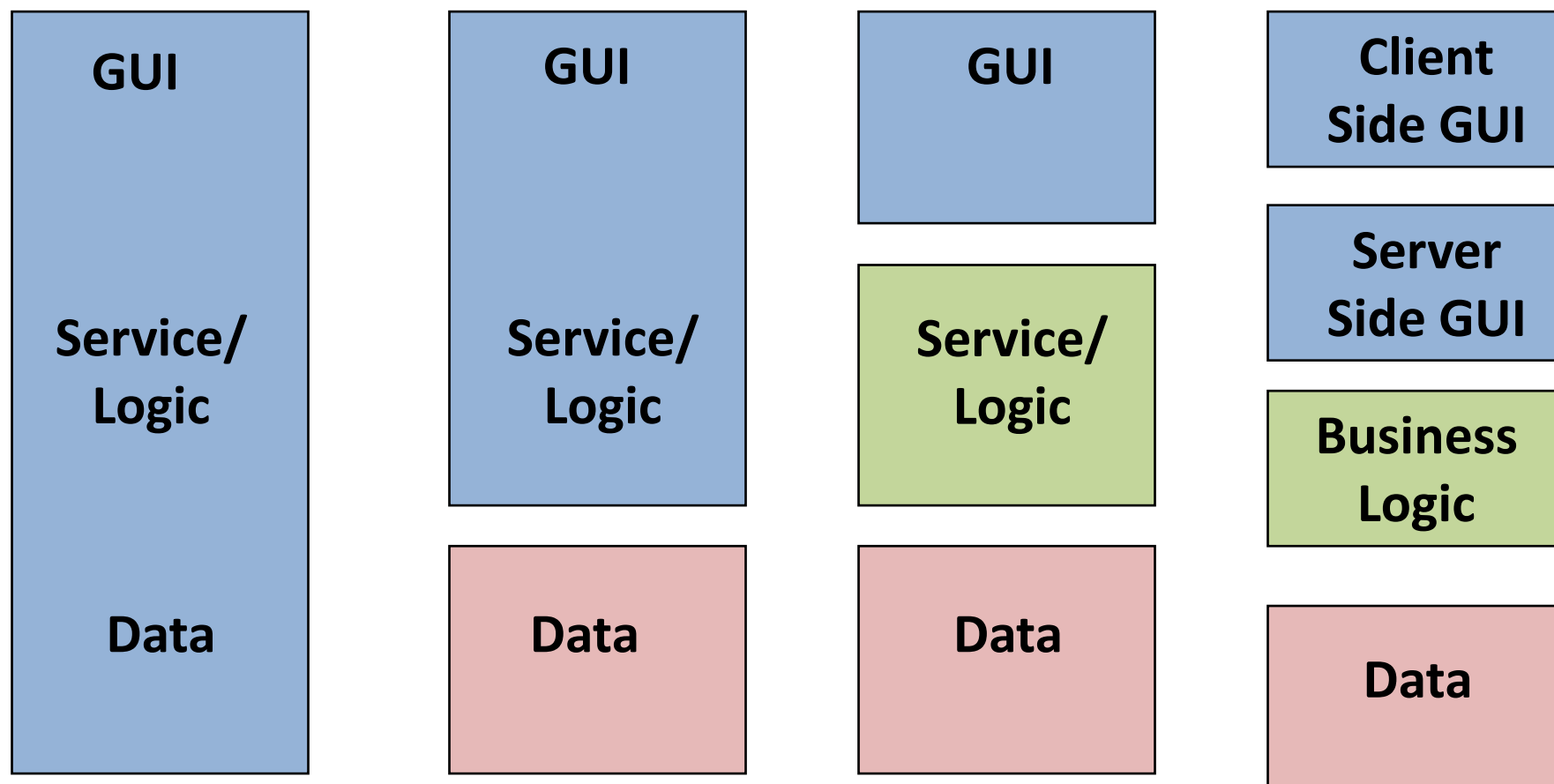


# Cloud Services & Distributed Computing

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## History of Distributed Systems

