CSE 4125: Distributed Database Systems
Chapter – 3

Levels of Distributed Transparency.

(part – C)

Outline

- Distribution transparency for read-only application.

- Distribution transparency for update application.

Distribution transparency for read-only application

Objective

- We analyze with an example the different levels of distribution transparency:
    - Level 1: Fragmentation transparency.
    - Level 2: Location transparency.
    - Level 3: Local mapping transparency.
- For a ***read-only*** application.

Scenario

- Global schema:

    SUPPLIER (SNUM, NAME, CITY)

- Fragmentation schema:

    $SUPPLIER_1 = SL_{CITY = DHK} (SUPPLIER)$

    $SUPPLIER_2 = SL_{CITY = CTG} (SUPPLIER)$

- Allocation schema:

    $SUPPLIER_1$ @ site 1.

    $SUPPLIER_2$ @ site 2, 3.

Scenario

Assume, a `SUPINQUIRY` application –

- Reading a value from terminal and assigning it to a variable:

  `read(terminal, v_SNUM);`

- Query: Get *NAME* for a given *SNUM*. Example –

  `select NAME into v_NAME`

  `from SUPPLIER[@siteNumber]`

  `where SNUM = v_SNUM;`
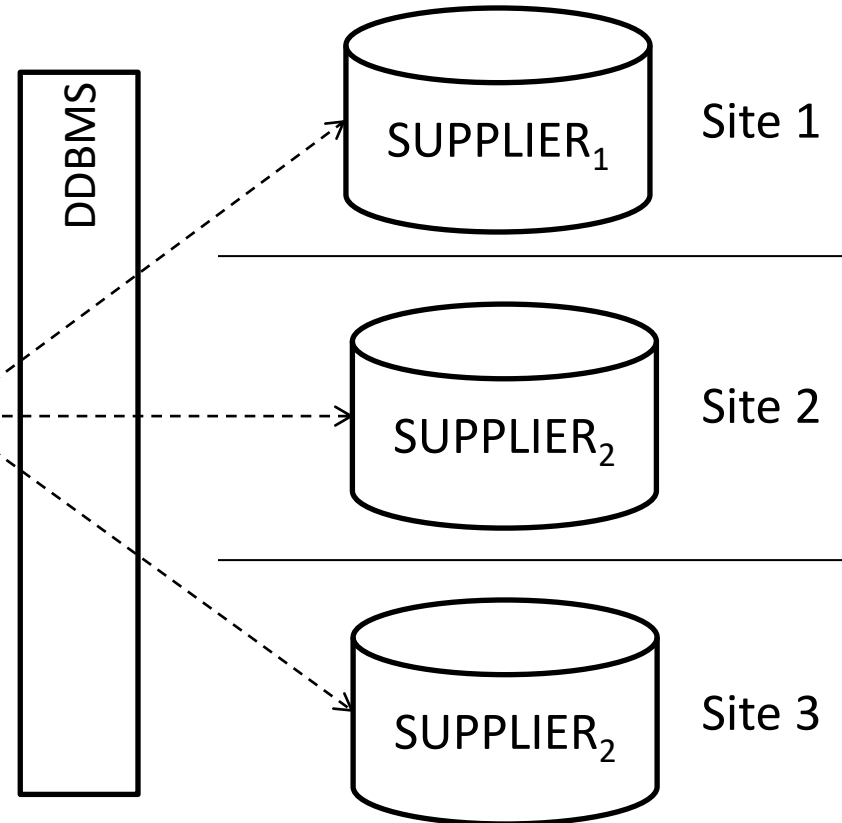
- Writing a value of a variable to terminal:

  `write(terminal, v_NAME);`

Analyzing Level – 1 transparency

SUPINQUIRY

Hint:

- Use global relation only. Because fragmentation information is hidden.
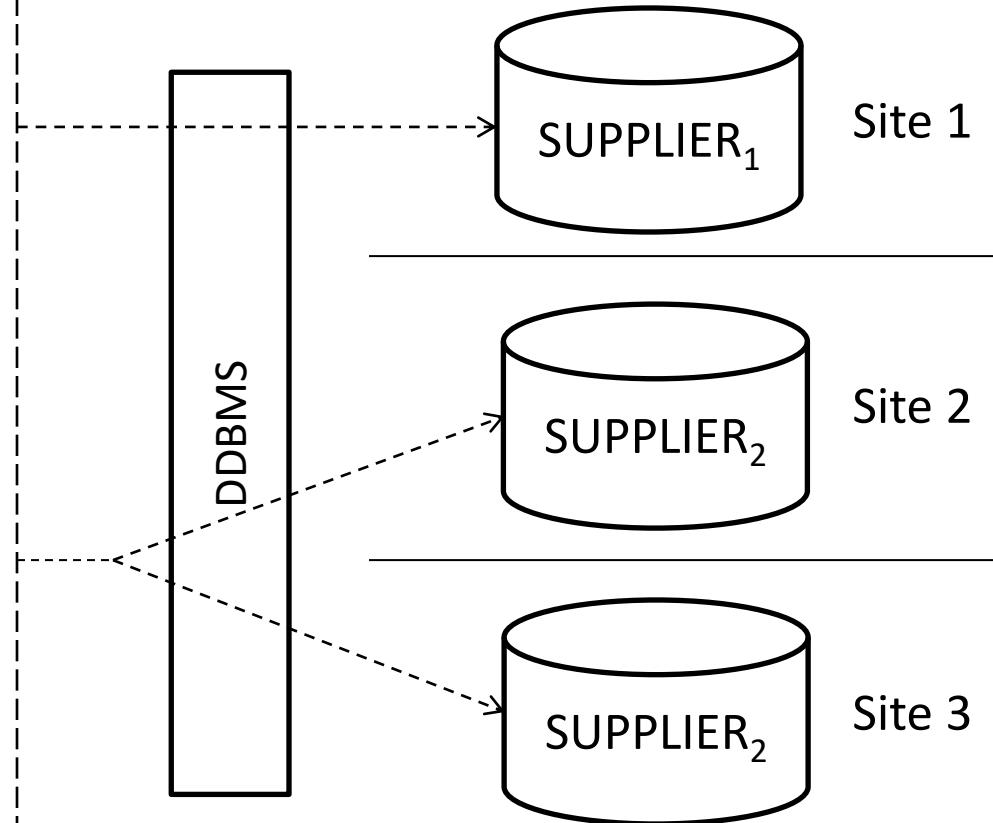
DDBMS

SUPPLIER$_1$ — Site 1

SUPPLIER$_2$ — Site 2

SUPPLIER$_2$ — Site 3

Analyzing Level – 2 transparency

SUPINQUIRY

Hint:
- Use fragmentation information.

