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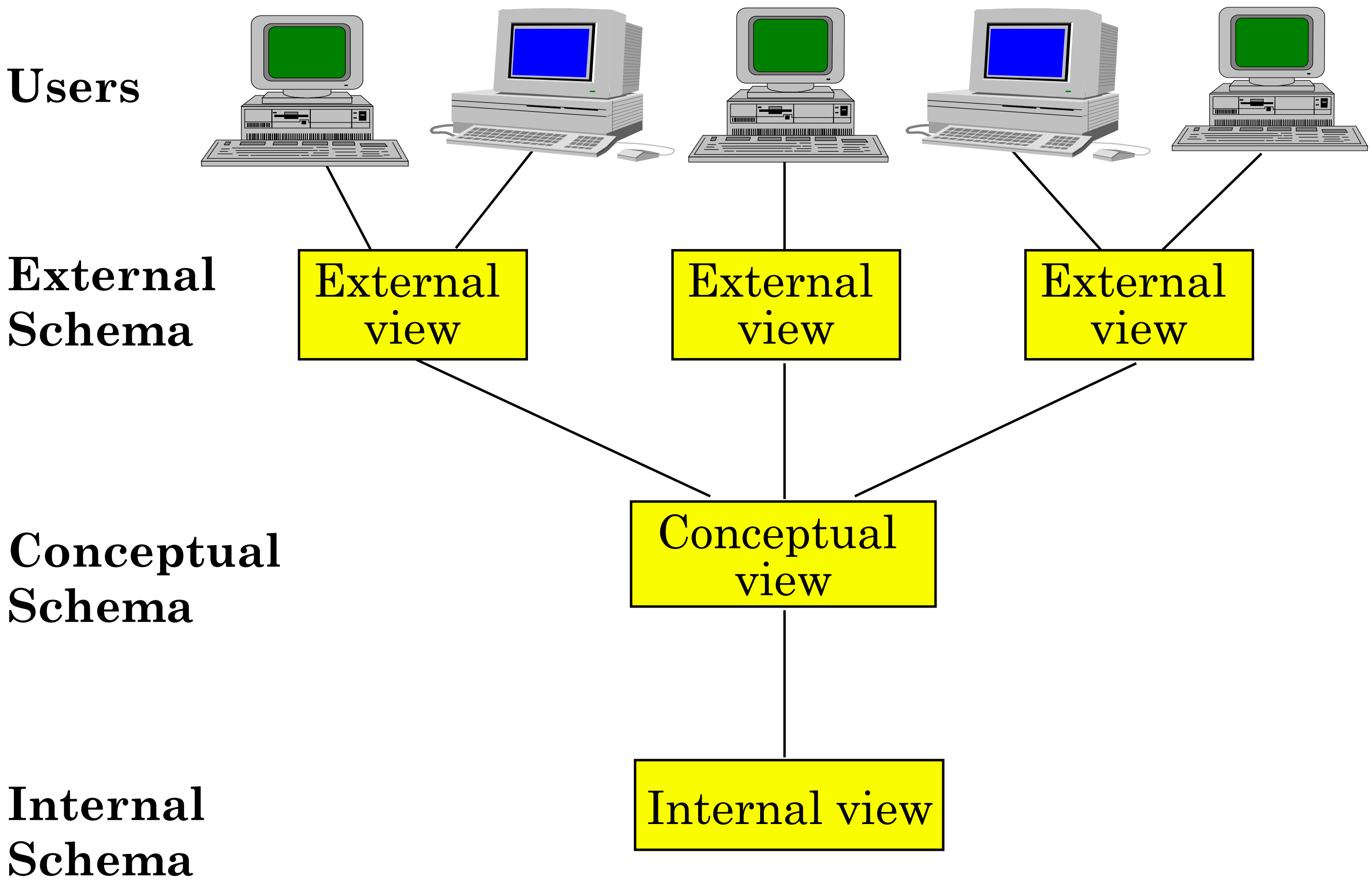
Architecture

- Defines the structure of the system
  - components identified
  - functions of each component defined
  - interrelationships and interactions between components defined

ANSI/SPARC Architecture



Standardization

Reference Model

- A conceptual framework whose purpose is to divide standardization work into manageable pieces and to show at a general level how these pieces are related to one another.

Approaches

- **Component-based**
  - Components of the system are defined together with the interrelationships between components.
  - Good for design and implementation of the system.
- **Function-based**
  - Classes of users are identified together with the functionality that the system will provide for each class.
  - The objectives of the system are clearly identified. But how do you achieve these objectives?
- **Data-based**
  - Identify the different types of describing data and specify the functional units that will realize and/or use data according to these views.

Conceptual Schema Definition

```
RELATION EMP [
    KEY = {ENO}
    ATTRIBUTES = {
        ENO     : CHARACTER(9)
        ENAME   : CHARACTER(15)
        TITLE   : CHARACTER(10)
    }
]
RELATION PAY [
    KEY = {TITLE}
    ATTRIBUTES = {
        TITLE   : CHARACTER(10)
        SAL     : NUMERIC(6)
    }
]
```

Conceptual Schema Definition

```
RELATION PROJ [
    KEY = {PNO}
    ATTRIBUTES = {
        PNO     : CHARACTER(7)
        PNAME   : CHARACTER(20)
        BUDGET  : NUMERIC(7)
    }
]
RELATION ASG [
    KEY = {ENO,PNO}
    ATTRIBUTES = {
        ENO     : CHARACTER(9)
        PNO     : CHARACTER(7)
        RESP    : CHARACTER(10)
        DUR     : NUMERIC(3)
    }
]
```