# Evolution of Distributed Systems



# Evolution of Distributed Systems

## Monolithic Systems (Single-Tier)

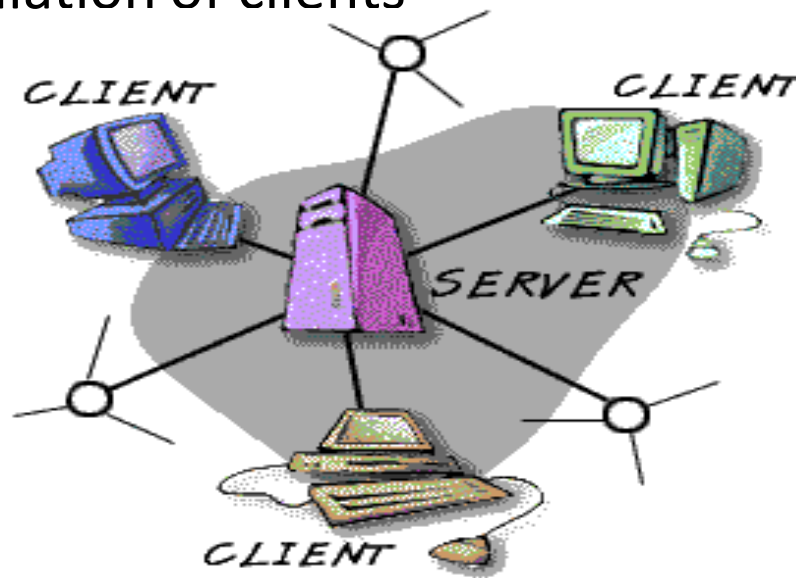
- Central processing (mainframe)
- Multiple access supported by time sharing Operating Systems
- Primitive User Interface



# Evolution of Distributed Systems

## Client/Server Database Systems (Two-Tier)

- Centralised DBMS, often running on a Unix system
- Windows clients connect over a LAN.
- Service Logic resides on a client, for example, calculation of pay after overtime rates etc..
- Manual Installation of clients



