CSCI235 Database Systems

Distributed Relational Database Systems

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Distributed Relational Database Systems

Outline

- Distributed database ? What is it ?
- Centralized database schema model
- Mainframe application architecture
- Client-server architecture
- Distributed client-server architecture
- Web based architecture
- Distributed Web based architecture
- Distributed database schema architecture
- Transparency
- Autonomy
- Advantages and disadvantages of DDBS
- Distributed database system Oracle 12c

Distributed database ? What is it ?

Distributed database system (DDBS) is a collection of multiple logically related databases distributed over a computer network

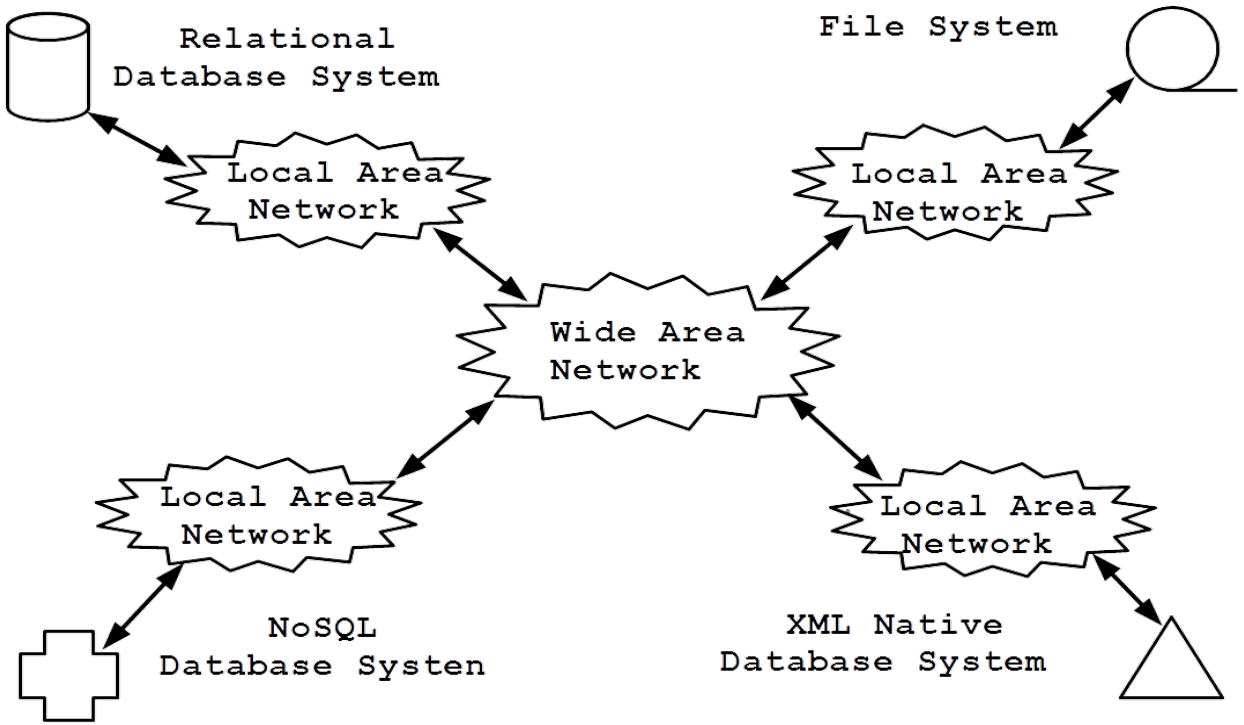
Distributed database management system (DDBMS) is a collection of database systems together with software providing a required set of operations on data and management features

Homogeneous DDBS is a collection of identical database systems distributed over a computer network, e.g. a collection of Oracle database systems

Heterogeneous DDBS is a collection of different database systems distributed over a computer network, e.g. a collection of Oracle + MySQL + DB/2 + MongoDB + XML native database systems + Excel spreadsheets + ... , systems

Distributed database ? What is it ?

