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CHAPTER

Planning

Sixteen percent (16%) of the *DB2 10.5 Fundamentals for LUW* certification exam (Exam 615) is designed to test your knowledge of the various DB2 editions and add-on products that are available from IBM. This portion of the exam is also designed to test your ability to identify which edition and products to use to create a specific type of database environment, as well as your knowledge of DB2 10.5 BLU Acceleration. The questions that make up this portion of the exam are intended to evaluate the following:

- Your knowledge of the DB2 10.5 products currently available
- Your ability to identify the characteristics of both data warehouse and online transaction processing (OLTP) workloads
- Your ability to identify which DB2 products should be used to create a particular database environment (data warehouse or OLTP)
- Your knowledge of DB2 10.5 BLU Acceleration, as well as your ability to configure a DB2 database for analytical workloads
- Your knowledge of the compatibility features that are available with DB2 10.5

This chapter introduces you to the various DB2 editions and add-on products that are currently available and shows you which editions and products to use to create a data warehouse or OLTP environment. In this chapter, you will learn about the products that make up the *DB2 Family*, the characteristics of data warehouse and OLTP databases, and

which DB2 products to use to create each type of database environment. You will also discover how to configure a database to take advantage of BLU Acceleration, and you will learn about the compatibility features that are available in DB2 10.5.

The DB2 Family

In 1969, while working at IBM's San Jose Research Laboratory in San Jose, California, Edgar Frank "Ted" Codd introduced a relational model for database management in a paper titled "A Relational Model of Data for Large Shared Data Banks." And over the next four years, a variety of research prototypes such as University of California, Berkley's *Ingres* and IBM's *System R* (short for *System Relational*) were developed based on this model. In 1980, as part of an effort to port the System R prototype to their mainframe computer, IBM began work on a new product called *DATABASE 2* (otherwise known as *DB2*), and on June 7, 1983, the company made DB2 available to a limited number of IBM mainframe customers. Then, in 1985, IBM made DB2 generally available to all customers who were using the MVST[™] operating system.

In 1987, DB2 arrived on the personal computer (PC) in the form of a product called *Database Manager*, which was one of two special add-on products that were included as part of the Extended Edition version of OS/2 1.3; a year later, a version emerged in the form of *SQL/400* for IBM's new AS/400[®] server. (IBM developers working on System R created a nonrelational programming language named *SEQUEL*, which was later renamed *SQL*—an acronym for *Structured Query Language*—and the name *SQL/400* was derived by combining this acronym with part of the AS/400 server name.)

By 1992, DB2 had become a standalone product on OS/2 (and was now called *DB2/2*), and in 1993, IBM made DB2 generally available to customers running AIX[®] on IBM RS/6000[®] series servers. (Initially, this port was known as *DB2/6000*, but eventually both *DB2/2* and *DB2/6000* were replaced with a product named *DB2 for Common Servers*.) DB2 for Common Servers arrived on HP-UX and Solaris servers in 1994, on Windows servers in 1995, and on Linux servers in 1999. Along the way the name changed yet again, and DB2 for Common Servers became *DB2 Universal Database*[™].

Today, essentially two flavors of DB2 are available: DB2 for Linux, UNIX, and Windows, sometimes referred to as *DB2 for LUW* or *DB2 for distributed platforms*, and DB2 for z/OS. (With the release of DB2 Version 9, the *Universal Database* moniker was replaced with the names of the three most prominent operating systems that the non-z/OS flavor of DB2 runs on.) Several editions of DB2 are available, and each edition has been

designed to meet a specific business need. These editions, along with a suite of add-on products that provide additional functionality, are known collectively as the *DB2 Family*. The editions that make up the heart of this family are:

- DB2 Express-C
- DB2 Express Server Edition
- DB2 Workgroup Server Edition
- DB2 Enterprise Server Edition
- DB2 Advanced Workgroup Server Edition
- DB2 Advanced Enterprise Server Edition
- DB2 for z/OS

Figure 2.1 shows all the aforementioned DB2 Family editions, along with the type of computing environment each edition is primarily designed for.

