App Servers & J2EE Platform

Contents:

- TP-Monitors, OTS
- CORBA
  - service
  - evolution
- Application Servers
- Component-based development
- J2EE Platform
  - EJBs

Mariano Cilia / mcilia@gmail.com

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Transaction Processing Monitors

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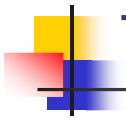

TP-Monitors

- TPMs are SW systems intended to provide transactional processing for large applications with many clients
- No "standard" TPM (many ad-hoc solutions)
- Main function of TPMs is to integrate systems and manage resources
- Repetitive workloads, i.e. users execute predefined simple functions (canned transactions)

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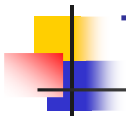

TP Monitors (cont)

- OLTP functions typically simple, 10 disk I/Os, 10^5 to 10^7 instructions
- High availability
- Many terminals (clients): 1000 to 100000
- Automatic load balancing
- TPMs are typically built according to a three tier architecture

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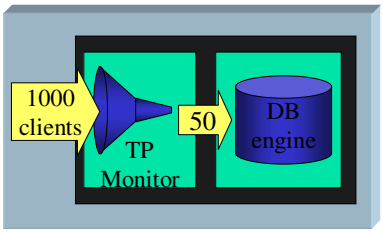
TP Monitors (cont)

- 30 years old technology (robust)
- maximize the reuse of scarce system resources
  - high-volume of transactions
- automatically manage the entire environment that the business system runs in, including:
  - transactions
  - resource management
  - fault tolerance
  - load balancing
  - communications
- procedure oriented



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TP Standards

- Standardization of APIs ==> portability of applications and DBMSs across TPMs
- Standardization of protocols ==> interoperability of TPMs
- Standardization began mid-80s and standards are still evolving

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Commercial TPM Products

- **CICS** (IBM)
- IMS (IBM)
- **TUXEDO** (BEA)
- ACMS (Digital)
- Encina (Transarc)
- TOP END (AT&T/NCR)
- Pathway/TS (Tandem)
- Adabas TPF (Software AG)
- **Microsoft Transaction Server (Microsoft)**
- **X/Open DTP** standard
- OTS

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TP-Monitors - Trends

- TP monitors become portable application server environments
- TP monitors become universal traffic managers
- TP monitors become resource brokers
- TP monitors discover client/server tools
- TP monitors meet objects ==> Object Monitors