A sample organization of heterogeneous distributed database system



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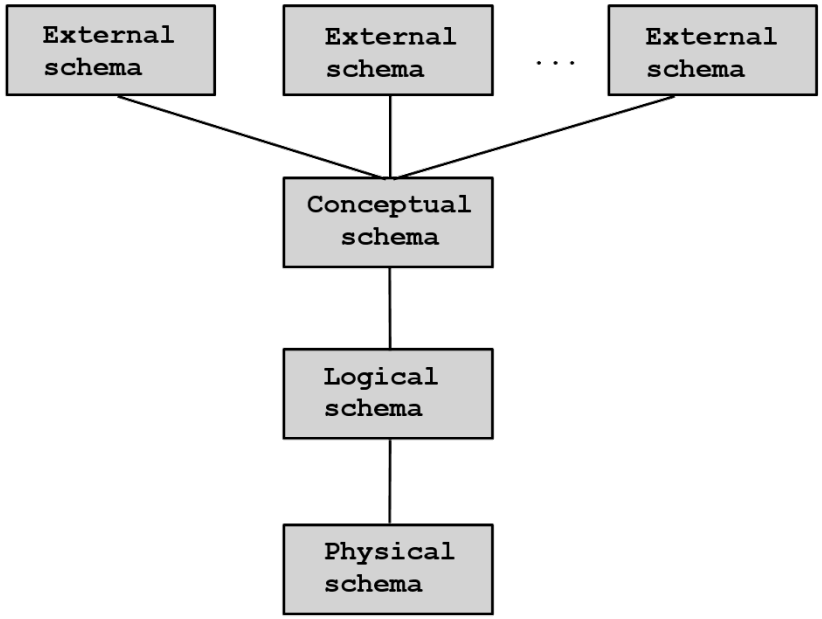
Centralized database schema model

In a centralized database schema model the users are provided their personal external schemas (views) of data

The external schemas are integrated into a single conceptual schema later on transformed into a logical schema and implemented as physical schema



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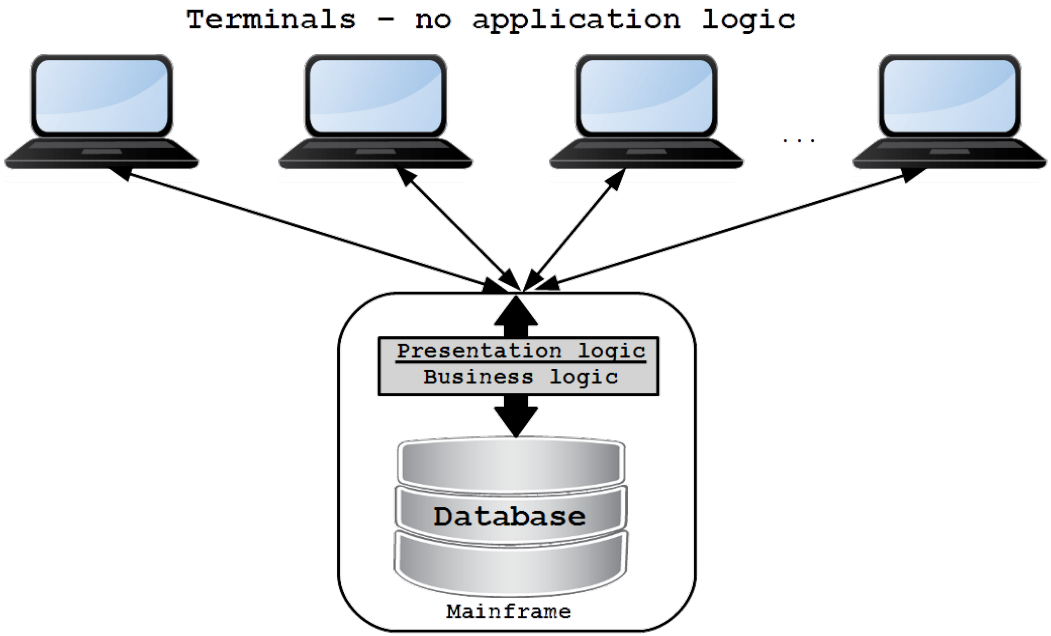
Mainframe application architecture

In mainframe application architecture "dumb" terminals are connected to a single database server



