Figure 24.1 Some different database system architectures. (a) Shared nothing architecture.

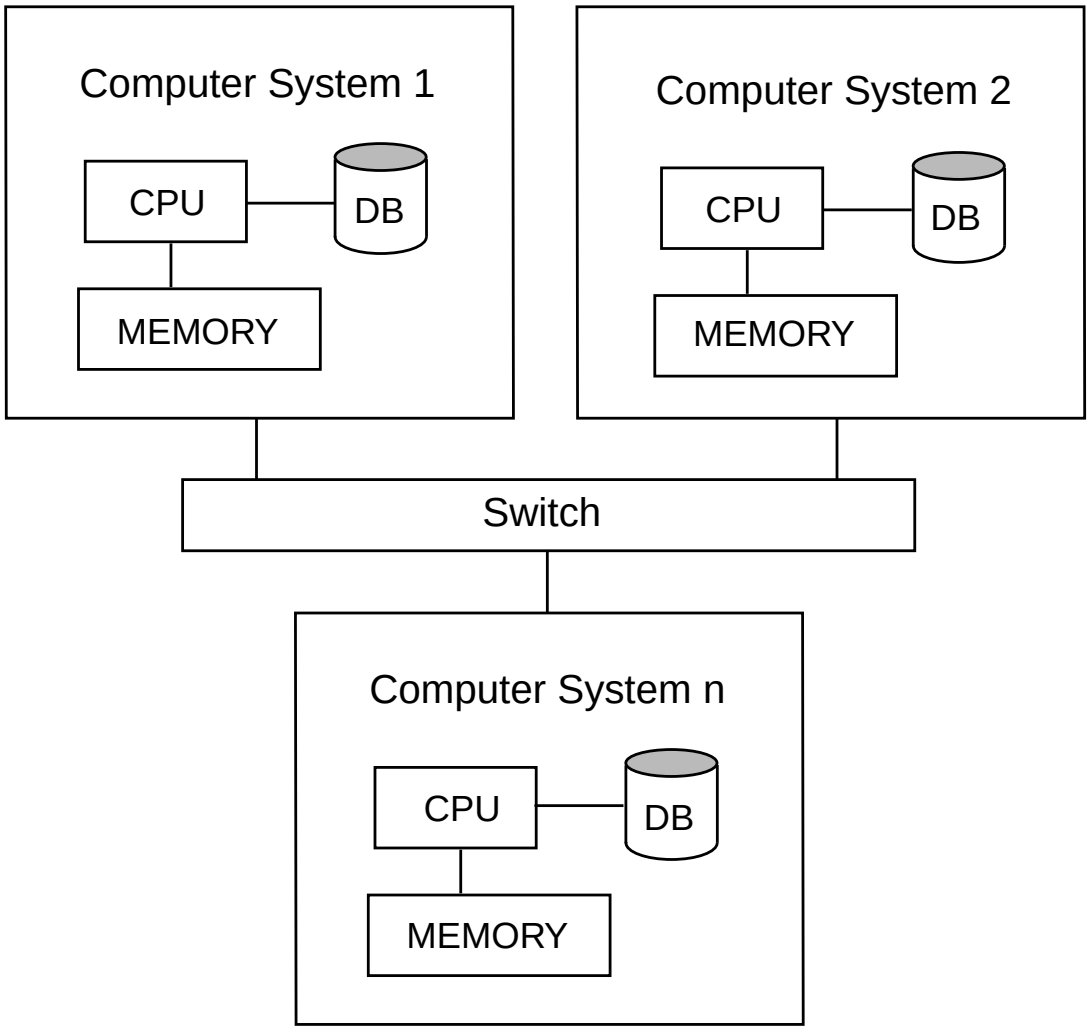


Figure 24.1 continued. (b) A networked architecture with a centralized database at one of the sites.

