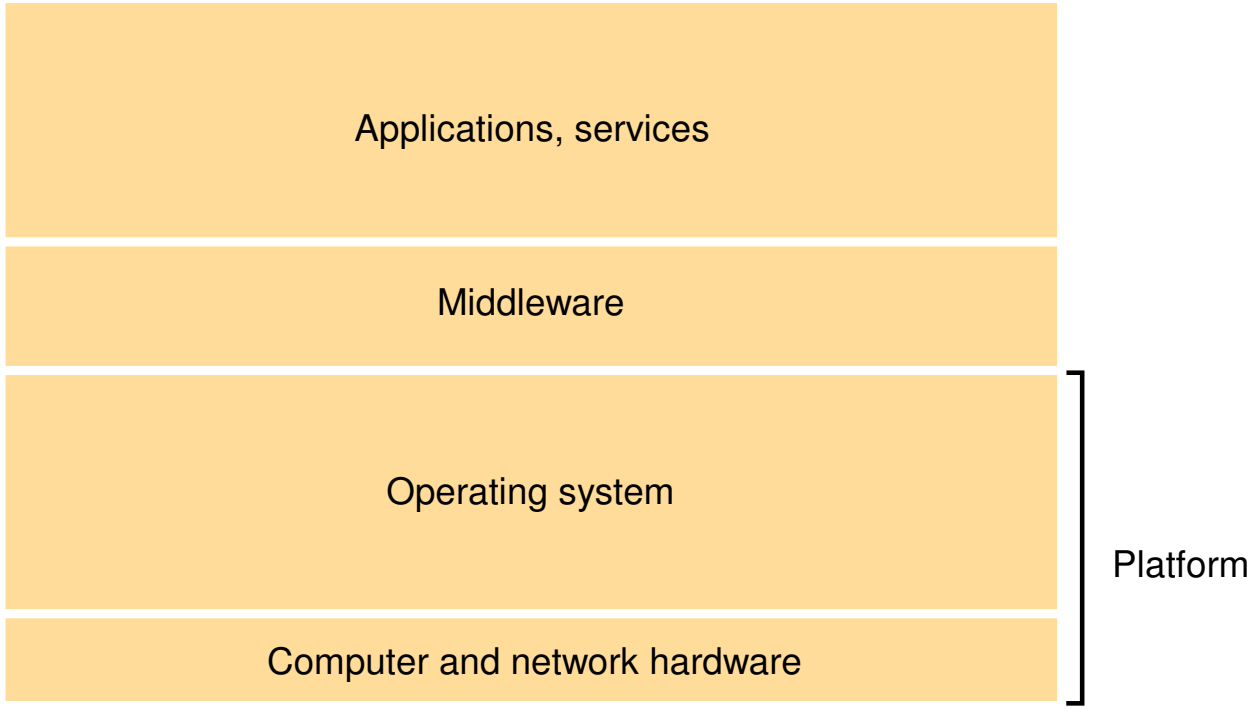
Chapter 2

System Models

Architectural Models

- In architectural models, we consider
  - Patterns of placement of components (tasks)
  - Patterns of communication between components
- All architectural models are based on the software service layers.