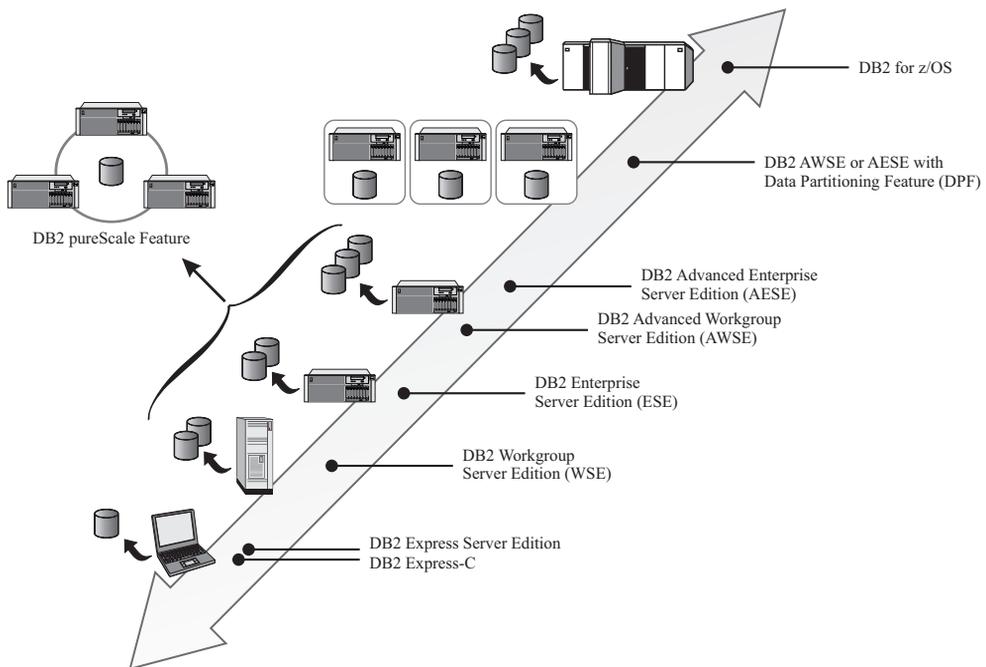


Figure 2.1: The DB2 editions available



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Note: Do not confuse DB2 for Linux on System z (also known as zLinux) with DB2 for z/OS. In this case, the DB2 product that runs on zLinux is DB2 for Linux, UNIX, and Windows—and any DB2 client or driver can connect to it, without the need for DB2 Connect™ software (an add-on product that provides connectivity between DB2 for Linux, UNIX, and Windows and DB2 for z/OS databases).

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It is important to note that you can easily move from one DB2 edition to another—provided you are not trying to move from an edition of DB2 that has been developed for Linux, UNIX, or Windows to an edition that has been developed for z/OS (or vice versa). That's because on Linux, UNIX, and Windows platforms, approximately 90 percent of the DB2 code base is common, with only 10 percent being slightly different to tightly integrate the software with the underlying operating system (for instance, to leverage huge pages on AIX or the NTFS file system on Windows).

Consequently, if you use DB2 Express-C to create a database and later decide to upgrade to DB2 Enterprise Server Edition, you merely replace the existing DB2 Express-C software with a DB2 Enterprise Server Edition (ESE) image. The end result will be a database environment that looks exactly as it did before, but that can take advantage of additional features and functionality that have been made available to it. This means that any application developed for one edition will work, without modification, with other editions. It also means that any DB2-specific skills that you have learned will remain applicable, regardless of the edition you are using.

DB2 Express-C

DB2 Express-C (also known as *DB2 Express-Community edition*) is a no-charge, entry-level database management system that is ideal for small businesses, IBM business partners, developers, instructors, and students who want to evaluate DB2 or develop applications that interact with DB2 for Linux, UNIX, and Windows databases. DB2 Express-C is simple to set up, easy to use, and contains many of the core features and functionality available with other DB2 editions, including:

- **IBM Data Studio:** An Eclipse-based integrated development environment that can be used to perform instance and database administration; create, deploy,

and debug data-centric Java applications; and analyze and provide query-tuning recommendations



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Note: IBM Data Studio consists of the *Data Studio client* and the *Data Studio Web console*. For most installations, the Data Studio client component is sufficient; to monitor database health and availability, as well as create and manage jobs, you also need the Data Studio Web console.

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- **pureXML®:** Offers a simple, efficient way to store well-formed XML documents while providing the same level of security, integrity, and resiliency that is available for relational data; this allows XML data to be stored in its native, hierarchical format and be manipulated using XQuery, SQL, or a combination of the two
- **Backup compression:** Used to reduce the size of backup images by compressing all of the data in an image, including catalog tables, user tables, index objects, large objects, auxiliary database files, and database metadata, thereby reducing storage space requirements
- **Time-Travel Query:** Lets businesses discover how data looked (or will look) at a specific point in time; (special tables called temporal tables associate time-based, state information with relational data values; data in temporal tables can be valid for a time period that is defined by the database system, user applications, or both)
- **Federation with DB2 for LUW and Informix® data sources:** Makes it possible to access objects like tables and views that reside in other DB2 for Linux, UNIX, Windows, and/or Informix databases as if they were local objects
- **SQL compatibility:** Lets individuals run applications written for Oracle, Sybase, and MySQL databases seamlessly against a DB2 for Linux, UNIX, and Windows database
- **Net Search Extender:** Provides users and application programmers a way to use SQL queries to search full-text documents that are stored in DB2 databases, other databases, and/or file systems
- **DB2 Spatial Extender:** Provides a way to generate and analyze spatial information about geographic features, as well as store and manage the data this information is based upon (a geographic feature is anything in the real world that has an

identifiable location or anything that can be imagined as existing at an identifiable location)

- **Native encryption:** Lets businesses meet security and regulatory requirements by encrypting both the database and any database backup images created

DB2 Express-C is available in more than 16 different languages and can be installed on any server that is running the Linux or Windows operating system (32-bit or 64-bit versions). The server used can contain any number of processors/cores and any amount of memory. However, total resource utilization is limited to two processors/cores and 4 GB of RAM.

