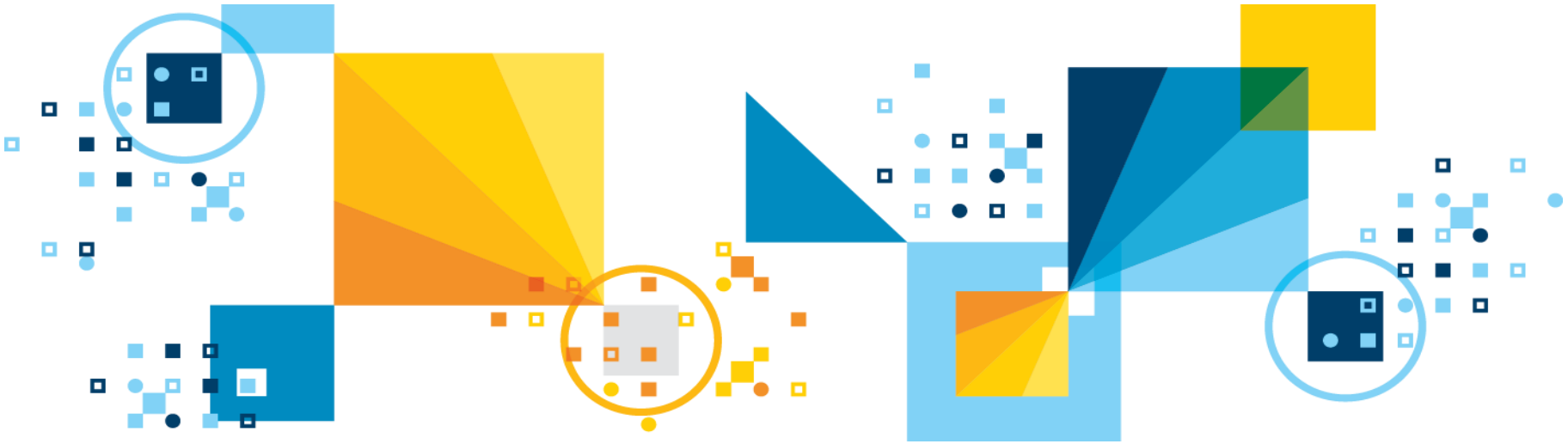
# DB2 Fundamentals

**Module ID** | 10101

**Length** | 1.5 hours



**For questions about this presentation contact** askdata@ca.ibm.com

January 30, 2015

# Disclaimer

# Module Information

- After completing this module, you should be able to:
  - Describe the features of DB2 10.5 LUW
  - Explain the concepts of:
    - DB2 Architecture
    - Process Model
  - Be able to perform following tasks:
    - Catalog the remote system and database
    - Create database
    - Get configurations of DB2 instance and database

# Module Content

- Product Overview
  - Next Generation Databases
  - Simplified Packaging & Licensing
- Fundamentals
  - Users
  - Architecture
    - Data server, Instances, Databases, Process model
  - Diagnostics Log
  - IBM Data Server Drivers and Clients
  - Database Fundamentals
    - Creating databases
    - Table spaces and Buffer pools
  - Security
  - Application Development and Language Support
  - Tools, Commands and APIs

# Market changes driving the need for next generation databases

## Technology allows us to consume more data and generate new insight

The scale and scope of big data present new opportunities for innovation and competitive advantage

## Fast access to insight is a top requirement

Businesses need to more quickly generate insight from information to accelerate decision making

## These insights are sparking new & rapidly evolving analytic requests


Organizations need fast, simple and agile technology strategies for manipulating data and developing new applications

*Are you ready to respond?*
*How to do it leveraging existing investments?*
*How to achieve the full potential without disrupting the business?*

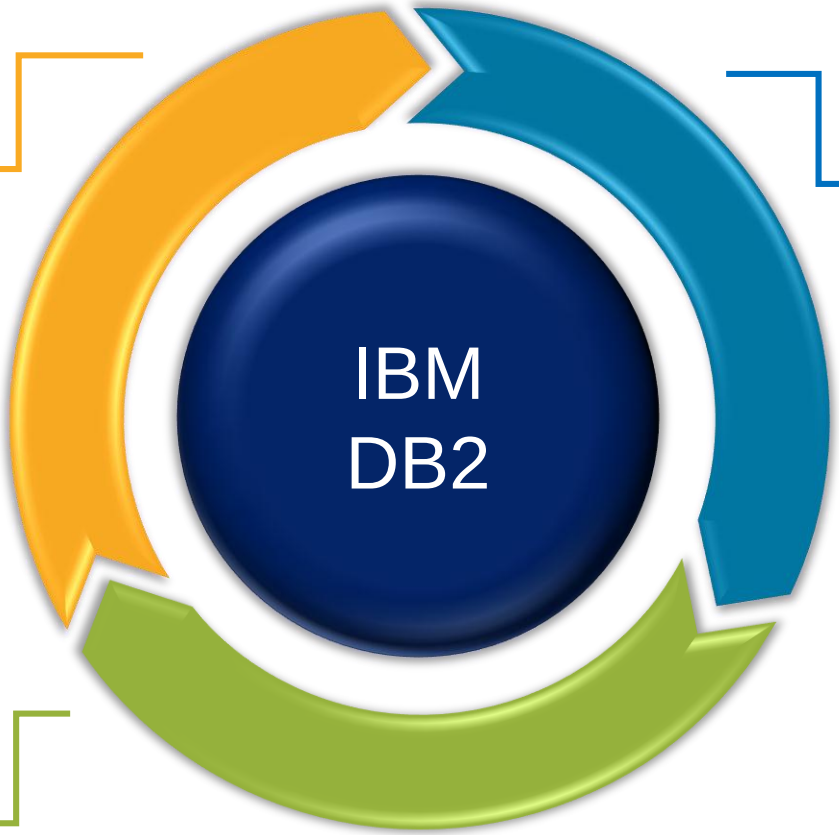
# What does the next generation database look like?

- ✓ The most advanced in-memory technology on the market today
- ✓ Super fast for transactional and analytic workloads
- ✓ Available, reliable, resilient
- ✓ Simple, intelligent and agile
- ✓ Easy to deploy, cloud ready

# The Next Generation Data Platform

## Transact

- Provide high levels of service without the high price
- Seamlessly expand or contract as needed, paying only for what you use when you use it
- Enhance customer experience by delivering data when and where it's needed




## Analyze

- Leverage next generation in-memory technology
- Get instant insight into operational and warehouse data without compromising performance of either
- Deploy analytics solutions faster with "load and go" and operational simplicity

## Innovate

- Free your applications from database complexity for faster delivery
- Transform your ability to make business decisions with 35x to 73x faster analytics, with some queries running more than 1400x faster[1,2]
- Optimize IT resources and utilization with built-in simplicity and autonomics

1. Based on internal IBM testing of sample client analytic workloads comparing queries accessing row-based tables on DB2 10.1 vs. columnar tables on DB2 10.5 with BLU Acceleration. Performance improvement figures are cumulative of all queries in the workload. Individual results will vary depending on individual workloads, configurations and conditions.
2. Based on internal IBM tests of analytic workloads comparing queries accessing row-based tables on DB2 10.1 vs. columnar tables on DB2 10.5 with BLU Acceleration. Results not typical. Individual results will vary depending on individual workloads, configurations and conditions, including size and content of the table, and number of elements being queried from a given table.

# Introducing DB2 10.5

## *Get the answers you need in the moment*

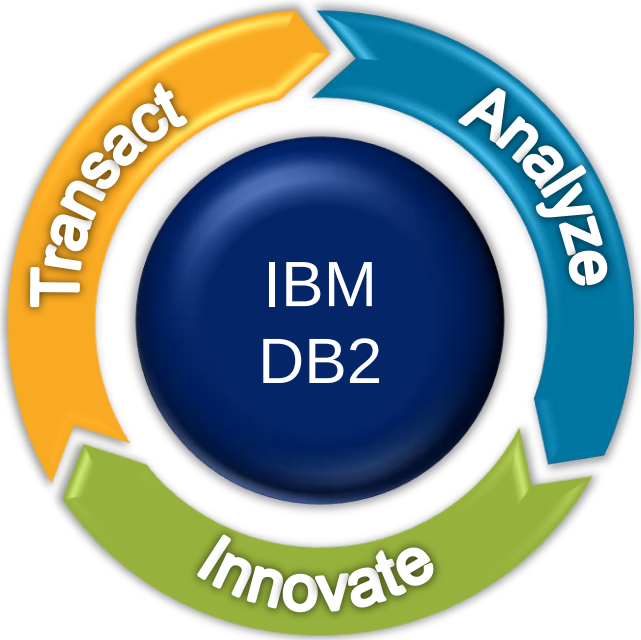
- Get real-time answers to ALL questions with instant insight into historical and “as it happens” data

  – Change the economics of continuous availability with broad infrastructure choices at every price point

  – Improve performance of transactions and analytics while reducing complexity and overhead

  – Get fast time-to-value using skills you already have for Oracle database

  – Superior performance at lower cost



# Simplify and Automate Database Administration

## *Self-Managing Improves IT Staff Productivity*

| | |
|---|---|
| Self-monitoring | Based on thresholds and alerts, system will automatically make changes as needed to improve performance |
| Self-balancing | Automatic load balancing optimizes resource utilization and overall performance |
| Self-tuning | Memory management dynamically adjusts memory usage based on workload needs |
| Self-optimizing | Selects best data placement and access based on usage statistics for optimal query performance |
| Self-healing | Failed database nodes are isolated and recovered automatically |

# DB2 Brings New Economics to Continuous Availability

## *More Flexible and More Affordable*

- Leverage commodity hardware and network adapters
- Continuous availability
  - Deliver uninterrupted data access with consistent performance
- Extreme scalability
  - Add capacity as your needs grow, without over provisioning
- Application transparency
  - Avoid the time, risk and cost of application changes