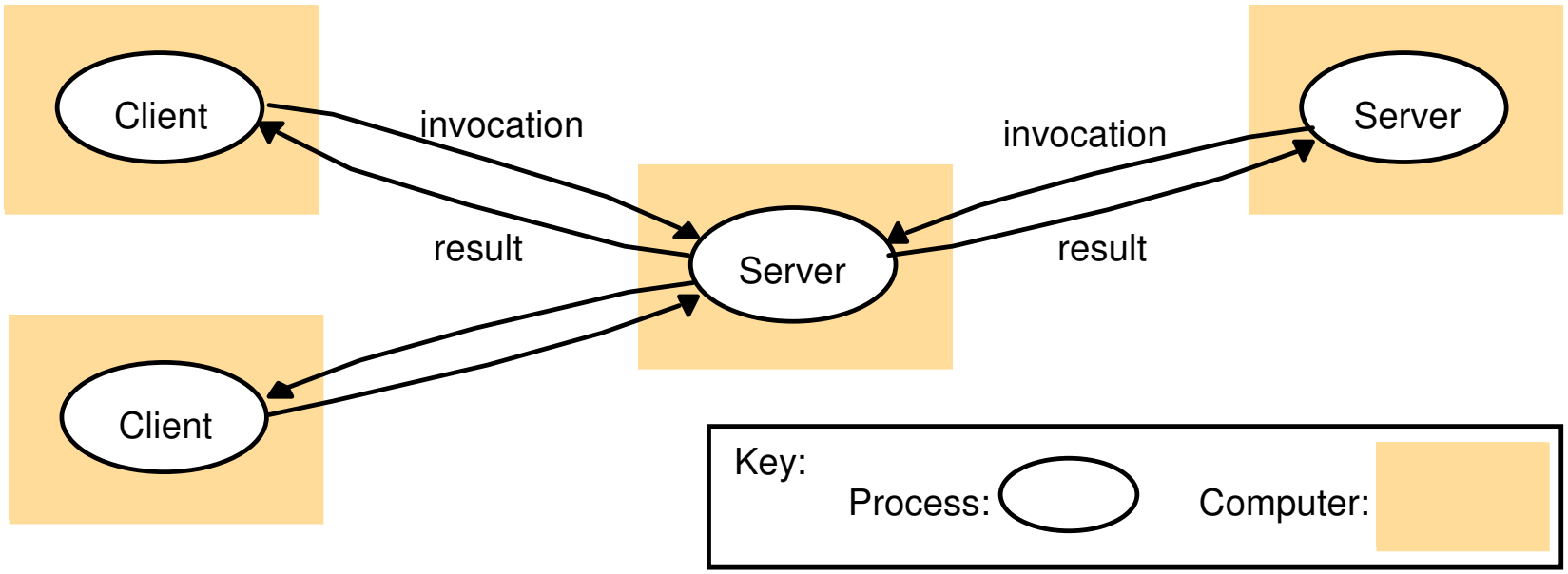


Layered Software Architecture

- Software service layers are offered and requested by processes on the same or different computers.
- Platform
  - Provides interface for services to the layers above.
  - May be heterogeneous, e.g. Sun SPARC/SunOS, Pentium/Windows, Pentium/Linux, PowerPC/MacOS
- Middleware is processes or objects in a set of computers that interact with each other to implement communication and resource sharing support.
  - Masks heterogeneity.
  - Provides programming model for applications and building blocks for construction of applications (e.g. remote method invocation, group communication, notification of events)