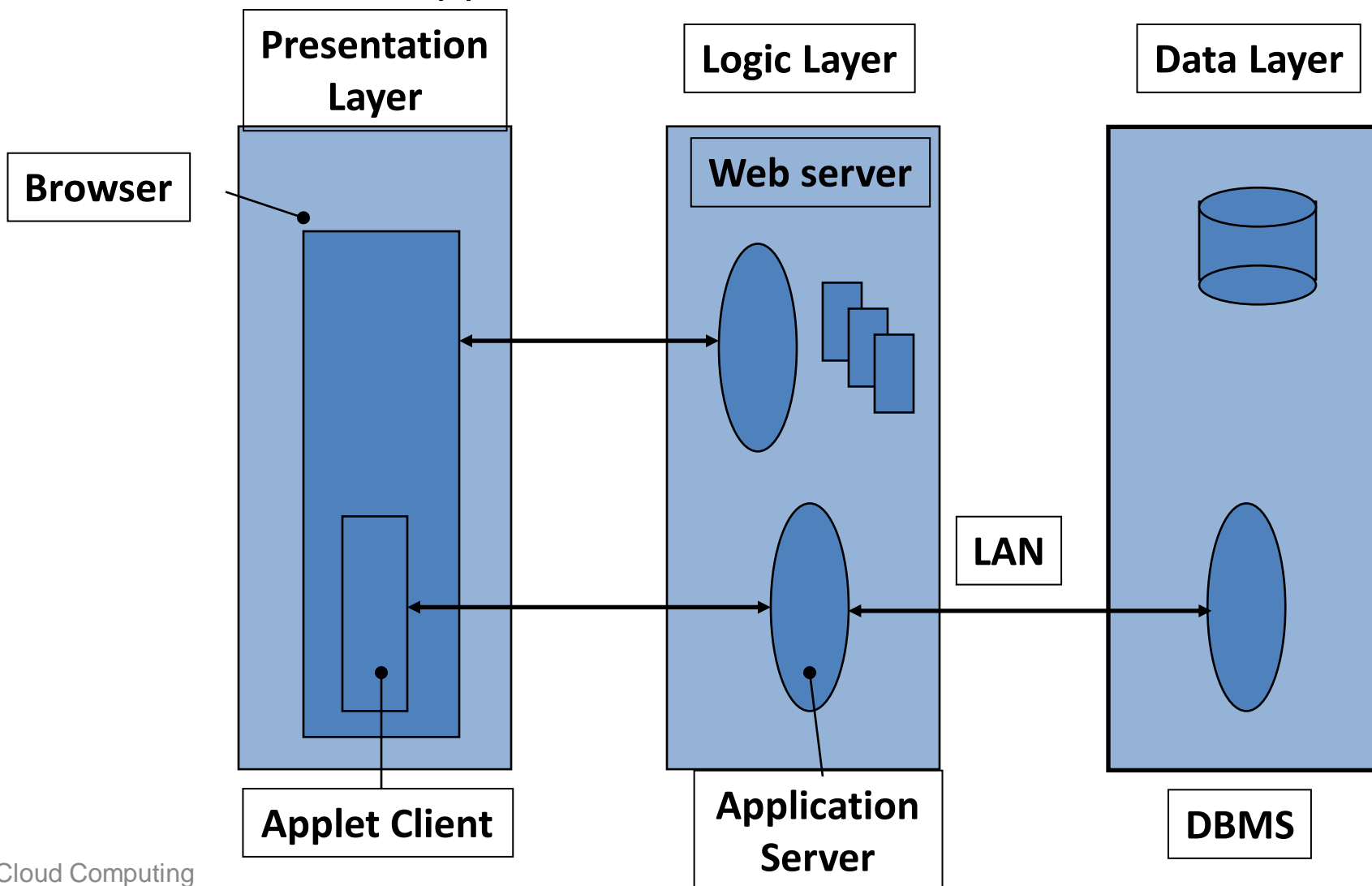
# Evolution of Distributed Systems

## Multi-Tier Systems

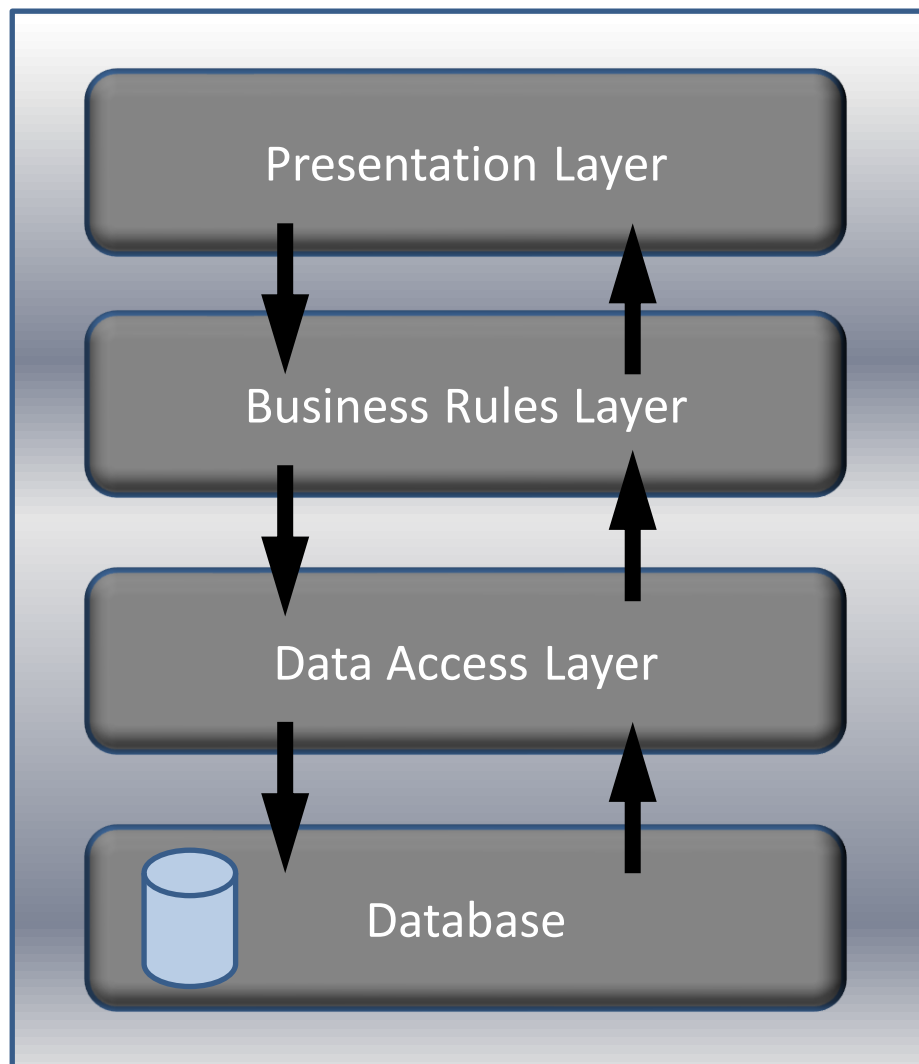
- Database server on one host
- Web server and Application server on another host (connected by a LAN)
- (Thin) Clients downloaded as applets. Communicates with the application server.