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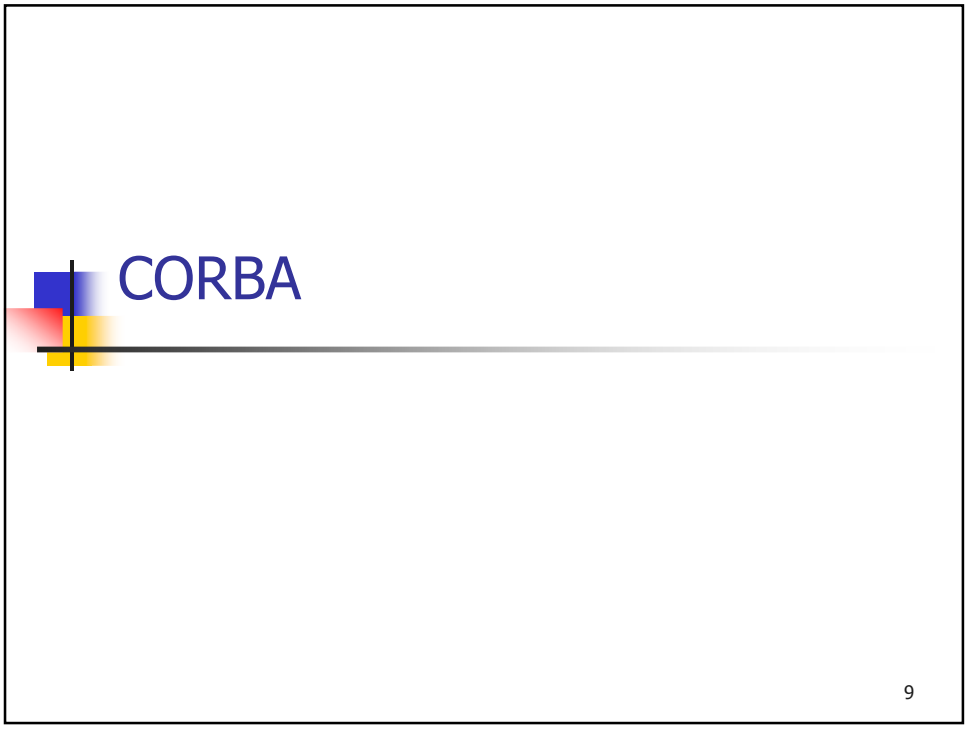
CORBA
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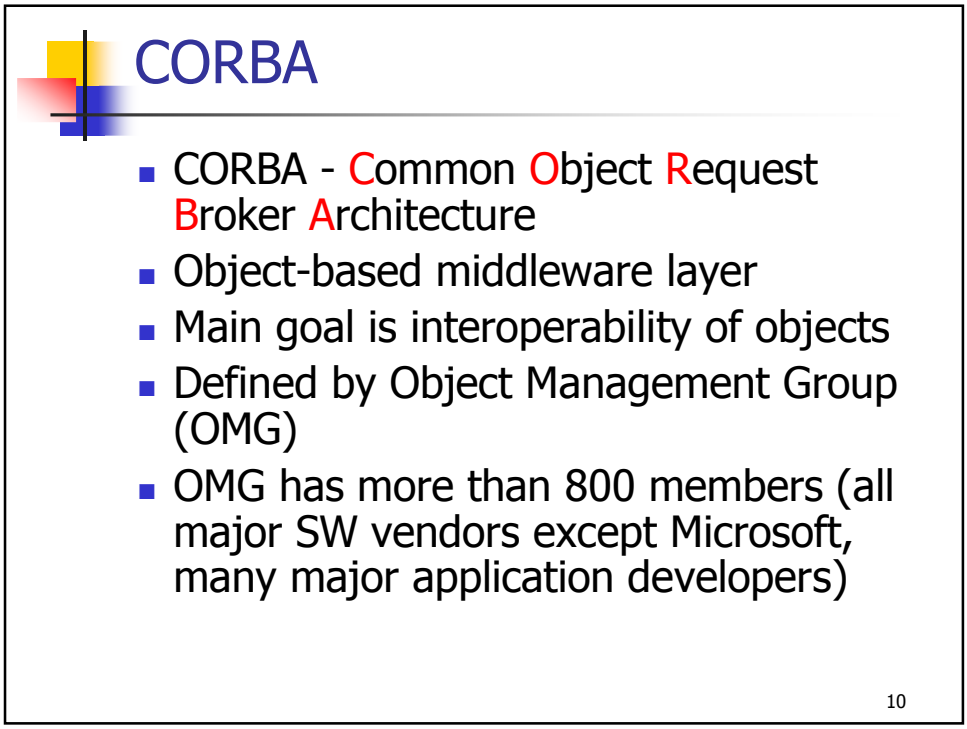
CORBA
CORBA - Common Object Request Broker Architecture
Object-based middleware layer
Main goal is interoperability of objects
Defined by Object Management Group (OMG)
OMG has more than 800 members (all major SW vendors except Microsoft, many major application developers)
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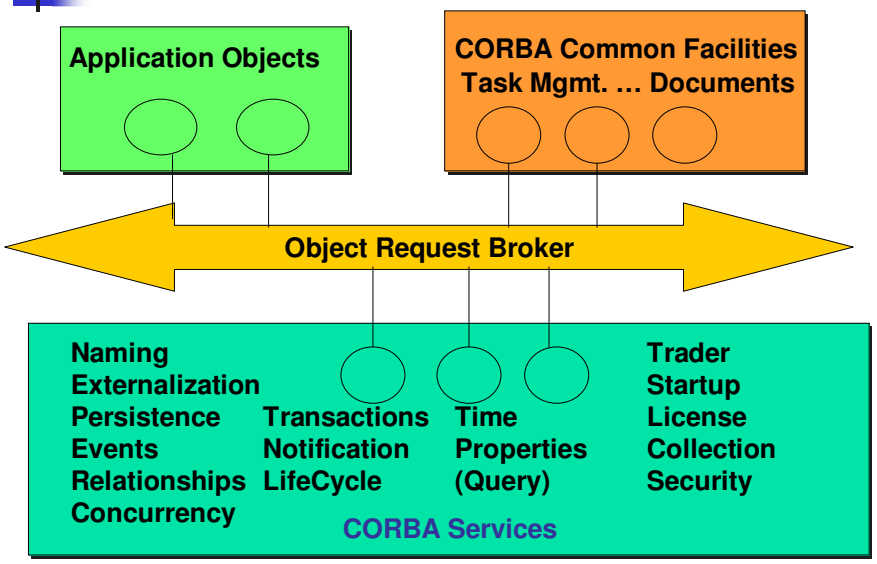
OMG Object Management Arch.