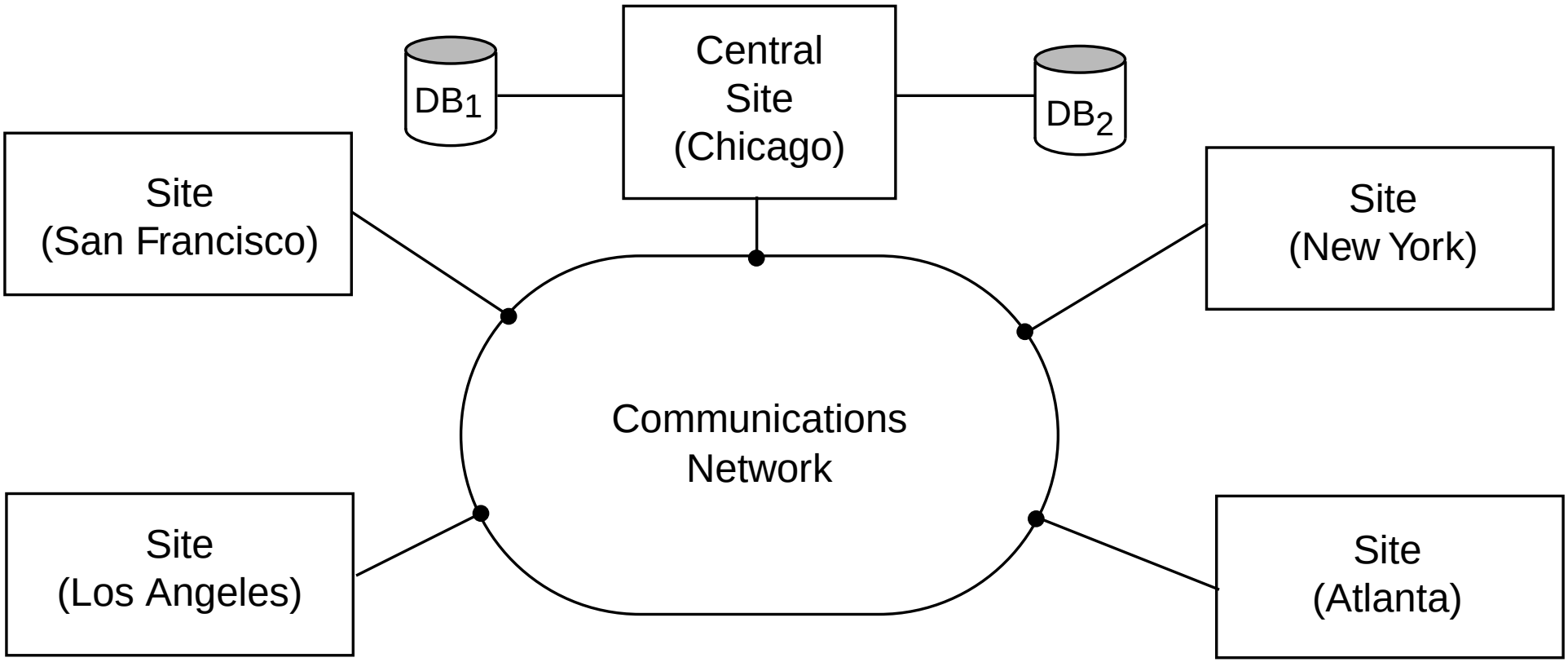