Internal Schema Definition

```
RELATION EMP [
    KEY = {ENO}
    ATTRIBUTES = {
        ENO      :  CHARACTER(9)
        ENAME    :  CHARACTER(15)
        TITLE    :  CHARACTER(10)
    }
]

INTERNAL_REL EMPL [
    INDEX ON E# CALL EMINX
    FIELD = {
        HEADER   : BYTE(1)
        E#       : BYTE(9)
        ENAME    : BYTE(15)
        TIT      : BYTE(10)
    }
]
```

External View Definition – Example 1

Create a BUDGET view from the PROJ relation

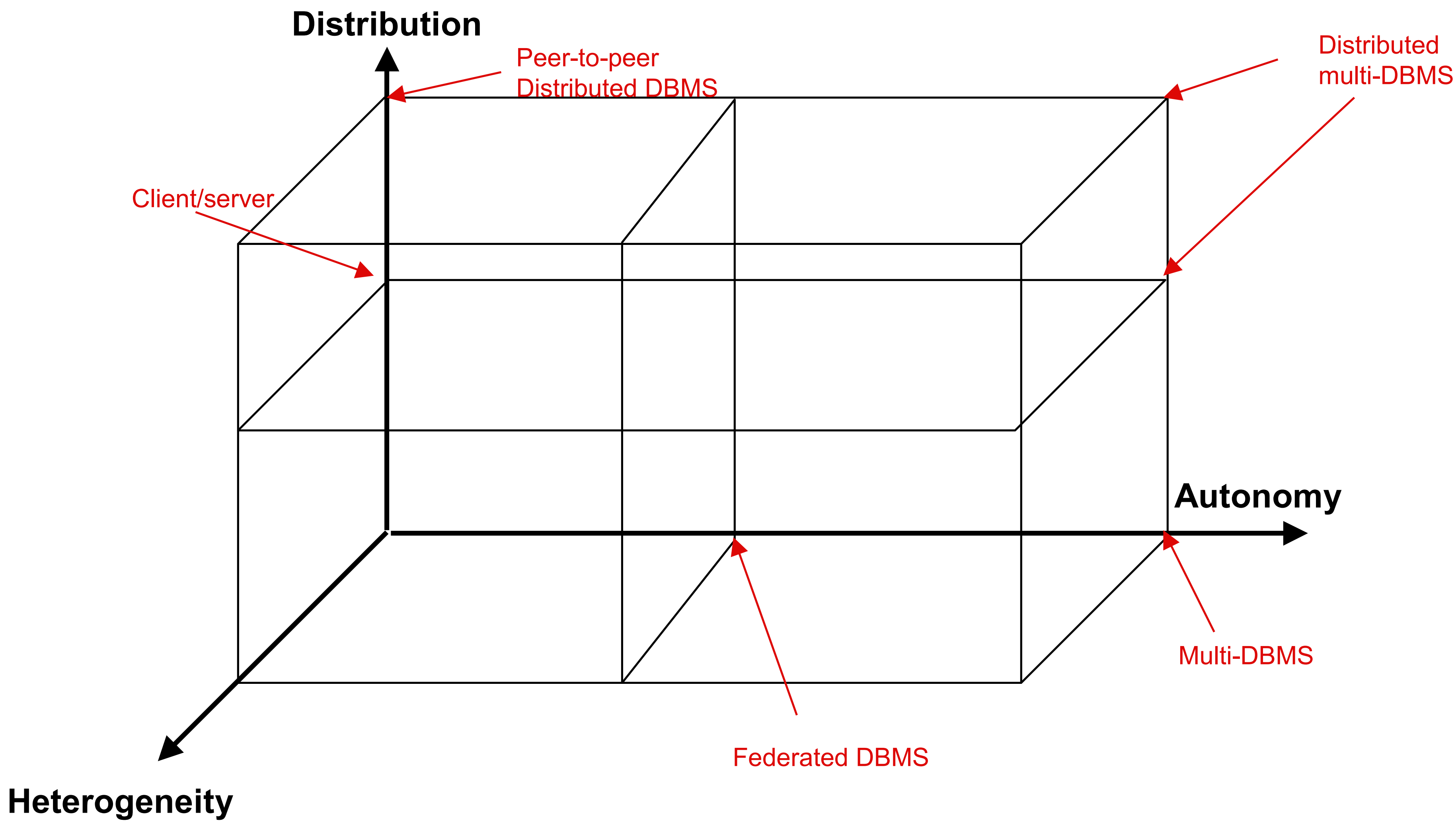
```
CREATE   VIEW    BUDGET(PNAME, BUD)
 AS      SELECT  PNAME, BUDGET
         FROM    PROJ
```

External View Definition – Example 2

Create a Payroll view from relations EMP and TITLE_SALARY

```
CREATE   VIEW     PAYROLL (ENO, ENAME, SAL)
AS       SELECT   EMP.ENO,EMP.ENAME,PAY.SAL
         FROM     EMP, PAY
         WHERE    EMP.TITLE = PAY.TITLE
```

