Chapter 1: Introduction

What is a Distributed System?

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- *A distributed system is a collection of independent computers that appears to its users as a single coherent system.*

Examples (1)

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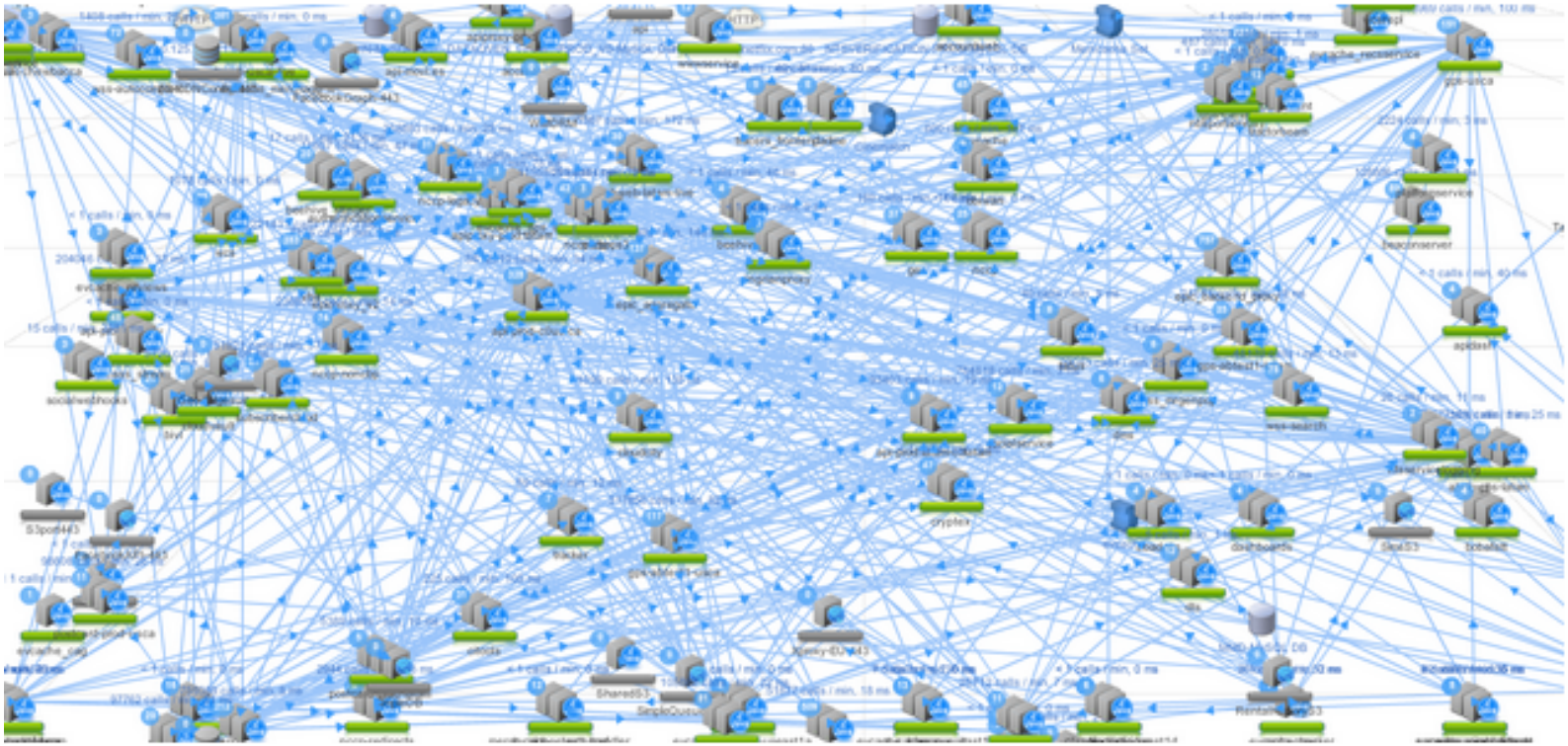

http://techblog.netflix.com/2012/06/netflix-operations-part-i-going.html

The Internet is just a world passing around notes in a classroom. –Jon Stewart

Examples (2)