# DB2 with BLU Acceleration
## *Rich capability integrated with IBM DB2 10.5*

*Fast Answers. Simply Delivered.*

- What is DB2 with BLU Acceleration?
- In-memory analytic database
- Multiple IBM innovations
  - In-memory processing of columnar data without the limitations of memory size
  - Analyze compressed data with actionable compression
  - CPU Acceleration
  - …and more
- Ready for Analytics: Cloud, On premise, SAP, Cognos, and more
- Agile warehousing via BLU for Cloud

**BLU** Acceleration

*Analyze more data faster and more efficiently*

# What Makes BLU Acceleration Different?

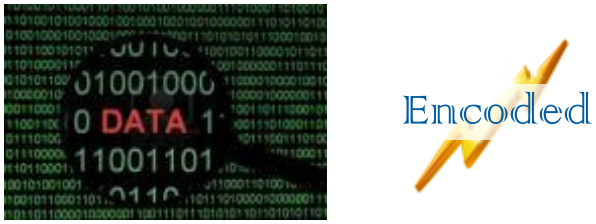
*Unmatched innovations from IBM Research & Development labs*

## Next Generation In-Memory

In-memory columnar processing with dynamic movement of data from storage

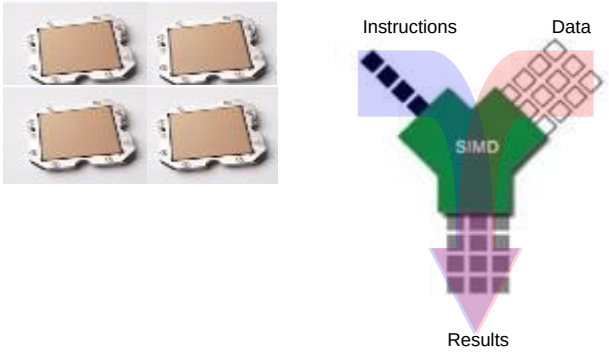

## Analyze Compressed Data

Patented compression technique that preserves order so data can be used without decompressing



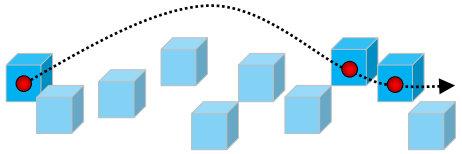

## CPU Acceleration

Multi-core and SIMD parallelism (Single Instruction Multiple Data)




## Data Skipping

Skips unnecessary processing of irrelevant data

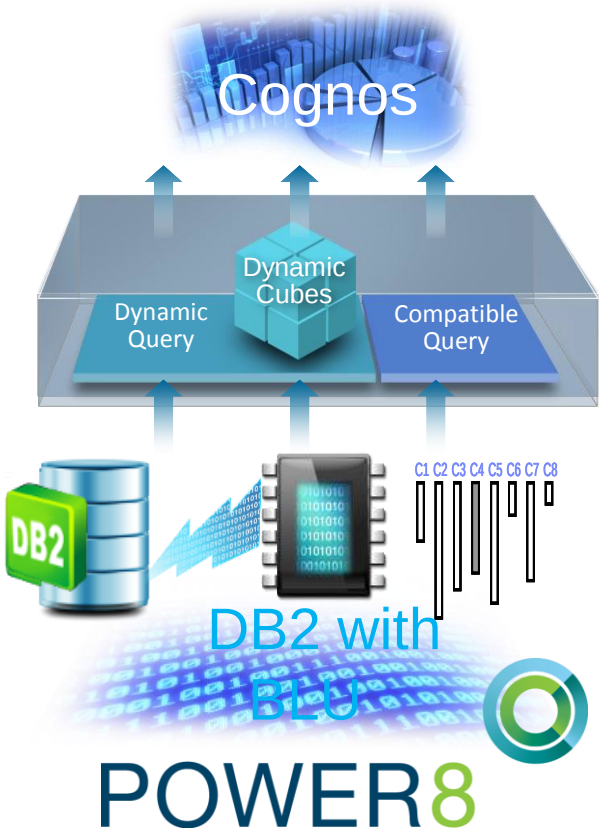


# Cognos BI and BLU Acceleration on Power Systems
## *Fast on Fast on Fast*

**82x faster**

vs. Competitor Row Store Database on Ivy Bridge (x86)[1]

- Exploitation of processors designed for big data with massive parallelism and bandwidth
- Efficient and improved storage savings for Cognos BI customers
- DB2 with BLU complements and enhances Cognos BI




1) Based on IBM internal tests as of April 7, 2014 comparing IBM DB2 with BLU Acceleration on Power with a comparably tuned competitor row store database server on x86 executing a materially identical 2.6TB BI workload in a controlled laboratory environment. Test measured 60 concurrent user report throughput executing identical Cognos report workloads. Competitor configuration: HP DL380p, 24 cores, 256GB RAM, Competitor row-store database, SuSE Linux 11SP3 (Database) and HP DL380p, 16 cores, 384GB RAM, Cognos 10.2.1.1, SuSE Linux 11SP3 (Cognos). IBM configuration: IBM S824, 24 cores, 256GB RAM, DB2 10.5, AIX 7.1 TL2 (Database) and IBM S824, 16 of 20 cores activated, 384GB RAM, Cognos 10.2.1.1, SuSE Linux 11SP3 (Cognos). Results may not be typical and will vary based on actual workload, configuration, applications, queries and other variables in a production environment.

82x calculation based on geometric mean calculation giving equal weighting to the report per hour (RPH) improvements in the three categories of simple, intermediate, and complex reports. GEOMEAN(RPH_simple,RPH_intermediate,RPH_complex) = GEOMEAN(18.85,40.07,747.63)=82.66

# Breakthrough Savings with DB2 Compression and BLU

DB2 9.1
Table
Compression

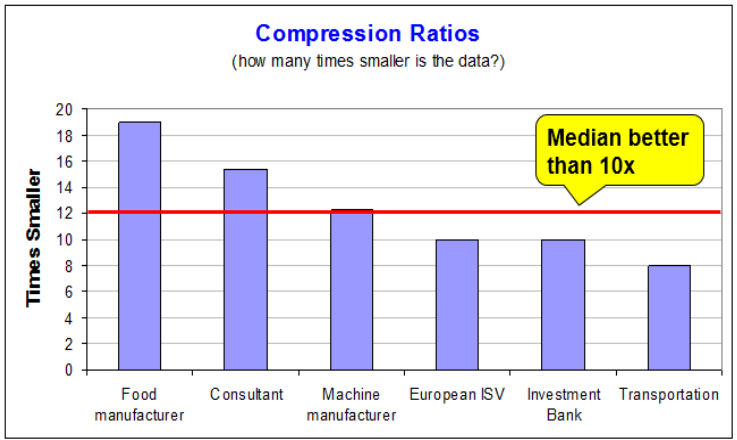
DB2 9.5
On-line
Automatic
Dictionary
Creation

DB2 9.7
Temp Space &
Index
Compression

DB2 10.1
Adaptive
Compression

DB2 10.5
BLU

- Table re-orgs not required to maintain high compression
- Compress archive logs
- Faster re-orgs and backups
- Compress data in memory for massive reductions in I/O
- Automatic Dictionary Creation
- Adaptively apply both table-level and page-level compression

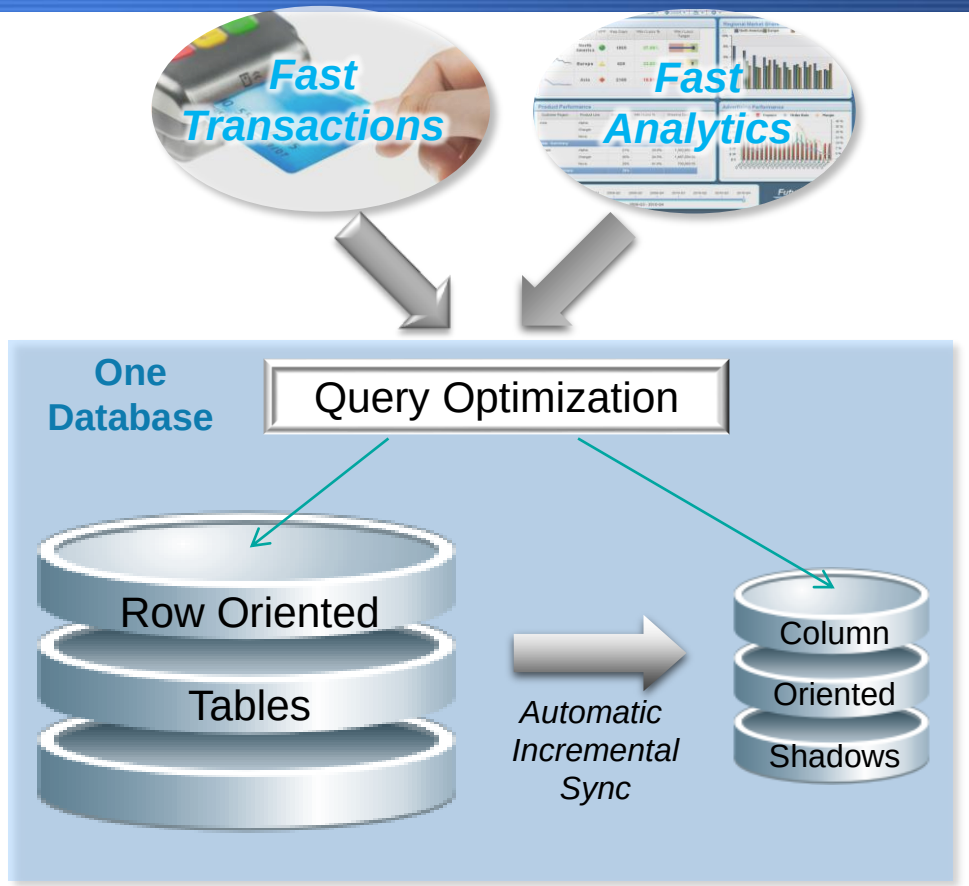


# BLU Shadow Tables

New

## *Fast Answers. Simply Delivered.*

- Instant insight into operational data without compromising transaction performance
- DB2 creates column-based 'Shadow Table' versions of row-based operational data
- Analytic queries **are seamlessly routed to** Shadow Tables to take advantage of BLU Acceleration analytics performance **in the transaction processing environment**
- With BLU Shadow Tables, the performance of analytical queries can improve by 10x or more, with equal or greater transactional performance*. In one instance, the removal of secondary analytic indexes improved transactional performance by 2x**