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IDL

- Declarative language used to define objects and their contractual interfaces
- IDL provides OS- and PL-independent interfaces to all the services on the CORBA bus
- IDL only for specification of attributes, parent classes, methods and events supported, and exceptions raised, no implementation
- Implementations in any language for which bindings exist (C, C++, Ada, Smalltalk, COBOL, Java)

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IDL (cont.)

- To request a service from another object, an object must know the target object's supported interface
- Interface Repository contains the metadata needed to discover other components at run time

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Object Request Broker (ORB)

- ORB functions as an object bus
- Static (compile-time) and dynamic (run-time) method invocation
- High-level language bindings: standard interfaces and language-independent types allow invocation of a service independent of the language it is written in
- Self-describing system through metadata for interface definitions, either IDL precompiler or directly from OO-PL compiler (Java bytecode)

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ORB (cont.)

- Local/remote transparency: ORB can function on stand-alone machine or interoperate with other ORBs (via IIOP - Internet Inter-ORB Protocol)
  - while user doesn't need to be concerned with location of an object, price is in the performance
- Support for security and transactions
- Polymorphic messaging (target specific)
- Coexistence with legacy systems through encapsulation of legacy code with IDL interface

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CORBA Services

- Life Cycle Service
  - defines operations for creating, copying, moving and deleting components on the bus
- Persistent State Service
  - provides single interface for storing objects persistently on various storage servers (OODBMSs, RDBMSs, files)
- Event Service
  - allows components to register/unregister interest in specific events. Event channel collects and distributes events among objects

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CORBA Services (cont.)

- Naming Service
  - allows components on the bus to locate other components by name. Also allows objects to be bound to existing network directories or naming contexts (ISO X.500, OSF DCE, Sun NIS+, Internet LDAP)
- Concurrency Control Service
  - provides a lock manager that can obtain locks on behalf of transactions or threads

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CORBA Services (cont.)

- Transaction Service
  - provides two-phase commit coordination among recoverable components using either flat or nested transactions
- Relationship Service
  - provides a way for creating dynamic links among components and to traverse them. May be used for enforcing referential integrity, containment, etc.

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CORBA Services (cont.)

- Externalization Service
  - provides a standard way for getting data into and out of a component using a stream-like mechnanism
- Query Service
  - provides query operations on objects. Based on SQL3 and ODMG's OQL (not implemented)
- Licensing Service
  - provides metering of a component's use for fair charging (per session, per node, per site, ...)

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CORBA Services (cont.)

- Properties Service
  - associates named values (properties) with any component.
- Time Service
  - provides interfaces for synchronizing time in a distributed object environment and for defining and managing time-triggered events

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CORBA Services (cont.)

