CSE 4125: Distributed Database Systems
Chapter – 3: Part A

Levels of Distributed Transparency

A scenario..

R

ID	NAME	DEPT
1	A	CSE
2	B	ARC
3	C	EEE
4	D	CSE

R_1

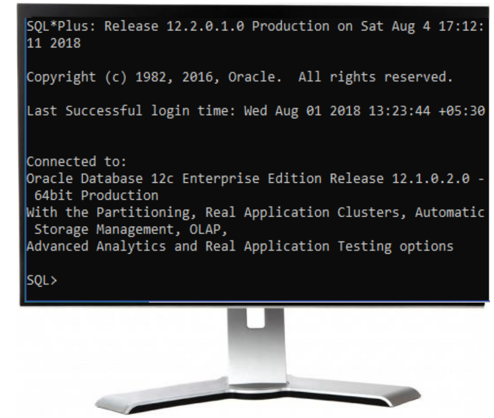
ID	NAME	DEPT
1	A	CSE
4	D	CSE

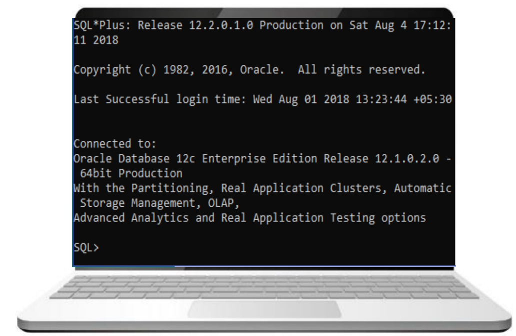
R_2

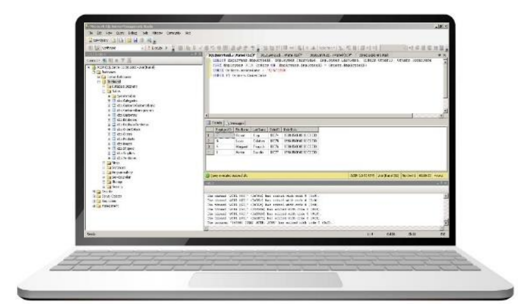
ID	NAME	DEPT
2	B	ARC

R_3

ID	NAME	DEPT
3	C	EEE







Reference Architecture for DDB

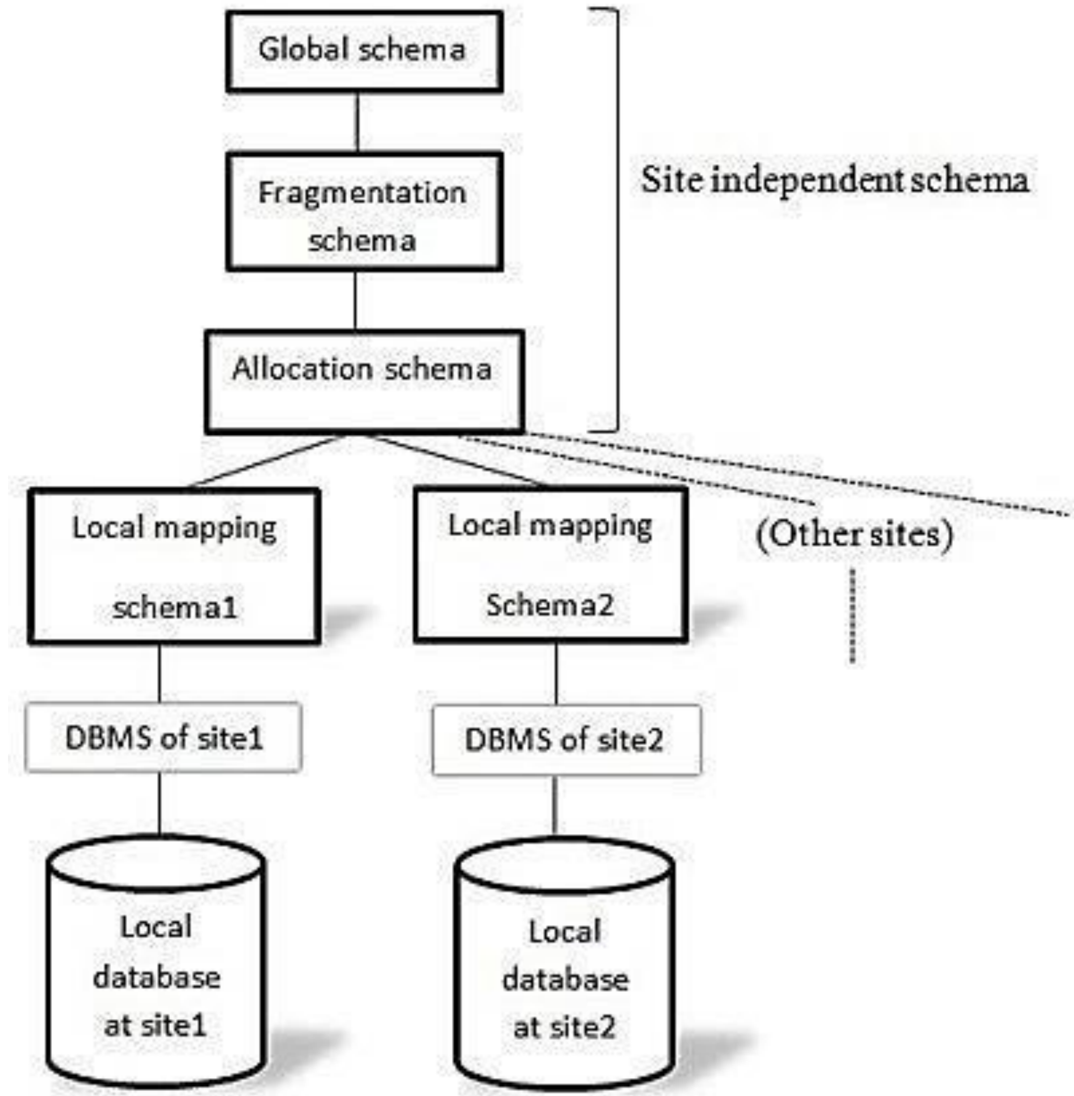
- Represents the organization of any DDB.

- Not explicitly implemented in all DDBs.
  - But conceptually relevant in order to understand the working mechanism of DDB.

Reference Architecture for DDB

Components:

1. Global Schema.