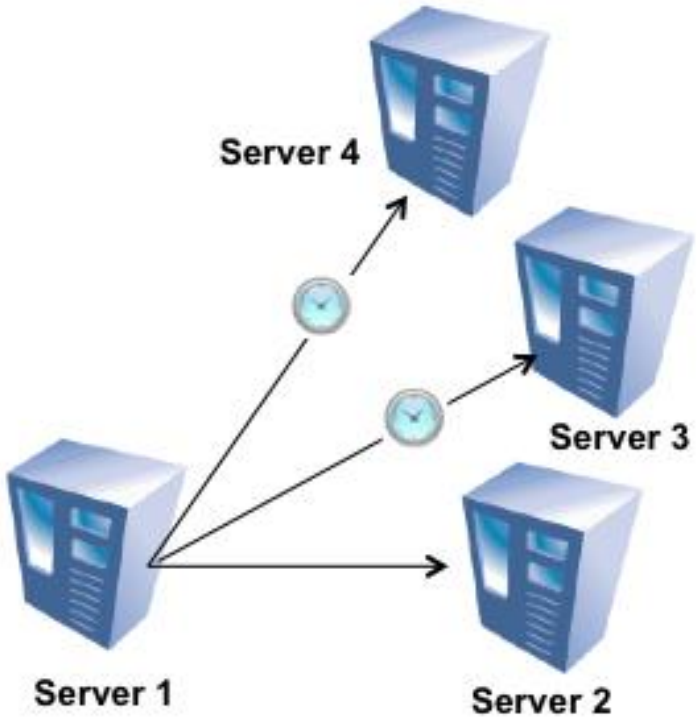



*Reporting and Transactions in the same continuously available system*

* - Based on internal IBM testing of sample transactional and analytic workloads by replacing 4 secondary analytical indexes in the transactional environment with BLU Shadow Tables. Performance improvement figures are cumulative of all queries in the workload. Individual results will vary depending on individual workloads, configurations and conditions.
** - Based on internal IBM testing of sample transactional and analytic workloads by replacing 20 secondary analytical indexes in the transactional environment with BLU Shadow Tables. Performance improvement figures are cumulative of all queries in the workload. Individual results will vary depending on individual workloads, configurations and conditions.

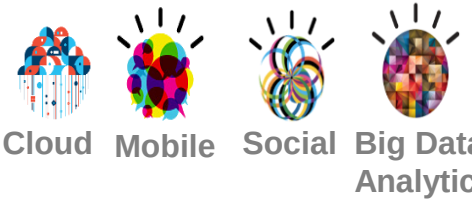
# HADR Supports Multiple Standby Servers

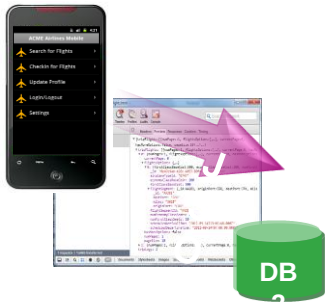
- HADR supports more than one stand-by server
- If Primary Server fails, Principal Standby takes over
- If Principal Standby then fails, can switch to Auxiliary Standby
- Auxiliary Standby can provide complete offsite availability, while maintaining speed of local standby
- BLU Acceleration with HADR availability – DB2 Cancun(10.5 FP 4) onwards



# More NoSQL with DB2 : Native JSON Support

- Combine data from systems of engagement with traditional data in same DB2 database
  - Best of both worlds
  - Simplicity and agility of JSON + enterprise strengths of DB2
- Store data from web/mobile apps in it's native form
  - New web applications use JSON for storing and exchanging information
  - It is also the preferred data format for mobile application backends
- Move from development to production in no time!
  - Ability to create and deploy flexible JSON schema
  - Gives power to application developers by reducing dependency on IT; no need to pre-determine schemas and create/modify tables
  - Ideal for agile, rapid development and continuous integration




# Moving Your Applications to DB2 is Easy


- Easily move your applications from Oracle database or data warehouse environments
- Integrated, cross-platform tools support both DB2 and Oracle Database
- Applications moved to DB2 run quickly with full native execution
- DB2 provides a lower cost, higher performance alternative to Oracle RAC
- Leverage existing skills and people without re-training
- Customers and partners have moved in only days

# Real-Time Data Warehousing

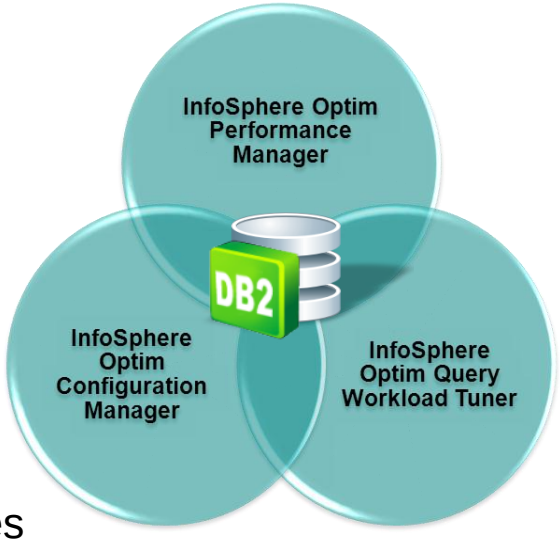
- Ingest utility
  - Continuous feed of data
  - Parallel processing
  - Minimal impact on availability
- Higher performance
  - Faster availability of data
  - Minimal impact on query performance
  - No downtime (even for large volumes of data)
- Lower costs
  - Costs less than solutions outside database


LIS.TEC ISV Distributor

"You can now continuously feed data into your data warehouse at a high rate even whilst you are running queries against the tables in your data warehouse. InfoSphere Warehouse 10 represents a greatly strengthened offering for the data warehouse market."
—Ivo Grodtke, LIS.TEC GmbH

# Accelerate Value for New Features

- Updated Database Administration solutions:
  - IBM Data Studio
  - InfoSphere Data Architect
- Updated Performance Mgmt solutions:
  - InfoSphere Optim Performance Manager
  - InfoSphere Optim Query Workload Tuner
  - InfoSphere Optim Configuration Manager




- Higher performance
  - Immediate support for new performance features
  - Enhanced Visual Explain, Access Plan Explorer and Index Advice
  - Extended Insight identifies source of performance issues
- Lower costs
  - Immediate support for new time saving features (incl. Temporal, Multi-Temperature Data Management & Row and Column Access Control)
  - IBM solutions are integrated and consistent

# What is BLU for Cloud?

## DB2 BLU for Cloud
### Self-service Data Warehousing & BI in the Cloud

The same benefits of DB2 with BLU Acceleration, plus

- On-demand analytics, deploy analytics in under an hour
- Powerful database & analytic capabilities at a fraction of the cost
- No infrastructure investment
- Cognos Business Intelligence included
- Expert-built schemas for business insight

*Available on:*

amazon web services™

SOFTLAYER® an IBM Company

*For use by:*

| | |
|---|---|
| **Business** | **Data Scientists**<br>**Business Analysts**<br>**Line of Business Users** |
| **IT** | **DBAs**<br>**Developers** |

# DB2® 10.5

## *with BLU Acceleration*

Multi-workload database software for the era of Big Data

***BLU Acceleration** – Extreme performance and storage savings, leveraging dynamic "in-memory" and columnar technologies, for analytic processing*

***Shadow Tables** – A single database solution for both your OLTP and OLAP queries without compromising performance*

***DB2 pure Scale** – High availability, extreme scalability, and application transparency for OLTP workloads*

***NoSQL** – Continue to support the next generation of applications*

***Oracle Application Compatibility** – Continue to reduce the cost and risk associated with migrating Oracle applications to DB2*

***Enhanced Tooling** - Reducing the total cost of ownership with DB2 and making the adoption, management, monitoring, and maintenance very simple*

# DB2 10.5- Simplified Packaging

## Departmental Market

### Advanced Workgroup Server Edition

Advanced functionality
(Default, PS, BLU, DPF, Tools)
Base Capacity
(limited by TB, Memory, sockets, and cores)

### Workgroup Server Edition

Core Functionality
(Default)
Base Capacity
(limited by TB, Memory, sockets, and cores)

## Enterprise Market

### Advanced Enterprise Server Edition

Advanced functionality
(Default, PS, BLU, DPF, Tools)
Full Capacity
(No limit)

### Enterprise Server Edition

Core Functionality
(Default only)
Full Capacity
(No limit)

Advanced Recovery Feature
New Purchasable Feature

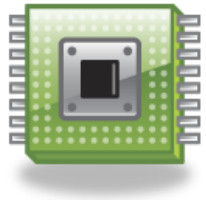
Developer Edition –advanced functions

Express and Express-C

# Licensing

- **Authorized user**
  - IDs cannot be shared or transferred
  - Can establish one or more connections to the DB2 database system and counts as a single authorized user
  - ID is needed for each data server