# Evolution of Distributed Systems

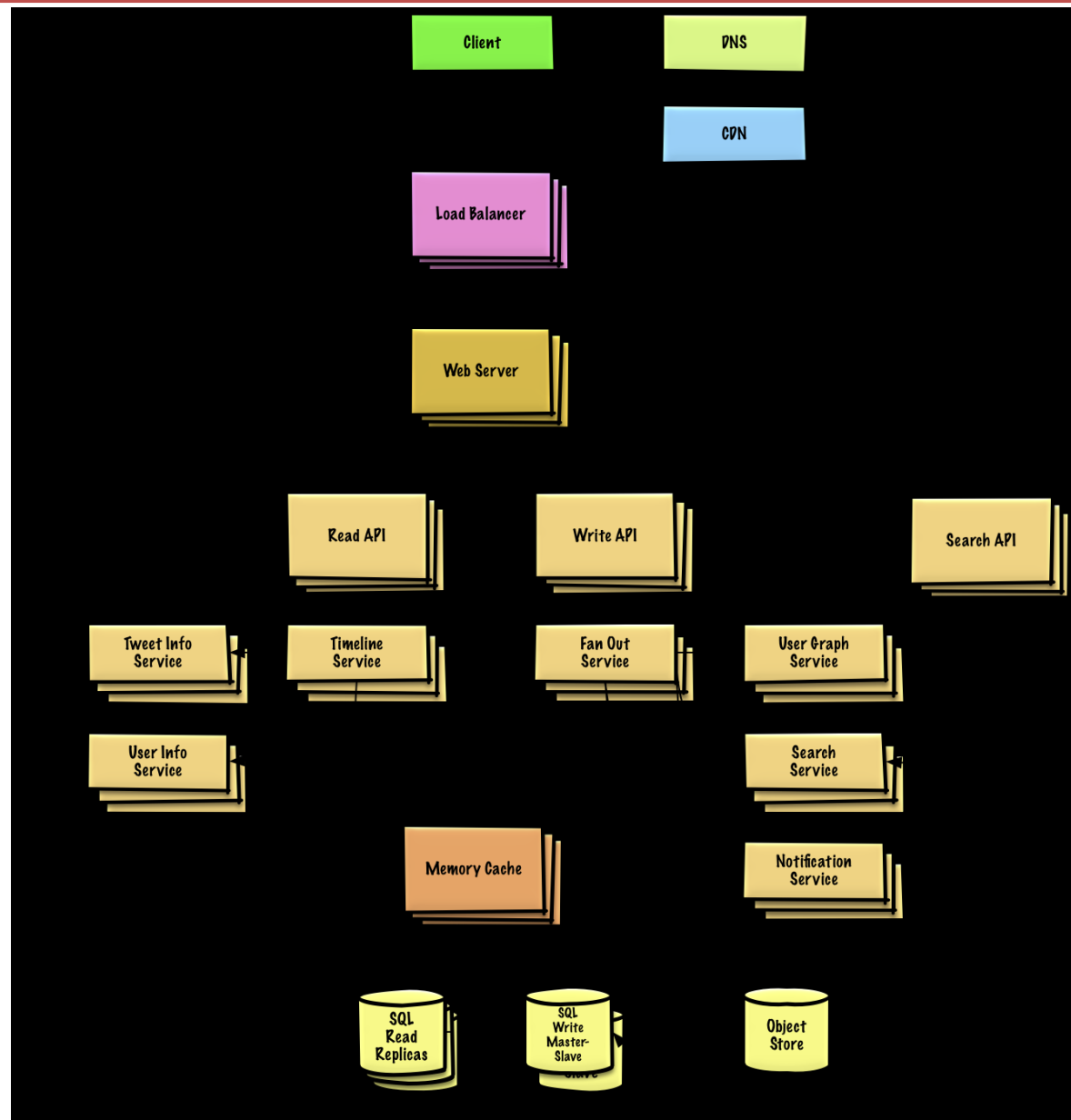
## Multi-Tier Web Applications



# Multi Tier Applications



# Sample N-Tier (Twitter)





# Centralised System Characteristics

- One component with non-autonomous parts
- Component shared by users all the time
- All resources accessible
- Software runs in a single process
