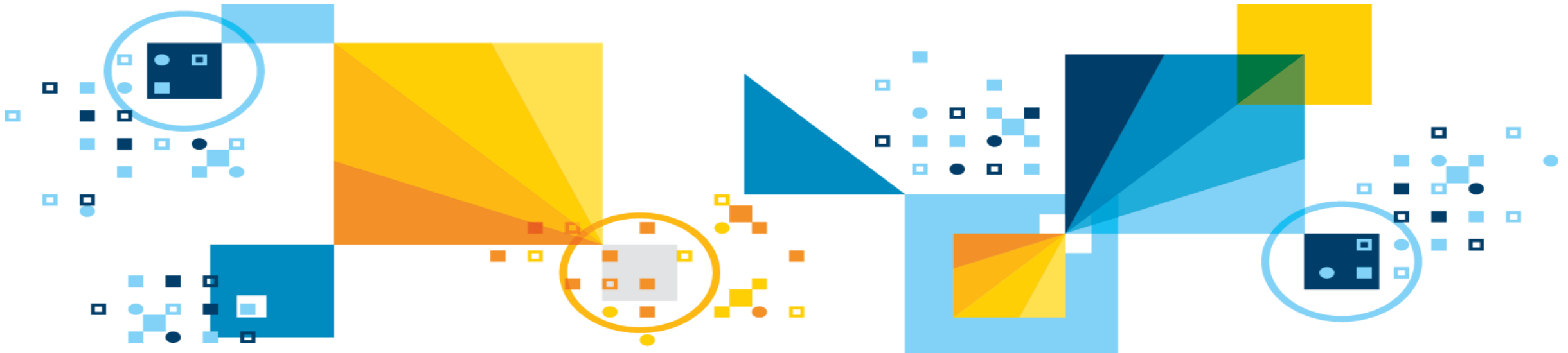
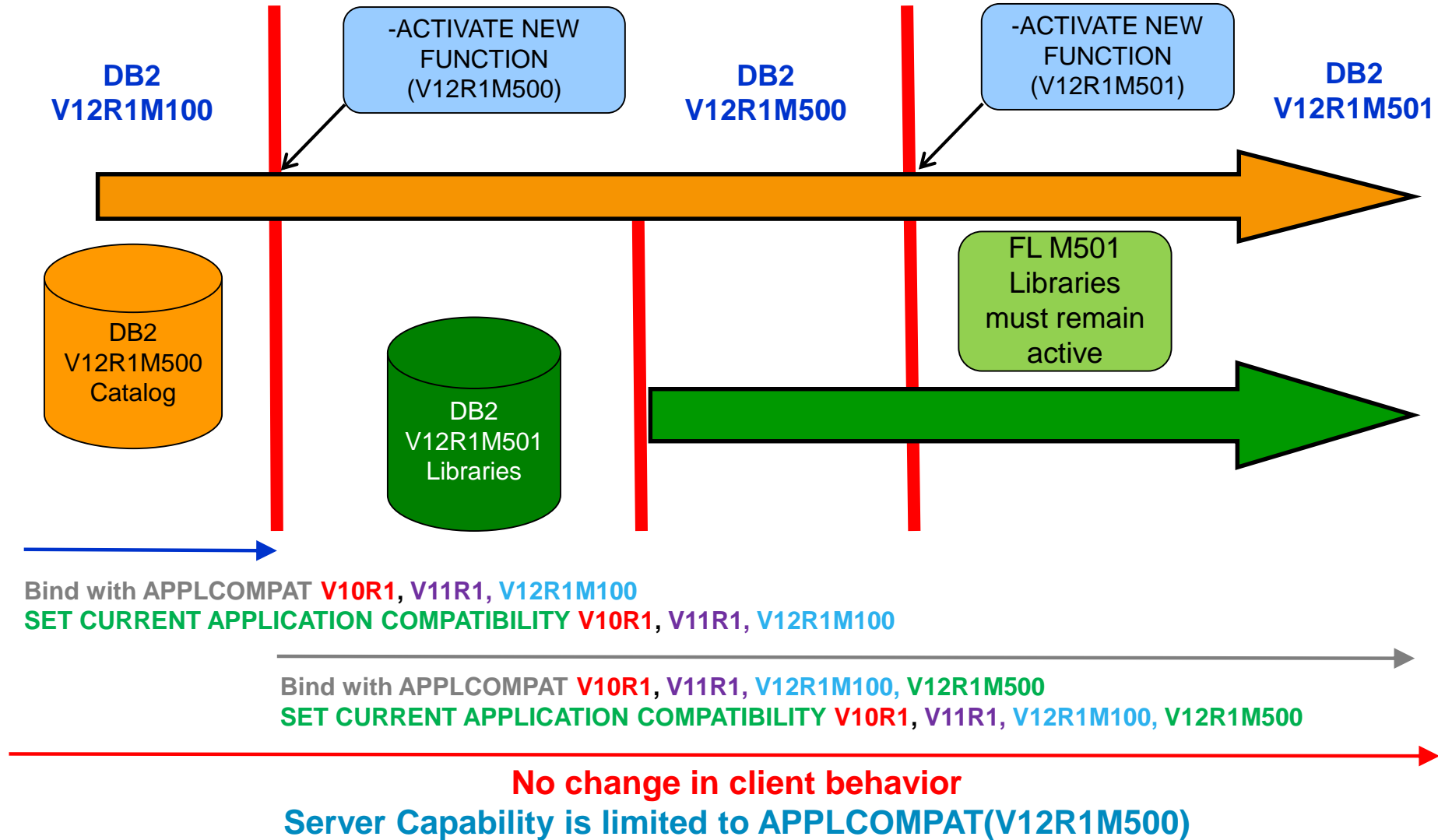# New client property to control new function - clientApplCompat