Owners of DB2 Express-C can purchase a low-cost, yearly subscription option (known as a *Fixed-Term License* or *FTL*) that provides the following additional benefits and features that are not available with the no-cost version:

- 24/7 customer support, fix packs, and upgrade protection
- Increased resource utilization: eight cores (two sockets) and 8 GB memory
- Failover capabilities with High Availability Disaster Recovery (HADR)
- Enhanced security with both Row and Column Access Control (RCAC) and Label-Based Access Control (LBAC)
- SQL replication

DB2 Express Server Edition

DB2 Express Server Edition is a comprehensive, budget-friendly database management system that is designed to meet the needs of small and midsize businesses, academic institutions, and IBM Business Partners. With support for up to eight processor cores and 8 GB of RAM, DB2 Express Server Edition is ideal for building database environments that are robust, resilient, secure, and cost-efficient. With the exception of native encryption, DB2 Express Server Edition comes with all the features and functionality provided with DB2 Express-C, as well as the following:

- **Advanced Copy Services (ACS):** Enables the use of fast, disk-based replication technology that is available with some storage devices for backup and recovery operations (use of this technology can drastically reduce the amount of time required to back up and restore large databases)
- **Row and Column Access Control (RCAC):** Complements the authorities and privileges security model available with DB2 by controlling access to a table at the

row level, the column level, or both the row and column level; this feature can also be used to mask sensitive information so unauthorized users cannot see it

- **Label-Based Access Control (LBAC):** Provides multilevel data security by controlling who has read access, who has write access, and who has both read and write access to individual rows, individual columns, or individual rows and columns in a table; this feature is implemented by assigning unique labels to users and data and allowing access only when assigned labels match
- **Online reorganization:** Reorganizes tables and rebuilds indexes to eliminate fragmentation and/or compress data; as the name implies, this work can take place while a database remains online and accessible
- **High Availability Disaster Recovery (HADR):** Provides ultrafast hardware and software failover capabilities by replicating data changes made to a source database (called the *primary database*) to one or more target databases (called *standby databases*) and failing over to one of the standbys, if for some reason, the primary becomes inaccessible
- **SQL Replication with DB2 for LUW and Informix data sources:** Captures changes made to source tables and views and writes them to staging tables—changes are then read from the staging tables and replicated to corresponding target tables in other DB2 for Linux, UNIX, and Windows or Informix databases
- **IBM Tivoli® System Automation for Multiplatforms:** Provides high availability for critical business applications and middleware through policy-based self-healing that is easily tailored to an individual application environment; it includes plug-and-play automation policy modules for many IBM and non-IBM middleware and applications, such as DB2®, WebSphere®, Apache, and mySAP Business Suite

Like DB2 Express-C, DB2 Express Server Edition is available in multiple languages; unlike DB2 Express-C, DB2 Express Server Edition can be installed on servers that are running 32- or 64-bit versions of the following operating systems:

- Red Hat Enterprise Linux (RHEL) 5, 6, 7, or 7.1
- SUSE Linux Enterprise Server (SLES) 10, 11, or 12
- Ubuntu Linux 12.04 LTS or 14.04 LTS
- Sun Solaris 10
- Microsoft® Windows (Windows 8.1 Enterprise, Windows 8.1 Professional, Windows 8.1 Standard, Windows 8 Enterprise, Windows 8 Professional, Windows 8 Standard, Windows 7 Ultimate, Windows 7 Enterprise, Windows 7 Professional,

Windows Server 2012 Datacenter Edition, Windows Server 2012 Standard Edition, Windows Server 2012 Essentials Edition, Windows Server 2008 Datacenter Edition, Windows Server 2008 Enterprise Edition, Windows Server 2008 Standard Edition)



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Note: While native encryption functionality is not provided as part of DB2 Express Server Edition, this functionality can be added by purchasing the **IBM DB2 Encryption Offering** product. With DB2 Version 10.5, FixPack 5 and later, the **IBM Advanced Recovery Feature** and the **IBM DB2 Performance Management Offering** can be added to DB2 Express Server Edition as well.