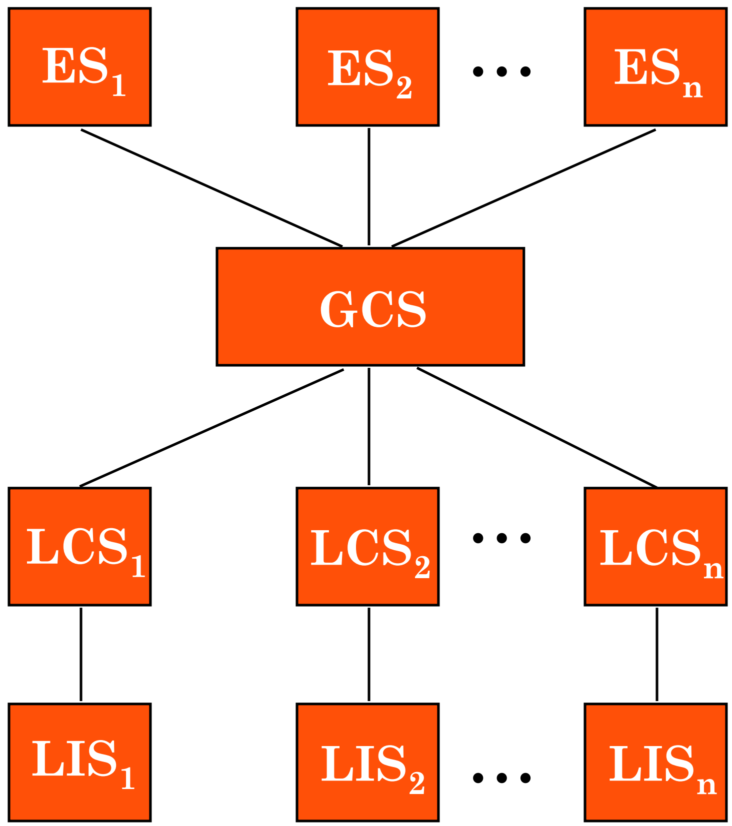
DBMS Implementation Alternatives



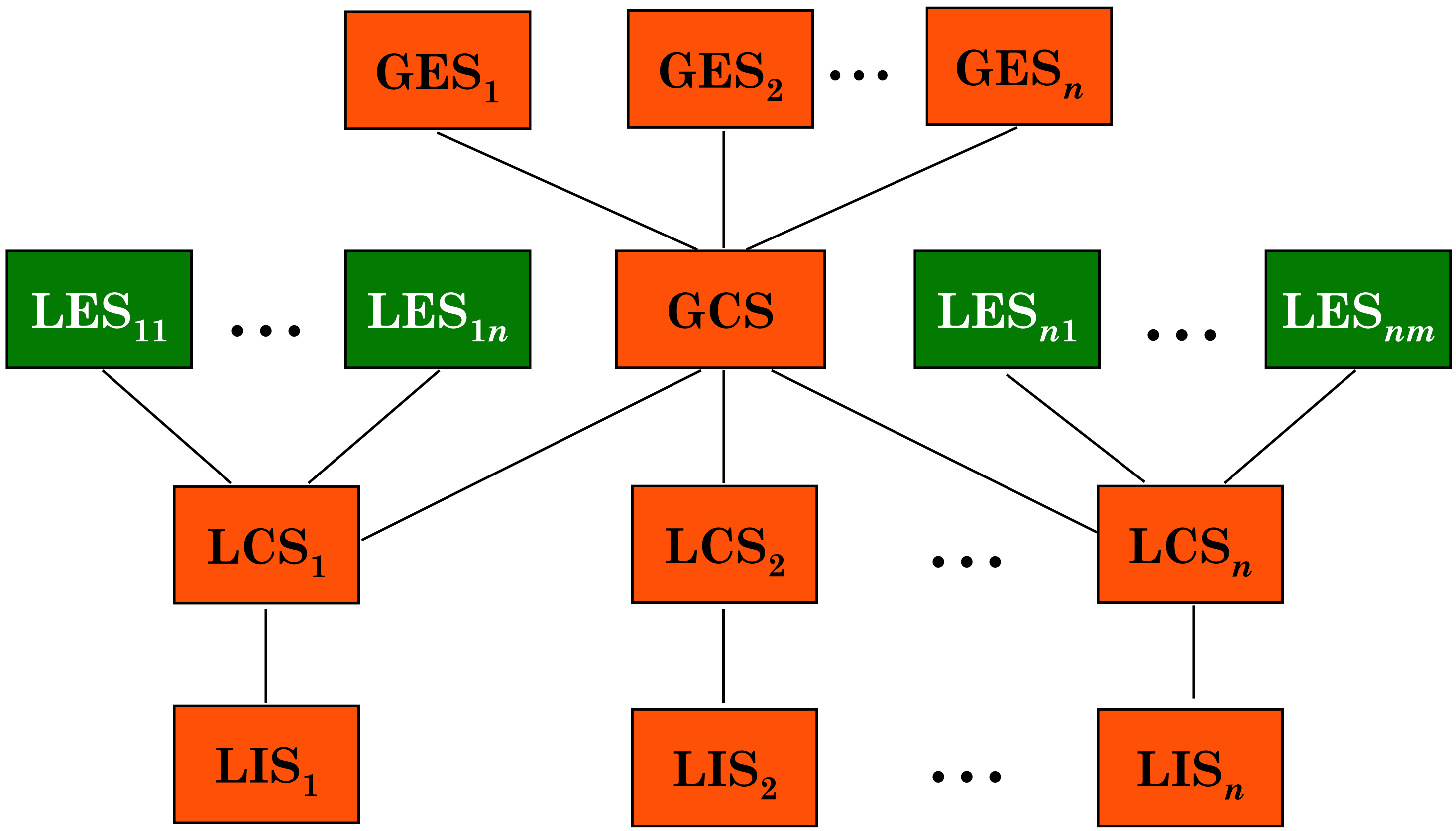
Dimensions of the Problem

- Distribution
  - Whether the components of the system are located on the same machine or not
- Heterogeneity
  - Various levels (hardware, communications, operating system)
  - DBMS important one
    - data model, query language,transaction management algorithms
- Autonomy
  - Not well understood and most troublesome
  - Various versions
    - Design autonomy: Ability of a component DBMS to decide on issues related to its own design.
    - Communication autonomy: Ability of a component DBMS to decide whether and how to communicate with other DBMSs.
    - Execution autonomy: Ability of a component DBMS to execute local operations in any manner it wants to.