- Any level of DB2 Connect drivers should work with DB2 V12, both before and after new function is activated with no behavior change.

- Data server clients and drivers must be at the following levels to exploit DB2 for z/OS function-level application compatibility of V12R1M501 or greater:

  - IBM® Data Server Driver for JDBC and SQLJ: Versions 3.72 and 4.22, or later

  - Other IBM data server clients and drivers: DB2 for Linux, UNIX, and Windows Version 11.1 Modification 1 Fix Pack, or later

- clientApplCompat lets you control the capability of the client when updated drivers ship changes to enable new sever capability.   You might what specific control of driver capability when:

  - DB2 client driver introduces new behavior currently not controlled by DB2 application compatibility

  - Change needs to be controlled at the application level to ensure compatibility with new behavior

- clientApplCompat V12R1M500 is required to access DB2 12 Server capability shipped after GA at function levels beyond DB2 V12R1M500.

clientApplCompat relationship to DB2 APPLCOMPAT

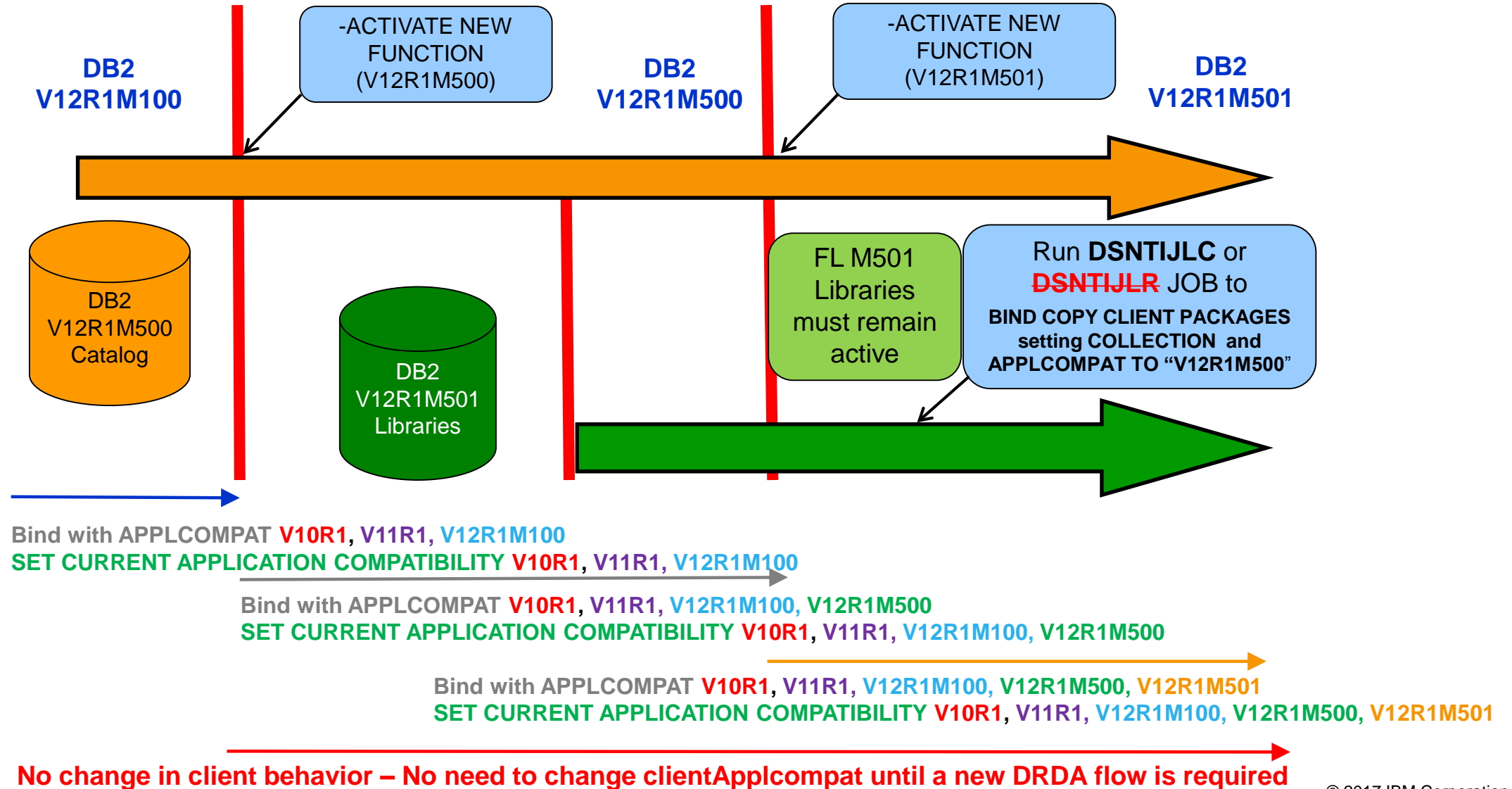| Driver Level	clientApplCompat setting	APPLCOMPAT setting***	Application Capability
V10.5 FP2(-) V11 V11 FP1(+)	n/a n/a not provided	V10R1 V11R1 V12R1M100 V12R1M500	Applications may exploit DB2 10 functionality Applications may exploit DB2 11 functionality Applications may exploit DB2 11 functionality Applications may exploit DB2 V12R1M500 functionality
V10.5 FP2(-) V11 V11 FP1(+)	n/a n/a not provided	V12R1M501 – V12R1M5xx	SQLCODE -30025 Function Level V12R1M501 has a dependency on clientApplCompat being set
V11 FP1(+)	V12R1M500 To Exploit function level V12R1M501 and beyond, clientApplCompat must be set	V10R1 V11R1 V11R1M100 V12R1M501 V12R1M5xx – V12R1M5(zz-1)	Applications may exploit DB2 10 functionality Applications may exploit DB2 11 functionality Applications may exploit DB2 11 functionality Applications may exploit DB2 V12R1M501 functionality Applications may exploit DB2 V12R1M5xx functionality Applications may exploit DB2 V12R1M5(zz-1) functionality
V11 FP1(+)	V12R1M501(+)	V12R1M500	SQLCODE -30025 clientApplCompat must not exceed the server APPLCOMPAT setting
Vyy Fpy ###	V12R1M5zz	V12R1M5zz	Applications may exploit DB2 V12R1M5zz functionality Future function that requires new DRDA data flow