2. Fragmentation Schema.
3. Allocation Schema.
4. Local Mapping Schema.



Global Schema

Global schema defines all the data which are contained in the distributed database.

– *Conceptual view* of the database.*

– As if the database were not distributed at all.

Global schema defines a set of *global relations*

Example

Global Schema:

R (ID, NAME, DEPT)

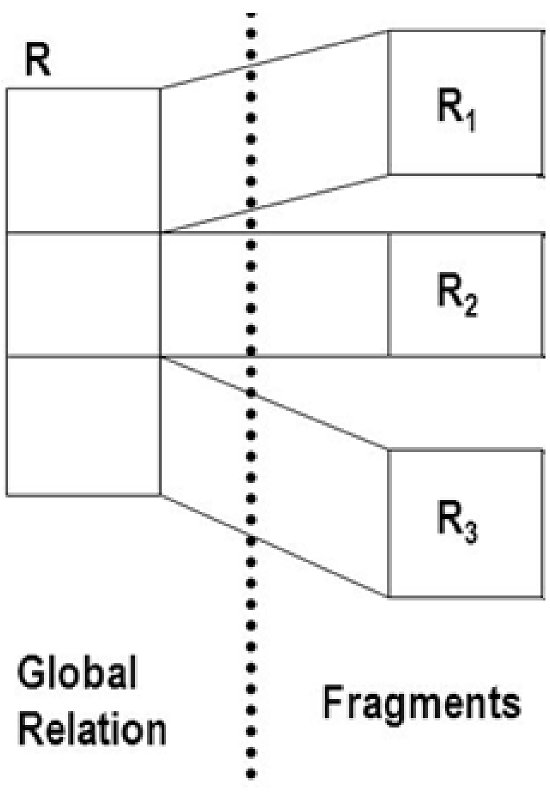
Global Schema:

Emp (*eid*, *ename*, *age*, *salary*)
Works (*eid*, *did*, *pct_time*)
Dept (*did*, *dname*, *budget*, *managerid*)

Fragmentation Schema

Each global relation *(R) can be split into several non-overlapping portions which are called fragments.*

–Logical portions of *R*.