Datalogical Distributed DBMS Architecture

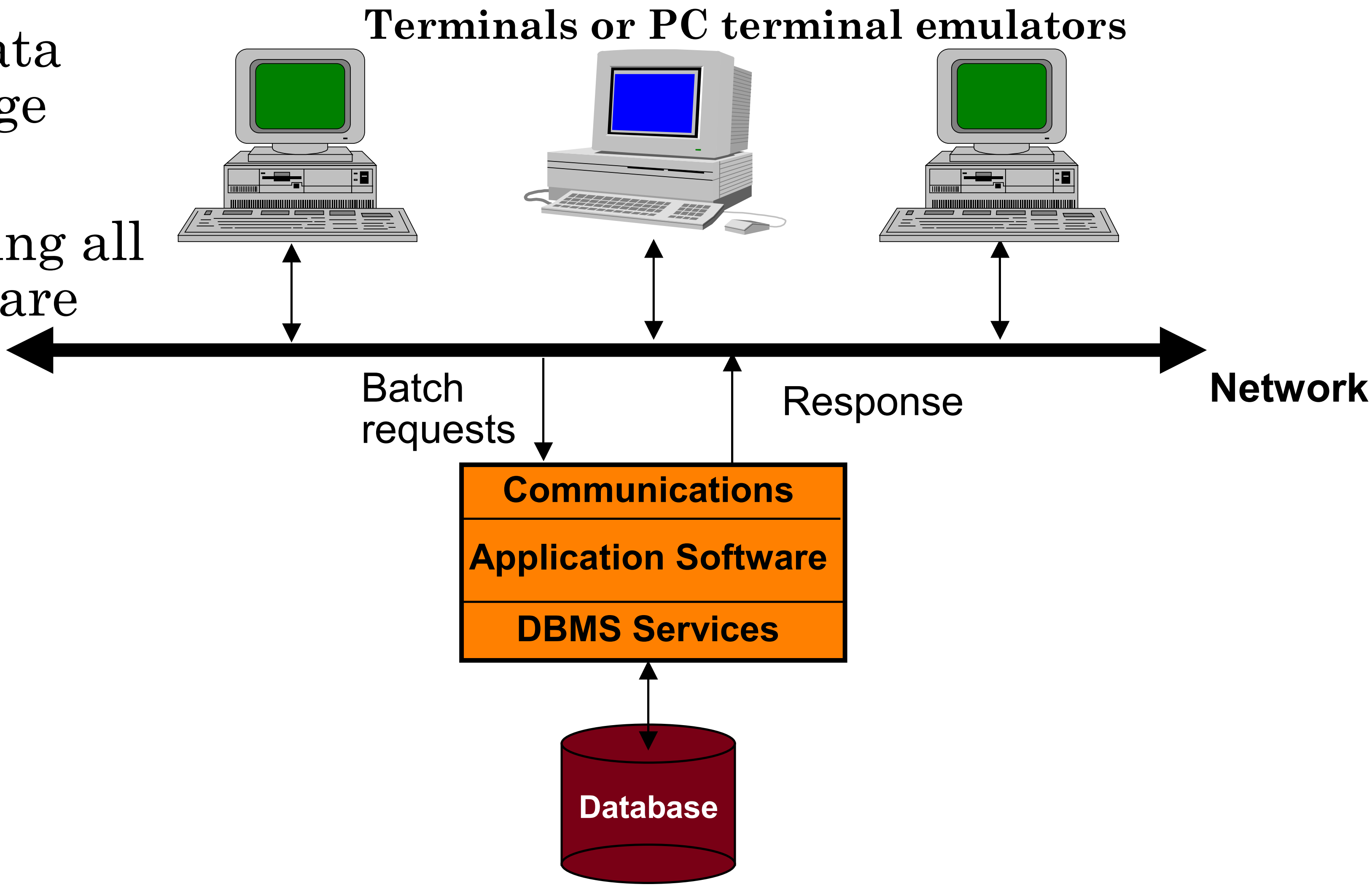


Datalogical Multi-DBMS Architecture

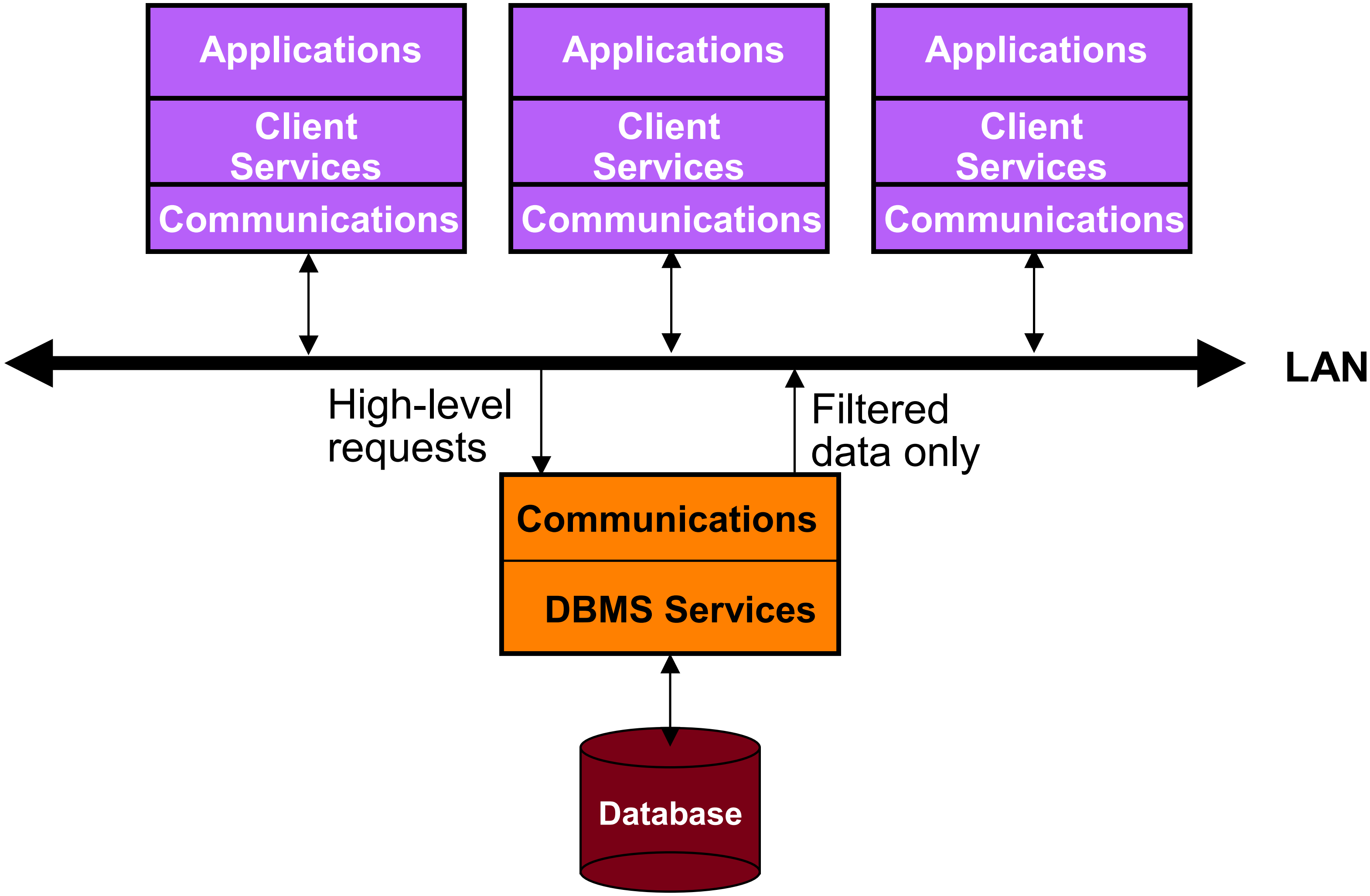