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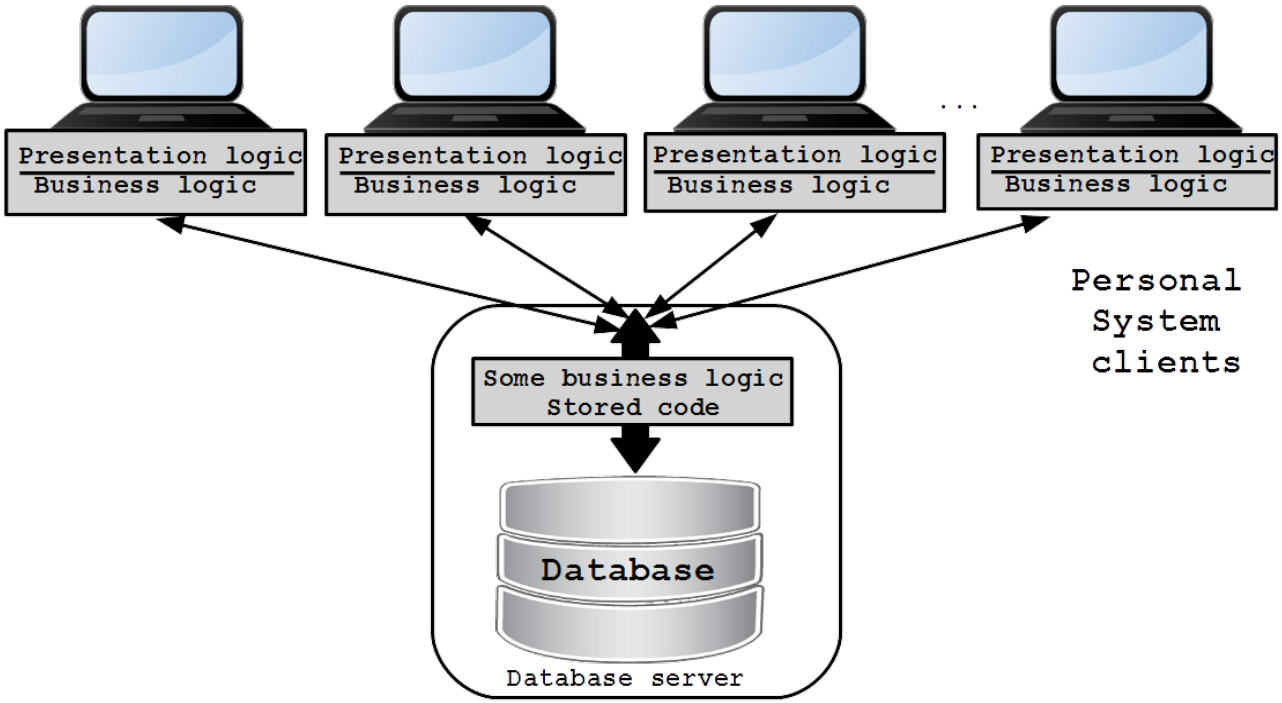
Client-server architecture

In client-server architecture personal systems communicate with a single database server



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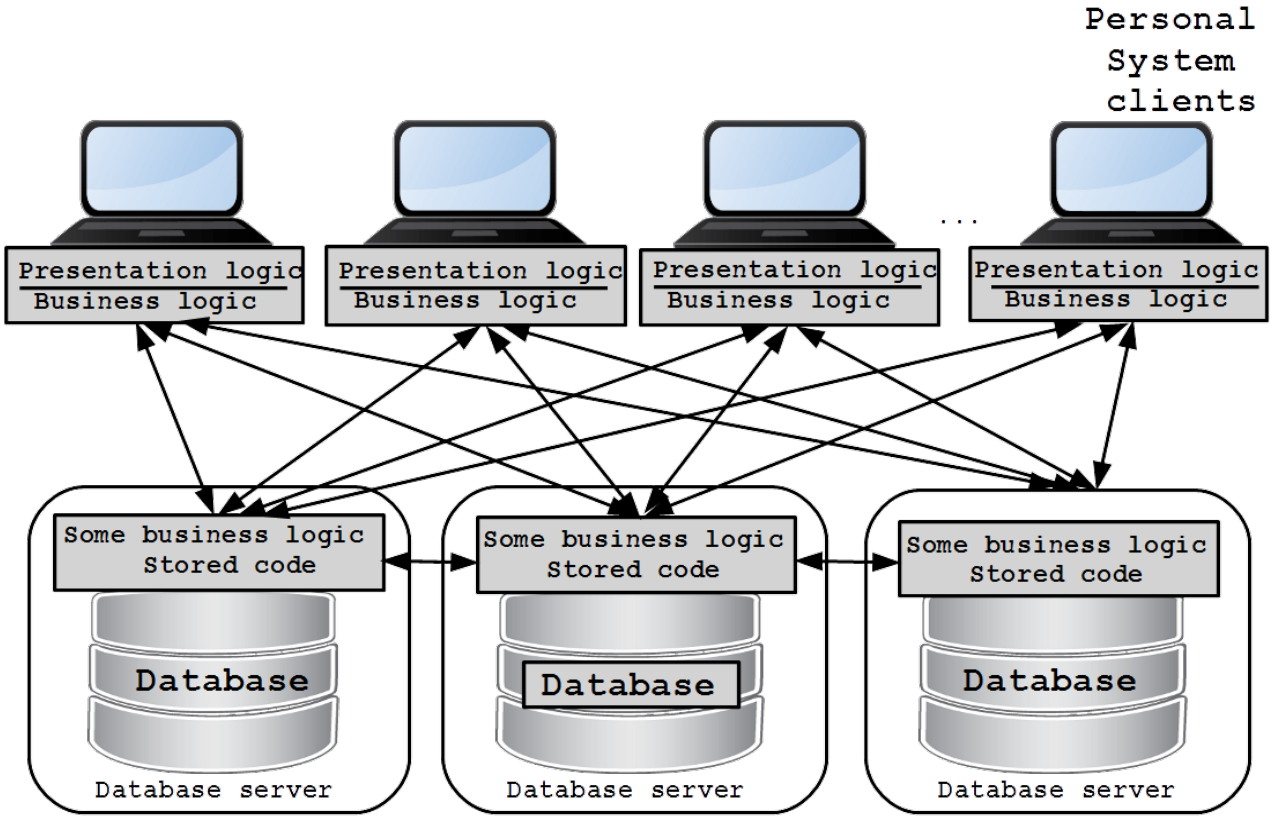
Distributed client-server architecture