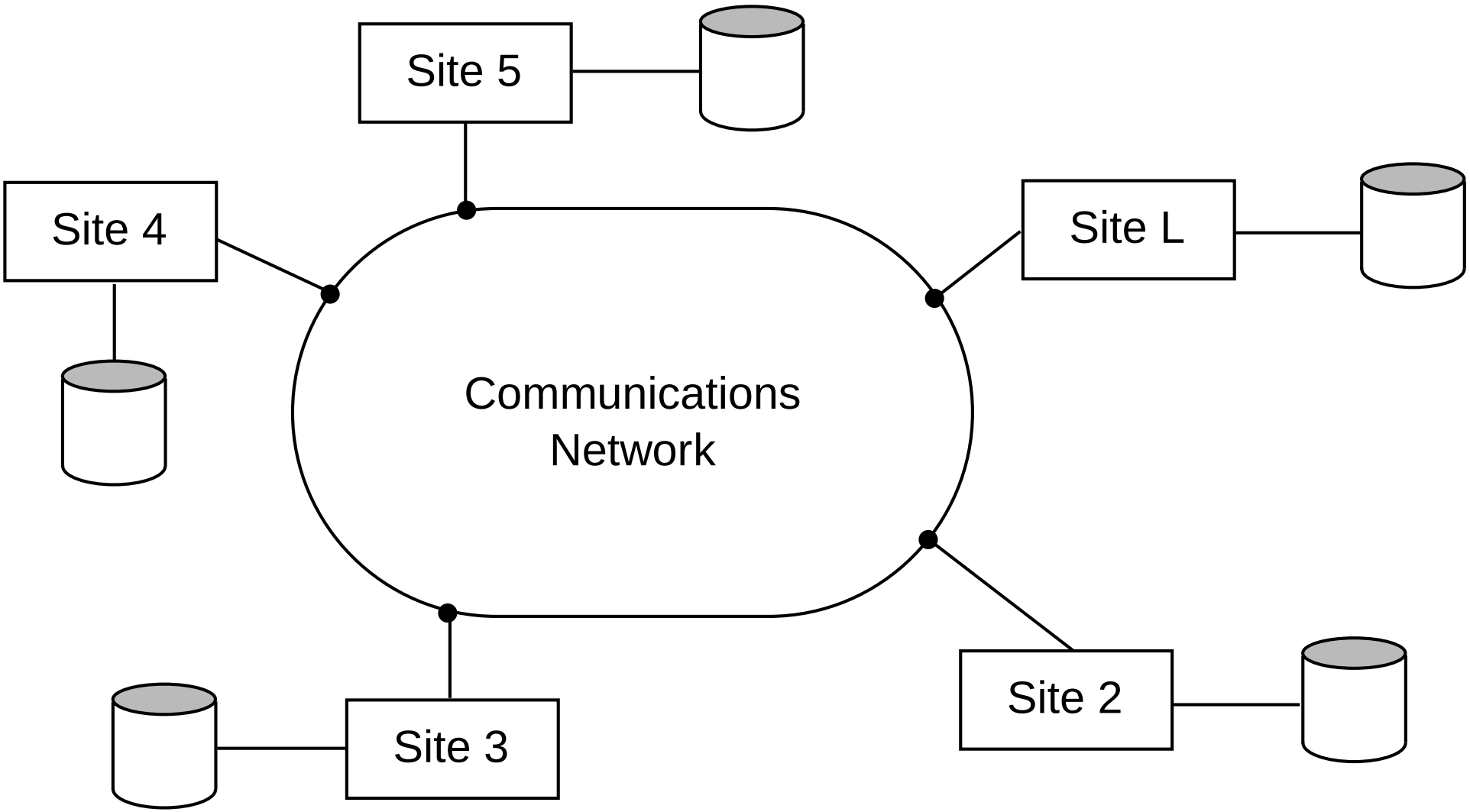