***This is the APPLCOMPAT setting for the IBM Data Server Driver Packages specified by the collection id
Hypothetical future Driver fixpack needed to support a DB2 for z/OS server change at FL V12R1M5zz

Data Server Drivers - Pre DB2 11 FP1*

DB2 V12R1M100

-ACTIVATE NEW FUNCTION (V12R1M500)

DB2 V12R1M500

-ACTIVATE NEW FUNCTION (V12R1M501)

DB2 V12R1M501

DB2 V12R1M500 Catalog

DB2 V12R1M501 Libraries

FL M501 Libraries must remain active

Bind with APPLCOMPAT **V10R1, V11R1, V12R1M100**
SET CURRENT APPLICATION COMPATIBILITY **V10R1, V11R1, V12R1M100**

Bind with APPLCOMPAT **V10R1, V11R1, V12R1M100, V12R1M500**
SET CURRENT APPLICATION COMPATIBILITY **V10R1, V11R1, V12R1M100, V12R1M500**

No change in client behavior
Server Capability is limited to APPLCOMPAT(V12R1M500)

*Including any any Data Server Driver post DB2 11 FP1 if clientApplCompat = V12R1M500 is not specified

Data Server Drivers - DB2 11 FP1(+)

**DB2
V12R1M100**

-ACTIVATE NEW FUNCTION (V12R1M500)

**DB2
V12R1M500**

-ACTIVATE NEW FUNCTION (V12R1M501)

**DB2
V12R1M501**

DB2
V12R1M500
Catalog

DB2
V12R1M501
Libraries

FL M501 Libraries must remain active

Run **DSNTIJLC** or ~~**DSNTIJLR**~~ JOB to

BIND COPY CLIENT PACKAGES setting COLLECTION and APPLCOMPAT TO "V12R1M500"

Bind with APPLCOMPAT **V10R1**, **V11R1**, **V12R1M100**
SET CURRENT APPLICATION COMPATIBILITY **V10R1**, **V11R1**, **V12R1M100**

Bind with APPLCOMPAT **V10R1**, **V11R1**, **V12R1M100**, **V12R1M500**
SET CURRENT APPLICATION COMPATIBILITY **V10R1**, **V11R1**, **V12R1M100**, **V12R1M500**

Bind with APPLCOMPAT **V10R1**, **V11R1**, **V12R1M100**, **V12R1M500**, **V12R1M501**
SET CURRENT APPLICATION COMPATIBILITY **V10R1**, **V11R1**, **V12R1M100**, **V12R1M500**, **V12R1M501**

No change in client behavior – No need to change clientApplcompat until a new DRDA flow is required

clientApplCompat – control of future function

- DB2 12 only allows the new client behavior to control behavior when the APPLCOMPAT package at the server supports that level of client server function.

- We anticipate that at some point in the future, a new server feature will require a new clientApplCompat level.