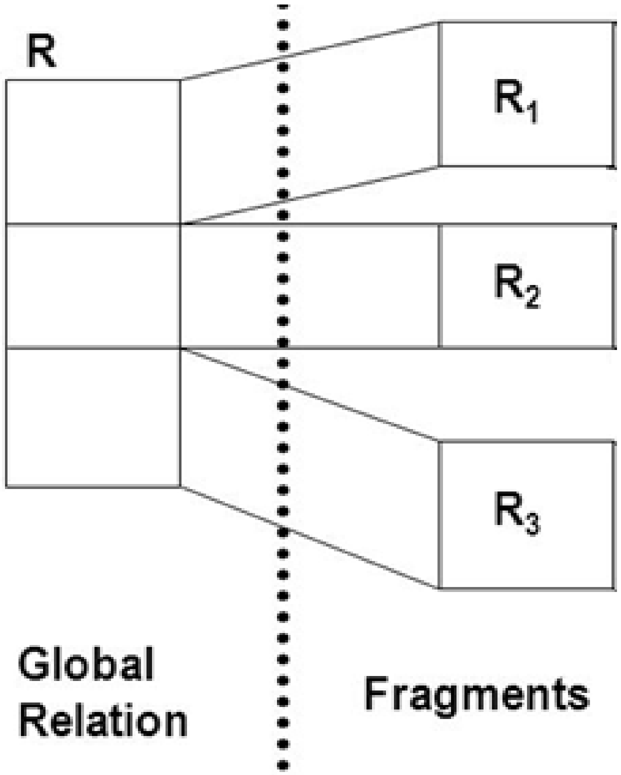


Example –

R can be partitioned into R_1 ,R_2 *and* R_3

The mapping between global relations and fragments is defined in the *fragmentation schema*.

R_i indicates i th fragment of global relation R.



Example

Global Schema:

R (ID, NAME, DEPT)

Fragments: $\boldsymbol{R_1}$, $\boldsymbol{R_2}$, $\boldsymbol{R_3}$

Fragmentation Schema:

$\boldsymbol{R_1} = SL_{DEPT=CSE}\ R$

$\boldsymbol{R_2} = SL_{DEPT=EEE}\ R$

$\boldsymbol{R_3} = SL_{DEPT=ARC}\ R$

Example

Global schema:

STUDENT (SNUM , SNAME, DEPT, SEM)
TEACHER (TNUM , TNAME , DEPT)
COURSE (CNUM , TNUM, DEPT, CREDIT)

