DATABASE SOFTWARE

(RELATIONAL DATABASE MANAGEMENT SYSTEM)

What Is Database?

A database is an organized collection of data, generally stored and accessed electronically from a computer system. Where databases are more complex, they are often developed using formal design and modeling techniques

What Are Database Management System Software??

The database management system Software (DBMS) is the software that interacts with end users, applications, and the database itself to capture and analyze the data. The DBMS software additionally encompasses the core facilities provided to administer the database. The sum total of the database, the DBMS and the associated applications can be referred to as a "database system". Often the term "database" is also used to loosely refer to any of the DBMS, the database system or an application associated with the data

Formally, a "database" refers to a set of related data and the way it is organized. Access to this data is usually provided by a "database management system" (DBMS) consisting of an integrated set of computer software that allows users to interact with one or more databases and provides access to all of the data contained in the database (although restrictions may exist that limit access to particular data). The DBMS provides various functions that allow entry, storage and retrieval of large quantities of information and provides ways to manage how that information is organized. Base

Computer scientists may classify database-management systems according to the database models that they support. Relational databases became dominant in the 1980s. These model data as rows and columns in a series of tables, and the vast majority use SQL for writing and querying data. In the 2000s, non-relational databases became popular, referred to as NoSQL because they use different query languages. Some of the well-known database system software are as follows: -

A. MySQL
B. Microsoft Access
C. Oracle
D. IBM DB2 (luw)
E. Teradata
F. Microsoft SQL Server

MY SQL

1.0 Introduction: -

Mysql is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. Mysql is free and open-source software under the terms of the GNU General Public License, and is also available under a variety of proprietary licenses.

History: -

The first version of MySQL appeared on 23 May 1995. It was initially created for personal usage from mSQL based on the low-level language ISAM, which the creators considered too slow and inflexible.

2.0 Features: -

a) Easy to use
b) It is secure:
c) Client/ Server Architecture.
d) It is scalable:

MySQL can handle almost any amount of data, up to as much as 50 million rows or more. The default file size limit is about 4 GB. However, you can increase this number to a theoretical limit of 8 TB of data.

e) Allows roll-back:

MySQL allows transactions to be rolled back, commit and crash recovery.

f) High Performance:

MySQL is faster, more reliable and cheaper because of its unique storage engine architecture

g) High Flexibility:

MySQL supports a large number of embedded applications which makes MySQL very flexible.

h) High Productivity:

MySQL uses Triggers, Stored procedures and views which allows the developer to give a higher productivity.

3.0 Drawbacks: -

a) MySQL version less than 5.0 doesn't support ROLE, COMMIT and stored procedure.

b) MySQL does not support a very large database size as efficiently.

c) MySQL doesn't handle transactions very efficiently and it is prone to data corruption.

d) MySQL is accused that it doesn't have a good developing and debugging tool compared to paid databases.

e) MySQL doesn't support SQL check constraints.

4.0 Project Forks (Currently in Use): -

A variety of MySQL forks exist, including the following.

MariaDB: -

MariaDB is a community-developed fork of the MySQL relational database management system intended to remain free under the GNU GPL. Being a fork of a leading open source software system, it is notable for being led by the original developers of MySQL, who forked it due to concerns over its acquisition by Oracle.

Percona Server for MySQL: -

Percona Server for MySQL, forked by Percona, aims to retain close compatibility to the official MySQL releases, while focusing on performance and increased visibility into server operations. Also included in Percona Server for MySQL is XtraDB, Percona's fork of the InnoDB Storage Engine.

5.0 Graphical Interface

1. MySQL Workbench
2. Adminer
3. Cluster Control
4. Database Workbench
5. DBeaver
6. DBEdit
7. LibreOffice Base
8. Navicat
9. OpenOffice.org
10. Webmin
11. Toad for MySQL
12. SQLyog
13. SQLBuddy

7.0 Command line interface: -

A command-line interface is a means of interacting with a computer program where the user issues commands to the program by typing in successive lines of text MySQL ships with many command line tools, from which the main interface is the mysql client. MySQL Utilities is a set of utilities designed to perform common maintenance and administrative tasks. Originally included as part of the MySQL Workbench, the utilities are a stand-alone download available from Oracle.