DDBMS

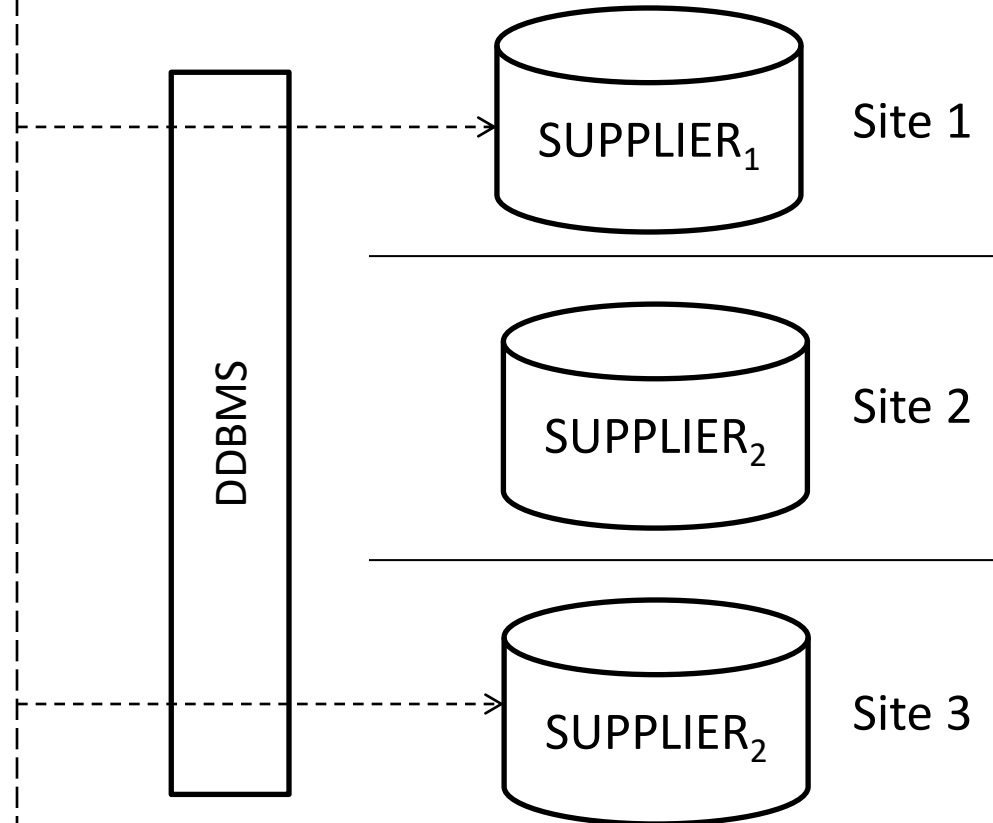SUPPLIER$_1$ — Site 1

SUPPLIER$_2$ — Site 2

SUPPLIER$_2$ — Site 3

Analyzing Level – 3 transparency

SUPINQUIRY

Hint:

- Use fragmentation information + location information (i.e. site numbers).

DDBMS

SUPPLIER$_1$ — Site 1

SUPPLIER$_2$ — Site 2

SUPPLIER$_2$ — Site 3

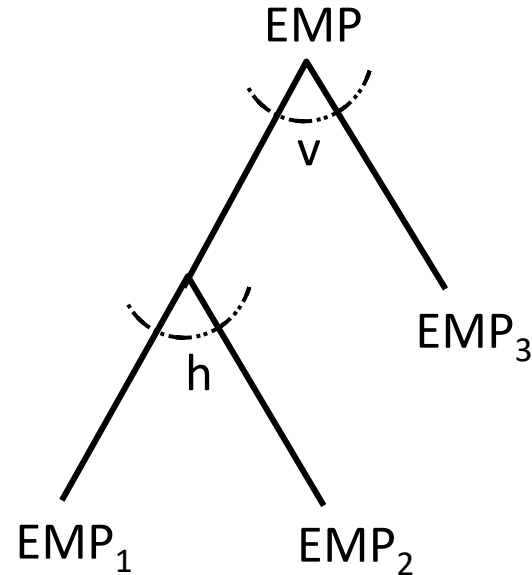# Distribution transparency for update application

Update Sub-tree

Example:

$EMP_1 = SL_{DEPTNUM \leq 10} PJ_{EMPNUM, NAME, MGRNUM, DEPTNUM} (EMP)$
$EMP_2 = SL_{DEPTNUM > 10} PJ_{EMPNUM, NAME, MGRNUM, DEPTNUM} (EMP)$
$EMP_3 = PJ_{EMPNUM, NAME, SAL, TAX} (EMP)$

Which part of the tree will be effected if *DEPTNUM* is updated?

Objective

- We analyze with an example the different levels of distribution transparency:
    - Level 1: Fragmentation transparency.
    - Level 2: Location transparency.
    - Level 3: Local mapping transparency.
- For an *update* application.