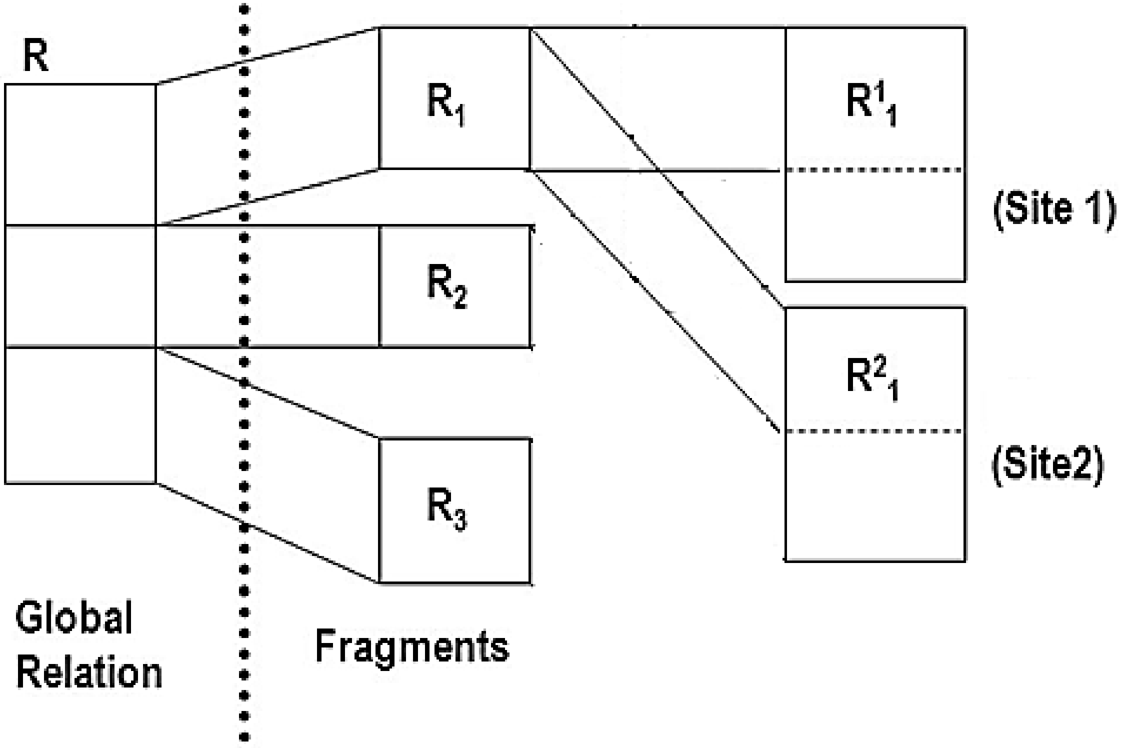
Fragmentation schema:

$STUDENT_1 = SL_{DEPT = 'CSE'}\ STUDENT$
$STUDENT_2 = SL_{DEPT = 'ME'}\ STUDENT$
$STUDENT_3 = SL_{DEPT = 'EEE'}\ STUDENT$
$COURSE_1 = COURSE\ SJ_{q1}\ STUDENT_1$
$COURSE_2 = COURSE\ SJ_{q1}\ STUDENT_2$
$TEACHER_1 = TEACHER\ SJ_{q2}\ COURSE_1$
$TEACHER_2 = TEACHER\ SJ_{q2}\ COURSE_2$

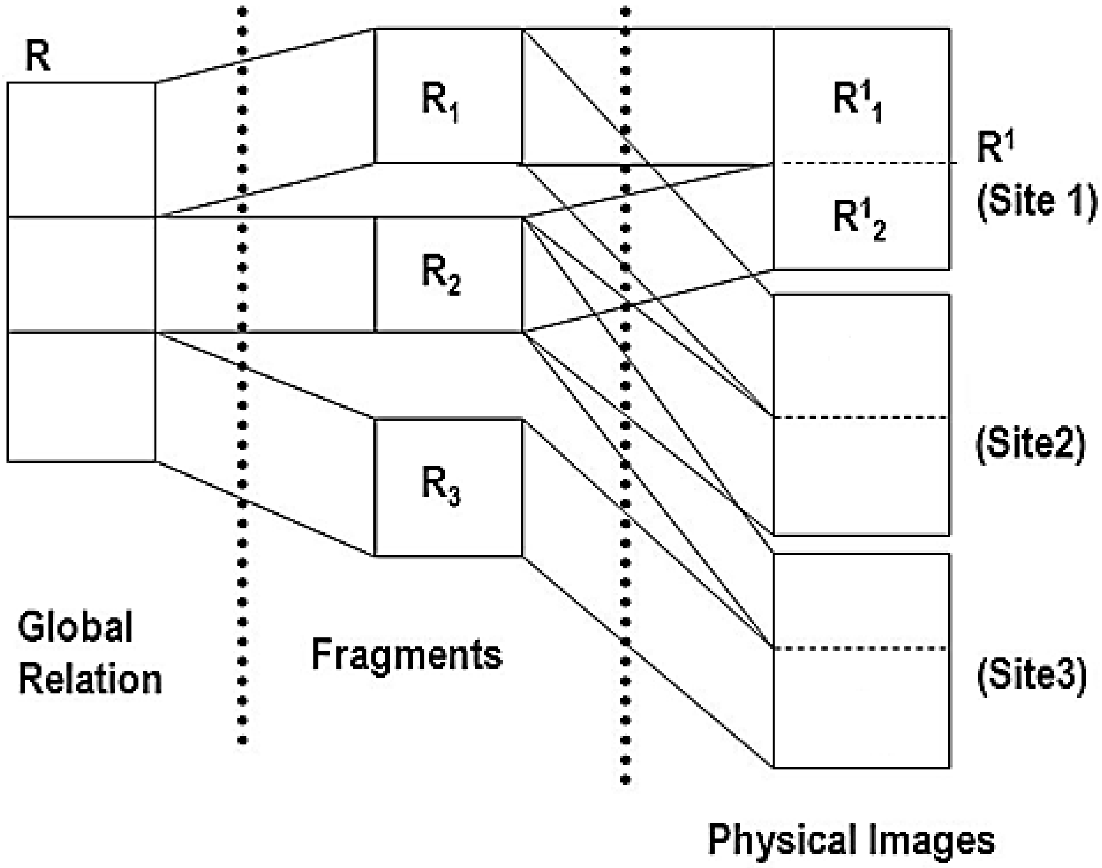
where, q1: $COURSE.\ DEPT = STUDENT_i.\ DEPT$
q2: $TEACHER.\ DEPT = COURSE_i.\ DEPT$