Figure 24.1 continued. (c) A truly distributed database architecture.



(c) A distributed database on a network

Figure 24.2 Data distribution and replication among distributed databases

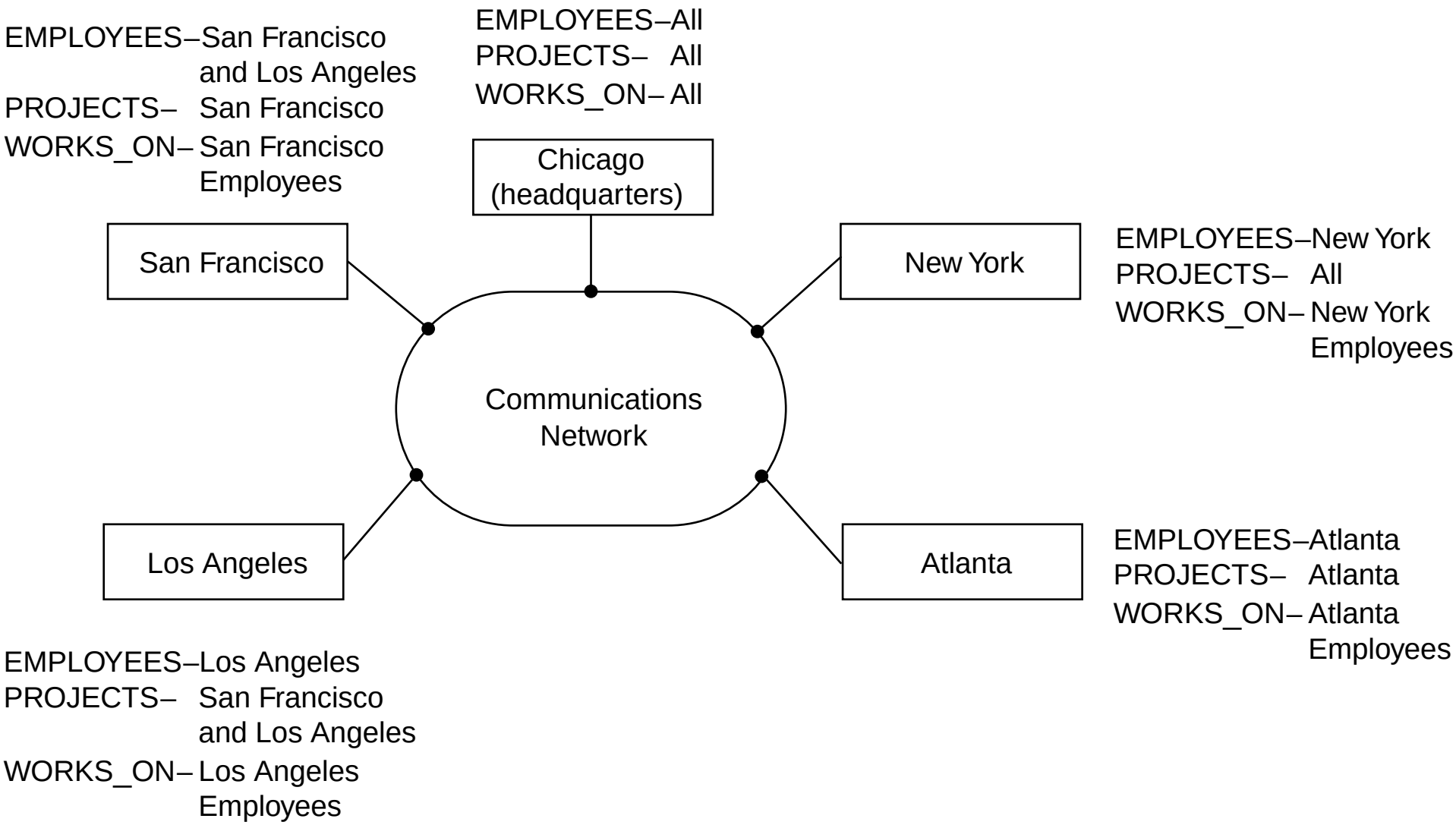


Figure 24.3 Allocation of fragments to sites.
(a) Relation fragments at site 2 corresponding to department 5.
(b) Relation fragments at site 3 corresponding to department 4.

(a)

EMPD5	FNAME	MINIT	LNAME	SSN	SALARY	SUPERSSN	DNO
	John	B	Smith	123456789	30000	333445555	5
	Franklin	T	Wong	333445555	40000	888665555	5
	Ramesh	K	Narayan	666884444	38000	333445555	5
	Joyce	A	English	453453453	25000	333445555	5

DEP5	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Research	5	333445555	22- MAY-78

DEP5_LOCS	DNUMBER	LOCATION
	5	Bellaire
	5	Sugarland
	5	Houston

WORKS_ON5	ESSN	PNO	HOURS
	123456789	1	32.5
	123456789	2	7.5
	666884444	3	40.0
	453453453	1	20.0
	453453453	2	20.0
	333445555	2	10.0
	333445555	3	10.0
	333445555	10	10.0
	333445555	20	10.0

PROJS5	PNAME	PNUMBER	PLOCATION	DNUM
	Product X	1	Bellaire	5
	Product Y	2	Sugarland	5
	Product Z	3	Houston	5

