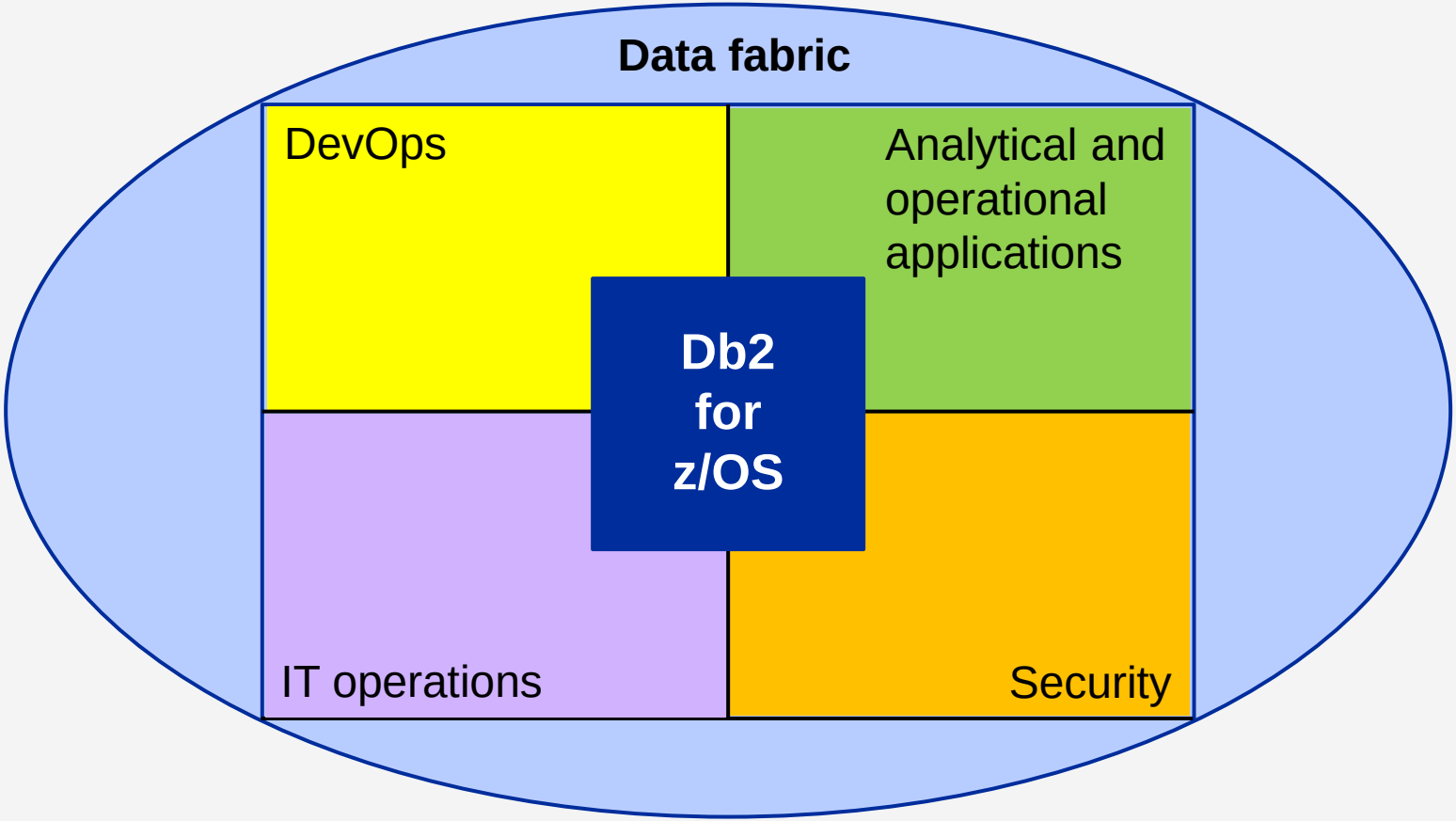
Db2 13 ecosystem

The Db2 for z/OS ecosystem



Ecosystem – DevOps

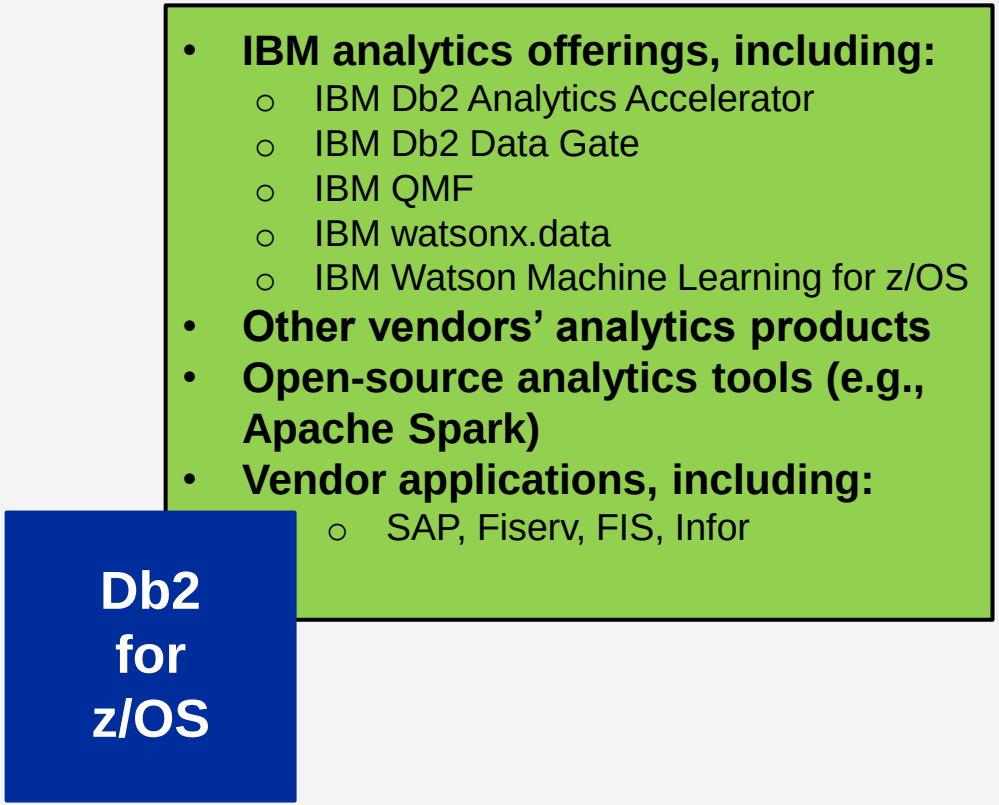
- The aim: enable developers, DevOps engineers, and DBAs to be more productive and agile in developing and deploying applications that access Db2 for z/OS
- Support modern APIs (REST, JDBC, ODBC) for interaction with Db2 and other z/OS subsystems
- Through virtualization, enable federation of Db2 for z/OS data with non-relational and outside-of-z/OS data sources

- **IBM offerings, including:**
  - IBM Db2 DevOps Experience for z/OS
  - IBM Db2 for z/OS Developer Extension for Visual Studio Code
  - IBM Urban Code Deploy
  - IBM z/OS Connect
  - IBM Data Virtualization Manager
  - IBM Optim Test Data Management
- **Open source tools (e.g., GitLab, Jenkins)**
- **Other vendors' products**

Db2 for z/OS

Ecosystem – analytical and operational applications

- The aim: for analytical applications, enable sophisticated, high-performance analysis of low-latency (or zero-latency) Db2 for z/OS data to support decision-making
- Support development of predictive models using Db2 and other z/OS-based data sources, and deployment of those models for z/OS applications
- Provide a robust and modern data-serving platform for leading vendor-supplied operational applications