- Security Service
  - provides framework for distributed object security (authentication, access control, confidentiality and non-repudiation, delegation of credentials)
- Trader Service
  - provides "yellow pages" allowing objects to publizise their services and bid for jobs
- Collection Service
  - provides interfaces to create and manipulate collections

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CORBA 1.0

- CORBA 1.0 specified minimal ORB functionality:
  - Basic ORB
  - IR (Interface Repository, BOA (Basic Object Adaptor)
  - C Bindings
  - Naming
  - Events
  - Life Cycle
  - Persistence

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CORBA 2.0

- CORBA 2.0 provides for interoperability among ORBs

IIOP	Licensing
Federated IR Documents	Compound
C++ bindings	Trader
Transactions	Concurrency
Security	Externalization
Collections	Relationships
Time	Query

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CORBA 3.0

- CORBA 3.0 addresses the issues of portability, vertical integration, life in the object-Web
  - Messaging (MOM) — Server Portability (POA)
  - Multiple Interfaces — Java Bindings
  - Business Objects/Java Beans
  - Objects-by-Value — Mobile Agents
  - CORBA/DCOM — Automatic Persistence
  - IIOP Firewall Support — Workflow
  - Domain-Level Frameworks

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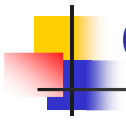

Object Transaction Service (OTS)

- Object Transaction Service specification defines transactional service based on CORBA for OO programming environment
- Specified by OMG (Object Management Group)

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ORB vs. TP monitor

- ORB performs many functions of a TP monitor
  - if object is defined as transactional (via IDL attribute) ORB directs transactional client calls to transactional server
  - when client issues method invocations, ORB manages the transaction context using the transaction service
- OTS does not specify a required 2PC protocol ==> interoperability depends on implementation
- ORB doesn't provide performance of TPM

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from TP-Monitors to Component Transaction Monitors

(also known as Application Servers)

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N-tiered Systems

- n-tiered systems developed with applications deployed over the Internet
  - client
  - [the network: ISP - Internet Service Provider]
  - web server
  - application server(s)
  - resource (e.g. database) server(s)

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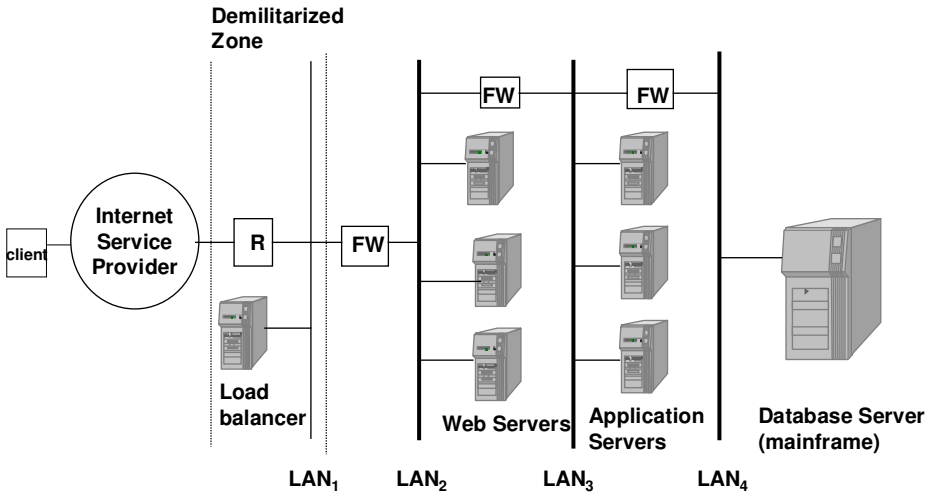
N-tiered Sys: Reference Arch.