Timesharing Access to a Central Database

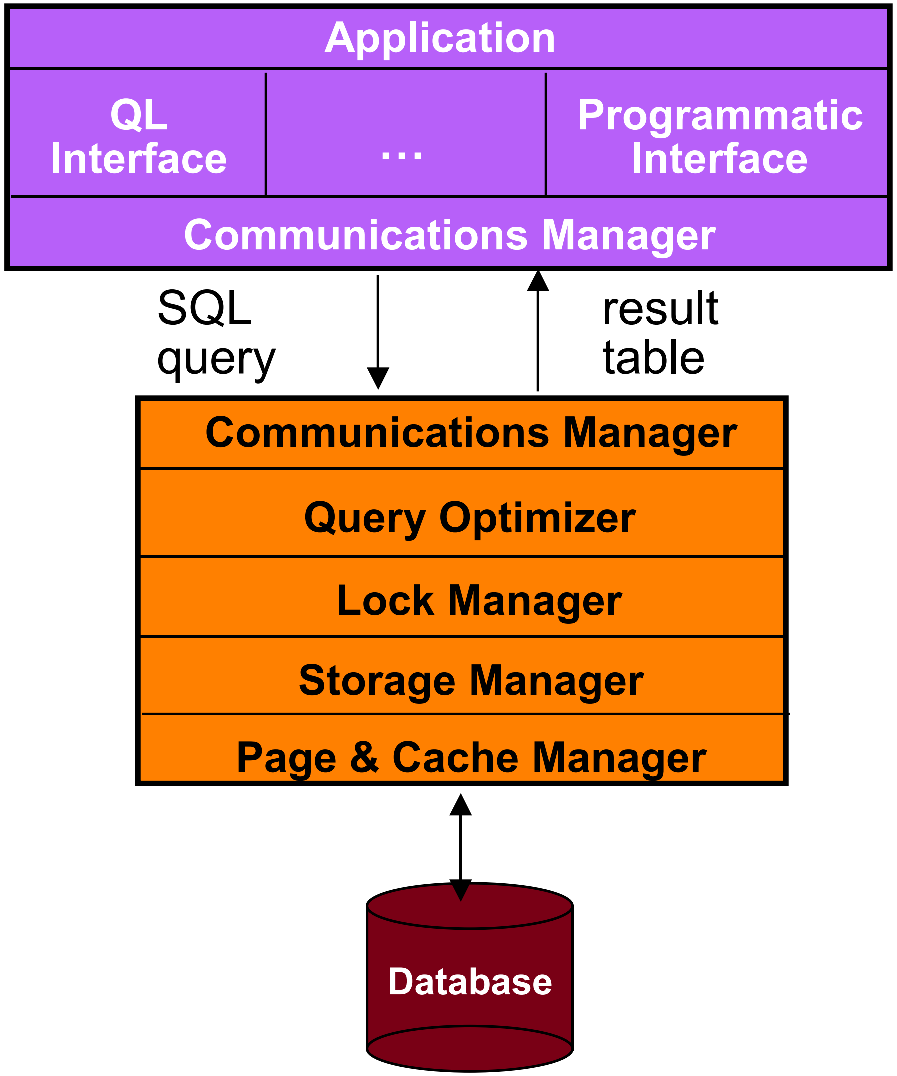
- No data storage
- Host running all software