Ecosystem – IT operations

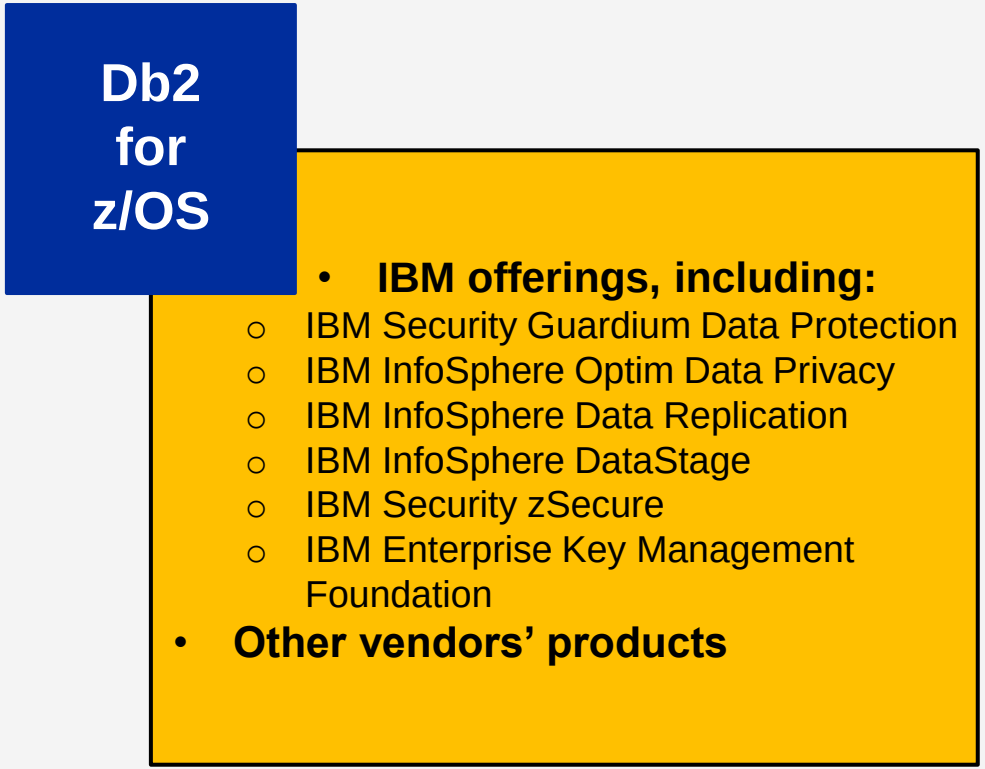
- The aim: provide database and system administrators with the tools to effectively and efficiently manage Db2 and the overall z/OS environment
- A “force multiplier” for experienced administrators
- A capability booster for newer people on the Db2 and/or z/OS teams
- Several of the IBM offerings in this space can make a Db2 system more self-monitoring and self-managing

Db2 for z/OS

- **IBM offerings, including:**
  - IBM OMEGAMON for Db2
  - IBM Db2 Administration Tool
  - IBM Db2 Recovery Expert
  - IBM Db2 Query Monitor
  - IBM Db2 AI for z/OS
  - IBM Administration Foundation for Db2 for z/OS
  - IBM Z Operations Analytics
- **Other vendors’ products**