Scenario

- Global schema:

  EMP (EMPNUM, NAME, SAL, TAX, MGRNUM, DEPTNUM)

- Fragmentation schema:

  $EMP_1 = PJ_{\text{EMPNUM, NAME, SAL, TAX}}\ SL_{\text{DEPTNUM} \leq 10}\ (EMP)$

  $EMP_2 = PJ_{\text{EMPNUM, MGRNUM, DEPTNUM}}\ SL_{\text{DEPTNUM} \leq 10}\ (EMP)$

  $EMP_3 = PJ_{\text{EMPNUM, NAME, DEPTNUM}}\ SL_{\text{DEPTNUM} > 10}\ (EMP)$

  $EMP_4 = PJ_{\text{EMPNUM, SAL, TAX, MGRNUM}}\ SL_{\text{DEPTNUM} > 10}\ (EMP)$

- Allocation schema:

  EMP_1 @ site 1, 5; EMP_2 @ site 2, 6

  EMP_3 @ site 3, 7; EMP_4 @ site 4, 8

Scenario

Assume, a `UPDTEMP` application –

Updating *DEPTNUM* to 15 where *EMPNUM* is *100.*

Example –

```
update EMP [@siteNumber]
set DEPTNUM = 15
where EMPNUM = 100;
```

Analyzing Level – 1 transparency

Hint: Use global relation. No concept of fragments.

Analyzing Level – 2 transparency

Hints: Use fragments.

- – Use the concept of *update sub-tree*.
- – Follow the *effect of update.*

Effect of Update

$$EMP_1 = PJ_{\underline{EMPNUM}, NAME, SAL, TAX} \; SL_{DEPTNUM \leq 10} (EMP)$$
$$EMP_2 = PJ_{\underline{EMPNUM}, MGRNUM, DEPTNUM} \; SL_{DEPTNUM \leq 10} (EMP)$$
$$EMP_3 = PJ_{EMPNUM, NAME, DEPTNUM} \; SL_{DEPTNUM > 10} (EMP)$$
$$EMP_4 = PJ_{EMPNUM, SAL, TAX, MGRNUM} \; SL_{DEPTNUM > 10} (EMP)$$

EMP_1

EMPNUM	NAME	SAL	TAX
100	Smith	10000	1000

EMP_2

EMPNUM	MGRNUM	DEPTNUM
100	20	3

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

Effect of Update (cont.)

$$EMP_1 = PJ_{\text{EMPNUM, NAME, SAL, TAX}} \, SL_{\text{DEPTNUM} \leq 10}(EMP)$$

$$EMP_2 = PJ_{\text{EMPNUM, MGRNUM, DEPTNUM}} \, \underline{SL_{\text{DEPTNUM} \leq 10}}(EMP)$$

$$EMP_3 = PJ_{\text{EMPNUM, NAME, DEPTNUM}} \, SL_{\text{DEPTNUM} > 10}(EMP)$$

$$EMP_4 = PJ_{\text{EMPNUM, SAL, TAX, MGRNUM}} \, SL_{\text{DEPTNUM} > 10}(EMP)$$

EMP_1

EMPNUM	NAME	SAL	TAX
100	Smith	10000	1000

EMP_2

EMPNUM	MGRNUM	DEPTNUM
100	20	3

15 ?

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

Effect of Update (cont.)

$$EMP_1 = PJ_{\text{EMPNUM, NAME, SAL, TAX}} SL_{\text{DEPTNUM} \leq 10} (EMP)$$
$$EMP_2 = PJ_{\text{EMPNUM, MGRNUM, DEPTNUM}} SL_{\text{DEPTNUM} \leq 10} (EMP)$$
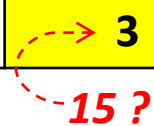$$EMP_3 = PJ_{\text{EMPNUM, NAME, DEPTNUM}} SL_{\text{DEPTNUM} > 10} (EMP)$$
$$EMP_4 = PJ_{\text{EMPNUM, SAL, TAX, MGRNUM}} SL_{\text{DEPTNUM} > 10} (EMP)$$