- Single Point of control
- Single Point of failure

# Distributed System Characteristics

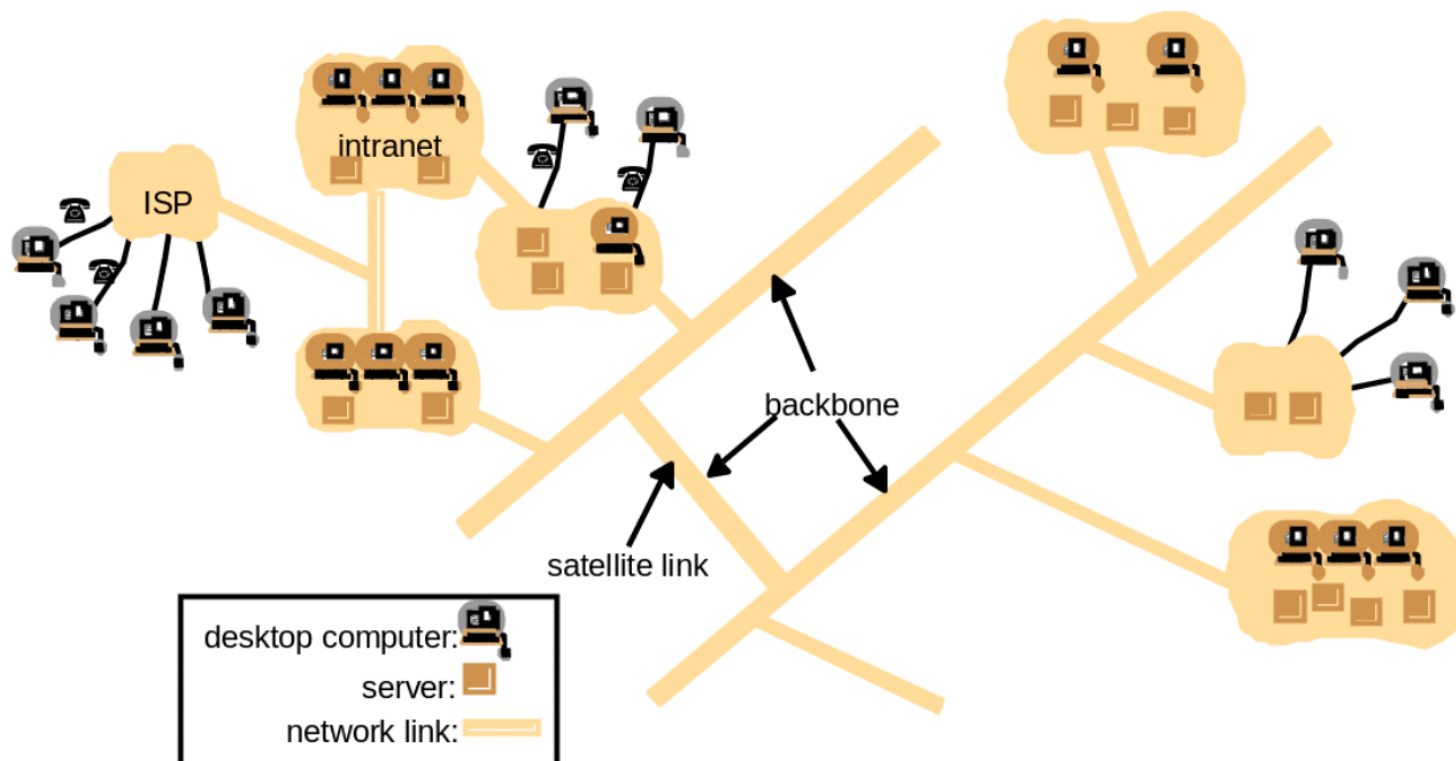
- Multiple autonomous components
- Components are not shared by all users
- Resources may not be accessible
- Software runs in concurrent processes on different processors
- Multiple Points of control
- Multiple Points of failure