Google Search I'm Feeling Lucky

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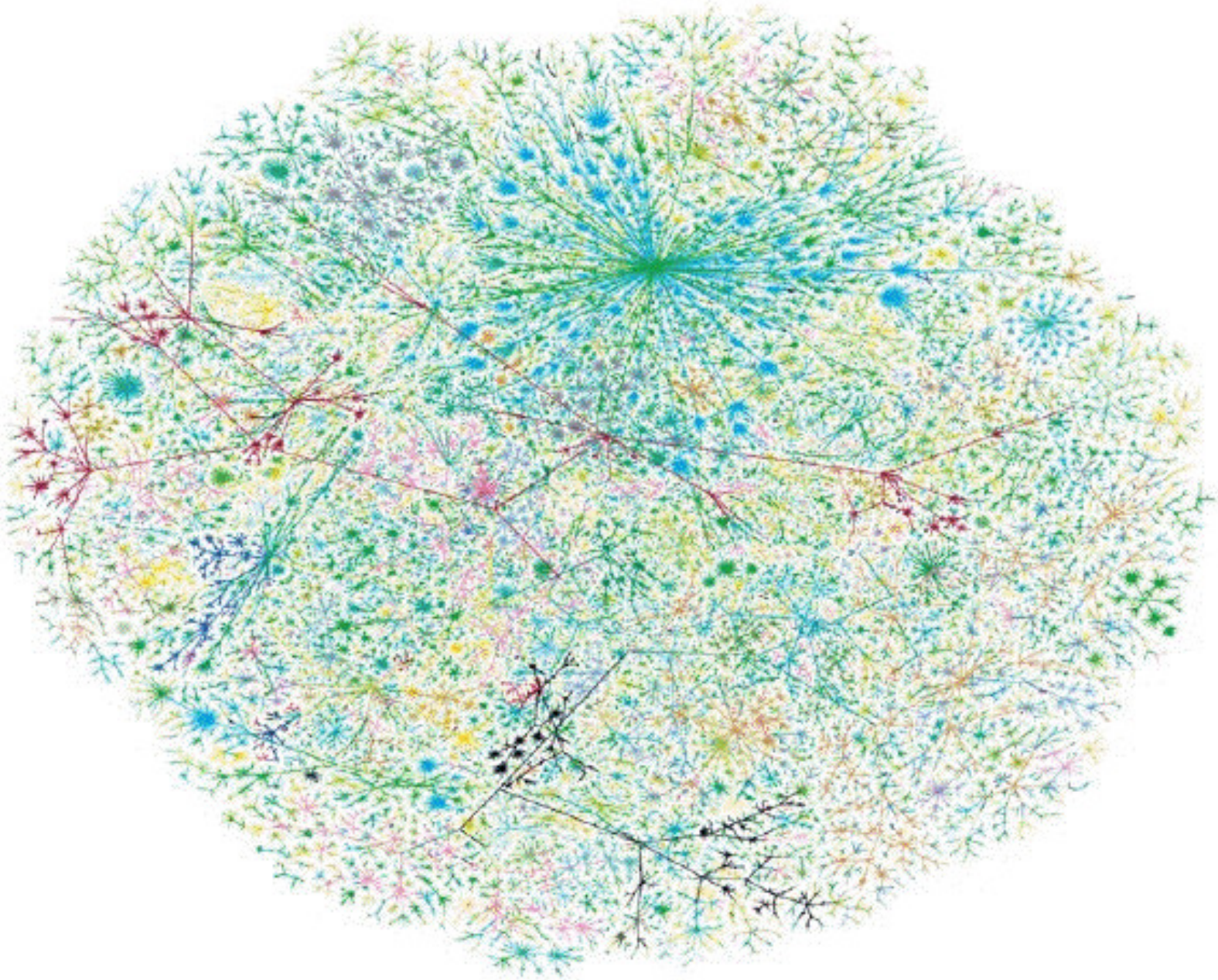