8.0 version and release date: -

version	General availability	Latest minor version	Latest release Date	End of support
5.1	November 14, 2008; 10 years ago,	5.1.73	2013-12-03	December 2013
5.5	December 3, 2010; 8 years ago,	5.5.62	2018-10-22	December 2018
5.6	February 5, 2013; 6 years ago,	5.6.45	2019-07-22	February 2021

Oracle Database

1.0 Introduction: -

Oracle Database (commonly referred to as oracle RDBMS or simply as Oracle is a proprietary multi-model database management system produced and marketed by Oracle Corporation.It is a database commonly used for running online transaction processing (OLTP), data warehousing (DW) and mixed (OLTP & DW) database workloads. The latest generation, Oracle Database 19c, is available on-prem, on-Cloud, or in a hybrid-Cloud environment.

2.0 History: -

Larry Ellison and his two friends and former co-workers, Bob Miner and Ed Oates, started a consultancy called Software Development Laboratories (SDL) in 1977. SDL developed the original version of the Oracle software.

3.0 Updates for user: -

Oracle Corporation releases Critical Patch Updates (CPUs) or Security Patch Updates (SPUs) and Security Alerts to close security holes that could be used for data theft. Critical Patch Updates (CPUs) and Security Alerts come out quarterly on the Tuesday closest to 17th day of the month.

- Customers may receive release notification by email.

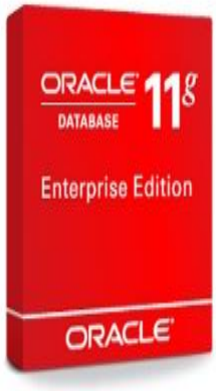
4.0 Oracle numbering and naming: -

Oracle products follow a custom release-numbering and -naming convention. The "c" in the current release, Oracle Database 19c, stands for "Cloud". Previous releases (e.g. Oracle Database 10g and Oracle9i Database) have used suffixes of "g" and "i" which stand for "Grid" and "Internet" respectively. Prior to the release of Oracle8i Database, no suffixes featured in Oracle Database naming conventions.

5.0 Database editions: -

As of 2017, the latest Oracle Database version (12.2.0.1) comes in three editions for on-premises deployments:

- Oracle Database **Enterprise Edition** (EE): offers industry-leading scalability and reliability In both clustered and single system configurations and imposes no limitation on server resources available to the database.
- Oracle Database **Standard Edition 2** (SE2): intended for small- to medium-sized implementations, SE2 includes Real Application Clusters and may be deployed on servers or clusters with a maximum of 2 sockets total and capped to use a maximum of 16 concurrent user threads. SE2 uses the same code base as EE, and therefore upwardly compatible and simple to upgrade to EE.



6.0 Cons Of Oracle

- High cost for small organizations
- Require significant resources for installation
- Hardware upgrades may be required to even implement Oracle
- takes up a lot of space

7.0 Supported Platforms: -

Oracle Database 12c is supported on the following OS and architecture combinations:

- Linux on x86-64 (only Red Hat Enterprise Linux, Oracle Linux and SUSE distributions are supported
- Microsoft Windows on x86-64
- Oracle Solaris on SPARC and x86-64
- IBM AIX on POWER Systems
- Linux on IBM z Enterprise Systems
- HP-UX on Itanium

8.0 Database options: -

The Oracle Database offers a wide range of options and features in the areas of Availability, Scalability, Analytics, Performance, Security, Management, Developers and Integration. These aim to enhance and complement existing database functionality to meet customer-specific requirements. All Database Options are only available for Enterprise Edition and offered for an extra cost.

9.0 Tools: -

As of 2007 Oracle Corporation had started a drive toward "wizard"-driven environments with a view to enabling non-programmers to produce simple data-driven applications.

The most popular application development tool that ships with Oracle Database is Oracle Application Express (APEX), a browser-based tool that allows developers to build responsive, database-driven applications, leveraging their SQL and PL/SQL skills.

Users can also develop their own applications in Java and in PL/SQL, optionally using tools such as:

- Oracle Forms
- Oracle JDeveloper
- Oracle Reports

10.0 Programming language: -

Oracle Database can be accessed from many programming languages and environments. These include:

- Java via JDBC, SQLJ
- Microsoft .NET via ODP.NET
- C and C++ via OCI, OCCI, Oracle's ODBC Driver, ODPI-C, OCILIB, Pro*C/C++
- Node.js via node-oracledb
- Python via cx_Oracle
- PHP via PHP OCI8, PDO_OCI
- Go via goracle, ora, go-oci8
- R via ROracle

11.0 Database structure (schema): -

Most Oracle database installations come with a default schema called `SCOTT`. After the installation process sets up sample tables, the user logs into the database with the username `scott` and the password `tiger`. The name of the `SCOTT` schema originated with Bruce Scott, one of the first employees at Oracle (then Software Development Laboratories), who had a cat named Tiger.