# Examples of Distributed Systems

## 1. The Internet

- Heterogeneous network of computers and applications
- Implemented through the Internet Protocol Stack
- Typical configuration:

**A typical portion of the Internet:**



# Examples of Distributed Systems

## 2. Distributed Multimedia- Systems

- Often use Internet infrastructure
- Characteristics
  - Heterogeneous data sources that need to be synchronized in real time
    - Video
    - Audio
    - Text
  - Often: Distribution services
    - Multicast

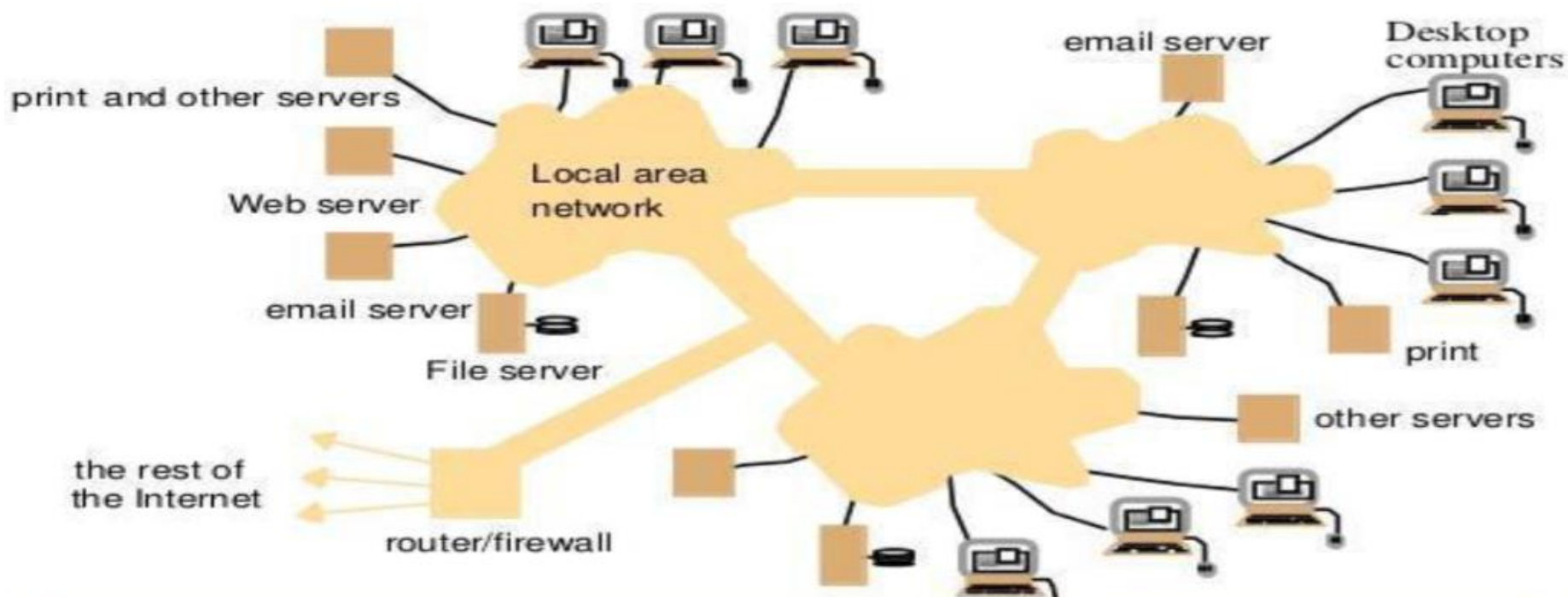
### Examples

- Tele-teaching tools
- Video- conferencing
- Video and audio on demand

# Examples of Distributed Systems

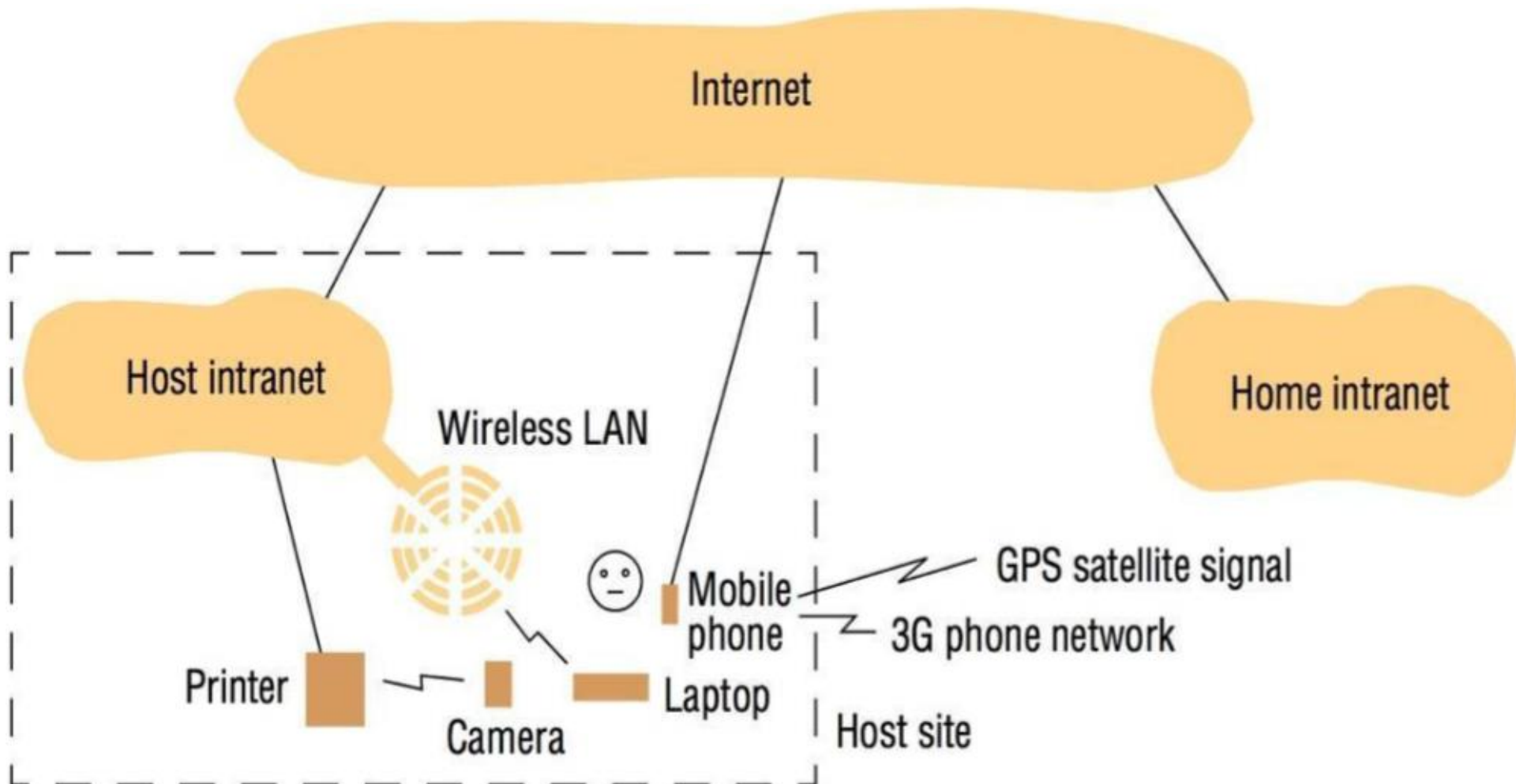
## 3. Intranets

- Locally administered network
- Usually proprietary (e. g., the University campus network)
- Interfaces with the Internet
  - Firewalls
- Provides services internally and externally



# Examples of Distributed Systems

## 4. Mobile and Ubiquitous Computing Systems



# Examples of Distributed Systems

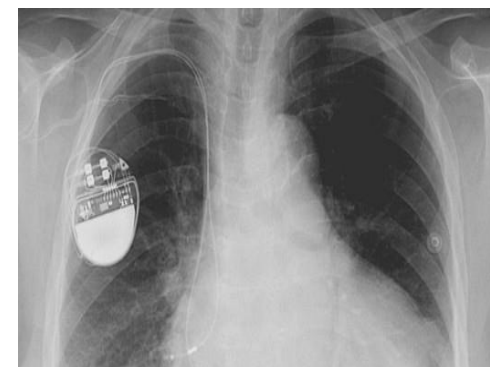