In distributed client-server architecture personal systems communicate with many database servers



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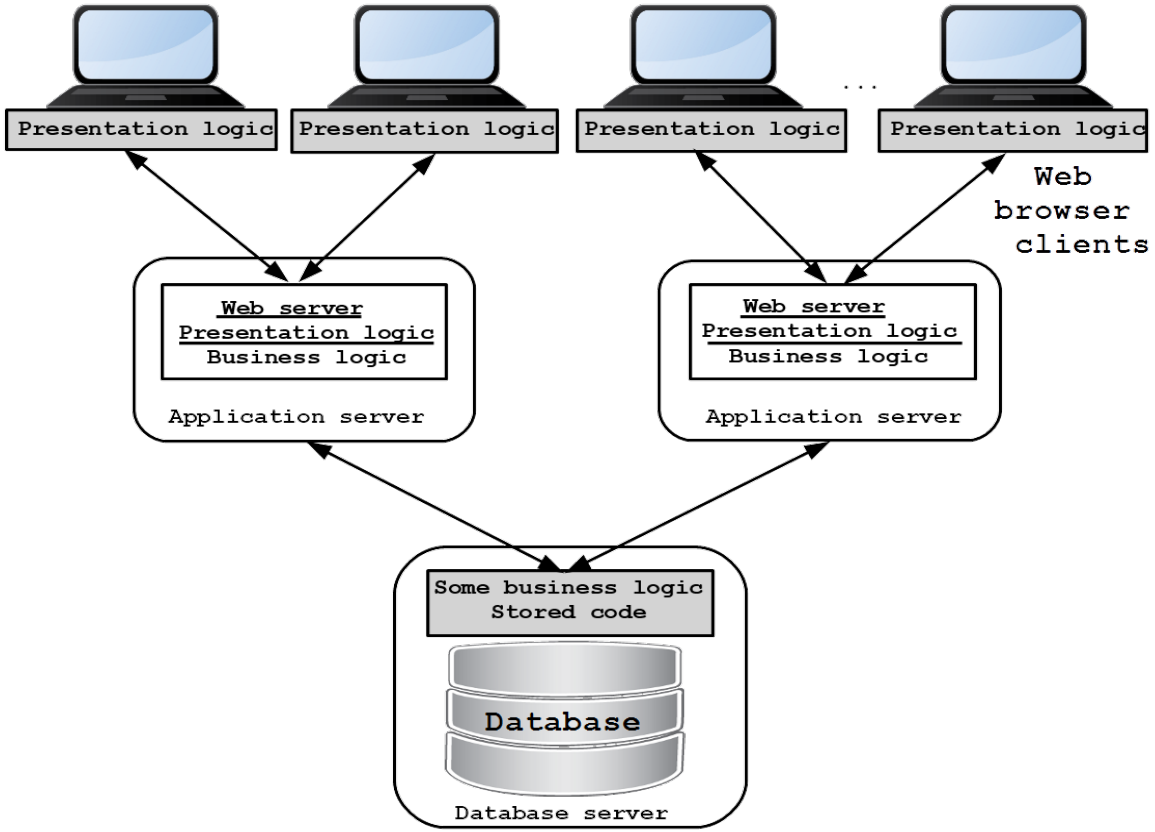
Web based architecture