Other default schemas include:

- `SYS` (essential core database structures and utilities)
- `SYSTEM` (additional core database structures and utilities, and privileged account)
- `OUTLN` (used to store metadata for stored outlines for stable query-optimizer execution plans.)
- `BI`, `IX`, `HR`, `OE`, `PM`, and `SH` (expanded sample schemas containing more data and structures than the older `SCOTT` schema).

12.0 Globalization: -

Oracle Database software comes in 63 language-versions (including regional variations such as British English and American English). Variations between versions cover the names of days and months, abbreviations, time-symbols (such as A.M. and A.D.), and sorting.

Oracle Corporation provides database developers with tools and mechanisms for producing internationalized database applications: referred to internally as "Globalization

13.0 Release date and Versions: -

Oracle database version	version	Release date
Oracle v2	2.3	1979
Oracle v3	3.1.3	1983
Oracle v4	4.1.4.0	1984
Oracle v5	5.0.22 (5.1.17)	1985
Oracle v6	6.0.17	1988
Oracle 6.2	6.2.0	
Oracle7	7.0.12	June 1992
Oracle 7.1	7.1.0	May 1994
Oracle 7.2	7.2.0	May 1995
Oracle 7.3	7.3.0	February 1996
Oracle8 Database	8.0.3	June 1997
Oracle8i Database	8.1.5.0	1998
Oracle9i Database	9.0.1.0	2001
Oracle9i Database Release 2	9.2.0.1	2002
Oracle Database 10g Release 1	10.1.0.2	2003
Oracle Database 10g Release 2	10.2.0.1	July 2005
Oracle Database 11g Release 1	11.1.0.6	September 2007

MICROSOFT SQL SERVER

1.0 Introduction: -

Microsoft SQL Server is a relational database management system developed by Microsoft. As a database server, it is a software product with the primary function of storing and retrieving data as requested by other software applications—which may run either on the same computer or on another computer across a network (including the Internet).

2.0 Architecture: -

The protocol layer implements the external interface to SQL Server. All operations that can be invoked on SQL Server are communicated to it via a Microsoft-defined format, called Tabular Data Stream (TDS). TDS is an application layer protocol, used to transfer data between a database server and a client.

3.0 Editions: -

1. Enterprise
2. Standard
3. Developer
4. Workgroup
5. Win Compact
6. Enterprise Evaluation
7. Express
8. Web
9. Datacenter
10. Business Intelligence

4.0 Data Storage: -

In Microsoft sql server data in tables is stored in row and column format at the logical level, but physically it stores data in data pages which are allocated from the data files of the database. Every SQL Server database has at least two operating system files: a data file and a log file. Data files can be of two types: Primary or Secondary. The Primary data file contains startup information for the database and points to other files in the database.

Buffer Management: -

SQL Server buffers pages in RAM to minimize disk I/O. Any 8 KB page can be buffered in-memory, and the set of all pages currently buffered is called the buffer cache. The amount of memory available to SQL Server decides how many pages will be cached in memory. The buffer cache is managed by the Buffer Manager. Either reading from or writing to any page copies it to the buffer cache.