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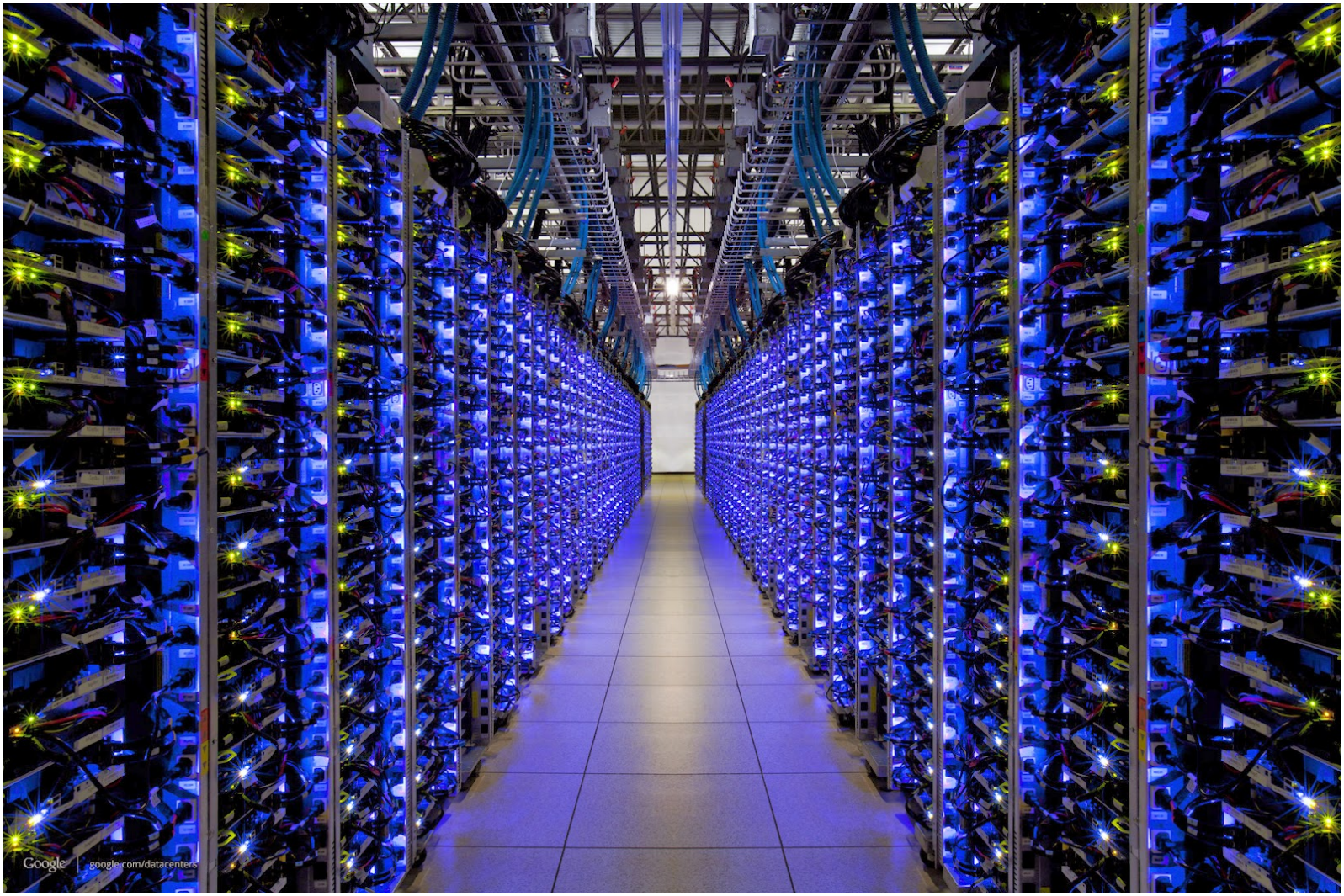

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- Virtually every substantial website!

In-class Exercise

- Walk through architecture of various distributed systems ranging from: single server/client, multiple server/clients to point to point.

How to Implement a Distributed System?

- In order to support a single system view on multiple computers and networks, we need a layer of abstraction implemented in software that is logically placed in the middle of higher layer of users and applications and the lower layer of operating systems and networks. We call this layer the middleware.