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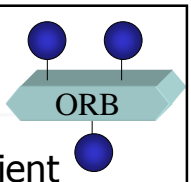
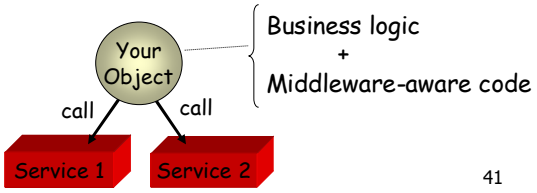
ORBs



- facilitate *connectivity* between the client application and the distributed objects
  - locate and use distributed objects
  - communication backbone
- let distributed objects *interoperate* across address spaces, languages, OS, and networks
- not always adequate in high-volume transactional environments



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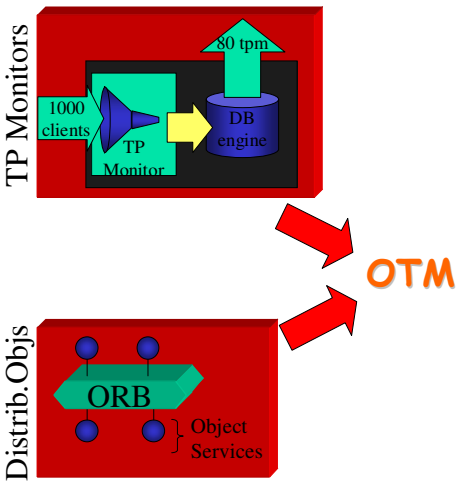
Object Transaction Monitor



- (OTM)
- hybrid of:
  - TP Monitors
  - ORB Technologies
- make easier for developers to create, use and deploy business systems
- capable of handling huge user population and mission-critical work
- provide an infrastructure to manage:
  - transactions, object distribution, concurrency, persistence and resource management

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Component Transaction Monitor

- (Application Servers)
- Component Model + (TP-Monitor + ORB)
  - robust server-side component model
- *deployers* define and administer declaratively the properties of the components by setting their attributes
- resource and service management (monitor)

- CTMs are to business objects what ...
  - RDBMS are to data
  - the railway system is to the trains

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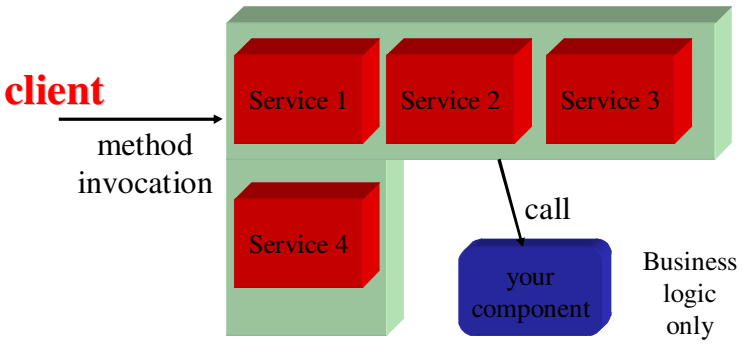
CTM Approach



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Component Transaction Monitor

- At runtime,
  - it "intercepts" all incoming calls
  - invokes the appropriate callback objects within a container
  - and then passes the request to your object
- Also,
  - pre-starts pools of objects
  - distributes loads
  - provides fault-tolerance
  - coordinates multi-component transactions
- if you play by the CTM's rules, your objects become managed, transactional, robust, persistent, secure and high-performing

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Application Servers

- Modern equivalents to traditional TP monitors
- All based on Java 2 Enterprise Ed (except M$)
- Commercial:
  - BEA WebLogic, IBM WebSphere, Oracle AS, CA, IONA, Fujitsu, …
- Open Source
  - JBoss, JOnAS, Apache's Geronimo, SUN's GlassFish, …
- Vendors differentiation based on:
  - Scalability, high availability, reliability, ease of use, legacy data and app integration, complementary prods (e.g. personalization, workflow,…), etc.

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Application Servers (cont.)