In Web based architecture personal systems communicate with the Web servers that communicate with a single database server



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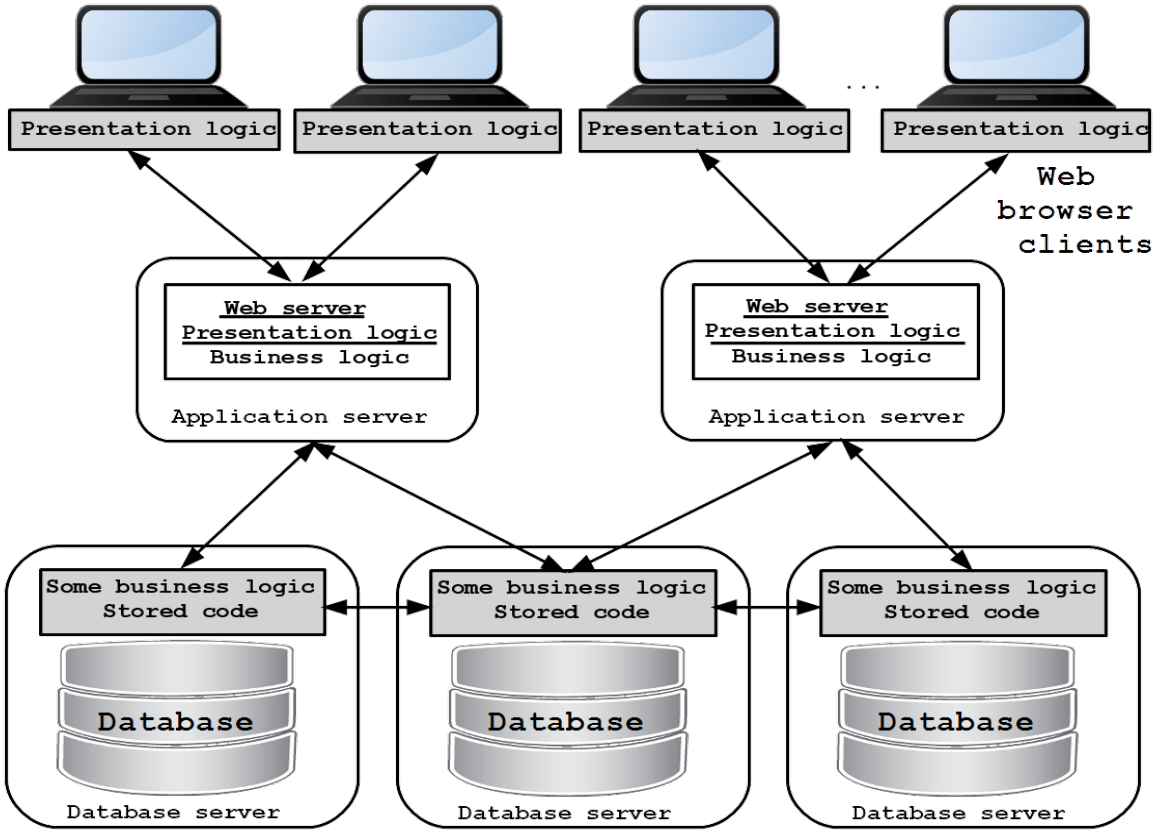
Distributed Web based architecture

In Distributed Web based architecture personal systems communicate with the Web servers that communicate with many database servers



