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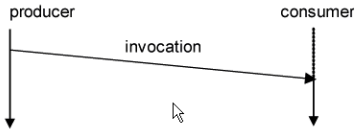
Paradigms for distributed applications

Producer-consumer interaction

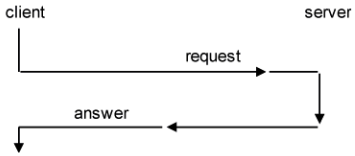
In this interaction type (also called fire & forget interaction) after an invocation of the consumer, the producer resumes its execution immediately (and is not suspended).



Special case: Pipe mechanism (similar to unix pipes); after information has been provided to the consumer, the producer terminates the execution.

Paradigms for distributed applications

The client-server model implements a sort of handshaking principle, i.e., a client invokes a server operation, suspends operation (in most of the implementations), and resumes work once the server has fulfilled the requested service.



SOA

Service-oriented architecture (SOA): abstract architectural approach

- loose coupling and dynamic binding between services
- based on principles of modularized software and interface/component-based design

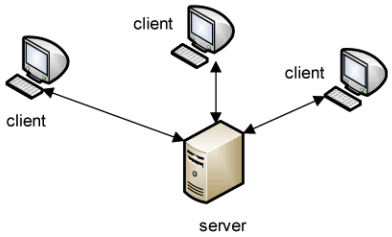
Collection of services

- services communicate with each other, e.g. data passing or remote invocation
- each service must manage its own data

SOA contains 3 roles: service requestor, service provider and service registry.

Web services represent an implementation of SOA concept (currently the most important one)

A central component (the server) provides a service to requesting clients.



Request-Answer Interaction

SOA

Examples for servers

In a distributed environment, a server manages access to shared resources (e.g. a file server).

Problems:

- server crash ⇒ resource is no longer available in the network.
- server becomes a bottleneck for accessing the resource.

Internet Explorer, Netscape/Opera browser are examples for clients and Apache Web-Server is an example for a server.

Web Server - HTTP

Communication between Web Browser and Web Server is based on the HTTP protocol

- stateless protocol.
- based on TCP sockets using typically port 80.
- session information is handled by the application layer (cookies).

HTTP protocol supports

- the methods get, put, post, ..
- return values / status code, such as
  - 404: not found
  - 401: unauthorized
  - 400: bad request

Paradigms for distributed applications

Client-Server

Servers are centrally maintained and administered

Client has fewer resources than a server

Peer-to-Peer (P2P)

A peer's resources are similar to the resources of the other participants.

peers communicate directly with other peers and share resources.

Issues of P2P

Peer discovery and group management

Data location and placement

Reliable and efficient file exchange

Security/privacy/anonymity/trust

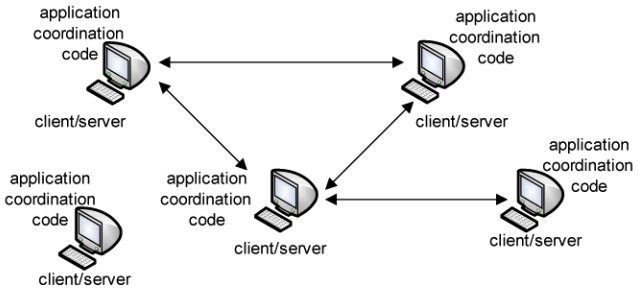
Peer-to-peer model

All processes play a similar role

interacting cooperatively as peers to perform a distributed computation.

there is no distinction between clients and servers.

clients talk directly to one-another.



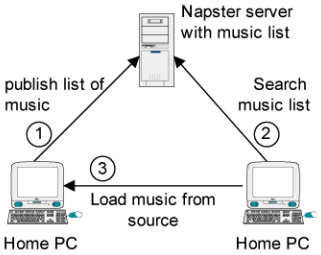
Client-Server vs. Peer-to-Peer

Napster

Gnutella

Other System Examples

Napster was one of the first P2P applications.



Technical issues

Many clients aren't accessible

many client systems come and go

Firewalls limit incoming connections to clients

round trip times to some regions are very slow

most clients had slow upload links

Clients might withdraw a file unexpectedly.

Legal issues

When service was launched, Napster designers hoped they had a way around the legal limits of sharing music:

- clients advertise stuff
- if some of that stuff happens to be music. That is the responsibility of the person who does it.
- the directory server "helps clients to advertise stuff" but it does not endorse the sharing of protected intellectual property.
- Napster is making money by integrating Ads.
- In the court case the judges saw it differently: Napster's clear purpose is to facilitate theft of intellectual property.

All processes play a similar role

- interacting cooperatively as peers to perform a distributed computation.
- there is no distinction between clients and servers.
- clients talk directly to one-another.