- For example let's say a new datatype is added in DB2 12 at DB2 function level DB2 V12R1M5zz. At that point, client-server applications wanting to exploit that new capability will need to have:
  - Packages bound at the server with APPLCOMPAT(V12R1M5zz)
  - clientApplCompat set to V12R1M5zz

- A clientApplCompat that exceeds the Server APPLCOMPAT bind option for the data server driver packages will result in:
  - -30025 EXECUTION FAILED BECAUSE FUNCTION NOT SUPPORTED BY THE SERVER: LOCATION location-name PRODUCT ID product-identifier REASON reason-code (sub-code)

- Although you "can" advance your clientApplCompat as you increase the APPLCOMPAT of the data server driver packages – it will only be necessary when new client capability needs to be exploited.

- Best Practice – only change your clientApplCompat when necessary

SQLCA and GET DIAGNOSTIC impacts

- SQL CONNECT is enhanced to return the DB2 product ID and its current and functional level of the connected server in the generated SQLCA

- Information about the server is placed in the SQLERRP and SQLERRMC fields
  - Information in the SQLERRP field contains the server product information
    - It contains the following information:
    - ppp is the product identifier:
      - 'AQT' IBM® DB2 Analytics Accelerator for z/OS
      - 'ARI' DB2 Server for VSE & VM
      - 'DSN' DB2 for z/OS
      - 'JCC' IBM Data Server Driver for JDBC and SQLJ
      - 'QSQ' DB2 for i
      - 'SQL' DB2 for Linux, UNIX, and Windows
    - vv The version identifier such as '11' for Version 11.
    - rr The release identifier such as '01'.
    - m The modification level.
  - Information in the SQLERRMC field contains the functional levels
    - First token contains the functional level of the connected DB2 (e.g. 'V12R1M506').

- Clients adding new APIs to retrieve the current DB2 functional level

DDF Commands and Messages

- **-DISPLAY LOCATION**
  - Changed to show the functional level of each connected system
- **DDF Location Statistics**
  - Changed to show the functional level of each connected system
- **DDF Accounting Header**
  - Changed to show the functional level of the connected systems

What the Clients see after Connect

- CLI introduce a new infotype SQL_DBMS_FUNCTIONLVL for SQLGetInfo api that will return the function level/buildlevel.

- JCC introduce a new getDatabaseFunctionalLevel() API driver that will return a string.

- DB2 LUW returns build level (e.g. "n1604281900").

- DB2 Z returns function level (e.g. "V12R1M504").

Catalog changes
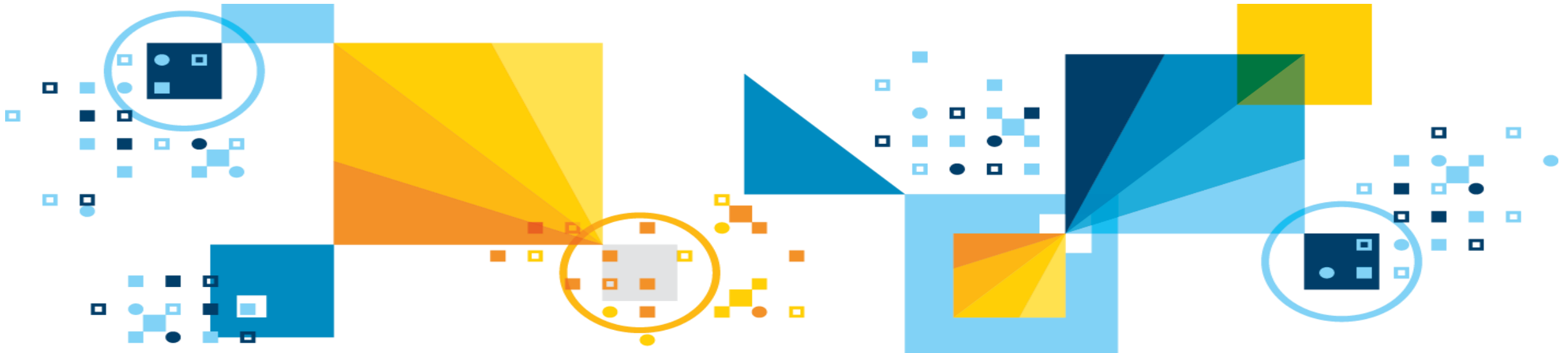
New catalog table SYSIBM.SYSLEVELUPDATES

A row will be inserted into this table during ACTIVATE FUNCTION LEVEL and CATMAINT UPDATE

Column name	Data type	Description
FUNCTION_LVL	VARCHAR(10)	Function level when this record is inserted
PREV_FUNCTION_LVL	VARCHAR(10)	Previous function level
HIGH_FUNCTION_LVL	VARCHAR(10)	Highest activated function level
CATALOG_LVL	VARCHAR(10)	Catalog level when this record is inserted
OPERATION_TYPE	CHAR(1)	Type of operation : 'C' for catalog change, 'F for function level, 'M' for maintenance update (some form of special catmaint for instance)
EFFECTIVE_TIME	TIMESTAMP(12)	Time when a change in function or catalog level has completed.
EFFECTIVE_LRSN	CHAR(10)	RBA (or LRSN for data sharing) at the time when a change in function or catalog level has completed.
OPERATION_TEXT	VARCHAR(256)	The text of the operation.
GROUP_MEMBER	VARCHAR(24)	Name of the group member on which the operation was executed.