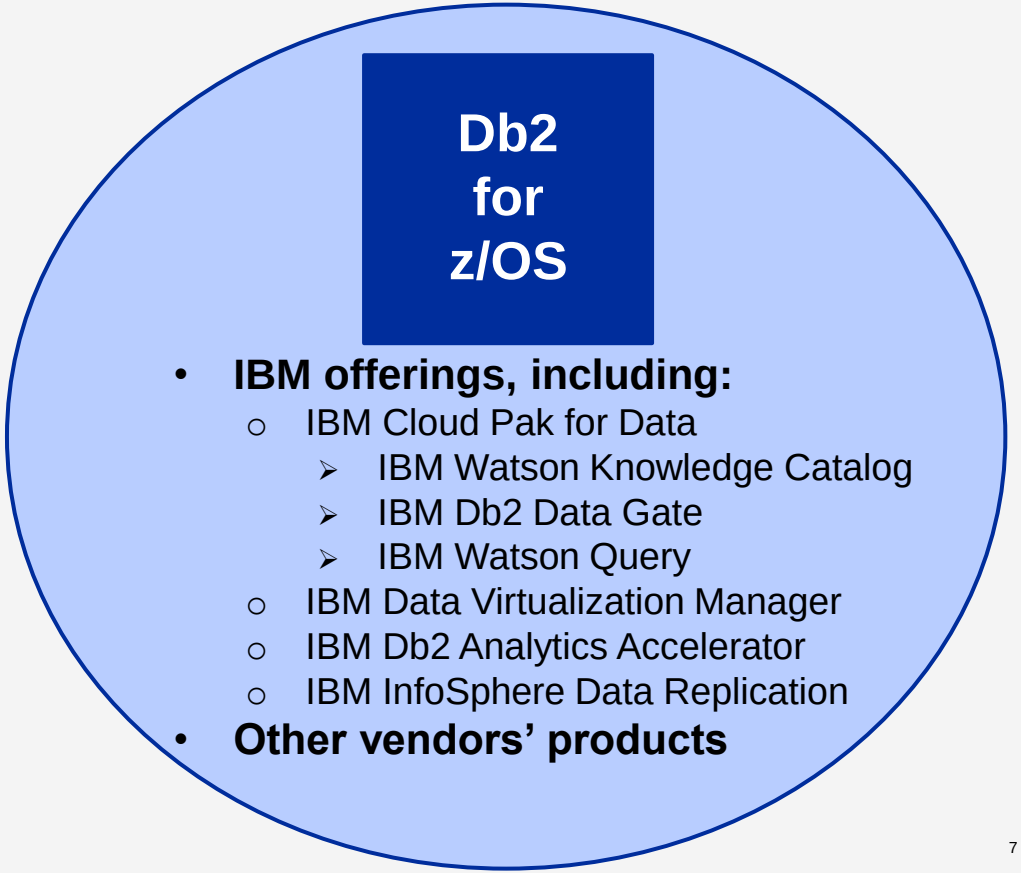
Ecosystem – security

- The aim: strengthen Db2 for z/OS data security
- Enterprise-level auditing of access to sensitive data
- Sophisticated masking of sensitive data values, especially in development and test systems
- Secure replication of Db2 for z/OS data to target systems
- Robust administration of a data encryption infrastructure, including key management



Ecosystem – data fabric

- The aim: make all of an enterprise's data – in Db2 for z/OS and otherwise – uniformly easy to discover, catalog, govern, access and use
- Virtualization removes friction by abstracting particulars of data sources, while enabling in-place access to data
  - High performance
  - Optimal security
  - Zero to near-zero latency
- Advanced federation for "360" data requirements



For more information on IBM products in the Db2 ecosystem…

- **DevOps**
  - IBM Db2 DevOps Experience for z/OS
  - IBM Db2 for z/OS Developer Extension for Visual Studio Code
  - IBM Urban Code Deploy
  - IBM z/OS Connect
  - IBM Data Virtualization Manager
  - IBM Optim Test Data Management
- **Analytics**
  - IBM Db2 Analytics Accelerator
  - IBM QMF
  - IBM watsonx.data
  - IBM Watson Machine Learning for z/OS
- **Data fabric**
  - IBM Cloud Pak for Data
    - IBM Watson Knowledge Catalog
    - IBM Db2 Data Gate
  - IBM Data Virtualization Manager
  - IBM Db2 Analytics Accelerator
  - IBM InfoSphere Data Replication
- **IT operations**
  - IBM OMEGAMON for Db2
  - IBM Db2 Administration Tool
  - IBM Db2 Recovery Expert
  - IBM Db2 Query Monitor
  - IBM Db2 AI for z/OS
  - IBM Db2 Administration Foundation for z/OS
  - IBM Z Operations Analytics
- **Security**
  - IBM Security Guardium Data Protection
  - IBM InfoSphere Optim Data Privacy
  - IBM InfoSphere Data Replication
  - IBM InfoSphere DataStage
  - IBM Security zSecure
  - IBM Enterprise Key Management Foundation

Ecosystem spotlight – Analytics Accelerator and Data Gate

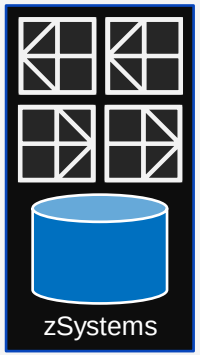
Containers on IBM zSystems
e.g., OpenShift, zCX

Data access modernization
(REST services, Java, …)