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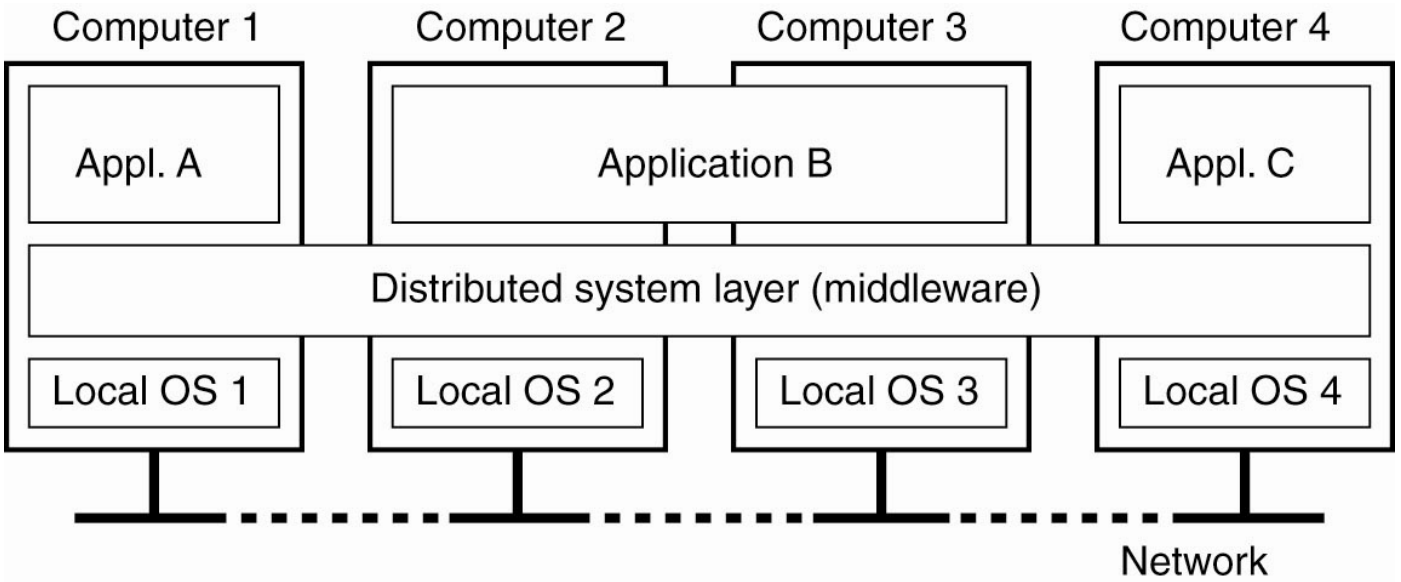

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  - Easier to collaborate and exchange information
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- Problems
  - Eavesdropping or intrusion on communication
  - Tracking of communication to build a profile

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Failure	Hide the failure and recovery of a resource

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- Signal transmission is limited by the speed of light as well as the speed of intermediate switches

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- Interoperability, Portability, Extensibility.
- Separating policy from mechanism. For example: *caching* in a web browser.

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- Administrative: be able to manage even if it spans independent administrative organizations

Centralized versus distributed implementations.

Centralized Solutions with Scalability Problems

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- There is no implicit assumption that a global clock exists.

In-class exercise. Simulate a centralized and a distributed algorithm for the same problem in class!

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- Hiding communication latencies: Examples would be asynchronous communication as well as pushing code down to clients (E.g. Javascript)
- Distribution: Taking a component, splitting into smaller parts, and subsequently spreading them across the system. (E.g. Domain Name System)
- Replication: Replicating components increases availability, helps balance the load leading to better performance, helps hide latencies for geographically distributed systems. Caching is a special form of replication.

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"A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable."
–Leslie Lamport

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In-class Exercise: Classify the examples we have seen so far into the three categories above.

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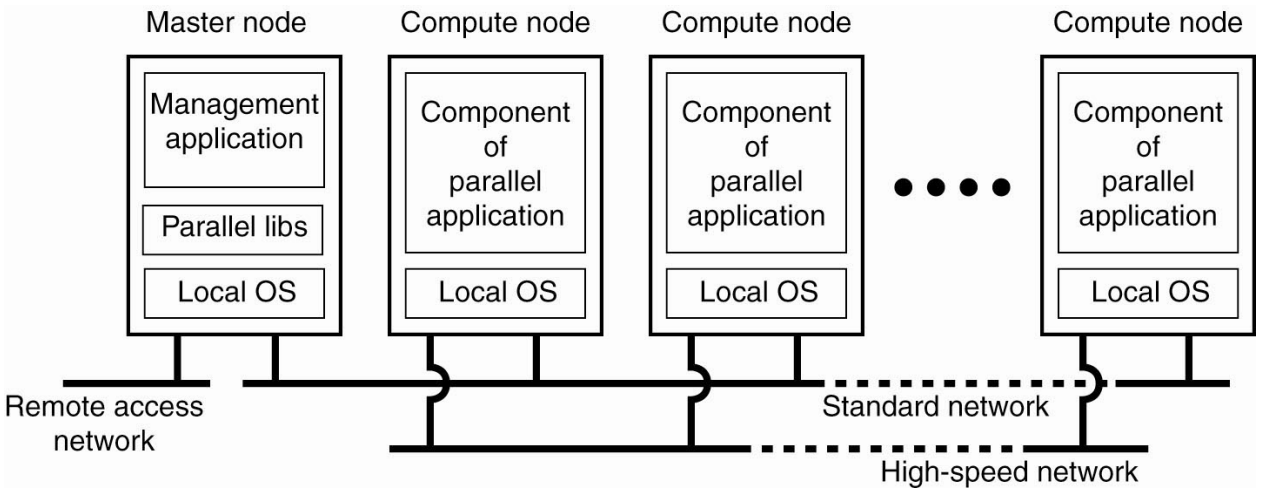