- **Processor Value Unit (PVU)**
  - PVU is a unit of measure that is assigned to each processor core, depending on vendor, brand, type and model number
  - Sub-capacity Licensing: Enables the licensing of DB2 to a subset of the processor cores on the server
  - Allows unlimited users to access DB2 on that server
- **Per Socket**
  - Socket is defined as electronic circuitry that accepts a processor chip
  - Only available for Workgroup Edition
  - Allows unlimited users to access DB2 on that server
  - Limit to 64 GB of memory and 4 sockets on a physical server



# Licensing (continued)

- **Per Server (virtual / physical)**
  - Limited use virtual server (LUV server): is a physical server OR a virtual server that is created by partitioning the resources available to a physical server
  - Only available for DB2 Express Edition
  - Allows unlimited users to access DB2 on that server
  - All instances cannot collectively exceed 4 processor cores and 4 GB of memory
- **Per ASL / OEM**
  - **ASL**
    - DB2 is restricted use and can only be used as part of the solution.
    - The Business Partner can ship DB2 as part of its application worldwide.
    - The Business Partner retains the licenses to DB2
  - **OEM**
    - DB2 not visible to the user
    - Partner lead sales
    - Embed DB2 with application
    - Simplified contracts – 1 for the solution
    - ISV owns relationship completely


- **Per usage**
  - Software as a Service Monthly Rental Model
    - Variable or Committed
  - Amazon Machine Images
    - “Bring your own IBM license” or Hourly pricing

Check the type of license applied with command: `db2licm -l`

# Licensing – Metrics and Summary

| | Express-C | Express | Workgroup | Advanced Workgroup | Enterprise / Advanced |
|---|---|---|---|---|---|
| Pricing metric | Free Download (Unsupported) | Authorized Users (minimum of 5 per server) or Per Server, Single Install, Limited Use Virtual Server, PVU, LUVS FTL | Authorized Users (minimum of 5 per socket) or Per Socket Single Install, Socket, PVU | Authorized Users (minimum of 25 per 100 PVUs) or PVUs Eligible for Sub-capacity pricing | Authorized Users (minimum of 25 per 100 PVUs) or PVUs Eligible for Sub-capacity pricing |
| Processor limit | DB2 throttles itself to use maximum of 2 cores | DB2 throttles itself to use maximum of 8 cores | DB2 throttles itself to use maximum of 16 cores and 4 sockets | DB2 throttles itself to use maximum of 16 cores | Unlimited |
| Memory limit | DB2 throttles itself to use maximum of 16 GB | DB2 throttles itself to use a maximum of 64 GB | DB2 throttles itself to use a maximum of 128 GB | DB2 throttles itself to use a maximum of 128 GB | Unlimited |
| Platforms supported | Windows, Linux, Solaris (x64) | Windows, Linux, Solaris (x64) | Windows, Linux, AIX, Solaris, HP-UX, zLinux | Windows, Linux, AIX, Solaris, HP-UX, zLinux | Windows, Linux, AIX, Solaris, HP-UX, zLinux |

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# DB2 Installation

- New in DB2 10:
  - You can install the IBM® DB2 pureScale Feature while installing DB2 Enterprise Server Edition, DB2 Workgroup Server Edition, DB2 Advanced Workgroup Server Edition and DB2 Advanced Enterprise Server Edition.
  - You can now install IBM Data Studio from the DB2 Launchpad.

## Installation Methods

| Installation | Windows | UNIX |
|---|---|---|
| db2setup Wizard | ✓ | ✓ |
| db2_install command | ✗ | ✓ |
| Response file | ✓ | ✓ |

Deprecated in DB2 10!

# DB2 Installation – DB2 Users *(non-pureScale)*

- On Linux or UNIX, three users and groups are created for a root installation

**Instance Owner**

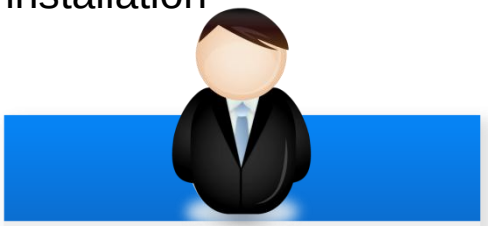
**The instance owner home directory is where the DB2 instance will be created**

**db2inst1**

**Fenced User**

**Used to run UDF's and stored procedures outside of the address space used by the DB2 database**

**db2fenc1**



**DB2 Administration Server User**

**The user ID is used to run the DB2 administration server on the system**

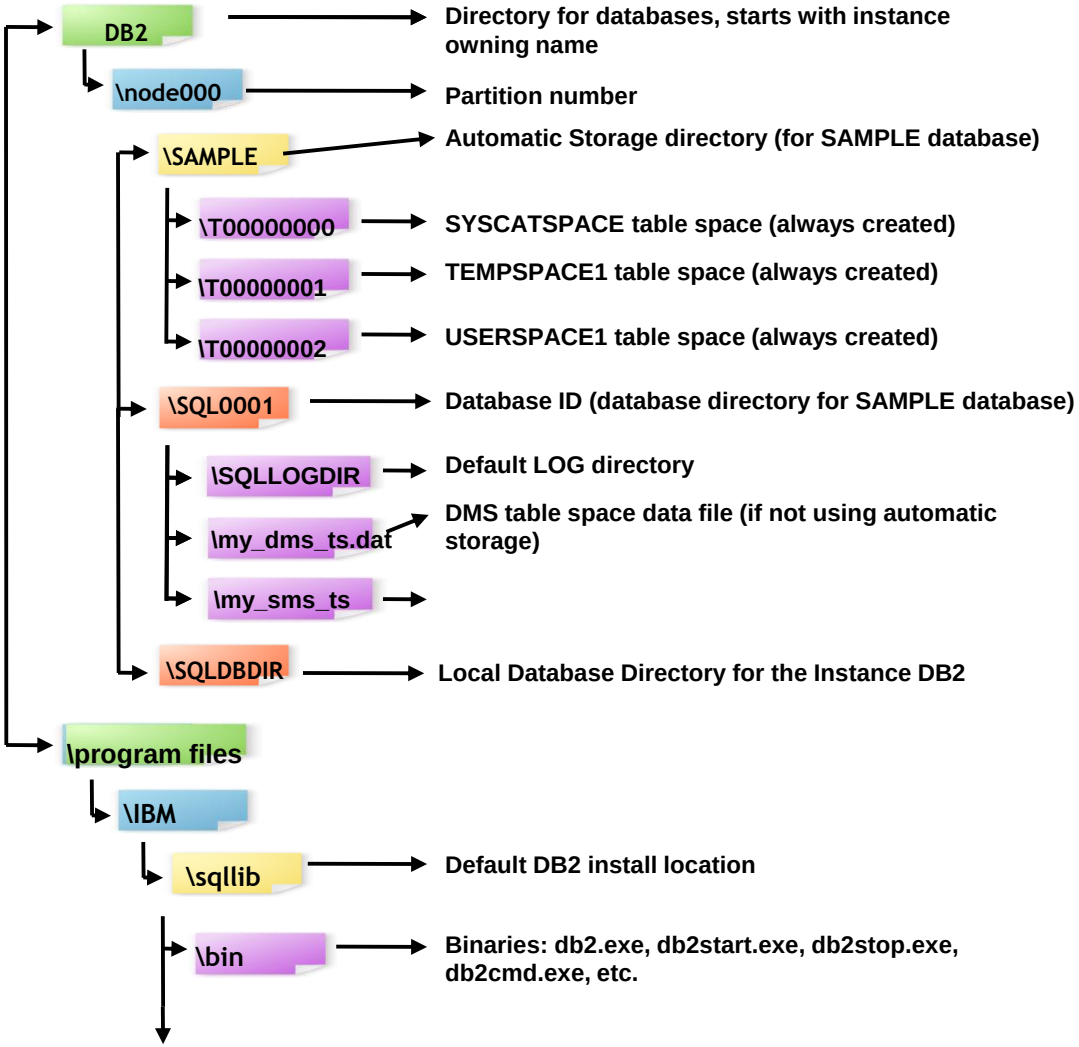
**dasusr1**

**Administration Server has been deprecated in DB2 9.7!**

- On Windows, the following user accounts are required:
  - Installation user account
    - Used to perform installation, normally a member of the Windows Administrators group
  - (Optional) one or more setup user accounts
    - DB2 instance user
    - DB2 Administration Server (DAS) user