Data at Site 2

(b)

EMPD4	FNAME	MINIT	LNAME	SSN	SALARY	SUPERSSN	DNO
	Alicia	J	Zelaya	999887777	25000	987654321	4
	Jennifer	S	Wallace	987654321	43000	888665555	4
	Ahmad	V	Jabbar	987987987	25000	987654321	4

DEP4	DNAME	DNUMBER	MGRSSN	MGRSTARTDATE
	Administration	4	987654321	01-JAN-85

DEP4_LOCS	DNUMBER	LOCATION
	4	Stafford

WORKS_ON4	ESSN	PNO	HOURS
	333445555	10	10.0
	999887777	30	30.0
	999887777	10	10.0
	987987987	10	35.0
	987987987	30	5.0
	987654321	30	20.0
	987654321	20	15.0

PROJS4	PNAME	PNUMBER	PLOCATION	DNUM
	Computerization	10	Stafford	4
	Newbenefits	30	Stafford	4

Data at Site 3

Figure 24.4 Complete and disjoint fragments of the WORKS_ON relation. (a) Fragments of WORKS_ON for employees working in department 5 (C=[ESSN IN (SELECT SSN FROM EMPLOYEE WHERE DNO=5)]). (b) Fragments of WORKS_ON for employees working in department 4 (C=[ESSN IN (SELECT SSN FROM EMPLOYEE WHERE DNO=4)]). (c) Fragments of WORKS_ON for employees working in department 1 (C=[ESSN IN (SELECT SSN FROM EMPLOYEE WHERE DNO=1)]).