Db2 Analytics Accelerator

Consistent data

Read & write
same API



IBM zSystems repositories, relational / non-relational, modern / historic

Move the cloud-native workload (containers) to the IBM zSystems

A

B

Move IBM zSystems data to the (private, public, hybrid, …) cloud

Containers and new services with requirement to access data on IBM zSystems

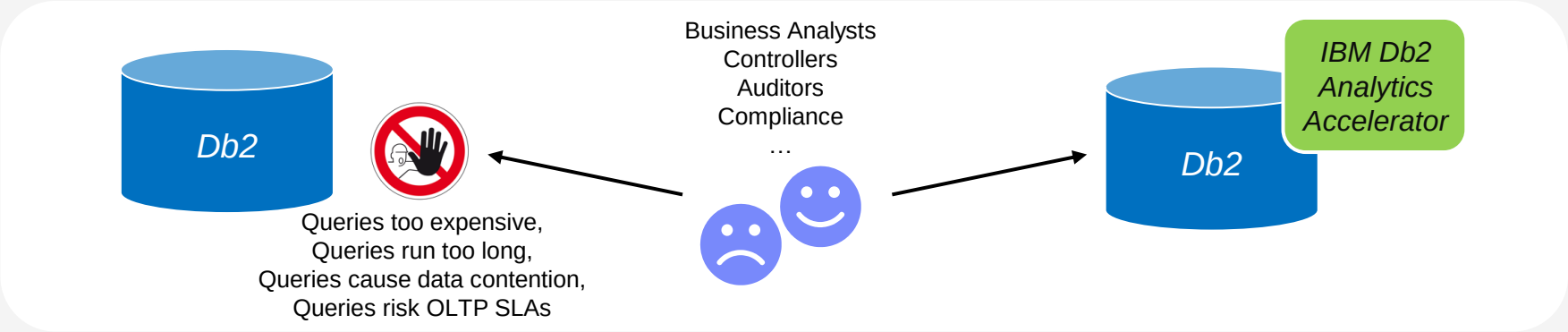
Security and governance
Copies of data

Data replication
Effort, cost

Latency
(depending on the technology)

Primarily read
How to access IBM zSystems for update?
Consistency?

Complement Db2 with Db2 Analytics Accelerator



Previous characteristics of the Accelerator:

- Form factor: dedicated appliance
- Database engine: Netezza
- Data synchronization: Change Data Capture

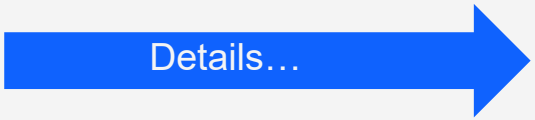
New characteristics of the Accelerator:

- Form factor: Secure Service Container (SSC) on IBM zSystems or IBM LinuxONE
  - Either way, runs on IFLs
- Database engine: Db2 Warehouse with BLU Acceleration (in-memory database)
- Data synchronization: Db2 Integrated Synchronization (extremely low latency, very little general-purpose CPU cost)

IBM Db2 Analytics Accelerator

Noteworthy recent enhancements for the Accelerator:

- Enhanced support for passthrough-only expressions
- SQL pagination support
- Support for MASKed columns
- Support for IN-list predicates with > 32K elements
- Support queries that include the LISTAGG and/or RAND functions



Passthrough-only expression support

The database engine of the Accelerator (Db2 Warehouse) offers a range of built-in functions for analytical purposes that are currently not supported natively by Db2 for z/OS

Db2 can successfully execute SQL statements containing these built-in functions when the query is routed to the Accelerator – this is called passthrough-only expression support

The enhancements for passthrough-only expressions were introduced for Db2 12 through APARs and function levels – this capability is included in the Db2 13 base code

- Db2 12 FL504 introduced passthrough support for the following functions:
  - OLAP/Aggregate functions: `CUME_DIST, FIRST_VALUE, LAG, LAST_VALUE, LEAD, NTH_VALUE, NTILE, PERCENT_RANK, RATIO_TO_REPORT`
  - Scalar functions: `REGEXP_COUNT, REGEXP_INSTR, REGEXP_LIKE, REGEXP_REPLACE, REGEXP_SUBSTR`
- With Db2 12 FL507 introduced passthrough support for the following functions:
  - Aggregate functions (all regression functions): `REGR_SLOPE, REGR_INTERCEPT, REGR_ICPT, REGR_R2, REGR_COUNT, REGR_AVGX, REGR_AVGY, REGR_SXX, REGR_SYY, REGR_SXY`

SQL pagination support

SQL pagination is now supported for queries that are routed to the Accelerator

SQL pagination support was introduced for Db2 12 via APARs – this capability is included in the Db2 13 base code

- With Db2 12 APAR PH42015 queries with OFFSET n ROWS can be routed to the Accelerator – for example:

```
SELECT * FROM T1 ORDER BY C1 OFFSET 10 ROWS;
```

- With Db2 12 APAR PH42015 queries with FETCH FIRST n ROWS ONLY can be routed to the Accelerator – for example:

```
SELECT * FROM T1 ORDER BY C1 FETCH FIRST 10 ROWS ONLY;
```