5.0 Services Provided: -

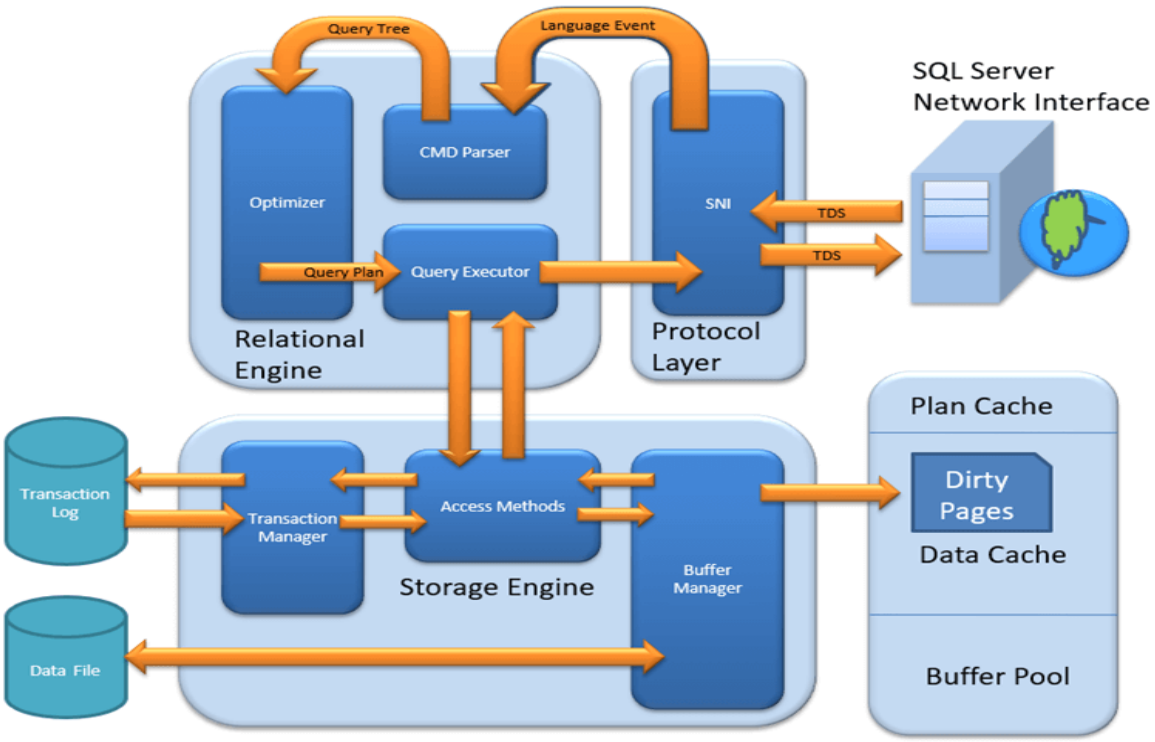
a. Machine Learning Services
b. Service Broker
c. Replication Services
d. Analysis Services
e. Reporting Services
f. Notification Services
g. Integration Services
h. Full Text Search Service
i. SQLCMD
j. Visual Studio
k. SQL Server Management Studio
l. SQL Server Operations Studio
m. Business Intelligence Development Studio

6.0 Features: -

- Support tools SQL Server Profiler, BI tools, SQL Server Management Studio, and Database Tuning Advisor.
- Offers online help and documentation, and live item support.
- Provides advanced customization choice for datatype mappings and erase and rename objects.
- Displays mistake, and cautioning messages about the relocation in an advanced window.
- Provides A single, coordinated condition for SQL Server Database Engine administration and approving.
- Resizable discoursed enable access to different instruments when an exchange is open.

7.0 Drawbacks: -

- it's not free
- it's not open source
- it only runs on Windows



Teradata

1.0 Over View: -

Teradata Corporation is a provider of database and analytics-related software, products, and services. The company was formed in 1979 in Brentwood, California, as a collaboration between researchers at Caltech and Citibank's advanced technology group. Teradata is an enterprise software company that develops and sells database analytics software subscriptions. The company provides three main services: business analytics, cloud products, and consulting.

2.0 Drawbacks: -

- It is not suitable for small transaction OLTP databases.
- Because it is mostly for big enterprise level market, it lags behind the cutting-edge open source technologies, such as in-memory and columnar type DBs. Teradata bought Aster Database make it easier to work with R language.
- It is not open sourced.

3.0 History: -

1979 – Teradata was incorporated.
1984 – Release of first database computer DBC/1012.
1986 – Fortune magazine names Teradata as 'Product of the Years
1999 – Largest database in the world using Teradata with 130 Terabyte
2002 – Teradata V2R5 released with Partition Primary Index And Compression
2006 – Launch of Teradata Master Data Management Solutions.
2008 – Teradata 13.0 released with Active Data Warehousing.

2011 – Acquires Teradata Aster and enters into Advanced Analytical space.

2012– Teradata 14.0 introduced.

4.0 Applications of Teradata:

- Customer Data Management: Helps to maintain long-lasting relationships with customers.
- Master Data Management: Helps to develop an environment where master data can be used, synchronized, and stored.
- Finance and Performance Management: Helps organization to improve the speed and quality of financial reporting. It reduces finance infrastructure costs, and proactively manage enterprise performance.
- Supply Chain Management: Improve supply chain operations which help to improved customer service, reduced cycle times, and lower inventories.

5.0 Features: -

- Unlimited Parallelism – Teradata database system is based on Massively Parallel Processing (MPP) Architecture. MPP architecture divides the workload evenly across the entire system. Teradata system splits the task among its processes and runs them in parallel to ensure that the task is completed quickly.