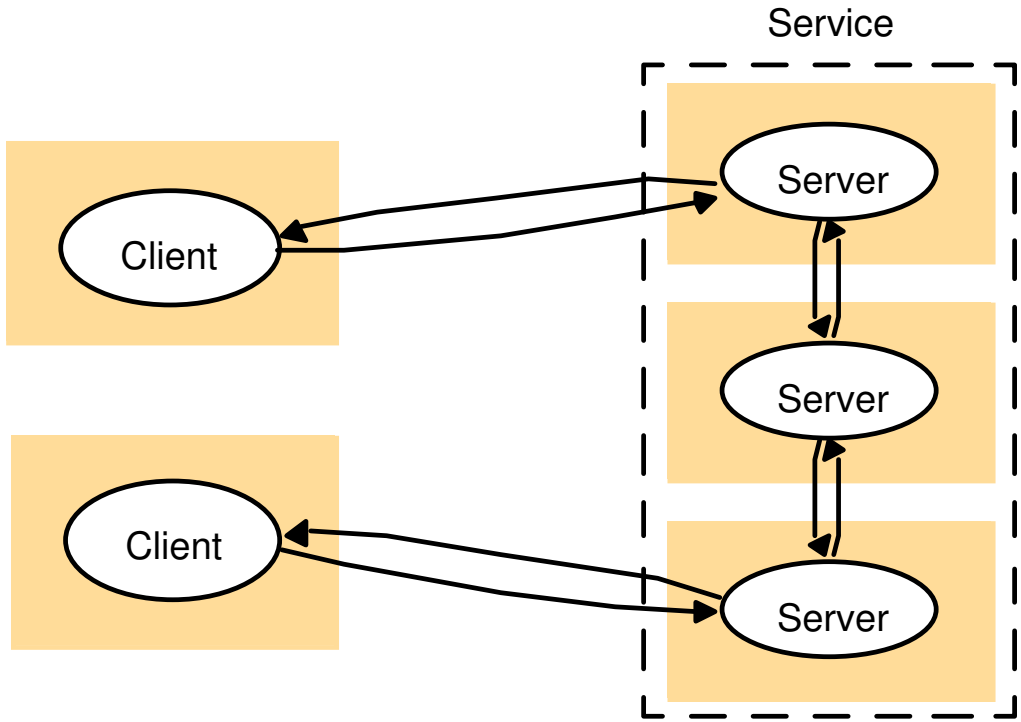
Client-Server

- This is the most important and widely employed architectural model.
- Servers may be clients of other servers:
  - Web server is client of local file server and DNS.
  - Search engine (its crawler) is client of other Web servers.



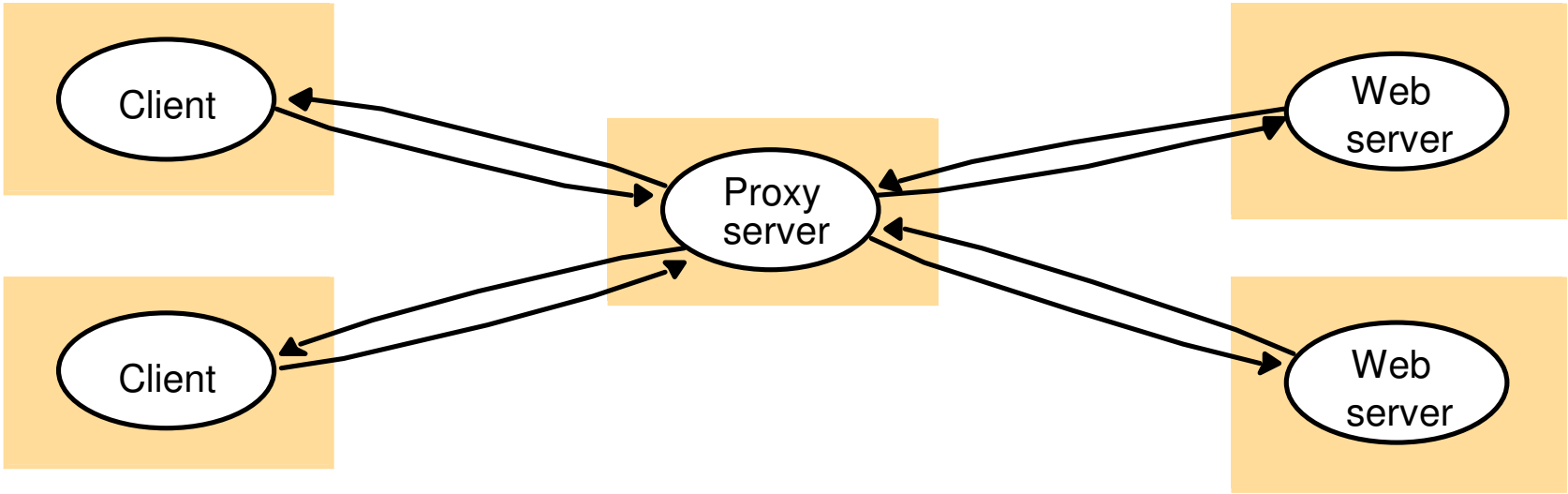
Service provided by multiple servers

- Set of objects on which the service is based is partitioned into multiple servers:
  - A browser can access multiple Web servers.
  - A Web server maintains consistent updates of its replicas.