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DB2 Workgroup Server Edition (WSE)

DB2 Workgroup Server Edition (WSE) is a scalable, full-function, high-performance database management system that is ideal for small and midsize businesses, workgroups, and departments that consist of a small number of internal users. In addition to having the power and reliability to handle department-level workloads with ease, DB2 Workgroup Server Edition is packed with all the features that DB2 Express Server Edition offers as well as features that reduce the total cost of ownership (TCO), including:

- **Autonomic features:** Helps lower the cost of data management by automating basic administration tasks, increasing storage efficiency, improving runtime performance, and simplifying the deployment of virtual appliances; the autonomic features available consist of:
 - » **Automatic storage:** Simplifies storage management by allowing DB2 to determine the storage characteristics for table spaces (including the location of containers) and by automatically monitoring and managing table space container growth
 - » **Self-Tuning Memory Manager (STMM):** Responds to significant changes in a database’s workload by dynamically distributing available memory resources among several different database memory consumers
 - » **Automatic maintenance:** Simplifies storage management by performing database backup operations automatically, keeping database statistics current, and reorganizing tables and indexes as necessary

- » **Self-configuration:** Automatically configures memory allocation, storage management, and business policy maintenance operations for DB2 databases
- » **Health monitoring:** Proactively monitors situations or changes in a database environment that can result in performance degradation or potential outages
- **Audit Facility:** Monitors data access and provides information needed for subsequent analysis; auditing can help discover unwanted, unknown, and unacceptable access to data as well as keep historical records of activities performed on a database system
- **Table partitioning:** A data organization scheme in which table data is divided across multiple storage objects (called *data partitions*) according to values stored in one or more columns; each data partition can reside in a different table space, in the same table space, or in a combination of the two

DB2 Workgroup Server Edition is also available in a variety of languages and can be installed on servers that are running 32- and 64-bit versions of the operating systems that DB2 Express Server Edition can be installed on. DB2 Workgroup Server Edition can also be installed on servers that are running 32- or 64-bit versions of the following operating systems:

- IBM AIX 6.1, 7.1, or 7.2
- Sun Solaris 11
- HP-UX 11i v3

One of the main advantages that DB2 Workgroup Server Edition offers over DB2 Express Server Edition (and DB2 Express-C) is that it can leverage more RAM and CPU processing power—DB2 Workgroup Server Edition is restricted to 16 processor cores and 128 GB of memory. Another advantage is that with DB2 Version 10.5, FixPack 5 and later, the following product offerings can be added to DB2 Workgroup Server Edition:

- IBM DB2 BLU Acceleration In-Memory Offering
- IBM DB2 Business Application Continuity Offering
- IBM DB2 Encryption Offering
- IBM Advanced Recovery Feature
- IBM DB2 Performance Management Offering

(We will take a closer look at these product offerings shortly.)

DB2 Enterprise Server Edition (ESE)

Ideal for high-performance, robust enterprise environments, DB2 Enterprise Server Edition (ESE) is designed to meet the data server needs of midsize and large businesses that have hundreds of internal and/or external users. DB2 Enterprise Server Edition can be deployed on Linux, UNIX, and Windows servers (physical or virtual) of any size and, unlike with other DB2 editions, there are no restrictions on the number of processor cores and the amount of memory that can be used.

DB2 Enterprise Server Edition includes all the features and functionality that come with DB2 Workgroup Server Edition, as well as the following additional features:

- **Connection Concentrator:** Improves the performance of applications that require frequent, but relatively transient, simultaneous user connections by allocating host database resources only for the duration of an SQL transaction
- **Federation with DB2 for Linux, UNIX, and Windows and Oracle data sources:** Makes it possible to access objects like tables and views that reside in Oracle databases as if they were local objects
- **Materialized Query Tables (MQTs):** Tables whose definitions are based on the results of a query; MQTs provide a powerful way to improve response time for complex queries, and they are similar to views in that their data comes from one or more base tables—MQT data is generated by executing the query the MQT is based upon, either at regular intervals or at a specific point in time that is dictated by the user; however, unlike with views, MQT data physically resides in the MQT itself
- **Multidimensional Clustering (MDC) Tables:** Offer an elegant way to cluster data along two or more dimensions; MDC tables can significantly improve query performance and drastically reduce the overhead of data maintenance operations—MDC tables are used primarily in data warehouse and large database environments, but they can be used in OLTP environments as well
- **Multi-temperature data management:** Utilizes *storage groups* (a named set of storage paths where data is to be stored) to represent different classes of storage (solid state disks, fibre channel drives, or serial ATA drives) that might be available to a database system—by using multi-temperature data management, it is possible to place frequently or constantly accessed data on faster storage devices and keep infrequently accessed data on slower (and cheaper) disks