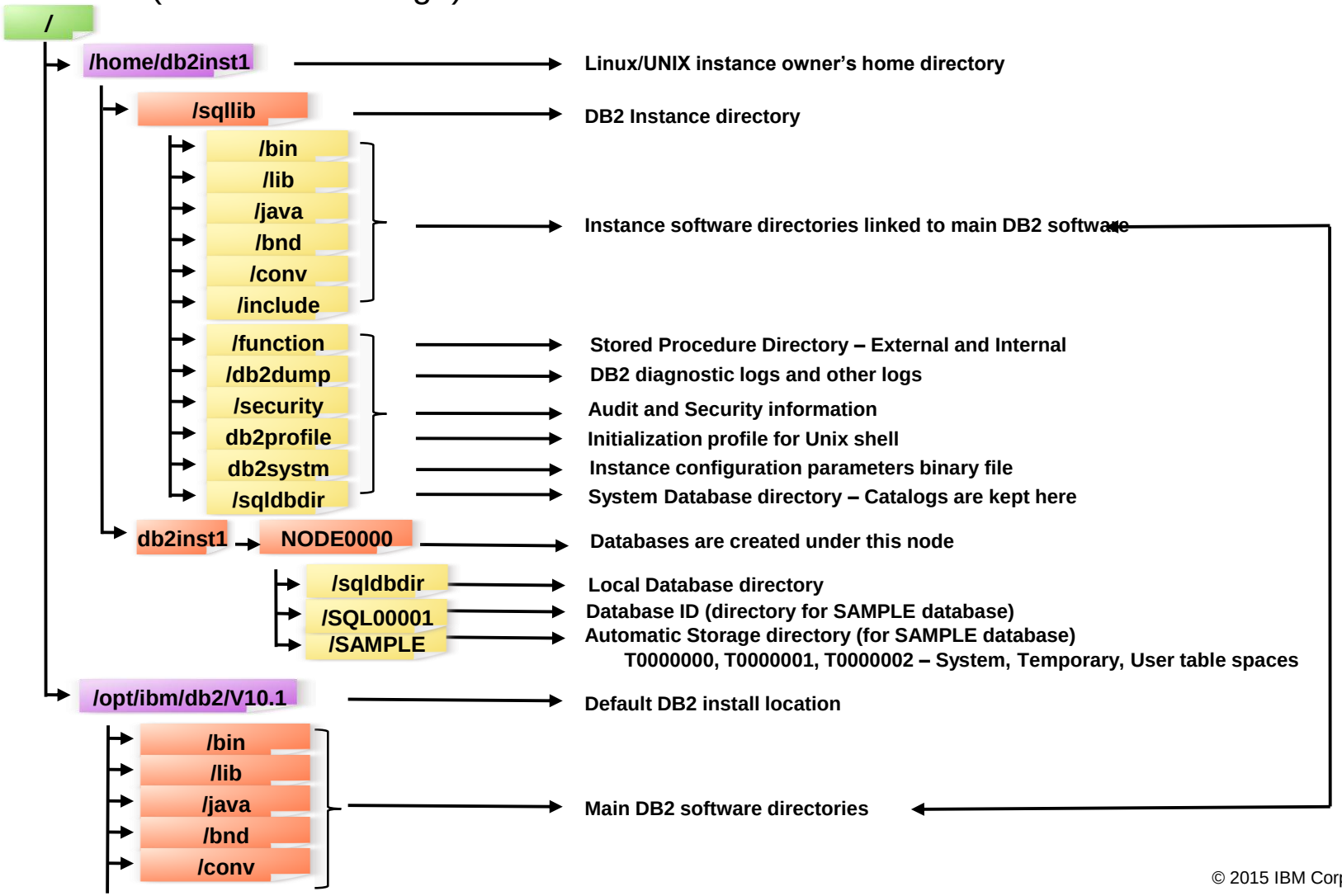
# DB2 Installation – Directory Structure

- Windows



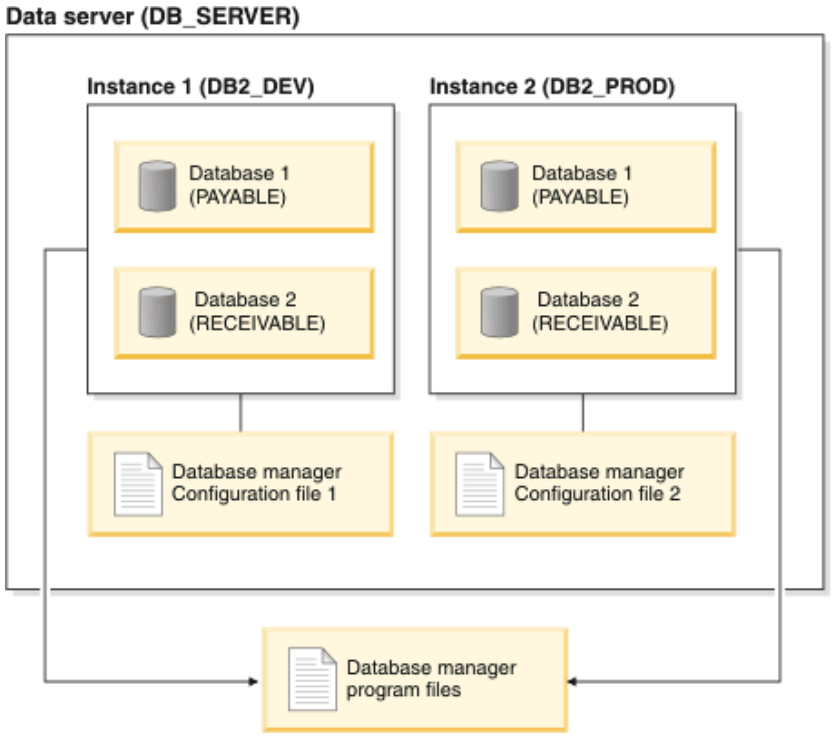
# DB2 Installation – Directory Structure

- Linux / UNIX (Automatic Storage)



# DB2 Environment – Data Server

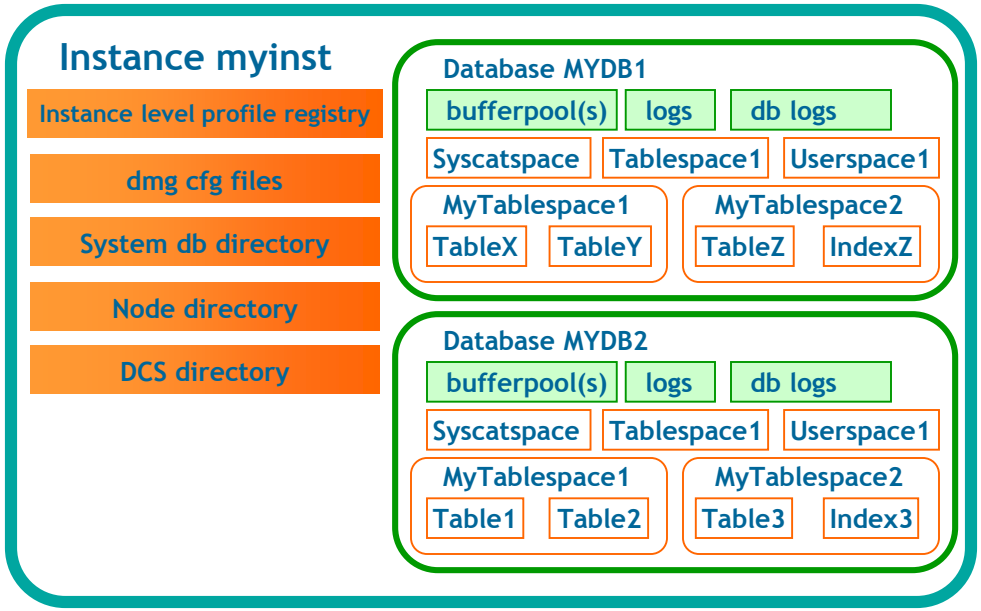
- A DB2 data server refers to a computer where the DB2 database engine is installed.




- A data server is able to host multiple instances and each instance can have and access more than one database at a time.

# DB2 Environment – Instances

- A DB2 instance is a logical database manager that serves as the access point to the databases structures
- Each instance has
  - its own configuration (dbm cfg)
  - multiple Engine Dispatchable Units (EDUs) shared among the databases in that instance




| Command | Description | Example |
|---|---|---|
| **db2start** | Start the current instance | `db2start` |
| **db2stop** | Stop the current instance | `db2stop / db2stop force` |
| **db2icrt** | Create an instance | `db2icrt -u db2fenc1 db2inst1` |
| **db2idrop** | Drop an instance | `db2idrop db2inst1` |
| **db2ilist** | List all instances | `db2ilist` |
| **db2iupgrade** | Upgrades an instance to the current release<br>It replaces the “db2imgr” command. | `db2iupgrade -u db2fenc1 db2inst1` |
| **db2iupdt** | Update an instance after installation of a fix pack | `db2iupdt -u db2fenc1 db2inst1` |

# DB and DBM Configurations

| Description | Example |
|---|---|
| View Database Manager Settings | `db2 get dbm cfg show detail` |
| Change a Database Manager Setting | `db2 update dbm cfg using health_mon off` |

| Description | Example |
|---|---|
| View Database Settings | `db2 get db cfg for testdb`<br>`db2 connect to testdb`<br>`db2 get db cfg show detail` |
| Change a DB Setting | `db2 update db cfg using logprimary 10` |

- Examples of what can be changed using DB and DBM configuration

**Connection Management**

- **Define user authentication type**
- **Set communication protocols**

**Memory Tuning**

- **Set sort limits**
- **Set hash limits**
- **Set utility impact limits**
- **Share memory resources among the databases**
- **Instance memory**