EMP_1

EMPNUM	NAME	SAL	TAX
100	Smith	10000	1000

EMP_2

EMPNUM	MGRNUM	DEPTNUM
100	20	3

EMP_3

EMPNUM	NAME	DEPTNUM
		15

EMP_4

EMPNUM	SAL	TAX	MGRNUM

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

Effect of Update (cont.)

$$EMP_1 = PJ_{\text{EMPNUM, NAME, SAL, TAX}} \, SL_{\text{DEPTNUM} \leq 10}(EMP)$$
$$EMP_2 = PJ_{\text{EMPNUM, MGRNUM, DEPTNUM}} \, SL_{\text{DEPTNUM} \leq 10}(EMP)$$
$$EMP_3 = PJ_{\text{EMPNUM, NAME, DEPTNUM}} \, SL_{\text{DEPTNUM} > 10}(EMP)$$
$$EMP_4 = PJ_{\text{EMPNUM, SAL, TAX, MGRNUM}} \, SL_{\text{DEPTNUM} > 10}(EMP)$$

EMP_1

EMPNUM	NAME	SAL	TAX
100	Smith	10000	1000

EMP_2

EMPNUM	MGRNUM	DEPTNUM
100	20	3

EMP_3

EMPNUM	NAME	DEPTNUM
100	Smith	**15**

EMP_4

EMPNUM	SAL	TAX	MGRNUM
100	10000	1000	20

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

Effect of Update (cont.)

$$EMP_1 = PJ_{\ EMPNUM,\ NAME,\ SAL,\ TAX}\ SL_{\ DEPTNUM \leq 10}\ (EMP)$$
$$EMP_2 = PJ_{\ EMPNUM,\ MGRNUM,\ DEPTNUM}\ SL_{\ DEPTNUM \leq 10}\ (EMP)$$
$$EMP_3 = PJ_{\ EMPNUM,\ NAME,\ DEPTNUM}\ SL_{\ DEPTNUM > 10}\ (EMP)$$
$$EMP_4 = PJ_{\ EMPNUM,\ SAL,\ TAX,\ MGRNUM}\ SL_{\ DEPTNUM > 10}\ (EMP)$$

EMP_1

EMPNUM	NAME	SAL	TAX
~~100~~	~~Smith~~	~~10000~~	~~1000~~

EMP_2

EMPNUM	MGRNUM	DEPTNUM
~~100~~	~~20~~	~~3~~

EMP_3

EMPNUM	NAME	DEPTNUM
100	Smith	15

EMP_4

EMPNUM	SAL	TAX	MGRNUM
100	10000	1000	20

Effect of updating *DEPTNUM =15* with *EMPNUM = 100*

Analyzing Level – 2 transparency (cont.)

Hints: Use fragments. Use the *update sub-tree*. Follow the *effect of update.*

- <u>Store</u> the necessary record from EMP_1 and EMP_2 to temporary variables.

- <u>Insert</u> the records into EMP_3 and EMP_4 from the temporary variables.

- <u>Delete</u> the records from EMP_1 and EMP_2.

Analyzing Level – 3 transparency

Hints: Use fragments + locations. Follow the *effect of update* (like previous level), but this time locations will be considered.

- <u>Store</u> the necessary record from EMP_1 and EMP_2 from any of the *corresponding sites* to temporary variables.

- <u>Insert</u> the records into EMP_3 and EMP_4 at *corresponding sites* from the temporary variables.

- <u>Delete</u> the records from EMP_1 and EMP_2 at *corresponding sites*.

Additional Reading

- Level – 4 transparency.

- Distribution transparency for a *more complex* read-only application.

  - Text book section 3.3.2 (page-51)

Practice Problems/ Questions

a) For the example provided in the lecture slides, determine the effect of updating *DEPTNUM = 5* where *EMPNUM = 100 (assume, the record is initially found in EMP_3 and EMP_4 with DEPTNUM = 19)*.

b) Text book:

- Exercise: 3.2 (a, b, c) and 3.3

c) Create your own scenario and analyze the different levels of distribution transparency for read-only and update application.