- **Query parallelism:** Provides the ability to break a query into multiple parts and process those parts in parallel across multiple partitions of a partitioned database (that spans one or more servers/workstations), thereby improving performance
- **Resource Description Framework (RDF):** A family of World Wide Web Consortium (W3C) specifications that employs Uniform Resource Identifiers (URIs) to create a relationship between data as a triple (for example, in the form of *subject-predicate-object* expressions) or as a quad—(RDF is similar to NoSQL)

As with DB2 Workgroup Server Edition, DB2 Enterprise Server Edition is available in multiple languages and can be installed on servers that are running AIX, Linux, Solaris, HP-UX, and Microsoft Windows (in other words, any operating system that DB2 Workgroup Server Edition can be installed on). Also like DB2 Workgroup Server Edition, with DB2 Version 10.5, FixPack 5 and later, the following product offerings can be added to DB2 Enterprise Server Edition:

- IBM DB2 BLU Acceleration In-Memory Offering
- IBM DB2 Business Application Continuity Offering
- IBM DB2 Encryption Offering
- IBM Advanced Recovery Feature
- IBM DB2 Performance Management Offering

DB2 Advanced Workgroup Server Edition (AWSE)

The second most comprehensive DB2 edition available, DB2 Advanced Workgroup Server Edition (AWSE) is a powerful database management solution that offers all the features and functionality available with DB2 Enterprise Server Edition, as well as the following additional benefits:

- **DB2 Storage Optimization Feature:** Helps decrease disk space utilization and storage infrastructure requirements by transparently compressing data using classic row compression (where data is compressed at the table level), adaptive row compression (where data is compressed dynamically at the page level), or a combination of the two; temporary tables are compressed when DB2 deems it necessary and indexes for compressed tables are compressed by default
- **Column-organized tables:** Adds columnar capabilities to DB2 databases, which includes the ability to store data using column organization and vector processing of column-organized data

- **DB2 Connect™:** Provides fast and robust connectivity to IBM mainframe databases for applications running on Linux, UNIX, and Windows operating systems
- **Data Partitioning Feature (DPF):** Provides the ability to partition a database within a single server or across a cluster of servers, resulting in scalability for very large databases and complex workloads, as well as parallelism for database administration tasks
- **The DB2 pureScale® Feature:** Utilizes a shared-disk, cluster architecture that allows a database to be efficiently scaled across several servers
- **DB2 Workload Manager (WLM):** A comprehensive workload management feature that can help identify, manage, and control database workloads (applications, users, and so forth) to maximize database server throughput and resource utilization; with WLM, it is possible to customize execution environments so that no single workload can control and consume all of the system resources available
- **Continuous Data Ingest (CDI):** A high-speed, client-side DB2 utility that streams preprocessed data from named pipes or output files produced by ETL tools (or some other means) directly into DB2 tables
- **Native encryption:** Lets businesses meet security and regulatory requirements by encrypting both the database and any database backup images created
- **IBM InfoSphere® Optim™:** A family of data life-cycle management tools and solutions that can be used to design, develop, deploy, and manage database applications throughout the data life cycle (from requirements to retirement); the IBM InfoSphere Optim product family consists of:
 - » **IBM InfoSphere Change Data Capture (CDC) for DB2 for LUW:** A log-based replication solution that captures database changes as they happen and delivers them to target databases, Java™ Message Service (JMS) message queues, or extract, transform, and load (ETL) solutions such as InfoSphere DataStage
 - » **IBM InfoSphere CDC Access Server:** Controls all non-command-line access to an IBM InfoSphere CDC for DB2 for LUW replication environment
 - » **IBM InfoSphere CDC Management Console:** Provides a way to configure, monitor, and manage CDC replication on various servers, as well as specify replication parameters, initiate refresh and mirroring operations from a client workstation, and monitor replication operations, latency, event messages, and other statistics supported by the source or target data store

- » **IBM InfoSphere Data Architect:** Offers a complete solution for designing, modeling, discovering, relating, and standardizing data assets; used for data modeling, transformation, and Data Definition Language (DDL) generation, as well as to build, debug, and manage database objects such as SQL stored procedures and user-defined functions (UDFs)
- » **IBM InfoSphere Optim™ Configuration Manager:** Provides advice on how to change database configurations; also stores states and changes in a repository, making it possible to compare current and historical data, which can be helpful when trying to understand and resolve problems related to configuration changes
- » **IBM InfoSphere Optim Performance Manager Extended Edition:** Used to identify, diagnose, solve, and prevent performance problems in DB2 products and associated applications
- » **IBM InfoSphere Optim pureQuery® Runtime:** Used to deploy advanced pureQuery applications that use static SQL; bridges the gap between data and Java technology by harnessing the power of SQL within an easy-to-use Java data access platform; and increases security of Java applications, helping to prevent threats like SQL injection
- » **IBM InfoSphere Optim Query Tuner:** Often referred to as the *Query Tuner*, used to analyze and make recommendations on ways to tune existing queries, as well as provide expert advice on writing new, efficient, high-quality queries
- **Q Replication:** Technologies within IBM InfoSphere Data Replication that move large volumes of data at high speeds to help businesses connect globally distributed operations, respond quickly to customers, and rapidly recover from problems that affect critical database systems