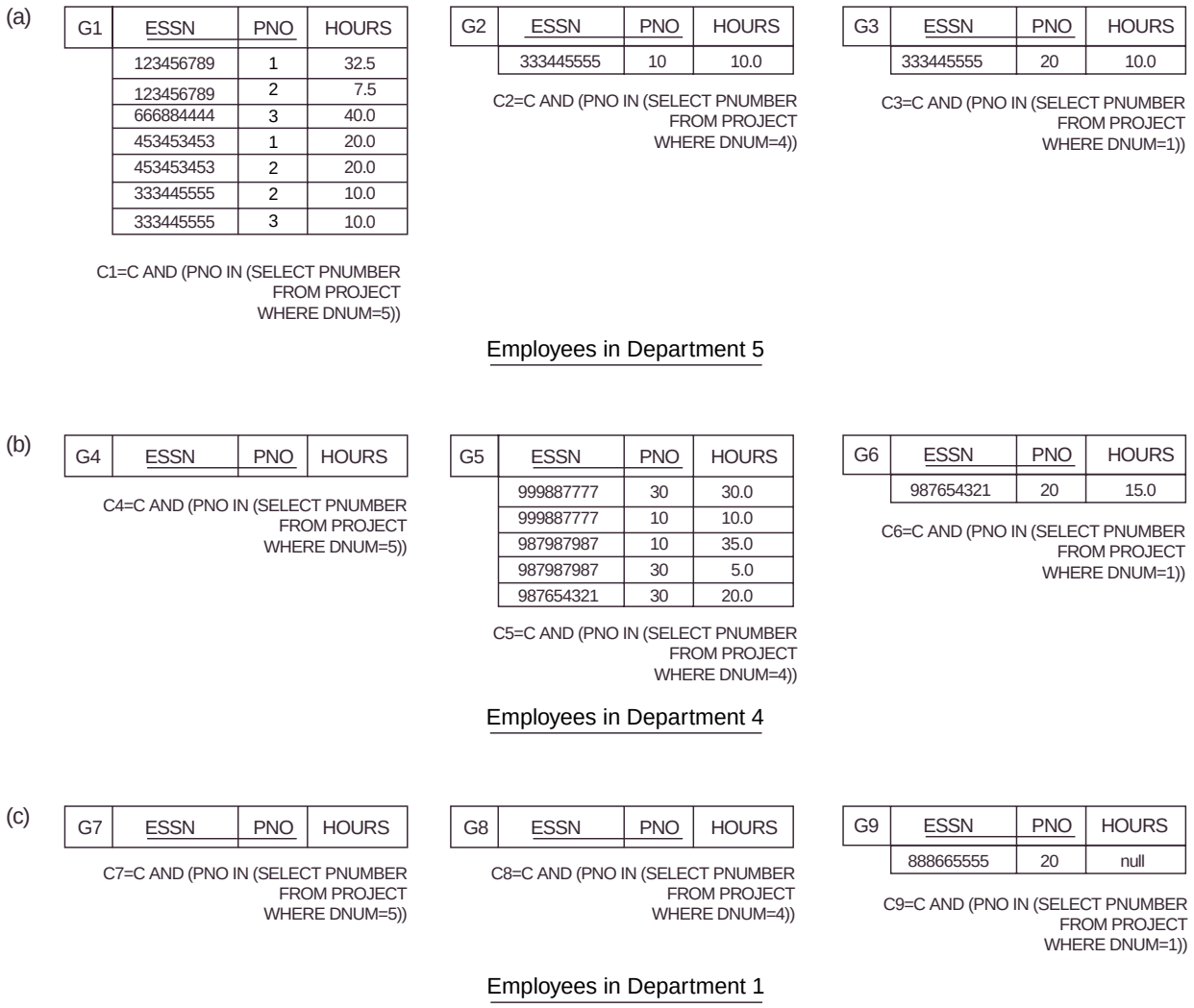


Figure 24.5 The five-level schema architecture in a federated database system (FDBS).

Source: Adapted from Sheth and Larson, Federated Database Systems for Managing Distributed Heterogeneous Autonomous Data-bases. ACM Computing Surveys (Vol. 22: No. 3, September 1990).