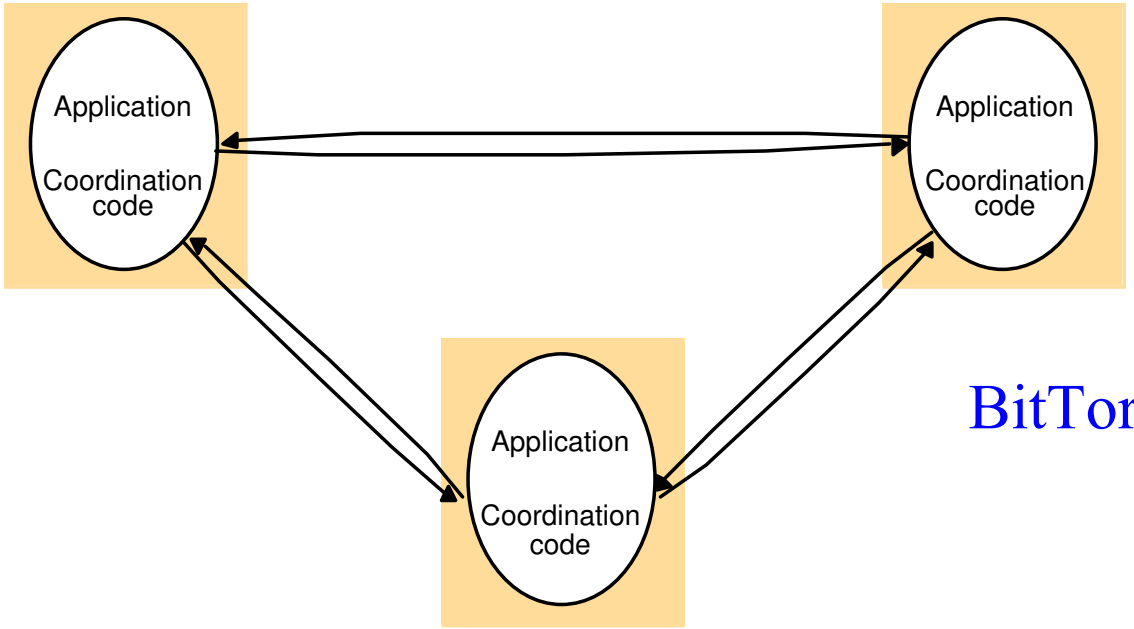
Proxy Servers and Caches

- A cache stores recently used data objects for fast access.
- It is checked if it is up-to-date when an object is needed. If not, an up-to-date copy is fetched. time-to-live
- Cache may be with each client (e.g. browser cache in local file system) or may be a proxy server to be shared by several clients (e.g. Web proxy).



Peer Processes

- All processes have similar roles.
- Code in the peer processes synchronizes their actions; patterns of communication depends on applications.
  - This provides good interactive response (e.g. whiteboard, online game); each site relies on the middleware for event notification and group communication to notify all the processes about changes generated at the site.

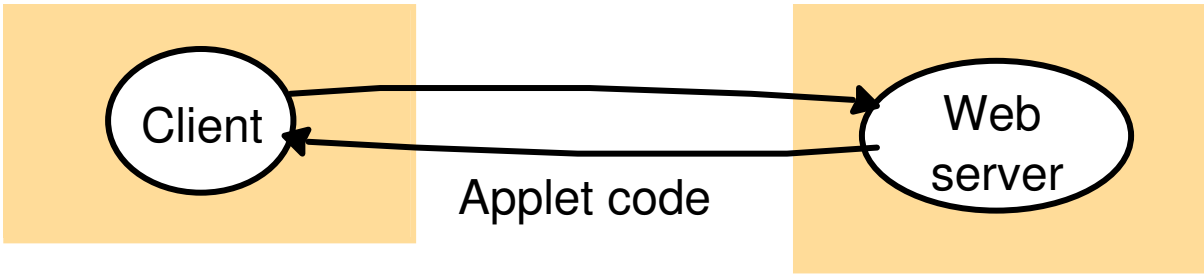


BitTorrent

Mobile Code

- Applet code is stored on Web server. Browser downloads it and runs when a link is selected.
- It gives good interactive response but is also a security threat; browser gives applet limited access to local resources.

