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00 Distributed database systems

Distributed Database Systems

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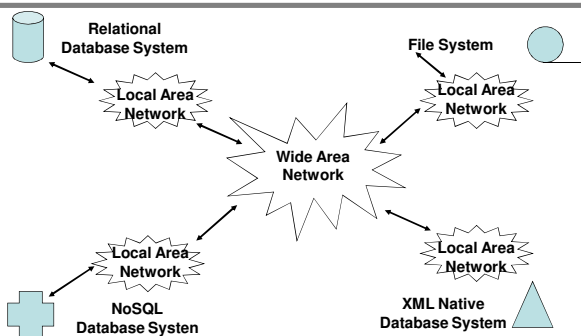
Homogeneous DDBS is a collection of identical database systems distributed over a computer network, e.g. a collection of Oracle systems

Heterogeneous DDBS is a collection of different database systems distributed over a computer network, e.g. a collection of Oracle +MySQL + DB/2 etc, systems

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Distributed database ? What is it ?

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Centralized DBS architecture
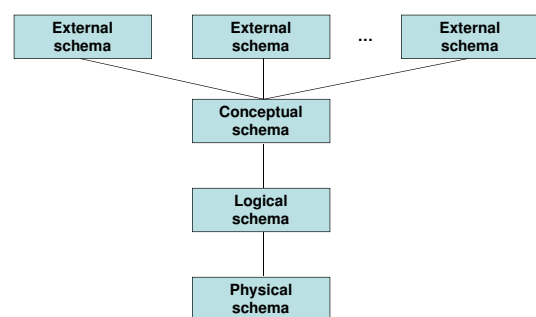
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Distributed DBS architecture
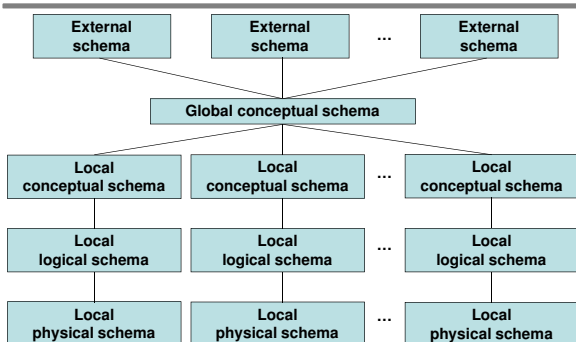
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DDBS versus Multiprocessor systems

Centralized database systems use shared transient storage (RAM) and shared persistent storage (HDD, SSD)

Distributed database systems use connections of database nodes over a computer network

Distributed database systems store logically related information

Distributed database systems do not require all database nodes to be identical in the terms of data, hardware, and software

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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

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Transparency

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

Higher level of **reliability** and **availability**
Improved **ease** and **flexibility** of application development
Improved **performance**
Easier **expansion**

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Problems with 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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Example: Oracle 12c

To use distributed option of Oracle a system initialization parameter `global_names` must be set to `TRUE`
It is possible to check a value of parameter `global_names` when connected as a database administrator

```
show parameters global_names

NAME                                 TYPE        VALUE
------------------------------------ ----------- -----
global_names                         boolean     TRUE
```

It is possible to set a value of parameter `global_names` when connected as a database administrator

```
ALTER SYSTEM SET global_names=TRUE;
```

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Example: Oracle 12c

Global database name uniquely identifies a database in the system

```
SELECT * FROM GLOBAL_NAME;
```

```
GLOBAL_NAME
----------------------------------------------------
CSCI.PC409C
```

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

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

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Example: Oracle 12c

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

```
SELECT * FROM USER_DB_LINKS;
```

```
no rows selected
```

It is possible to create a database link when connected as a an ordinary user

```
CREATE DATABASE LINK
jrg.f8y792s.informatics.uow.edu.au CONNECT TO test05
IDENTIFIED BY test05 USING 'jrg';
```

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Example: Oracle 12c

```
CREATE DATABASE LINK
jrg.f8y792s.informatics.uow.edu.au CONNECT TO test05
IDENTIFIED BY test05 USING 'jrg';
```

A name of database link
(jrg.f8y792s.informatics.uow.edu.au)
to a database must be the same as a global database name of the database linked to

```
CREATE DATABASE LINK
jrg.f8y792s.informatics.uow.edu.au CONNECT TO test05
IDENTIFIED BY test05 USING 'jrg';
```

A username (test05) that has a password (test05) must exist in the database linked to

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Example: Oracle 12c

```
CREATE DATABASE LINK
jrg.f8y792s.informatics.uow.edu.au CONNECT TO test05
IDENTIFIED BY test05 USING 'jrg';
```

A connection string (jrg) determines a physical location of the database linked to
It is possible to access a relational table located at a database system linked to

```
SELECT *
FROM EMP@jrg.f8y792s.informatics.uow.edu.au;
```

Relational table name: EMP

Database link: jrg.f8y792s.informatics.uow.edu.au

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Example: Oracle 12c

A synonym can be used to create location transparency

```
CREATE SYNONYM EMPJRG for
EMP@jrg.f8y792s.informatics.uow.edu.au;
```

```
SELECT *
FROM EMPJRG;
```

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References

Elmasri R., Navathe S. B., *Database Systems*, chapters 26.1, 26.2, 26.3, 26.10
```
http://www.uow.edu.au/~jrg/235/HOMEWORK/
```
11 How to process distributed database systems ?