Multiple Clients/Single Server



Task Distribution



Advantages of Client-Server Architectures

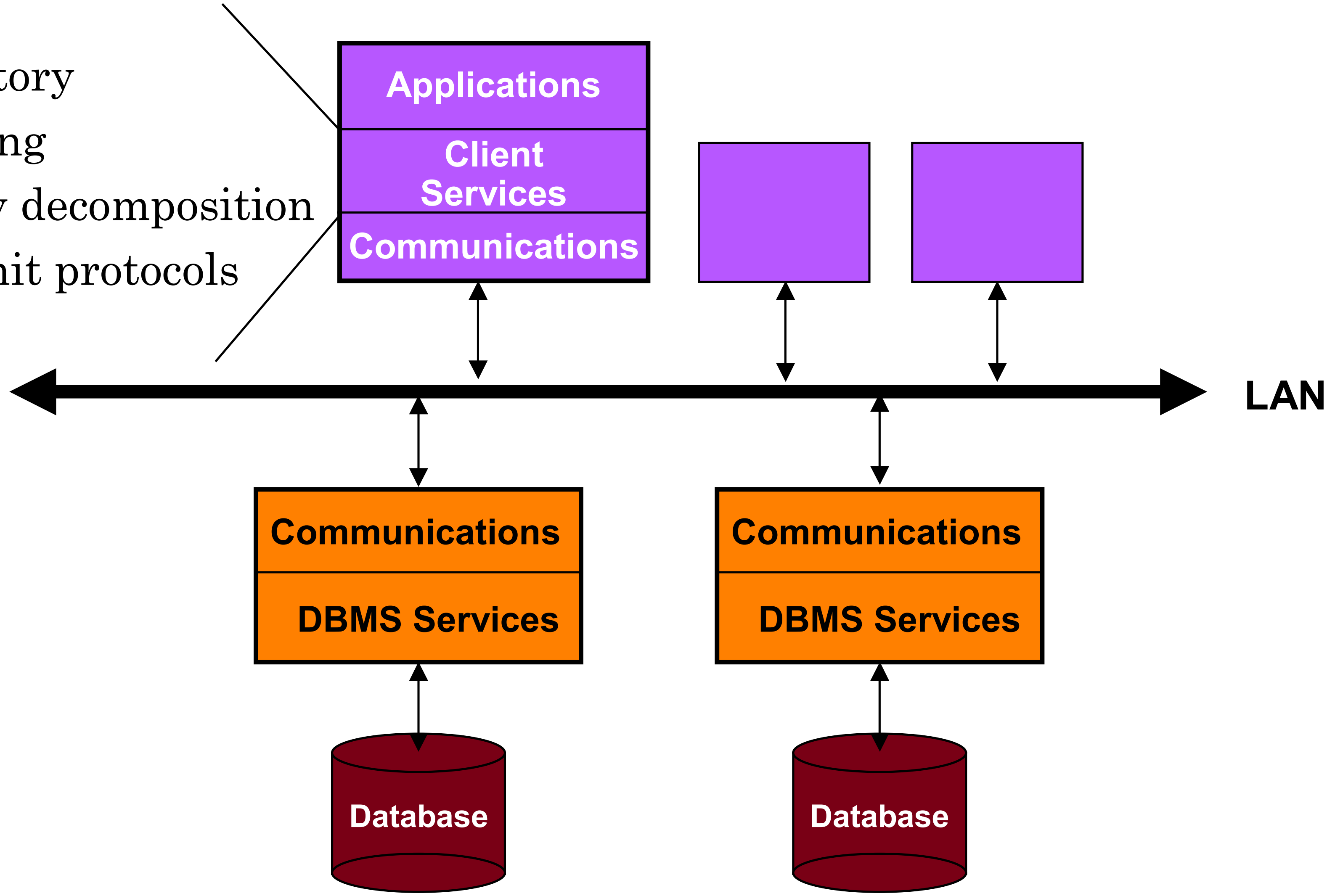
- More efficient division of labor
- Horizontal and vertical scaling of resources
- Better price/performance on client machines
- Ability to use familiar tools on client machines
- Client access to remote data (via standards)
- Full DBMS functionality provided to client workstations
- Overall better system price/performance

Problems With Multiple-Client/Single Server

- Server forms bottleneck
- Server forms single point of failure
- Database scaling difficult

