Middleware

Prof. David E. Bakken

Prof. Carl Hauser

Cpt. S 464/564 Lecture

Auxiliary Material

http://www.eecs.wsu.edu/~bakken/middleware.pdf

Last part of Jan 21 2003

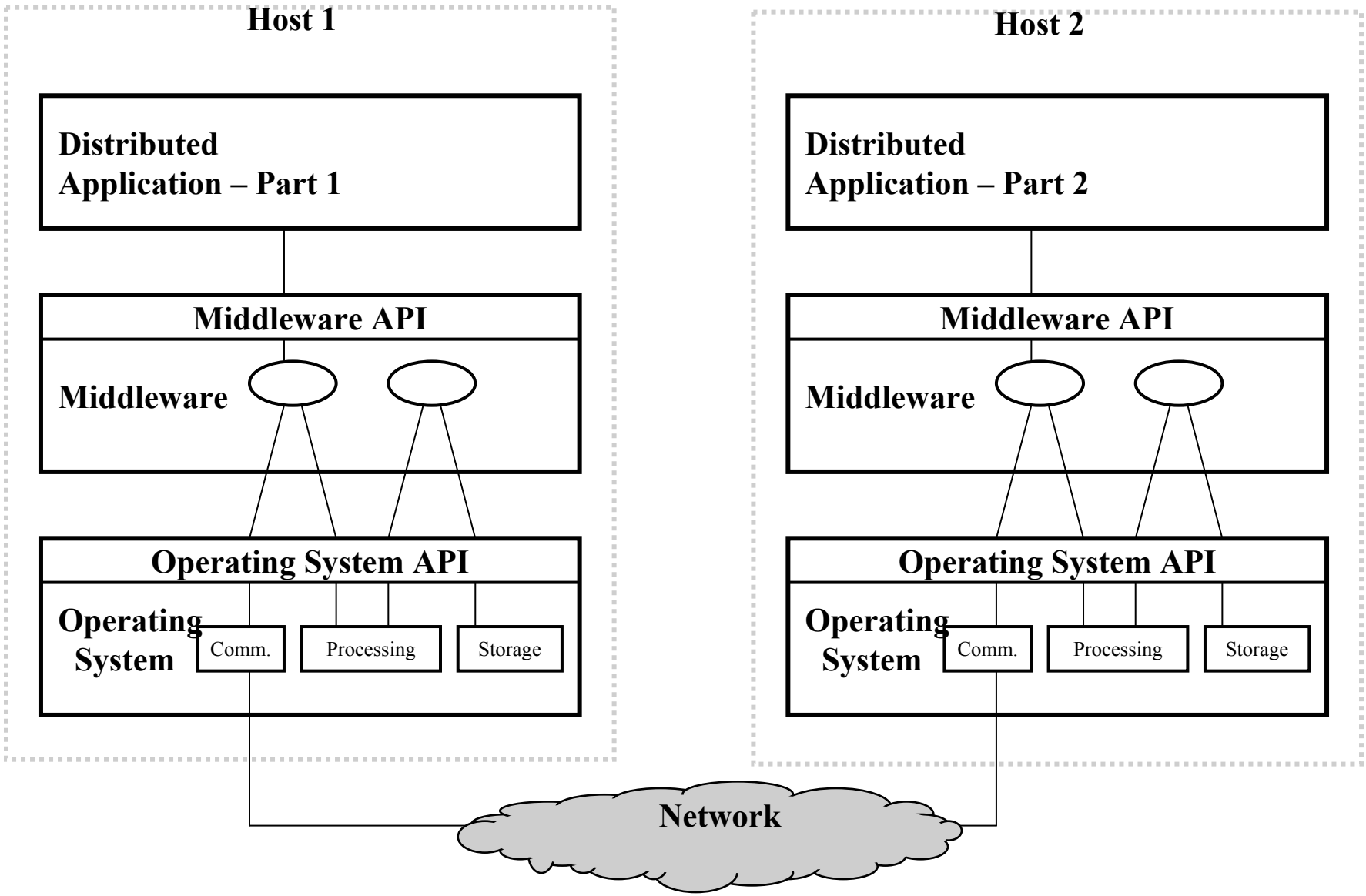
Middleware: © 2001-2003 Carl Hauser & David E. Bakken. Some figures © 2001 Verissimo and Rodrigues

Middleware

- Middleware== "**A layer of software above the operating system but below the application program that provides a common programming abstraction across a distributed system**"
- Middleware exists to help manage the complexity and heterogeneity inherent in distributed systems
- Middleware provides higher-level building blocks ("abstractions") for programmers than the OS provides
  - Can make them much more productive
  - Can make the resulting code have fewer errors
- Middleware sometimes is called "plumbing"
  - Connects parts of a distributed application with "data pipes" and passes data between them

Middleware: © 2001-2003 Carl Hauser & David E. Bakken. Some figures © 2001 Verissimo and Rodrigues

Middleware in Context



Middleware: © 2001-2003 Carl Hauser & David E. Bakken. Some figures © 2001 Veríssimo and Rodrigues

Middleware: Heterogeneity & Transparency

- Middleware's programming building blocks mask heterogeneity
  - Makes programmer's life much easier!!
- Kinds of heterogeneity masked by middleware
  - Heterogeneity in network technology always masked
  - Heterogeneity in host CPU always masked
  - Heterogeneity in operating system (or family thereof) usually masked
  - Heterogeneity in programming language usually masked
  - Heterogeneity in vendor implementations sometimes masked
- Middleware can provide transparency with respect to distribution:
  - Location transparency
  - Concurrency transparency
  - Replication transparency
  - Failure transparency
  - Mobility transparency
- Masking heterogeneity and providing transparency makes programming distributed systems much easier to do!

Kinds of Middleware

- Distributed Tuples: (a, b, c, d, e)
  - Relational databases, SQL, relational algebra
  - Linda and tuple spaces
  - Java Jini and JavaSpaces
- Remote procedure call (RPC
  - make a function call look local even if non-local
- Message-Oriented Middleware (MOM)
  - messages and message queues
- Distributed Object Middleware
  - Make an object method look local even if non-local
  - CORBA
  - DCOM/SOAP/.NET
  - Java RMI

Middleware and Legacy Systems

- Middleware often called a “glue” technology: integrated “legacy” components
- Middleware’s abstractions are general enough to allow legacy systems to be “wrapped”
- Distributed objects model

Programming with Middleware

- Programming with Middleware
  - Do not have to learn a new programming language! (Usually)
  - Use an existing one already familiar with: C++, Java, Ada, (yuk) Visual Basic, (yuk) COBOL
- Ways to Program with Middleware
  1. Middleware system provides library of functions (Linda, others)
  2. **External Interface Definition Language (IDL) that “maps” to the language and generates local “proxy”
  3. Support directly in language from beginning (Java, RMI and JVM)