- Trend to migrate business logic back to the server and away from the client
  - intellectual property protection/sensitive business data better kept on server, rights can be revoked
  - manageability through thin clients (upgrades, versioning, bug fixes managed on servers)
  - performance (especially of DB intensive apps.)
  - secure network communications
  - minimize downtime
  - reuse of components

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Application Servers (cont.)

- increased reliability through server redundancy
- increased flexibility through multiple tiers
- multi-client support
  - conventional desktops
  - web-clients
  - esoteric devices (smartcards, PDAs, information appliances, cell phones)
- support of variety of middleware services and resource management (multithreading, resource sharing, replication, load balancing)

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Open Standards

- Open Source: open reference impl.
- HTML: Web user interface
- XML: Web data & vocabularies
- EJBs: Business logic
- JCA: connectors
- Web Services (SOAP, WSDL, UDDI)
  - Dynamic app navigation, discovery and interaction
- BPEL4WS: flow composition

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App. Server Functionality

- Component container
- Transaction integration
- Thread/connection pooling
- Memory management
- Load balancing/failover
- Session/state mgmt
- Connections
  - RDBMS
  - Transaction Systems
  - ERP Systems
- Dynamic Page generation
- HTTP

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App. Server Functionality (2)

- Quality of service: clustering, cloning, routing, failover, session persistence, session migration, load balancing
- Caching: data and objects
- Authentication: single sign-on
- Messaging

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The Application Server Market

	2000	2001	2003	…	2006
(million dollars)	990	1180	2100	...	9100
Market share (%)					
BEA	33	34	27		
IBM	22	31	30		…
Sun	10	9	4		
Iona	0	3	5		
Oracle	1	1	19		
Others	34	22	…		

(Gartner May 2002)
(IDC May 2004)
(Gartner Nov 2006)

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Java Application Servers

- Java has grown into one of the premier PLs
  - ubiquitous on the I*Net
  - as 3GL it competes with C++ (less powerful but easier to use, interpreted, no memory leaks)
  - as 4GL it provides classes for business abstractions
  - loading of new functionality via standard bytecodes
  - platform for component-oriented computing
  - reasonably fast

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Java – Open Community

- Java Community Process
  - JCP.org (starting on 1999)
- members: companies + individuals
- Java Specification Request
- > 900 (2005), 224 (2002)
  - 60% are led by Java partner companies
  - 40% are led by Sun

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The J2EE Platform for E-Business

- Technology of Choice for Today's E-Business Systems
  - 80% of all enterprises use the Java language (Gartner)
  - 92% of companies that choose J2EE for enterprise computing are happy with their choice (Forrester)
  - 78% of executives view J2EE as the most effective platform for building and deploying Web Services (Giga poll)
  - The J2EE Platform market is more than $ 9 billion strong and growing

(Gartner Nov 2006, …)

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Some Java Numbers

- More than 2.5 Million of registrations at Sun's Java Developer Connection
- 60% of developers expect to use Java when building web services
  - (Evans, Spring 2002)
- J2EE is was $1+ billion market in 2001
  - $9 billion in 2006
- 53.8% of developers are either currently use J2EE or plan to use it
  - (Evans, Spring 2002)
- 31 v1.3 J2EE Commercial Licensees (Spring 2003)
- 6 v1.4 J2EE Commercial Licensees (Winter 2004)
- J EE 5 brought more consolidation

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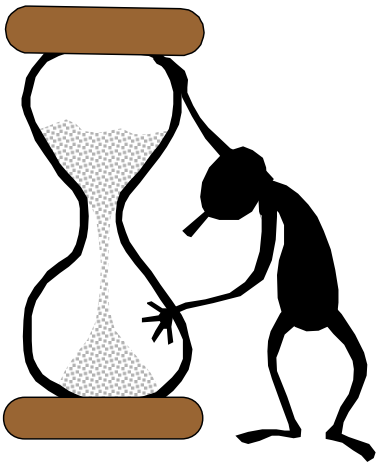

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