**Monitoring**

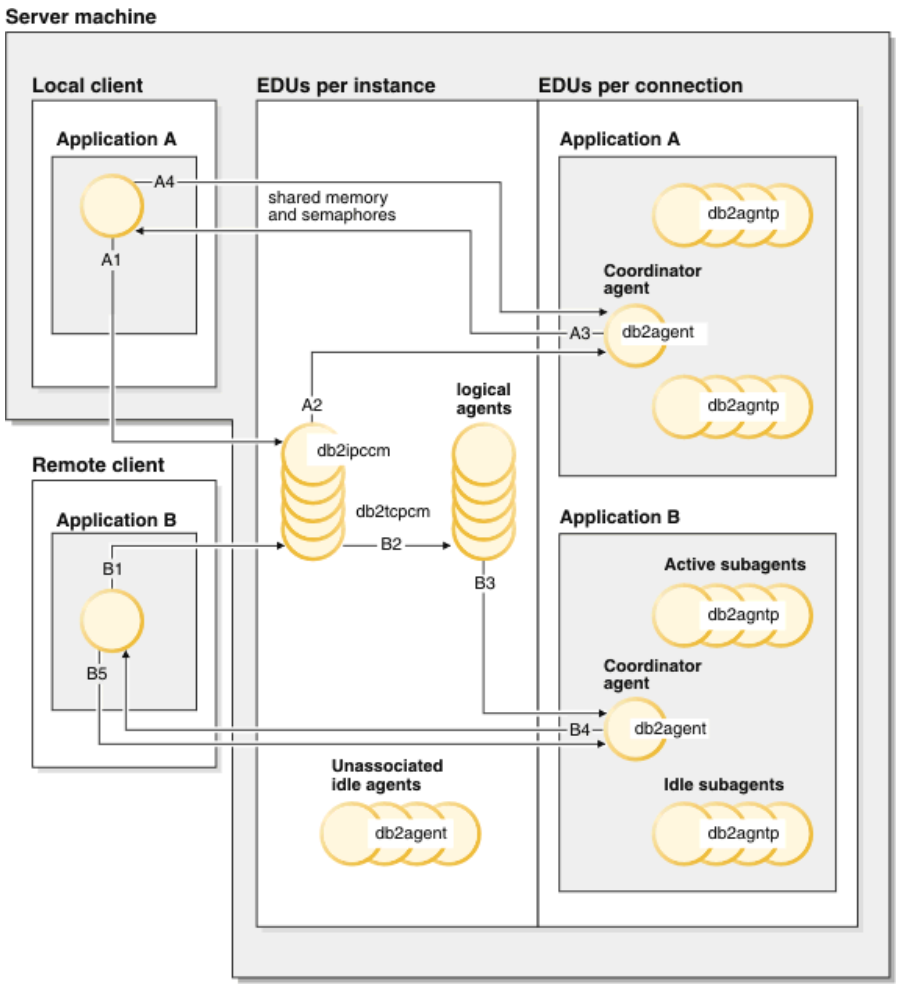
- **Get database snapshots**
- **Check database health and performance**

**Instance Management**

- **Control instance services**
- **Enable federation**
- **Set diagnostic log level**
- **Authorization user groups**

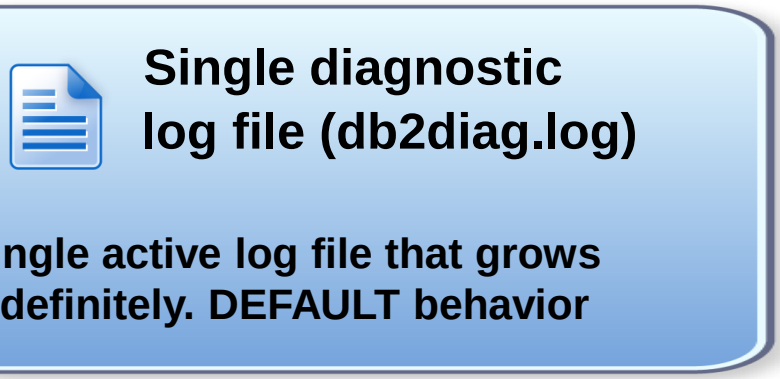
# DB2 Process Model

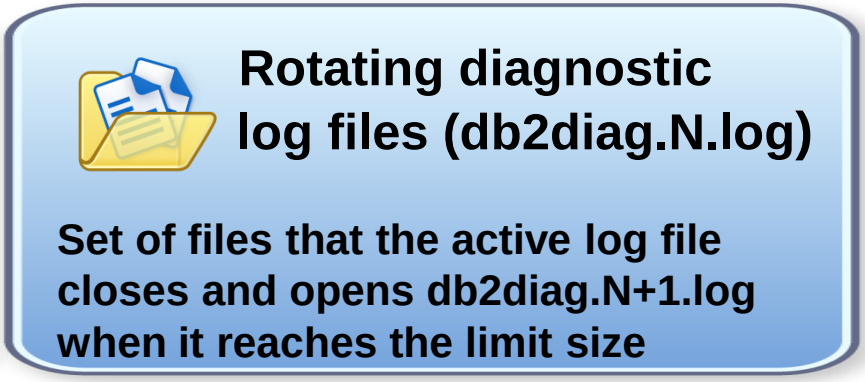
- **Single process and multithreaded model**
  - System controller: db2sysc (UNIX) or db2syscs.exe (Windows)
  - Threads: Engine Dispatchable Units (EDU)
- **DB2 Agents (db2agent)**
  - Special type of EDU to handle application requests
  - The DB2 engine keeps a pool of agents available to service requests
  - An application is mapped to a coordinator agent
- **DB2 has firewall to protect databases and DBM**
  - Application runs on different address space to prevent application errors leading to corruption of DBM files or internal buffer



# DB2 Diagnostic Log – db2diag.log

- Diagnostic and administration notification messages are logged into the DB2 diagnostic log files (db2diag). Primarily intended for troubleshooting purposes.
- Default location
  - **Linux/UNIX:** `<$DB2INSTANCE_HOME>/sqllib/db2dump/DIAG<member#>`
    - E.g.: `/home/db2inst1/sqllib/db2dump/DIAG0000`
  - **Windows:** `<$DB2INSTPROF>\<instance_name>\DIAG<member#>`
    - E.g. (Windows 7): `C:\ProgramData\IBM\DB2\DB2COPY1\DB2\DIAG0000`
- 2 forms:




- Configuration parameters:
  - `diagsize:` size of the log files for rotating log files form; 0 for single log file form
  - `diagpath:` Location of the log file(s)
  - `diaglevel:` Types of errors to be written to log
- The db2diag tool serves to filter and format the volume of information available in the db2diag log files.

# DB2 Data Server Clients

## IBM Data Server Driver Package

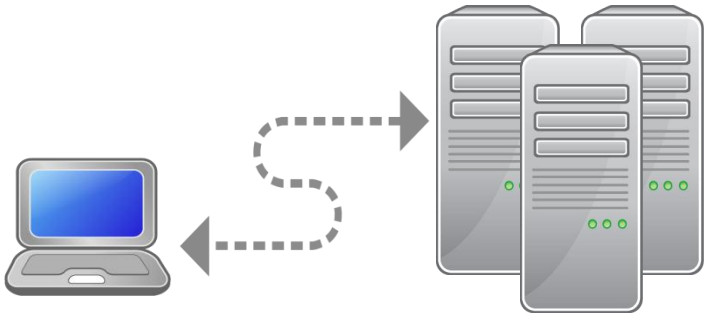
- Lightweight deployment solution that provides runtime support for applications using ODBC, CLI, .NET, OLE DB, PHP, Ruby, JDBC, or SQLJ

## IBM Data Server Driver for JDBC and SQLJ

- Provides support for applications that use JDBC or SQLJ to access local or remote servers

## IBM Data Server Driver for ODBC and CLI

- Runtime support for applications using ODBC API, or CLI API



## IBM Data Server Runtime Client

- Include all the functionality from IBM Data Server Driver
- Has CLP but GUI tools are not included
- Support LDAP exploitation, TCP/IP and Named Pipe, cataloging

## IBM Data Server Client

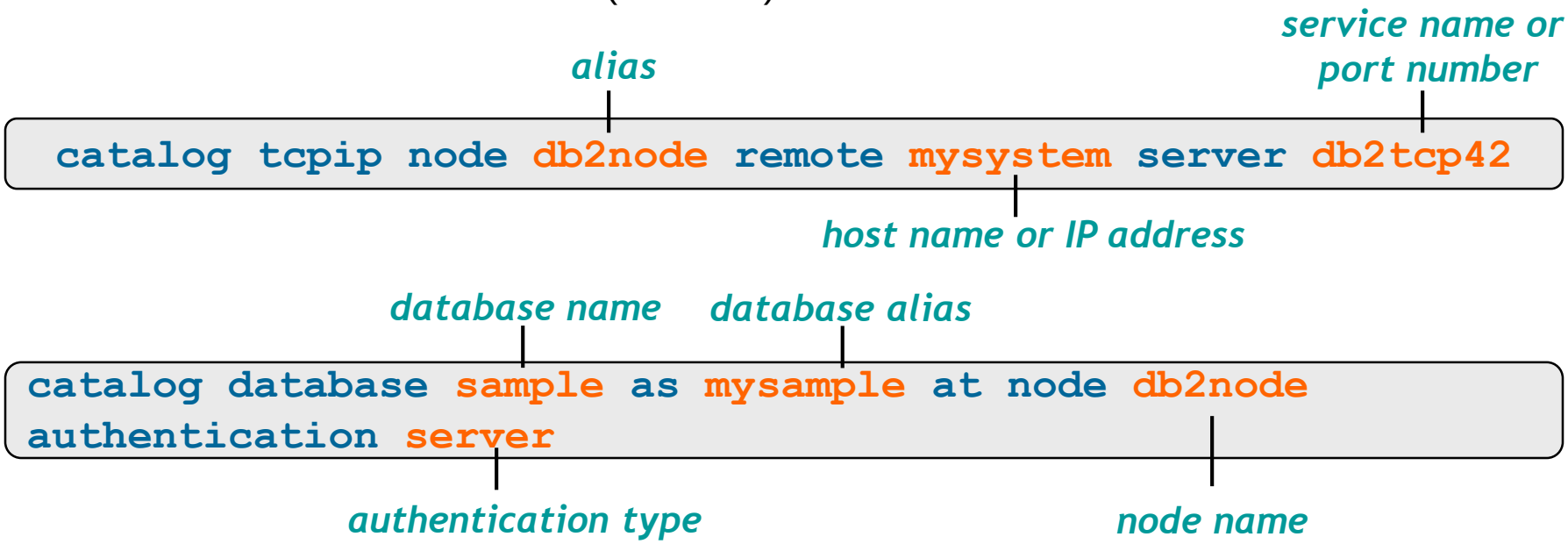
- Includes all the functionality of IBM Data Server Runtime Client
- Plus functionality for database administration, application development, and client/server configuration.
- Visual Studio tools, precompilers for various languages
- Samples and tutorials