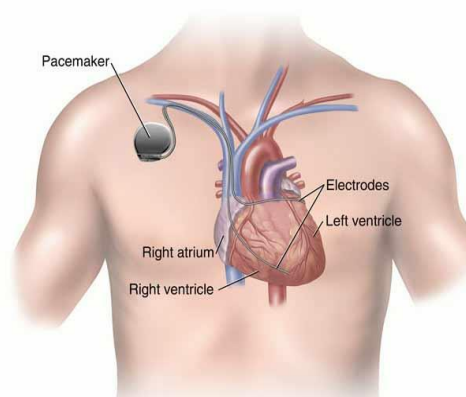
## 4. Mobile and Ubiquitous Computing Systems

- Cellular phone systems (e. g., GSM, UMTS)
  - Resources being shared
    - Radio frequencies
    - Transmission times on one frequency (UMTS: multiplexing)
    - The mobile on the move
- Laptop computers
  - Wireless LANs
  - Handheld devices,
    - PDAs etc. – Bluetooth networks
- Wearable devices

# Examples of Distributed Systems

## 5. Embedded systems

- Avionics control systems
  - Flight management systems in aircraft
- Automotive control systems
  - Mercedes S- Class cars are equipped with 50+ autonomous embedded processors
  - Connected through proprietary bus- like LANs
- Consumer Electronics
  - Audio HiFi equipment
- Medical Devices
  - Pace Makers





# Examples of Distributed Systems

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## Tele Surgery - "Lindbergh Operation"

<http://www.youtube.com/watch?v=d7lojFFHtiA>