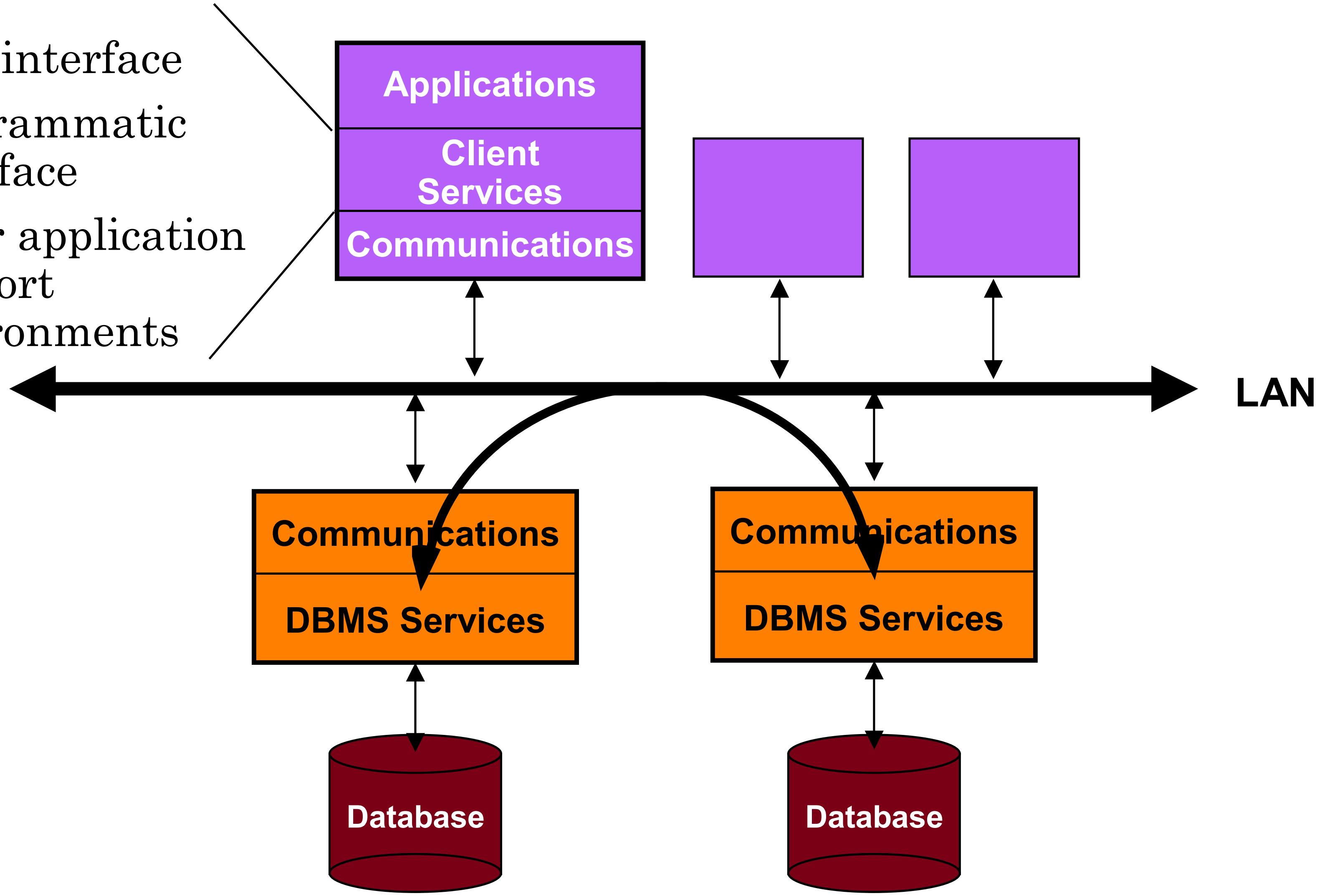
Multiple Clients/Multiple Servers

- directory
- caching
- query decomposition
- commit protocols

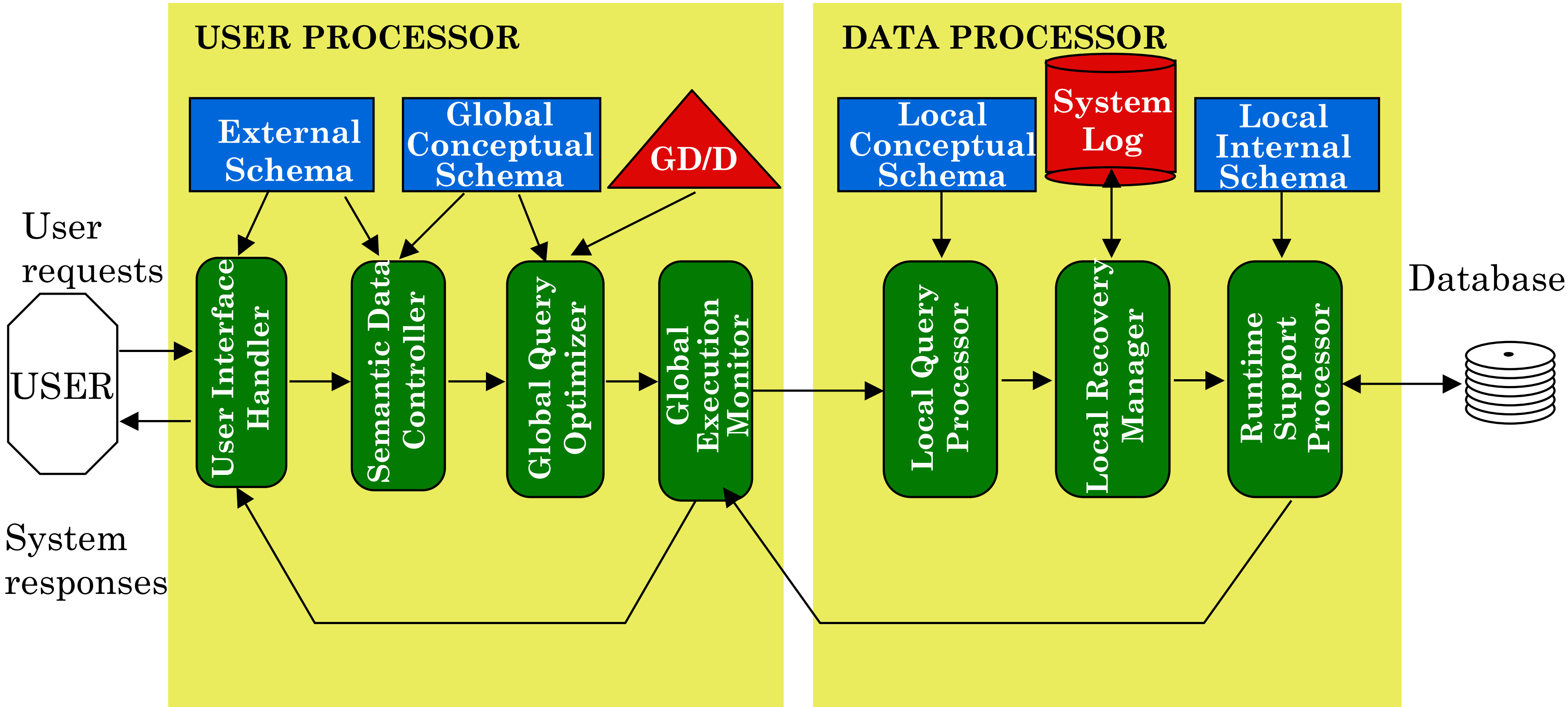


Server-to-Server