# Cataloging – Setting up Communications

- **To use a remote database:**
  - Catalog the remote system (node)
  - Catalog the database within the remote node
- **Tools for the job:**
  - Data Studio (graphical)
  - Command Line Processor (CLP)
  - Command Line Processor Plus (CLPPlus)

```
db2 list [database | node] directory
```

can be used to find the locally catalogued DB or node



# DB2 Databases

- A database contains a set of objects used to store, manage, and access data according to the relational model of data.
- When creating a database, these tasks are performed:
  - Setting up of all the system catalog tables that are needed by the database
  - Allocation of the database recovery log
  - Creation of the database configuration file and the default values are set
  - Binding of the database utilities to the database

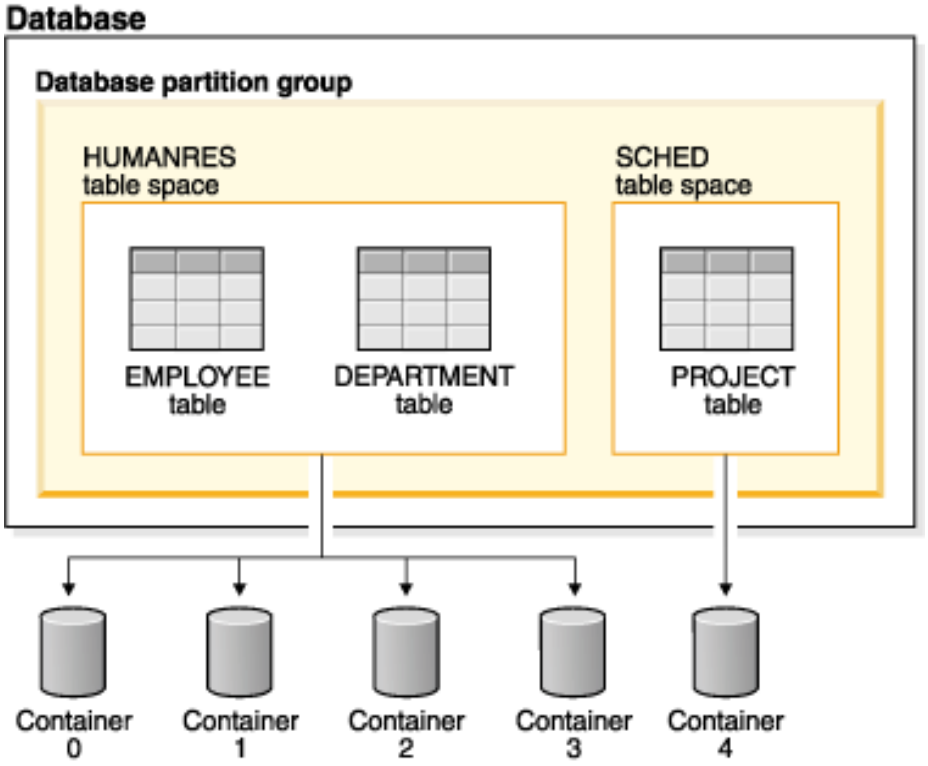
```
CREATE DATABASE prod1 ON /data1 DBPATH ON /dbfiles
```

*storage path* *database path*

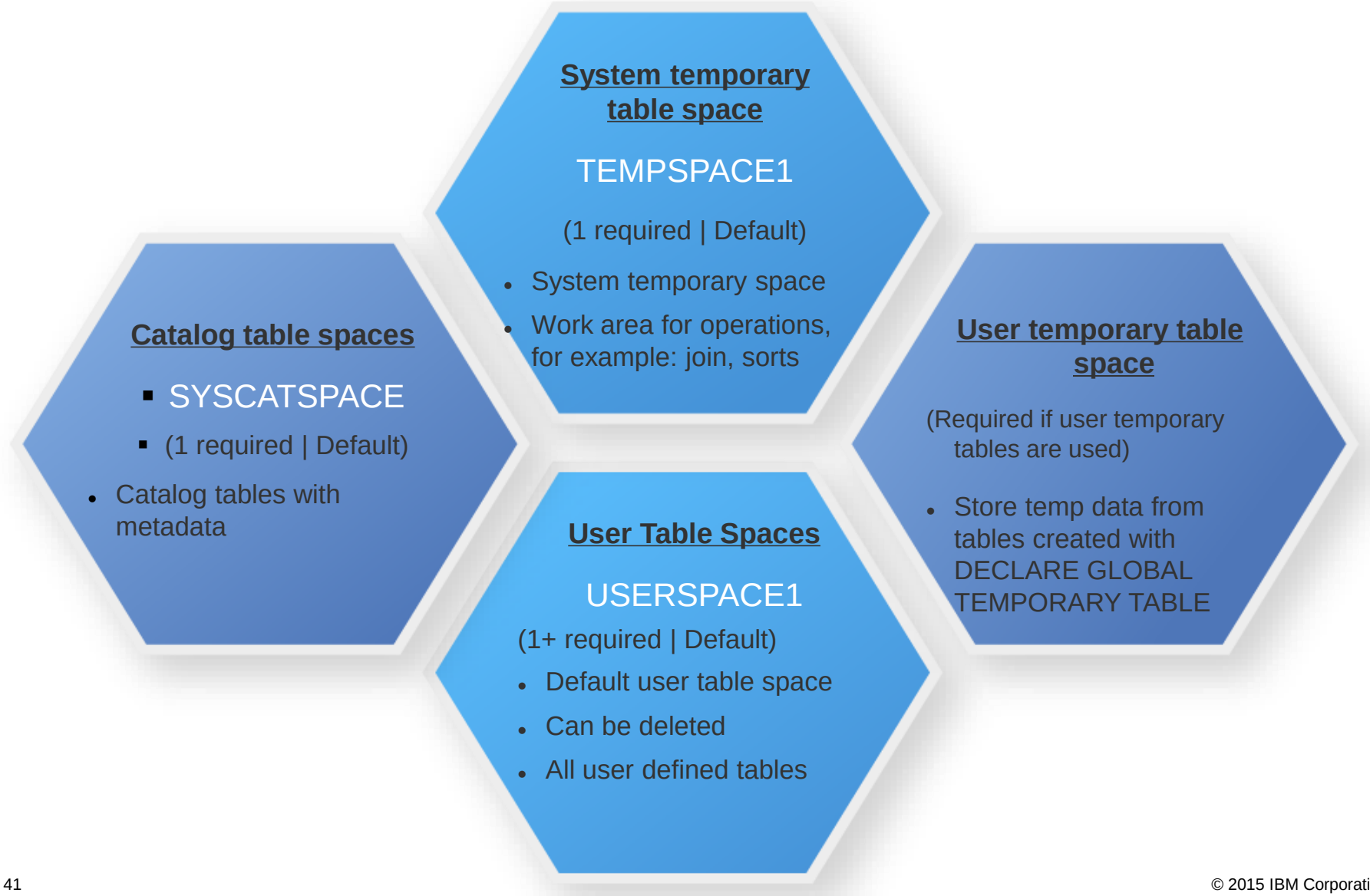
- By default:
  - Configuration advisor is invoked to tune configuration parameters
  - A detailed deadlocks event monitor is created
  - The database uses UTF-8 (Unicode) code set
  - PUBLIC is granted these privileges: CREATETAB, BINDADD, CONNECT, IMPLICIT_SCHEMA, and SELECT on the system catalog views

# Table Spaces

- Structure to organize data into logical storage groupings
- All tables, indexes, large objects and long data are stored in a table space
- A table space is consisted of one or more containers
  - Containers can be files, directories or raw devices
- It is associated to a specific buffer pool



# Types of Table Spaces



# Table Space Management

Deprecated in DB2 10.1 for user permanent table spaces

- **System Managed Spaces (SMS)**
  - Data stored in files representing data objects
  - Space is allocated on demand
  - Access to data controlled using standard I/O functions of the OS
  - ✔ Low maintenance
  - ✖ Performance is not optimal

```
CREATE TABLESPACE tbsp1 MANAGED BY SYSTEM
USING ('d:\acc_tbsp', 'e:\acc_tbsp', 'f:\acc_tbsp')
```

- **Database Managed Spaces (DMS)**
  - Data stored in files or on raw devices
  - Storage space pre-allocated in file system, typically contiguous physically
  - ✔ Ideal for performance-sensitive applications
  - ✖ Increased maintenance and monitoring

```
CREATE TABLESPACE tbsp2
PAGESIZE 8K MANAGED BY DATABASE
USING (FILE ' /storage/dms1' 10 M) AUTORESIZE YES
```

# Table Space Management

- **Automatic Storage Table Space**
  - DBM creates and extends containers as needed up the limits imposed by the storage paths associated with the database
  - Automatically handles resizing table spaces
  - Creates a DMS table space for regular/large table spaces
  - Creates a SMS table space for user or system temporary table spaces
  - New databases and table spaces use Automatic Storage by default

Parameter Deprecated in DB2 10

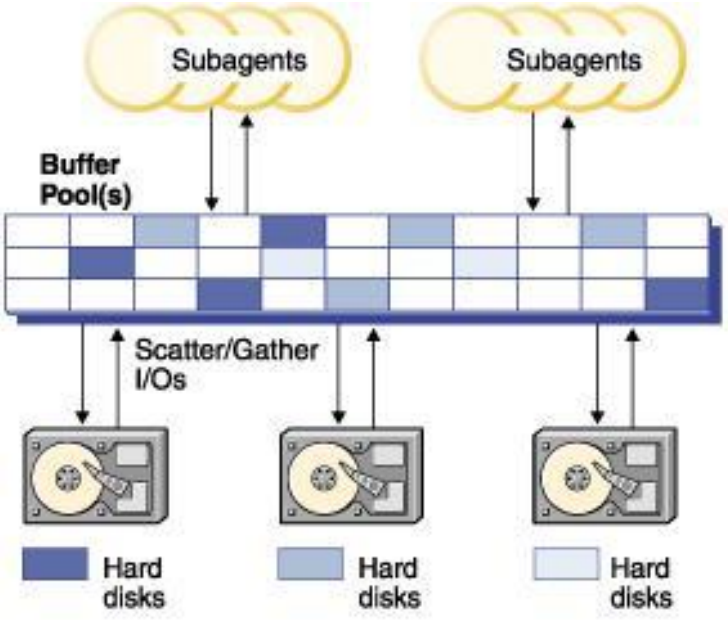
```
CREATE DATABASE mydb AUTOMATIC STORAGE YES

CONNECT TO mydb

CREATE TABLESPACE tbsp1 MANAGED BY AUTOMATIC STORAGE
```