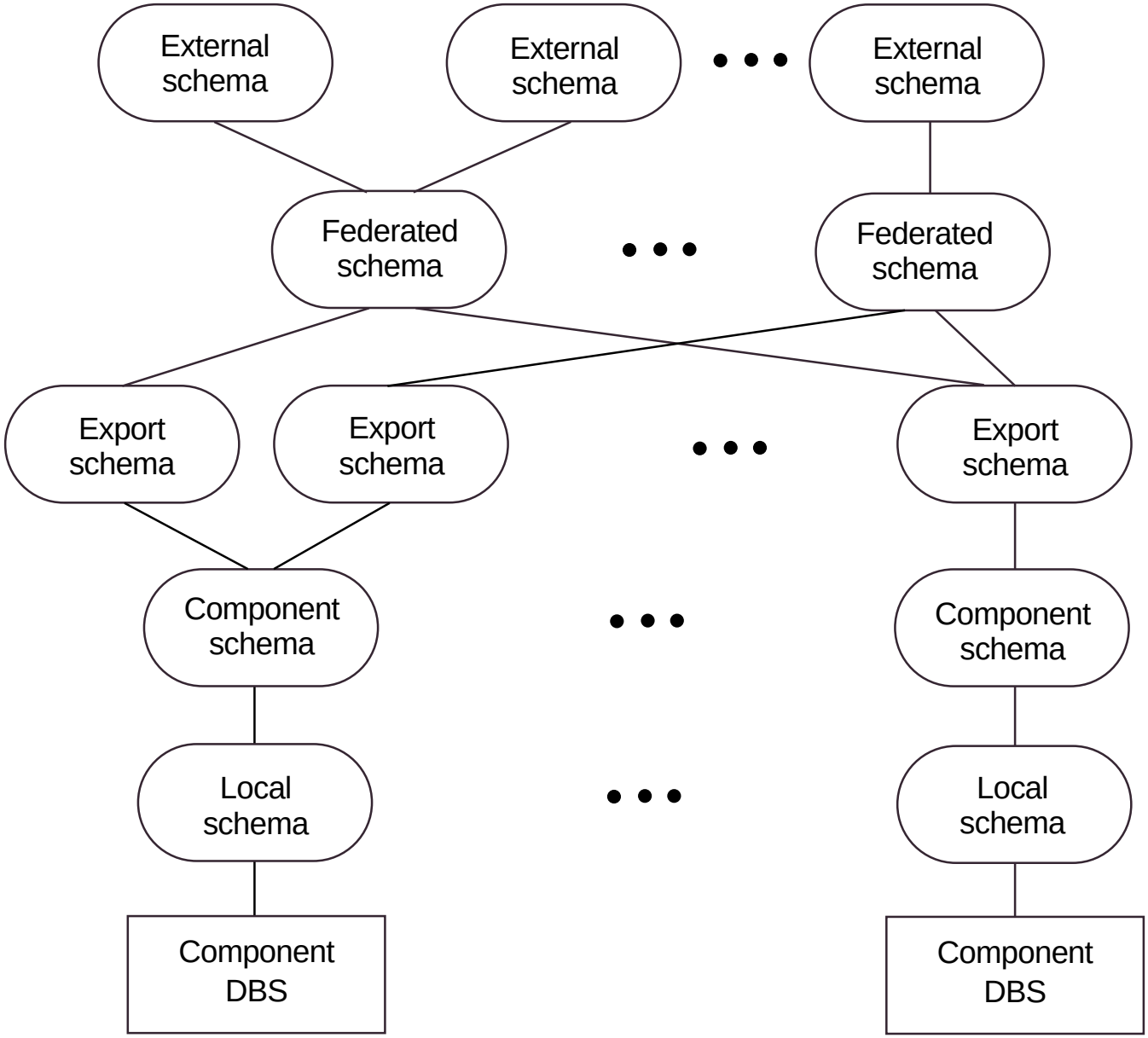


Figure 24.6 Example to illustrate volume of data transferred.

SITE 1:

EMPLOYEE

FNAME	MINIT	LNAME	SSN	BDATE	ADDRESS	SEX	SALARY	SUPERSSN	DNO

10,000 records
each record is 100 bytes long
SSN field is 9 bytes long FNAME field is 15 bytes long
DNO field is 4 bytes long LNAME field is 15 bytes long

SITE 2:

DEPARTMENT

DNAME	DNUMBER	MGRSSN	MGRSTARTDATE

100 records
each record is 35 bytes long
DNUMBER field is 4 bytes long DNAME field is 10 bytes long
MGRSSN field is 9 bytes long

Figure 24.7 Guard conditions and attributes lists for fragments. (a) Site 2 fragments. (b) Site 3 fragments.

(a) EMPD5
attribute list: FNAME,MINIT,LNAME,SSN,SALARY,SUPERSSN, DNO
guard condition: DNO=5
DEP5
attribute list: * (all attributes DNAME,DNUMBER,MGRSSN,MGRSTARTDATE)
guard condition: DNUMBER=5
DEP5_LOCS
attribute list: * (all attributes DNUMBER,LOCATION)
guard condition: DNUMBER=5
PROJS5
attribute list: * (all attributes PNAME,PNUMBER,PLOCATION,DNUM)
guard condition: DNUM=5
WORKS_ON5
attribute list: * (all attributes ESSN,PNO,HOURS)
guard condition: ESSN IN (π_{SSN} (EMPD5)) OR PNO IN ($\pi_{PNUMBER}$ (PROJS5))

(b) EMPD4
attribute list: FNAME,MINIT,LNAME,SSN,SALARY,SUPERSSN, DNO
guard condition: DNO=4
DEP4
attribute list: * (all attributes DNAME,DNUMBER,MGRSSN,MGRSTARTDATE)
guard condition: DNUMBER=4
DEP4_LOCS
attribute list: * (all attributes DNUMBER,LOCATION)
guard condition: DNUMBER=4
PROJS4
attribute list: * (all attributes PNAME,PNUMBER,PLOCATION,DNUM)
guard condition: DNUM=4
WORKS_ON4
attribute list: * (all attributes ESSN,PNO,HOURS)
guard condition: ESSN IN (π_{SSN} (EMPD4))
OR PNO IN ($\pi_{PNUMBER}$ (PROJS4))

Figure 24.8 Oracle distributed database systems.