New catalog table SYSIBM.SYSLEVELUPDATES

FUNCTION_LVL	PREV_FUNCTION _LEVEL	HIGH_FUNCTION _LEVEL	CATALOG_LVL	OPERATION_ TYPE	EFFECTIVE_ TIME	OPERATION_TEXT
V12R1M100	V11R1M500	V12R1M100	V12R1M500	C	TIME 1	CATMAINT UPDATE UNLDDN V12R1M500
V12R1M500	V12R1M100	V12R1M500	V12R1M500	F	TIME 2	ACTIVATE FUNCTION LEVEL(V12R1M500)
V12R1M503	V12R1M500	V12R1M503	V12R1M500	F	TIME 3	ACTIVATE FUNCTION LEVEL(V12R1M503)
V12R1M500	V12R1M503	V12R1M503	V12R1M500	F	TIME 4	ACTIVATE FUNCTION LEVEL(V12R1M500)
V12R1M500	V12R1M503	V12R1M503	V12R1M505	C	TIME 5	CATMAINT UPDATE UNLDDN V12R1M505
V12R1M505	V12R1M500*	V12R1M505	V12R1M505	F	TIME 6	ACTIVATE FUNCTION LEVEL(V12R1M505)

New Catalog Columns

Table Name	Column Name	Data Type	Description
SYSACCELERATEDPACKAGES SYSDYNQRY SYSPACKCOPY SYSPACKAGE SYSQUERY	FNLEVEL	VARCHAR(10)	Function level of the package/query at the time the row was inserted
SYSCONTROLS SYSINDEXES SYSROUTINES SYSTABLES	REGENERATETS	TIMESTAMP(12)	Time when the object was regenerated or altered
SYSKEYS SYSENVIRONMENT	CREATEDTS	TIMESTAMP(12)	Time when the row was inserted

Listed above are the new columns which have been added in places where we do not already have timestamp columns. We are not listing all the existing timestamp columns that could be used with SYSLEVELUPDATES in a similar fashion to that described on the previous slide.

```
SELECT LVU.FUNCTION_LVL,   LVU.CATALOG_LVL,
       LVU.EFFECTIVE_TIME,
       LVU.OPERATION_TEXT
FROM SYSIBM.SYSTABLES AS TAB,
     SYSIBM.SYSLEVELUPDATES AS LVU
WHERE TAB.CREATOR = 'MY' AND TAB.NAME = 'TABLE1'
  AND TAB.CREATEDTS > LVU.EFFECTIVE_TIME
ORDER BY LVU.EFFECTIVE_TIME DESC
FETCH FIRST 1 ROWS ONLY
```

Query to find the catalog level and function level when table MY.TABLE1 was created.

FUNCTION_LVL	CATALOG_LVL	EFFECTIVE_TIME	OPERATION_TEXT
V12R1M503	V12R1M500	TIME 3	ACTIVATE FUNCTION LEVEL (V12R1M503)

```
SELECT  …
FROM  SYSLEVELUPDATES AS LVU
WHERE LVU.FUNCTION_LVL = 'V12R1M505'
```

Query to find when function level 505 was activated.

FUNCTION_LVL	PREV_FUNC_LVL	HIGH_FUNC_LVL	CATALOG_LVL	EFFECTIVE_TIME
V12R1M505	V12R1M500*	V12R1M505	V12R1M505	2016-04-20-12.38.03.706031000000