MASKed column support

Queries referencing masked columns can be routed to the Accelerator if the MASKed columns are not part of the result set returned to the application

MASKed column support was introduced for Db2 12 via APAR PH33061, and is part of the Db2 13 base code (the capability requires IBM Db2 Analytics Accelerator for z/OS 7.5.6)

Example:

```
-- TABLE T1(C1, C2, C3) column mask on C2
-- TABLE T2(C1, C2, C3) column mask on C2

-- This query can be routed to the
-- Accelerator because the masked
-- column C2 is only used to join
-- the tables

SELECT A.C1, B.C3
FROM T1 A,
     T2 B
WHERE A.C2 = B.C2;
```

```
-- This query cannot be routed to the
-- Accelerator because the masked
-- column C2 is returned as part of
-- the result set

SELECT A.C1, B.C2
FROM T1 A,
     T2 B
WHERE A.C2 = B.C2;
```


Support for > 32K elements in IN-list, and RAND/LISTAGG

FL 503

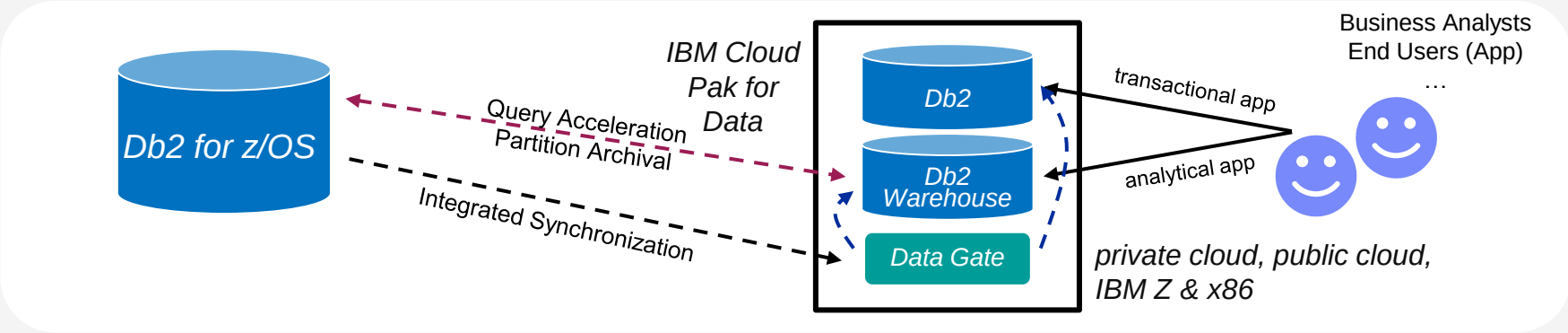
The IN-list limit for Db2 12 and 13 for z/OS is 32767 elements, but with Db2 13 queries with an IN-list having more than 32K elements can be routed to an Accelerator when…

- Query-issuing process is executing with Db2 application compatibility level V13R1M503 or higher
- Option 12 (support for > 32K IN-list elements) is specified in list of values for QUERY_ACCEL_OPTIONS in ZPARM (see Accelerator customization panel DSNTIP8A)
- Target accelerator is IBM Db2 Analytics Accelerator V7
- IN-list specifies only SQL constants

APAR PH48480 provides support for Accelerator routing of queries from Db2 12 or 13 that include the LISTAGG and/or RAND built-in functions

- Query routing involving these functions is supported by Analytics Accelerator 7.1.9 or later
- Also required: specify option 13 (ENABLE ACCELERATOR SPECIFIC RESULTS) in the list of values for QUERY_ACCEL_OPTIONS in ZPARM (see also Accelerator customization panel DSNTIP8A)

Optimize data movement to the cloud with Db2 Data Gate



- Db2 z/OS Data Gate is a service in IBM Cloud Pak for Data, which loads and replicates Db2 z/OS data to:
  - the Db2 service in Cloud Pak for data (and / or)
  - the Db2 Warehouse service in Cloud Pak for data
  - Apps (mobile workload, spiky workload, analytics workload) directly connect to the Cloud Pak databases
- Data Gate uses the same Integrated Synchronization as IBM Db2 Analytics Accelerator
  - Extremely low latency, very high throughput, very low z/OS CPU overhead
  - Also supports the WAIT FOR DATA protocol for optimized data consistency
- Db2 WH w/ Data Gate provides Db2 Query Acceleration (NEW)