a) client request results in the downloading of applet code



b) client interacts with the applet

Mobile Agent

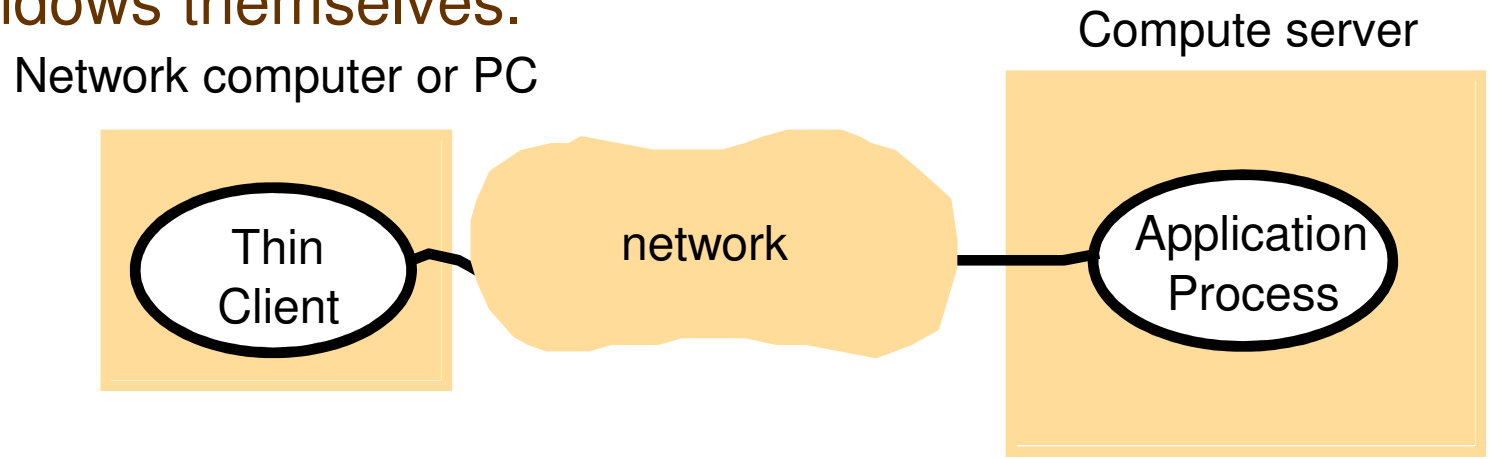
- It is a running program (code and data) that travels from one computer to another to carry out some task on someone's behalf:
  - To collect information
  - To install or maintain software
- It may invoke resources at each site it visits.
- There is a reduction in cost and time by local invocations, instead of remote ones (e.g. when transferring large amount of data).
- The site decides on which local resources are allowed to use based on the identity of the user on whose behalf the agent is acting.

Network Computer

- Typically, having application files and local software at a local computer requires the user to have technical skills to maintain.
- To reduce management cost, a network computer downloads operating system and software from a remote file server.
- Applications are run locally but the files are managed by a remote file server.
- The user can migrate from one computer to another to work.
- A disk may be used at a local computer as a cache, holding recently loaded software and data files.