Questions? ? ?
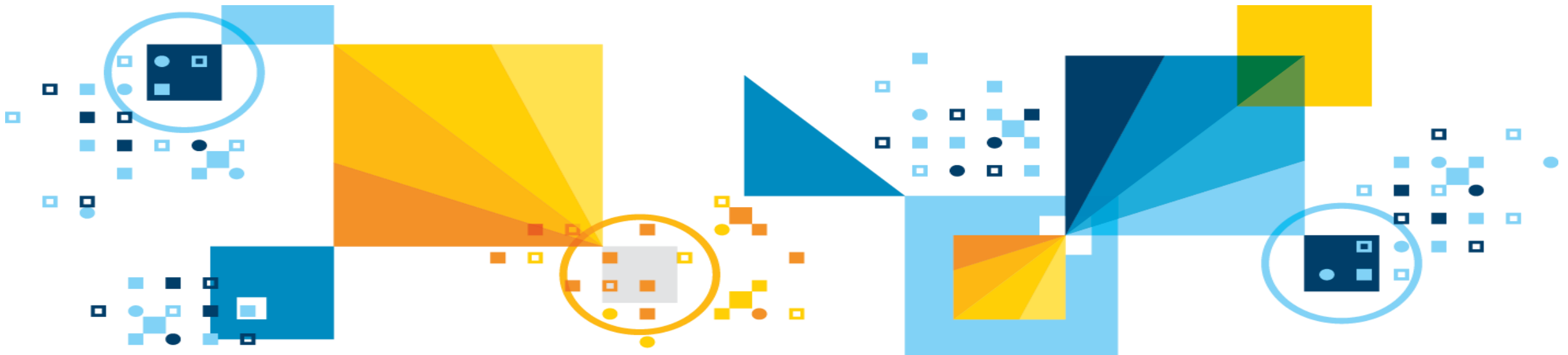
Summary
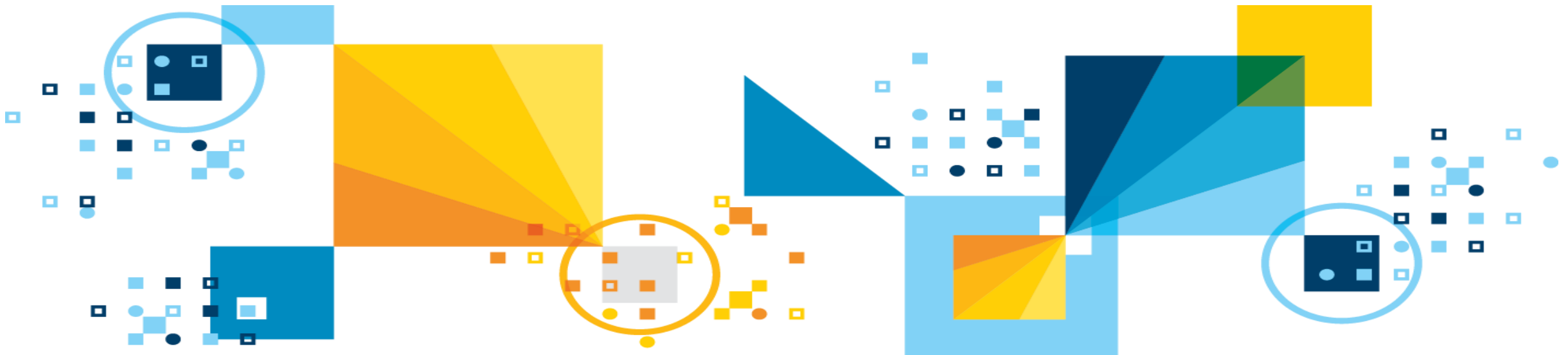
Summary

- Starting with DB2 12 New Function will ship in the maintenance stream (ML)
- Enabling new function is controlled by use of
  - Catmaint (CL)
  - -ACTIVATE FUNCTION LEVEL (FL)
  - APPLCOMPAT (APPLV)
- APPLCOMPAT is extended to apply to DDL, DCL, and to control IBM Data Server Driver Packages (ODBC, JDBC, .Net, PHP, RUBY… SAP).
- SYSLEVELUPDATES contains History on when system changes occurred
- Documentation will change to help highlight new function
- Working with Vendors to improve communication and early notification of changes, with access to PTFs prior to general availability

Appendix
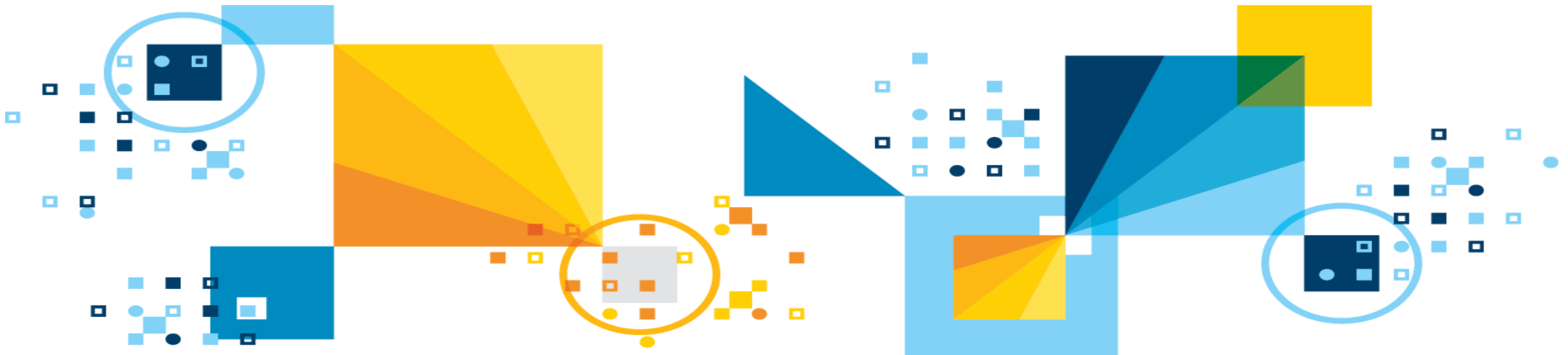
Documentation
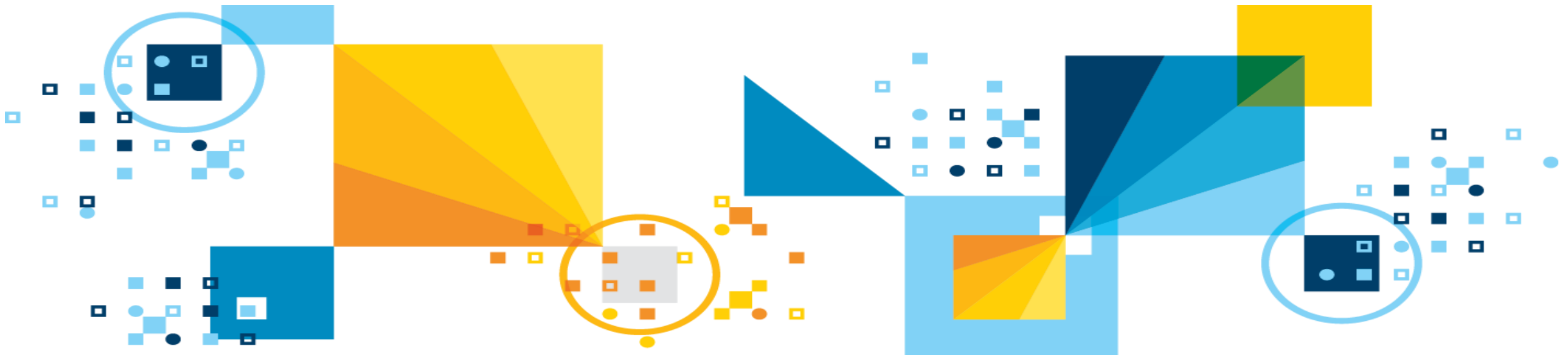
Function Level Information: Table of Contents