- Shared Nothing Architecture – Teradata's architecture is called as Shared Nothing Architecture. Teradata Nodes, its Access Module Processors (AMPs) and the disks associated with AMPs work independently. They are not shared with others.

- Linear Scalability – Teradata systems are highly scalable. They can scale up to 2048 Nodes. For example, you can double the capacity of the system by doubling the number of AMPs.

- Connectivity – Teradata can connect to Channel-attached systems such as Mainframe or Network-attached systems.

- Mature Optimizer – Teradata optimizer is one of the matured optimizers in the market. It has been designed to be parallel since its beginning. It has been refined for each release.

- SQL – Teradata supports industry standard SQL to interact with the data stored in tables. In addition to this, it provides its own extension.

6.0 Teradata Architecture: -

Teradata architecture is a Massively Parallel Processing Architecture.
Three important components of Teradata are:

- Parsing Engine
- BYNET
- Access Module Processors (AMPs).

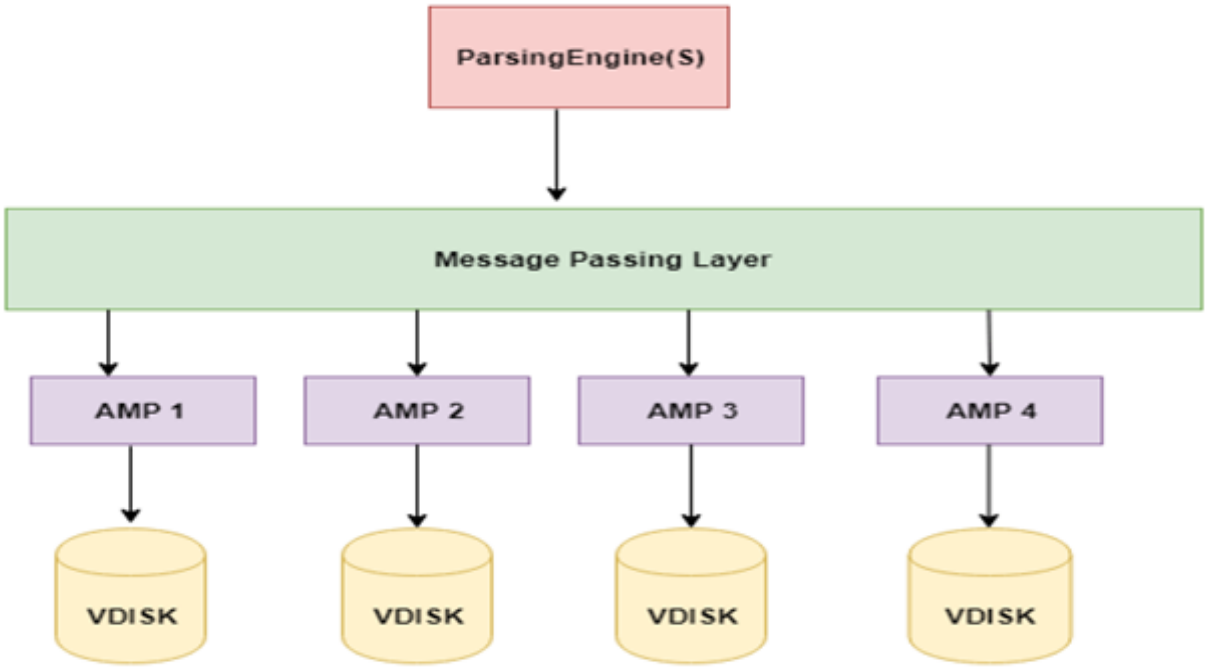
6.1 Storage Architecture

1.. Parsing Engine:

The Parsing Engine parses the queries and prepares the execution plan. It manages sessions for users. It optimizes & sends a request to the users. So, when the client executes queries for inserting records, Parsing Engine sends the records to Message Passing layer. Message passing layer or BYNET is a software and hardware component. It offers networking capability. It also retrieves the records and sends the row to the target AMP.

2. Retrieval Architecture

When the client runs queries to retrieve records, the Parsing engine sends a request to BYNET. Then BYNET sends the retrieval request to appropriate Amps. Amps search their disks in parallel and recognize the required records and send to BYNET. BYNET sends the records to Parsing Engine which in turn will send to the client.