DB2 Advanced Workgroup Server Edition is also available in a variety of languages and can be installed on servers that are running 32- and 64-bit versions of the operating systems that DB2 Workgroup Server Edition can be installed on. Like DB2 Workgroup Server Edition, DB2 Advanced Workgroup Server Edition is limited to environments that contain up to 16 cores and 128 GB of memory. In DB2 Version 10.5, FixPack 5 and later, the functionality provided by all the DB2 add-on offerings available is included by default with this edition. This edition also comes with a full complement of warehouse tools, Optim tools, and IBM Data Studio; however, these tools must be installed separately.

DB2 Advanced Enterprise Server Edition (AESE)

The most comprehensive DB2 edition available, DB2 Advanced Enterprise Server Edition (AESE) is a powerful database management solution that offers all the features and functionality available with DB2 Advanced Workgroup Server Edition. However, with this edition, there are no processor, memory, or database size limitations, which make it ideal for any size workload.

DB2 Advanced Enterprise Server Edition is also available in a variety of languages and can be installed on servers that are running 32- and 64-bit versions of the operating systems that DB2 Enterprise Server Edition can be installed on. Like DB2 Advanced Workgroup Edition, in DB2 Version 10.5, FixPack 5 and later, the functionality provided by all the available DB2 add-on offerings is included by default with DB2 Advanced Enterprise Server Edition. This edition also comes with a full complement of warehouse tools, Optim tools, and IBM Data Studio; however, these tools must be installed separately.

DB2 for z/OS

DB2 for z/OS is a multiuser, full-function database management system that has been designed specifically for z/OS, IBM's flagship mainframe operating system. Tightly integrated with the IBM mainframe—DB2 for z/OS takes advantage of the latest improvements in System z hardware and software to provide optimum performance and significantly cut IT infrastructure costs, DB2 for z/OS leverages the strengths of System z® 64-bit architecture to provide continuous availability and business resiliency, extraordinary scalability, unmatched security and compliance assurance, and the ability to support complex data warehouses.

Other DB2 Add-on Products

Along with the various editions that make up the bulk of the DB2 family, several add-on products that are designed to expand and enhance the functionality and capabilities of many of the non-advanced editions of DB2 available. As we saw earlier, these products, which make up the remainder of the DB2 family, are:

- IBM DB2 BLU Acceleration In-Memory Offering
- IBM DB2 Business Application Continuity Offering
- IBM DB2 Encryption Offering
- IBM Advanced Recovery Feature
- IBM DB2 Performance Management Offering

IBM DB2 BLU Acceleration In-Memory Offering

Based on the next-generation of in-memory technologies, the IBM DB2 BLU Acceleration In-Memory Offering delivers simple and scalable in-memory acceleration for analytic workloads. Available for DB2 Workgroup Server Edition and DB2 Enterprise Server Edition, the DB2 BLU Acceleration In-Memory Offering:

- Provides the benefits of in-memory columnar processing without the limitations or cost of in-memory only systems
- Provides workload management functionality for in-memory columnar processing
- Leverages Oracle skills with SQL compatibility to enable simple, low-risk migration from Oracle to DB2 with BLU Acceleration
- Reduces risk and improves performance of SAP environments with enhancements to SAP Business Warehouse support
- Offers “load-and-go” simplicity

IBM DB2 Business Application Continuity Offering

The IBM DB2 Business Application Continuity Offering is an affordable, continuous availability solution that is based on DB2 pureScale technology. This two-member DB2 pureScale cluster configuration enables one member to process application workloads, and a second member to perform administrative tasks, as well as provide availability when the first member undergoes a planned or unplanned outage. Available for DB2 Workgroup Server Edition and DB2 Server Enterprise Edition, the DB2 Business Application Continuity Offering helps you to:

- Meet expected or required service level agreements (SLAs)
- Protect your business from planned and unplanned outages
- Optimize resources by offloading administration to a second DB2 pureScale member
- Reduce the costs of high availability

IBM DB2 Encryption Offering

IBM DB2 Encryption Offering provides native data encryption at rest to assist businesses with security and regulatory requirements. Available for DB2 Express Server Edition, DB2 Workgroup Server Edition, and DB2 Enterprise Server Edition, the DB2 Encryption Offering:

- Is simple to enable and deploy
- Is transparent to applications accessing the data
- Applies to both the database and to backup images
- Complies with National Institute of Standards and Technology (NIST) Special Publication (SP) 800-131a requirements for cryptographic algorithms and key lengths
- Utilizes cryptographic libraries that are Federal Information Processing Standard (FIPS) Publication 140-2 certified—FIPS 140-2 is a U.S. government computer security standard that is used to accredit cryptographic modules

IBM Advanced Recovery Feature

The IBM DB2 Advanced Recovery Feature is a suite of advanced database backup, recovery, and data extraction tools that help improve data availability, mitigate risk, and accelerate crucial administrative tasks. Available as a product that can be purchased separately and used with DB2 Express Server Edition and higher, the DB2 Advanced Recovery Feature includes:

- **IBM DB2 Merge Backup for Linux, UNIX, and Windows:** Provides the ability to back up databases more efficiently, lessen impact on production systems, and shorten recovery times
- **IBM DB2 Recovery Expert for Linux, UNIX, and Windows:** Provides the ability to recover with more speed, flexibility, and precise granularity while protecting mission-critical business data and significantly reducing the amount of resources needed; reduces impact on production systems by using remote log analysis; and eliminates the need to resort to full database recovery
- **IBM Optim High Performance Unload for DB2 for Linux, UNIX, and Windows:** Provides the ability to perform high-speed unloads from live databases or backup files; improves regulatory compliance by offering increased data protection during the unload operation; increases data availability, mitigates risk, and accelerates the delivery of full database migrations; and lessens production impact and reduces storage costs by rapidly unloading, extracting and repartitioning data throughout the enterprise

IBM DB2 Performance Management Offering

IBM DB2 Performance Management Offering is a suite of tools that helps businesses monitor, manage, and improve database workload and application performance; it

provides users with the information they need to manage performance proactively and prevent problems before they impact the business. Available for DB2 Express Server Edition, DB2 Workgroup Server Edition, and DB2 Enterprise Server Edition, the DB2 Performance Management Offering helps you to:

- Identify emergent problems
- Diagnose the root cause of issues
- Receive notifications of degrading performance or emerging resource bottlenecks
- Isolate problematic components across applications, networks, and databases
- Prevent performance problems by defining and using a more predictable database server execution environment
- Solve performance problems with actionable tuning recommendations for entire workloads

Database Workloads

Operations performed against relational databases are often classified according to the frequency in which they are performed and the volume of data they modify or retrieve. Together, these characteristics identify the type of workloads a particular database supports; most database workloads fall into two distinct categories: *online transaction processing* (OLTP) and *data warehousing*, which includes reporting, online analytical processing (OLAP), and data mining.

What differentiates a data warehousing system from an OLTP system? Data warehousing involves storing and managing large volumes of data (often historical in nature) that is used primarily for analysis. For instance, a data warehouse could be used to summarize a company's sales by region or to identify patterns in products that have been sold over the last five years. Consequently, workloads in a data warehouse environment can vary—they might consist of bulk load operations, short-running simple queries, long-running complex queries involving aggregation, random ad hoc queries, infrequent updates to data, or the execution of online maintenance utilities. To handle these types of workloads, most data warehouse environments have the following requirements:

- **Performance:** This is a system's ability to execute any action within a given time interval. In a data warehouse environment, the system should perform the initial population of tables and any required incremental updates in the shortest amount of time possible. Ad hoc queries should be satisfied, at any time, without degrading the performance of other mission-critical or time-sensitive operations. Similarly,

complex and multidimensional queries should handle aggregations, full-table scans, and multiple table joins with little or no performance impact

- **Scalability:** This is a system's ability to be readily enlarged or to handle increases in load without adversely affecting performance. Both the hardware and software components used in building a data warehouse should enable the environment to grow, as needed, without reducing performance
- **Availability:** This relates to the proportion of time that a system is functional and working. A data warehouse should be available 24 hours a day, 7 days a week, 365 days a year. However, a data warehouse may be taken offline at regular intervals, and for a limited amount of time, to be updated or populated with a bulk-load operation
- **Manageability:** This defines how easily administrators can manage a system, usually through tools that are available for monitoring, debugging, and tuning. A data warehouse environment should be flexible and extensible, while minimizing the administrative costs involved in keeping it online and accessible

In contrast, OLTP systems are designed to support day-to-day, mission-critical business activities such as Web-based order entry, stock trading, and inventory management. Consequently, OLTP workloads are often characterized by simple, single-record lookups and by SQL operations (typically inserts, updates, and deletes) that access or modify a small number of records and perform few, if any, input/output (I/O) operations. To better handle these types of workloads, most OLTP environments have the following requirements:

- **High performance:** In an OLTP environment, high throughput, measured in hundreds of transactions per second, is required. And subsecond end-user response time is desired. (Performance of OLTP workloads can often be enhanced by minimizing I/Os, optimizing CPU utilization, eliminating sorts, and improving transaction concurrency.)
- **High volume:** A typical OLTP environment might consist of hundreds to thousands of users issuing millions of transactions per day against databases that vary in size. Consequently, the volume of data affected may be very large, even though each transaction typically makes changes to only a small number of records. (Data tends to be current.)