Info about the DB2 12 product at GA (traditional "What's New" information)

DB2 for z/OS

DB2 for z/OS 12.0.0

+ Welcome to DB2 12 for z/OS

+ Getting started with DB2 for z/OS

+ What's new in the initial DB2 12 release?

Info about the DB2 12 function levels (shipped by continuous delivery)

— What's new in DB2 12 function levels?

— Available DB2 function levels

Function level 500 (enabled by migration to DB2 12)

Topics about the available function levels and their enhancements, with the most recent function level on top

Function level 100 (activated by migration to DB2 12)

Summary of operational requisite changes for DB2 function levels

Code levels, catalog levels, function levels, and application compatibility

Conceptual information about continuous delivery and instructions for activating new capabilities

Activating new capabilities in DB2 12 function levels

"Available DB2 function levels" topic

Tip: Bookmark this topic because it will be updated every time a new DB2 function level is shipped!

Available DB2 function levels — Version 12.0.0 ▼

DB2® for z/OS® delivers new capabilities as they become available, which means you can benefit from new capabilities without waiting for an entire new DB2 for z/OS release. After the code to support a particular enhancement has shipped in the service stream, you activate a function level to make the enhancements available in your DB2 environment.

Function levels are specified by 9-byte strings that correspond to the DB2 version, release, and maintenance value.

The format is VvvRrMmmm, where vv is the version, rr release, and mmm is the modification level.

Sometimes a function levels are abbreviated. For example, "function level 501" refers to V12R1M501, which is the highest available function level in DB2 12.

Tip: GUPI To determine the catalog level and function level information for a DB2 data sharing group or subsystem and code levels of individual group members, issue a DISPLAY GROUP command. For examples of issuing this command, see -DISPLAY GROUP (DB2). The DSN7100I message indicates the catalog, and function levels of the data sharing group or subsystem, and the code levels of each data sharing member or subsystem. The DB2 LVL column indicates the code level of each data sharing member or subsystem. For detailed descriptions and example output, see DSN7100I GUPI

The following function levels are available in DB2 12. They are listed in descending order, beginning with the highest available function level:

This topic has links to topics about each new function level, with the most recent on top.

The paragraph under the link summarizes what is included in the function level

Function level 500 (enabled by migration to DB2 12)
Function level function level 500 (V12R1M500) represents the first opportunity for applications to take advantage of most new function in DB2 12, including new SQL capabilities and subsystem parameter settings. In many respects, it is comparable to new-function mode in DB2 11.

Function level 100 (activated by migration to DB2 12)
In function level 100 (V12R1M100), DB2 runs on DB2 12 code. However, most new function, including new SQL capabilities and subsystem parameters are not enabled. In many respects, this function level is comparable to conversion mode in DB2 11.

Info about Individual Function Levels

Example

Title of the function level *nnn* topics identifies the function level (V12R1M*nnn*) and the APAR/PTF that enables it.

The opening paragraph summarizes the enhancements.

Function level 505 (V12R1M505) (enabled by APAR apar# PTF ptf#)

Function level 505 includes the following enhancements: bitemporal support for the IBM DB2 Analytics Accelerator, ODBC support of the TIMESTAMP WITH TIMEZONE data type, and percentile support for the MEDIAN function.

Minimum required catalog level	V12R1M505
CATMAINT required?	Yes. Issue the `CATMAINT UPDATE`... utility control statement.
Incompatible changes?	Yes. For details, see *<link to topic with details>*.
Possibly other facts	TBD

A table provides basic facts about each function level.

Information about Individual Function Levels (continued)

Example

After the table of facts, you'll find one section for each enhancement in the function level, with a brief overview of that enhancement.