IBM DB2 (LUW)

1.0 Introduction: -

Db2 Database formerly known as Db2 for Linux, UNIX and Windows is a database server product developed by IBM. Also known as Db2 LUW for brevity, it is part of the Db2 family of database products. Db2 LUW is the "Common Server" product member of the Db2 family, designed to run on most popular operating systems. The powered by AI component of Db2 11.5 is derived from features that replace manual optimization with Machine Learning based optimization, as well as the inclusion of natural language in the querying process.

2.0 Features: -

In addition to standard ACID-compliant row-organized relational database functionality, some of its key features are:

- IBM BLU Acceleration: OLAP oriented column-organized tables, compressed with order-preserving "approximate Huffman encoding", exploiting SIMD vector processing of compressed data. Because the compression is order preserving, a greater range of operations can be performed on compressed data.
- Pure Scale: A data-sharing clustering of the database over multiple servers for scalability and resilience. This technology was taken from the mainframe (z-Series) Db2 product. This form of clustering suits OLTP workloads.
- Database partitioning feature: A shared-nothing approach to clustering, with data hashed across multiple partitions on the same server or different processors. With the right database design, this approach allows near-linear scaling. This form of clustering is generally employed for large data warehouses rather than OLTP workloads.
- XML support: XML-specific storage and indexing, accessible by both SQL and also XQuery.
- NoSQL support: Currently graph triple stores and JSON support
- Storage Optimization
- Data Federation
- Continuous Data Ingest

3.0 Editions: -

IBM offers three editions:

- Db2 Community Edition
- Standard Server Edition
- Advanced Server Edition.

4.1 IBM Db2 Community Edition:

IBM Db2 Community Edition is a free to download, use and redistribute edition of the IBM Db2 data server, which has both XML database and relational database management system features. It is limited to four CPU cores, 16 GB of RAM, a database size of 100 GB, and no Enterprise support and fix packs. Db2 Community Edition has no limit on number of users. On June 27, 2019, IBM released Db2 V11.5, a Db2 update designed to deliver enhancements to help automate data management, eliminate ETL, and support artificial intelligence data workloads. Along with the update, IBM unveiled streamlined offerings.

1.History: -

On January 30, 2006, IBM announced a special free version of DB2 Express edition called DB2 Express-C. The DB2 Express-C edition was created for the 8.2 release of IBM Db2. After this Db2 Express-C was created for all new DB2 versions: 9.1 (codenamed "Viper"), 9.5 (codename "Viper 2"), 9.7 (codename "Cobra"), 10.01 (codename "Galileo"), 10.5 (codename "Kepler") and 11.1.

2.Supported environments: -

The Community edition download is available for the following platforms: IBM Db2 11.5 Edition for AIX, IBM Db2 11.5 Edition for Windows on AMD64 and Intel EM64T systems (x64), IBM Db2 11.5 for Linux on AMD64 and Intel EM64T systems (x64), IBM Db2 11.5 for Linux on POWER little endian systems.

3.Limitations: -

IBM Db2 Community edition is limited to use up to 16 GB RAM and four CPU cores. The database engine does not limit the number of concurrent user connections. The prior version of IBM DB2 Express-C was limited to use up to 16 GB RAM (increase from 4 GB with v10.5) and two CPU cores. It has the following extra features enabled:

- Backup compression
- Homogeneous federation – only DB2, Informix Data Server and Oracle targets are supported
- Homogeneous SQL replication

4.Updates: -

Db2 Community edition is unsupported and regular Db2 fix packs cannot be applied to it. IBM does not release any fixes, but they do publish updated installation images and remove old ones. Unix versions need to be reinstalled, but it is possible to perform in-place updates on Windows versions by just running the installation program of a newer version.

5.Subscription: -

For Db2 Community editions there are no annual subscriptions, instead the free trial is available indefinitely. Users who want to scale beyond four cores and 16 GB of RAM do not need to migrate their workload to an upgraded environment, instead users apply a license key against the existing implementation to access additional capacity.

4.2 IBM Db2 Advanced Edition

The Db2 Advanced Edition is available only as a component of the IBM Hybrid Data Management Platform (HDMP). Within HDMP, Db2 is available both as a perpetual software license AND a monthly subscription for unrestricted production and non-production use with premium IBM support. For both HDMP perpetual license and subscription offerings, you need to buy Flex Points.

Db2 Advanced Edition offers these benefits:

- Improves application performance and analytics for faster decisions.
- Delivers high availability and disaster recovery capabilities.
- Provides a secure, flexible environment
- Interfaces with a variety of data more efficiently.
- Improves productivity and reduces administration efforts