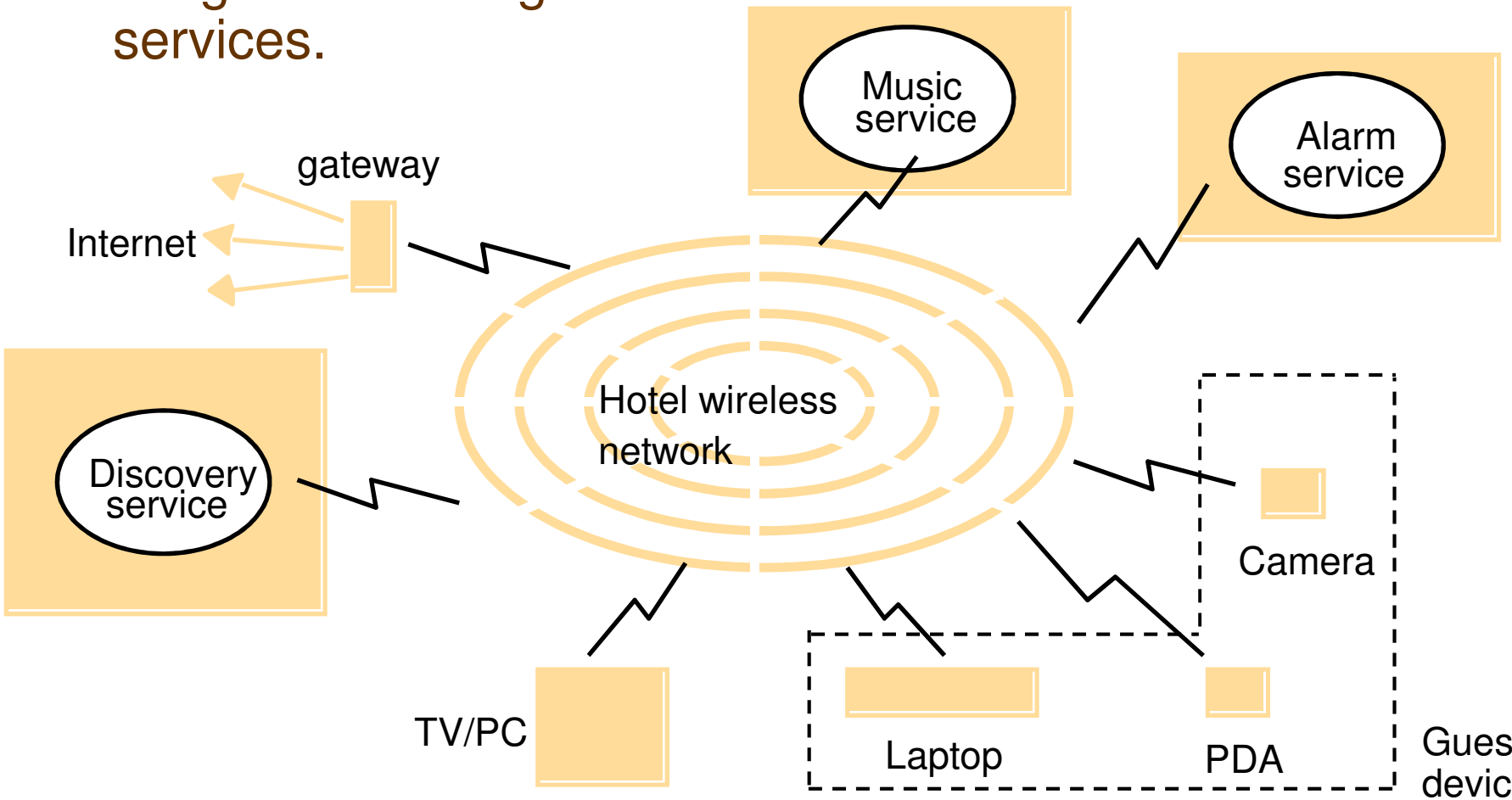
Microsoft Virtual Desktop Infrastructure

- Thin client is a software layer that supports a window-based user interface on a local computer while executing application programs on a remote compute server (e.g. X-11 window system on UNIX, WinFrame on NT, Web browser).
- The compute server is powerful to run many applications simultaneously, typically a multiprocessor or cluster computer.
- The drawback is in highly interactive graphical activities, transferring information to manipulate graphical objects and the windows themselves.



Spontaneous Networking (1)

- Mobile devices carried between network environments are integrated into a given network and can use local and remote services.



Spontaneous Networking (2)

- A device brought into a new network is transparently reconfigured to obtain connectivity there.
- The device discovers automatically what services are provided there.
- Users are not always connected as they move around; the system should support the user to work while disconnected.
- Users' privacy may be lost due to tracking of physical location while they move around (e.g. active badge, mobile phone)
- Security may be threatened when users on the move access their home intranet and may expose data that is to remain behind the firewall.

High availability

offline