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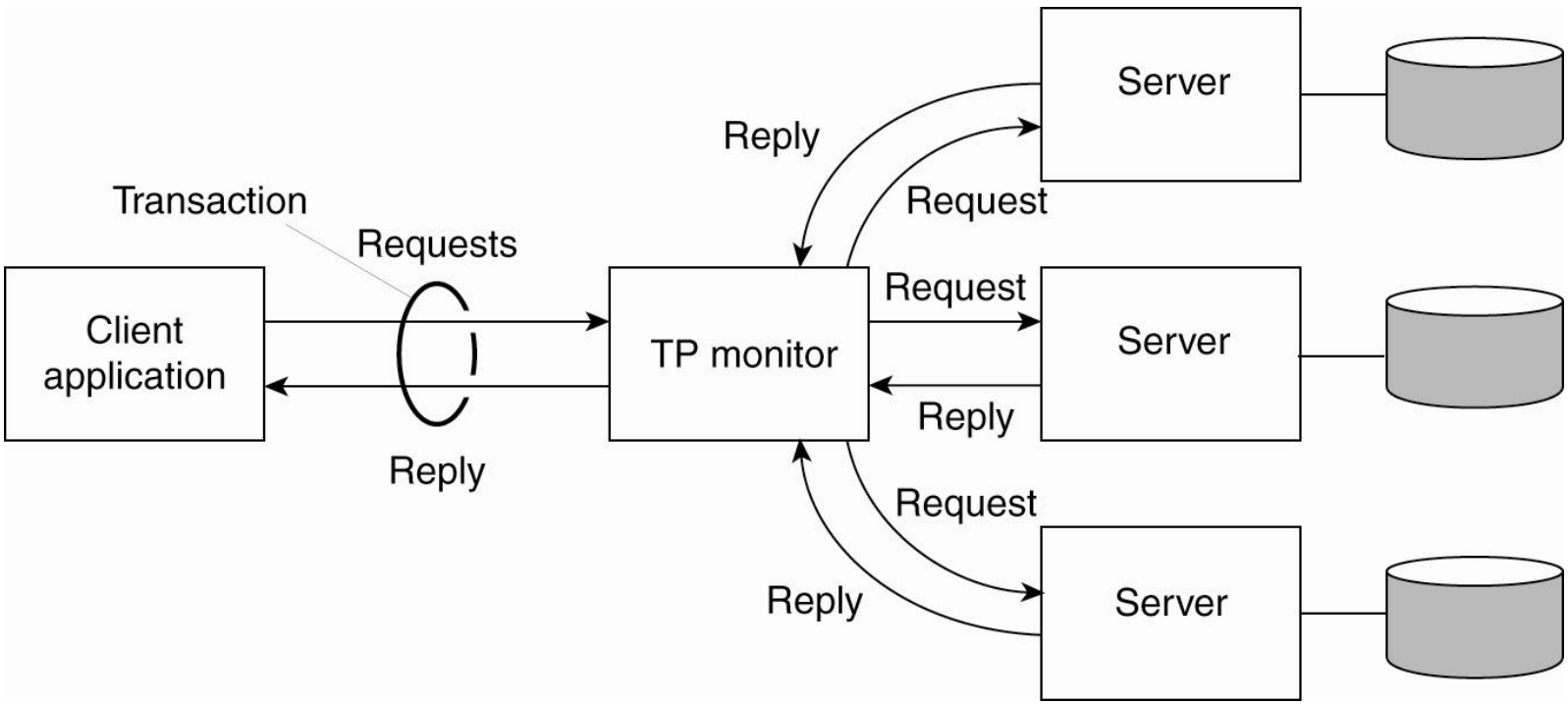
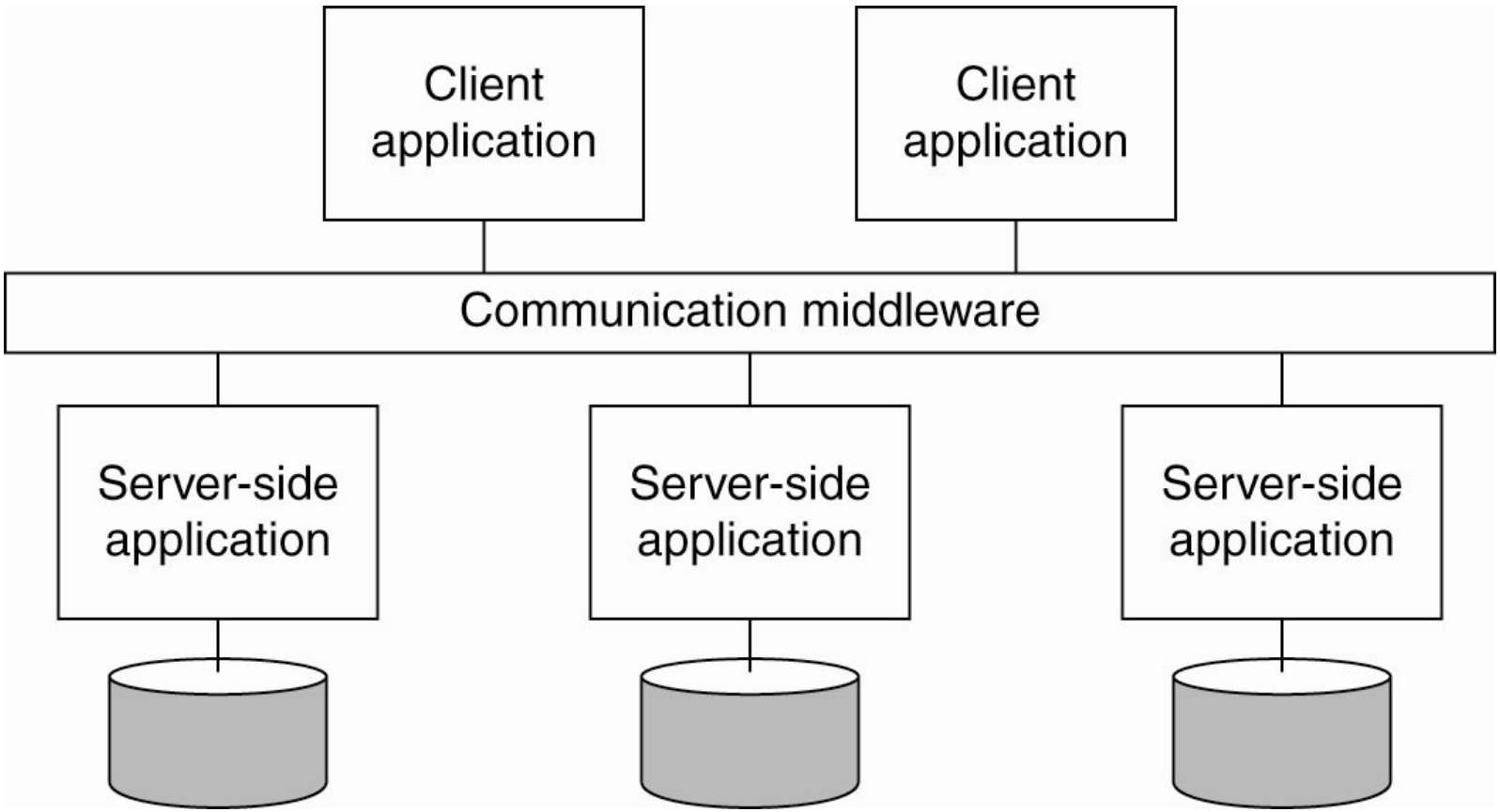
Transactions can be nested. Durability applies to top-level transactions only. For example: an airline and a hotel database.

Transaction Processing Systems (2)



Enterprise Application Integration



Middleware as a communication facilitator for enterprise application integration.

Distributed Pervasive Systems

Requirements for pervasive systems:

- Embrace contextual changes.
- Encourage ad hoc composition.
- Recognize sharing as the default.

Examples: Home systems, Body Area Networks, Sensor Networks.

Chapter 1: Recommended Exercises

- **Problem 1**. What is the role of middleware in a distributed system?
- **Problem 2**. Explain what is meant by transparency, and give examples of different types of transparency.
- **Problem 3**. Scalability can be achieved by applying different techniques. What are these techniques?
- **Problem 4**. Give further examples of distributed pervasive systems.