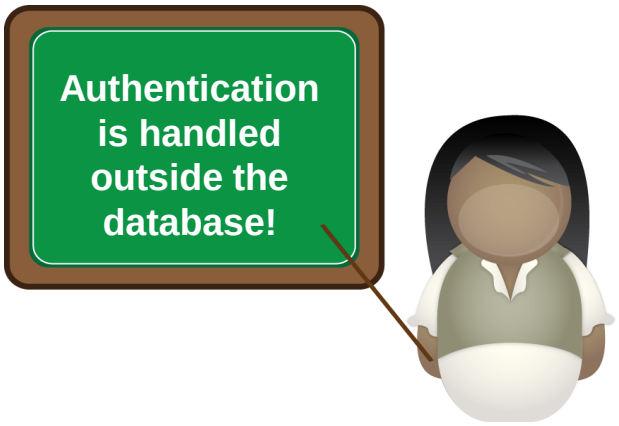
# Buffer Pools

- **Area of main memory used to cache table and index data**
- **Each database must have at least one buffer pool**
  - By default IBMDEFAULTBP is used
  - Buffer pools can be created, dropped or altered
  - SYSCAT.BUFFERPOOLS catalog view accesses the information for the buffer pools defined in the database
- **Every table space associates a specific buffer pool of the same page size**
  - Match buffer pool size with purpose of table to increase hit ratio
- **Self-Tuning Memory Manager (STMM) available**




```
CREATE BUFFERPOOL bp4k PAGESIZE 4K
CREATE TABLESPACE tbsp1 PAGESIZE 4K BUFFERPOOL bp4k
```

# DB2 Security




- **Authentication vs. Authorization**
  - Authentication
    - Access to the DB2 database system
    - Identification of a user with a password
  - Authorization
    - Access within DB2 database system
    - Authority and privileges to perform database operations, access data objects
- **Explicit vs. Implicit vs. Indirect Access**

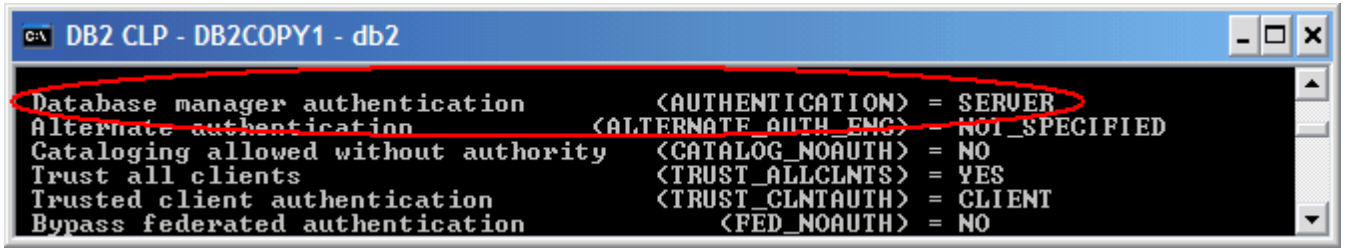
| Explicit | Implicit | Indirect |
|---|---|---|
| • User<br>• Group<br>• Role | • When a database or database object is created | • Inherited through execution of packaged code |

- **More Security Features**
  - Data Encryption
  - Fine grained security: Label Based Access Control, **Row and Column Access Control (New in DB2 10)** ⭐
  - Auditing

# Configuration of Authentication on DB2 Server

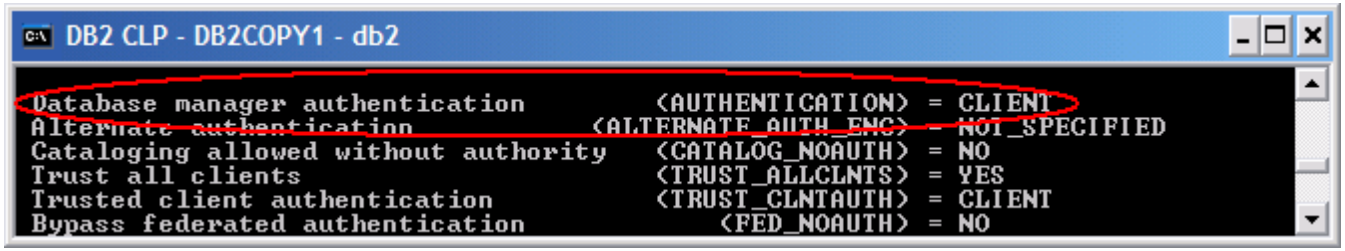
- Authentication type is defined in the Database Manager configuration file (DBM CFG)

```
db2 "GET DBM CFG"
```




- To configure how and where DB2 authenticates users, set the authentication parameter at the DB2 server

```
db2 "UPDATE DBM CFG USING AUTHENTICATION CLIENT"
```



# DB2 Sample Database

- To create the sample database populated with both relational data and XML data
- Verify the database creation by simply connecting and querying the data

```
db2sampl -sql -xml

db2 connect to sample
```

- For remote databases:

```
db2 catalog database sample as db_sample
at node mynode1

db2 connect to db_sample
```

# Application Development and Language Support

- Programming Languages Supported
  - ADO.NET, OLE DB, DB2CI, CLI and ODBC, Embedded SQL
  - Java (JDBC, SQLJ)
  - Ruby on Rails, Perl, PHP, Python, SQLAlchemy and Django framework
  - RDF – Resource Description Framework (**NEW in DB2 10**) 
  - JSON application development support (**NEW in DB2 10.5**) 
- SQL – Structure Query Language
- pureXML – storage and manipulation of XML documents
  - Supports XQuery and SQL/XML functions
- SQL Procedural Language (SQL PL)
  - It can be used to implement procedural logic in SQL statements
- PL/SQL – Procedural Language/Structured Query Language
  - Reduces the complexity of enabling existing PL/SQL solutions so that they will work with the DB2 data server

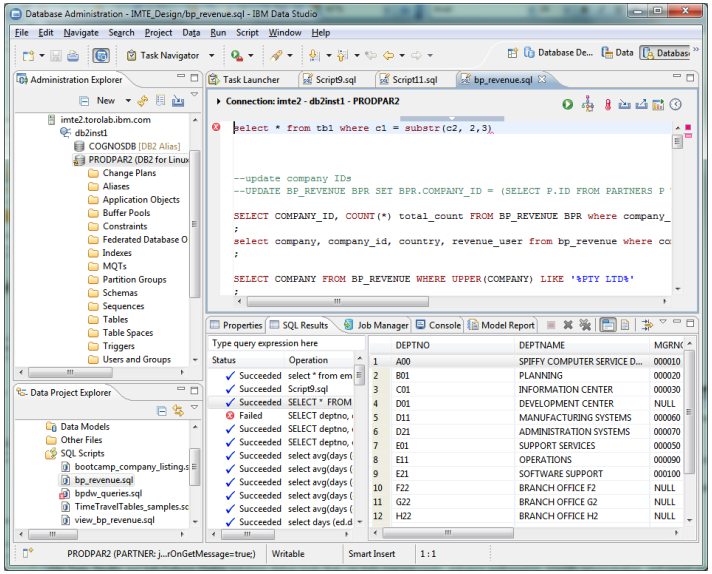
# Interfaces – Tools, Commands, APIs

- Built-in administrative routines and views
  - Programmatic interface to administer databases through SQL
- Command Line tools
  - CLP commands (e.g.: list applications)
  - CLPPlus commands (e.g.: connect, clear)
  - System commands (e.g.: db2start, db2diag)
- DB2 Administrative APIs
  - APIs providing functions for performing administrative tasks on instances, databases, databases objects and data
  - E.g.: SQLECREA API - Create database

IBM Data Studio

# Interfaces – Tools, Commands, APIs

- **Control Center tools have been discontinued**
  - Activity Monitor, Command Editor, Configuration Assistant,
  - Control Center and associated wizards and advisors,
  - Control Center plug-in extensions, Event Analyzer, Health Center,
  - Indoubt Transaction Monitor, Journal, License Center, Memory Visualizer,
  - Query Patroller Center, Satellite Administration Center, Task Center
  - User interface to access Spatial Extender functionality
  - User interface to Visual Explain
- **Replication Center is still available**
- **Data management and application development tools**
  - IBM Data Studio
  - IBM Data Studio web console
  - IBM InfoSphere® Optim™ tools




IBM Data Studio

# Summary

- DB2 10.5 for LUW is Multi-workload database software for the era of Big Data
- Several editions to fit your business needs
- Flexible licensing options
- Optimized architecture for high performance
- Practical troubleshooting utilities
- Comprehensive security structure
- Full suite of tools for easy data management and application development

# The next steps…

# The Next Steps…

- Complete the online quiz for this module
  - Log onto SKI, go to “My Learning” page, and select the “In Progress” tab.
  - Find the module and select the quiz
- Provide feedback on the module
  - Log onto SKI, go to “My Learning” page
  - Find the module and select the “Leave Feedback” button to leave your comments

# Questions?
# askdata@ca.ibm.com