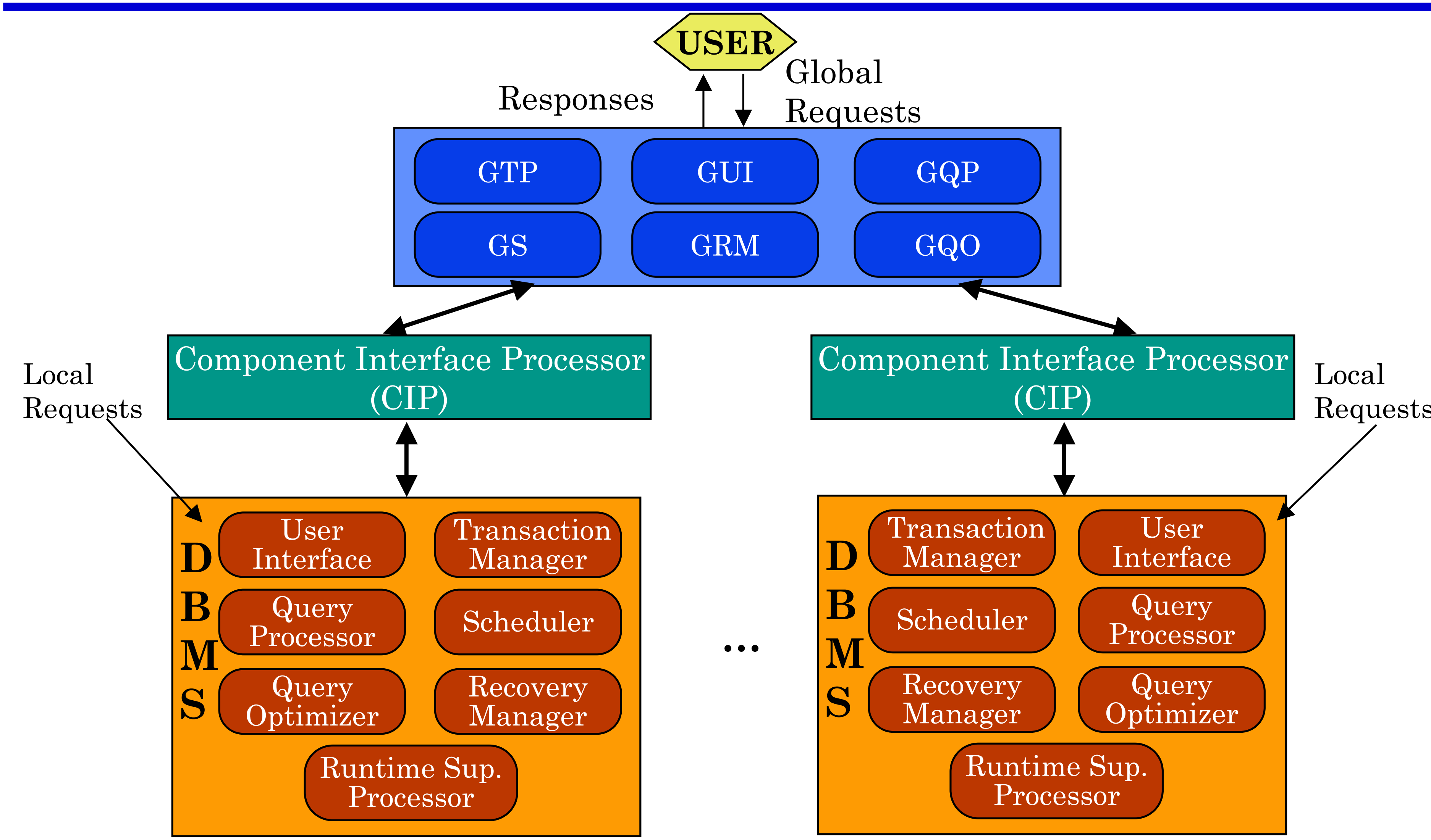
- SQL interface
- programmatic interface
- other application support environments



Peer-to-Peer Component Architecture



Components of a Multi-DBMS



Directory Issues