- **High availability:** Unlike data warehouses, which can be taken offline at regular intervals, OLTP databases typically must be available 24 hours a day, 7 days a week, 365 days a year.

Optimized Solutions for Each Workload Type

Although you can use all the DB2 Editions available *except* DB2 Express-C and DB2 Express Edition to create both data warehouse and OLTP environments, IBM offers two solutions that are tailored specifically for one workload type or the other: the *Data Partitioning Feature* (for data warehousing workloads) and the *DB2 pureScale Feature* (for OLTP workloads).

The Data Partitioning Feature (DPF)

Both DB2 Advanced Workgroup Server Edition and DB2 Advanced Enterprise Server Edition contain data warehouse–enhancing features such as support for Materialized Query Tables (MQTs), the starburst query optimizer, and support for multidimensional clustering (MDC) tables. And when used with either of these editions, the Data Partitioning Feature (DPF) provides the ability to divide very large databases into multiple parts (known as *partitions*) and store them across a cluster of inexpensive servers. (In the past, it was possible to add DPF to DB2 Enterprise Server Edition environments by activating a license key; however, that is no longer the case.)

Sometimes called a *database node* or simply a *node*, each database partition contains its own data, indexes, configuration files, and transaction log files. Because these components—as well as memory and storage—are not shared between partitions, a DB2 database that utilizes DPF is often referred to as a *shared-nothing* environment. Figure 2.2 shows what a simple DB2 with DPF database environment looks like.

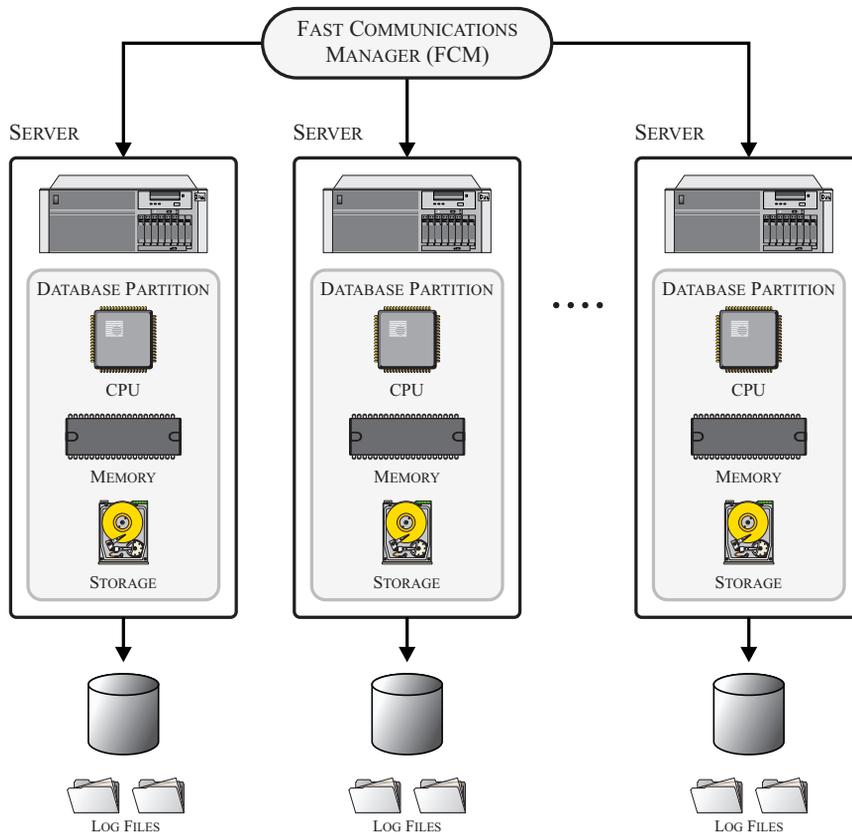


Figure 2.2: A simple DB2 with DPF database environment

When DPF is used, a database can be scaled as an organization's data needs grow simply by adding more database partitions. (The fact that the database is split across multiple partitions is transparent to applications and users.) DPF also enables DB2 to process complex queries more efficiently—data retrieval and update requests are decomposed automatically into subrequests and executed in parallel among all applicable partitions. In addition, DPF can improve data availability by reducing the impact of performing routine maintenance activities and by decreasing the time needed to do so; such activities can be performed on a single partition, one partition at a time rather than against the entire database at once.