The overview will focus on **Who, What, and WOW!**

Bitemporal support for DB2 Analytics Accelerator (V12R1M505)

The DB2 Analytics Accelerator now supports both system-period and application-period temporal tables.

Bitemporal tables are ideal for applications that rely on tables that keep application-period information and system-based historical information because this type of ta ble gives you a great deal of flexibility in how you query data based on periods of time. This DB2 Analytic Accelerator support of bitemporal tables improves the integration and power of the combination of DB2 for z/OS and the accelerator.

Related information:

Types of tables
ACCELERATION OPTIONS field (QUERY_ACCEL_OPTIONS subsystem parameter)

Each section for each enhancement concludes with links to:
- KC topics that provide more details about the enhancement
- Other resources (white papers, webcasts, etc.) about the enhancement

Details about Enhancements

Example

DB2 for z/OS 12.0.0 > Installing and migrating DB2 > Installation and migration > Tailoring DB2 jobs to your environment using the installation CLIST > DSNTIP82: Query accelerator preferences panel > ACCELERATION OPTIONS field (QUERY_ACCEL_OPTIONS subsystem parameter)

ACCELERATION OPTIONS field (QUERY_ACCEL_OPTIONS subsystem parameter)

The QUERY_ACCEL_OPTIONS subsystem parameter controls whether certain types of queries are allowed to execute on an accel

Acceptable values:	NONE, YES
Default:	NONE
DSNZP*xxx*:	DSN6SPRM.QUERY_ACCEL_OPTIONS (option NONE)

Choose NONE if you do not want to choose whether DB2 allows certain types of queries to run on an accelerator server. If you choo
types of queries to run on an accelerator server. If you choose YES, you proceed to panel DSNTIP8A after completing panel DSNTI

Other topics that are changed for a function level contain links back to the overview of the function level.

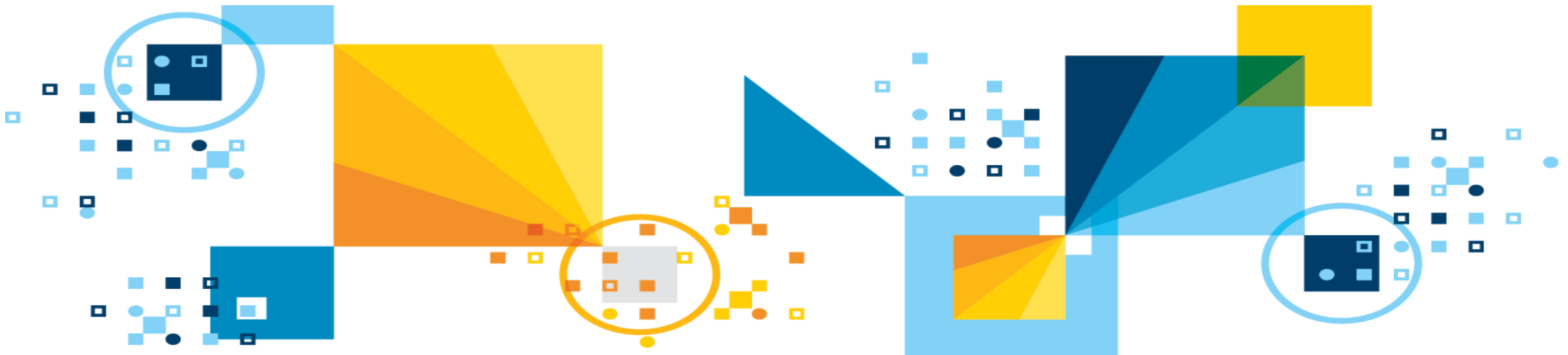**Parent topic:** DSNTIP82: Query accelerator preferences panel
Previous topic: GET ACCEL ARCHIVE field (GET_ACCEL_ARCHIVE subsystem parameter)
Next topic: CURRENT QUERY ACCEL (QUERY_ACCELERATION subsystem parameter)

Related information:

Bitemporal support for DB2 Analytics Accelerator (V12R1M505)

Vendor Continuous Delivery Process

Pre-Continuous Delivery Vendor Process

- Version upgrades
  - Separate vendor program - early and regular vendor involvement and communication
  - Code drops starting over a year prior to ESP start
  - PFS roll-ups starting over a year prior to ESP start
- Maintenance updates
  - Notification of APARs affecting modules or control blocks that vendors have indicated they are sensitive to
  - Regular sharing of documentation for design changes delivered in maintenance stream
- Improved communications to answer ad-hoc queries and aid resolution of high impact problems

Vendor Continuous Delivery Support Summary

- Overriding aim is ensure stability of DB2 for z/OS environments

- Exploitation is desirable, but secondary concern

- Help achieve this through
  - Improved, earlier, communication of changes
  - Early access to new maintenance
  - More consistent and timely update of serviceability information
  - Periodic longer-view updates
  - Ongoing use of improved communication channels between vendors and IBM development

- In spite of these efforts, Continuous Delivery places greater responsibility upon vendors to invest in ensuring stability and preventing regression from DB2 maintenance