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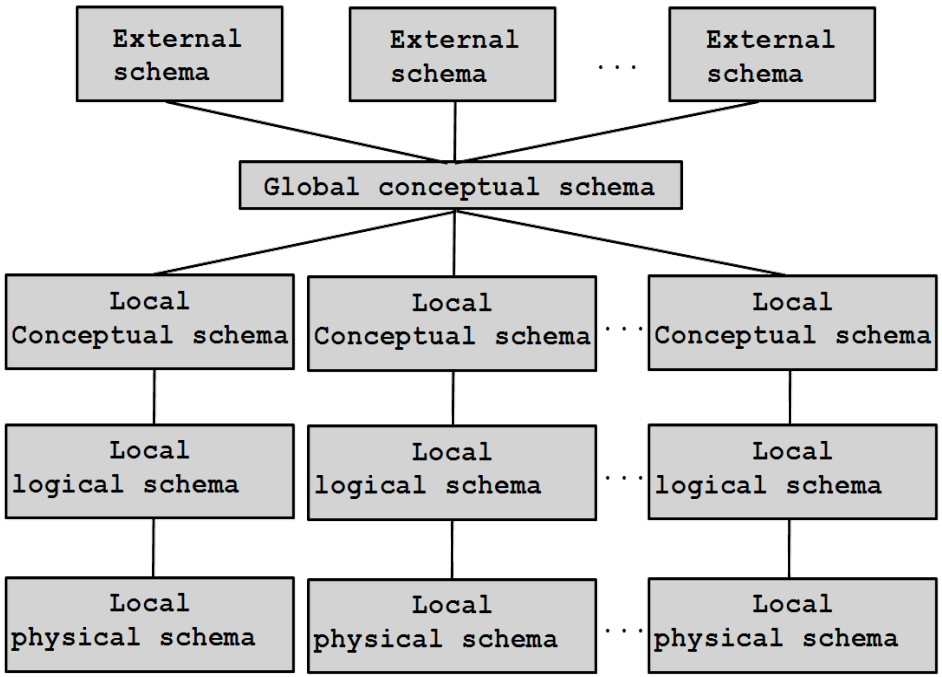
Distributed database schema architecture

In distributed database schema architecture a global conceptual schema hides distribution from the users

The users can see a distributed database system as a single monolithic database system



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Transparency

Transparency means hiding information from end users

Data organization (distribution or network) transparency means hiding network related information and data placement information; it is either location or naming transparency

Naming transparency allows for global naming of data objects

Location transparency allows the operations to be independent on the locations of data objects

Replication transparency means that users are unaware of the existence of multiple copies of the same data objects

Fragmentation transparency means that users are unaware of data fragmentation over many sites; it includes vertical and horizontal fragmentation

Transparency

Design transparency means that users are unaware of how distributed database was designed

Execution transparency means that users are unaware of how database transactions are processed

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Autonomy

Autonomy determines a level of independence of individual nodes in distributed database system

High degree autonomy is required for flexibility and customized maintenance of distributed database system

Design autonomy means a level of independence of data model usage and transaction management technique between the nodes

Communication autonomy means a level of independence to which a node can share information with other nodes

Execution autonomy means a level of independence to which users act as they please

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Advantages and disadvantages of DDBS

Higher level of reliability and availability

Improved ease and flexibility of application development

Improved performance

Easier expansion

Advantages and disadvantages of DDBS

Keeping track of data distribution

Distributed query processing

Distributed transaction management

Replicated data management

Distributed database recovery

Security

Distributed directory (catalog) management

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Global database name uniquely identifies a database in the system

Listing the contents of a system view GLOBAL_NAME

```
SELECT * FROM GLOBAL_NAME;
```

```
GLOBAL_NAME
--------------------------------------------------
DB.DATA-PC07
```

It is possible to change a global database name when connected as a database administrator

Renaming global database name

```
ALTER DATABASE RENAME GLOBAL_NAME TO jrg.f8y792s.informatics.uow.edu.au;
```

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Database link is a connection between two physical database servers that allow a user to access them as one logical database

Listing the existing database links

```
SELECT * FROM USER_DB_LINKS;
```

Message

```
no rows selected
```

Assume, that we are connected as a user `scott` to a database server `DATA-PC01`. Then, it is possible to create a database link to a user `jrg` located at a database server `DATA-PC07` in the following way

Creating a database link

```
CREATE DATABASE LINK "DB.DATA-PC07"
CONNECT TO jrg
IDENTIFIED BY rat
USING 'data-pc07.adeis.uow.edu.au:1521/db';
```

A name of database link (`"DB.DATA-PC07"`) to a database must be the same as a global database name of the database linked to

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A connection string (`'data-pc07.adeis.uow.edu.au:1521/db'`) determines a physical location of the database linked to

When a database link is created it is possible to access a relational table located in a database system linked to

Accessing a relational table over a database link

```
SELECT *
FROM EMP@"DB.DATA-PC07";
```

Relational table name used: `EMP`

Database link: `"DB.DATA-PC07"`

A synonym can be used to implement location transparency

Creating a synonym

```
CREATE SYNONYM EMP07 FOR EMP@"DB.DATA-PC07";
```

Using a synonym

```
SELECT *
FROM EMP07;
```

References

T. Connoly, C. Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, Chapter 24 Distributed DBMs - Concepts and Design, Chapter 25.7 Distribution in Oracle, Pearson Education Ltd, 2015