Allocation Schema

Allocation schema defines at which site(s) a fragment is located.



Fragments from *R creates physical image* (R^j) *of R at site j.*



Example

Global Schema:

R (ID, NAME, DEPT)

Fragmentation Schema:

$\boldsymbol{R_1} = SL_{DEPT=CSE}\ R$

$\boldsymbol{R_2} = SL_{DEPT=EEE}\ R$

$\boldsymbol{R_3} = SL_{DEPT=ARC}\ R$

Allocation Schema:

$R_1^1\ , R_2^1, R_3^{2,3}$

Example

Global schema:

STUDENT (SNUM , SNAME, DEPT, SEM)
TEACHER (TNUM , TNAME , DEPT)
COURSE (CNUM , TNUM, DEPT, CREDIT)

Fragmentation schema:

$STUDENT_1 = SL_{DEPT = \text{'CSE'}}\ STUDENT$
$STUDENT_2 = SL_{DEPT = \text{'ME'}}\ STUDENT$
$STUDENT_3 = SL_{DEPT = \text{'EEE'}}\ STUDENT$
$COURSE_1 = COURSE\ SJ_{q1}\ STUDENT_1$
$COURSE_2 = COURSE\ SJ_{q1}\ STUDENT_2$
$TEACHER_1 = TEACHER\ SJ_{q2}\ COURSE_1$
$TEACHER_2 = TEACHER\ SJ_{q2}\ COURSE_2$

where, q1: COURSE. DEPT = $STUDENT_i$. DEPT
q2: TEACHER. DEPT = $COURSE_i$. DEPT

Allocation schema:

$STUDENT_1$, $TEACHER_1$, $TEACHER_2$, $COURSE_1$ at sites 1, 2
$STUDENT_2$, $COURSE_2$, $STUDENT_3$ at site 3

Local Mapping Schema

Mapping physical images to database objects which are manipulated by local DBMS.

Depends on the types of the local DBMS.

–Example: if local DBMS is Oracle, the physical images must be mapped so that Oracle can understand

Questions

a) Do you think two physical images can be identical? Give an example with diagram.

Yes. Fragment R1 is located in Site 1, and it is also located in Site 2. So, their physical image can be identical.

b) What do you understand by the notation – *$STUDENT_5^3$* ?

Student is a global relation, It has many fragments (Student 5 is one of them), 5 no fragment is located at Site 3.

c) According to you, what could be the possible difficulties in local mapping schema for a heterogeneous DDBMS?

Suppose there are 3 sites. 2 of them use Oracle DBMS and another one is use MS SQL. Implementation is different. So, Maintenance is difficult.