

Mobile Computing

UNIT II:

Mobile Computing Architecture: History of computers and Internet – Architecture for mobile computing – Three-tier architecture – Design considerations for mobile computing Mobile computing through Internet – Making exiting applications mobile enabled.

TEXT BOOK:

“Mobile Computing”, Asoke K Talukder ,Roopa R Yavagal, TMH, 2005.

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History Of Computers

- Electronic computer was developed during second world war
- In 1941, Germans developed computers to design airplanes and missiles
- In 1943, British used computers to decode encrypted messages by Germans
- In 1946, ENIAC (Electronic Numerical Integrator and Computer) was developed
- First vacuum tubes were used in 1G computers
- Then transistors were used
- Later Integrated circuits (IC) were used
- Now VLSI (Very Large Scale Integration) squeezed hundreds of thousands of components onto a chip

History Of Internet

- After 1957, in the US ARPA (Advanced Research Project Agency) was formed to fund Science and Technology projects
- Internet was developed through ARPA
- In 1971, Ray Tomlinson wrote a software to send Email
- In 1986, US developed NSFNET (National Science Foundation Network) for Internet
- In 1995, Internet was officially defined as “the global information system that
 - i) is logically linked together by a globally unique address space based on the Internet Protocol (IP)
 - ii) is able to support communications using the Transmission Control Protocol / Internet Protocol (TCP / IP)
 - iii) provides, uses or makes accessible high level services layered on the communications and related infrastructure

Internet – The Ubiquitous Network

- Ubiquitous means : Everywhere at the same time”
- There are three types of content (Information): Audio, Video and Text
- Some content can tolerate little delay – for this type of content, Packet Switched Network like Internet are suitable
- Some real time content cannot tolerate delay – for this Telecommunication or Circuit Switched Networks are suitable

Segments of a Network

- Network can be divided into three segments:
 - i) Core – Innermost part of the network. Primary function of core is to deliver traffic efficiently at the least cost
 - ii) Edge – Outer part of the network. Managed and owned by ISP (Internet Service Provider). Responsible for the distribution of traffic
 - iii) Access – This part of the network services the device which needs the service. Responsible for the transmission of data

Architecture for Mobile Computing

- Mobile computing architecture uses Three tier Architecture
- First tier is User Interface or Presentation Tier
- Second tier is Process Management or Application Tier
- Third tier is Database Management or Data Tier

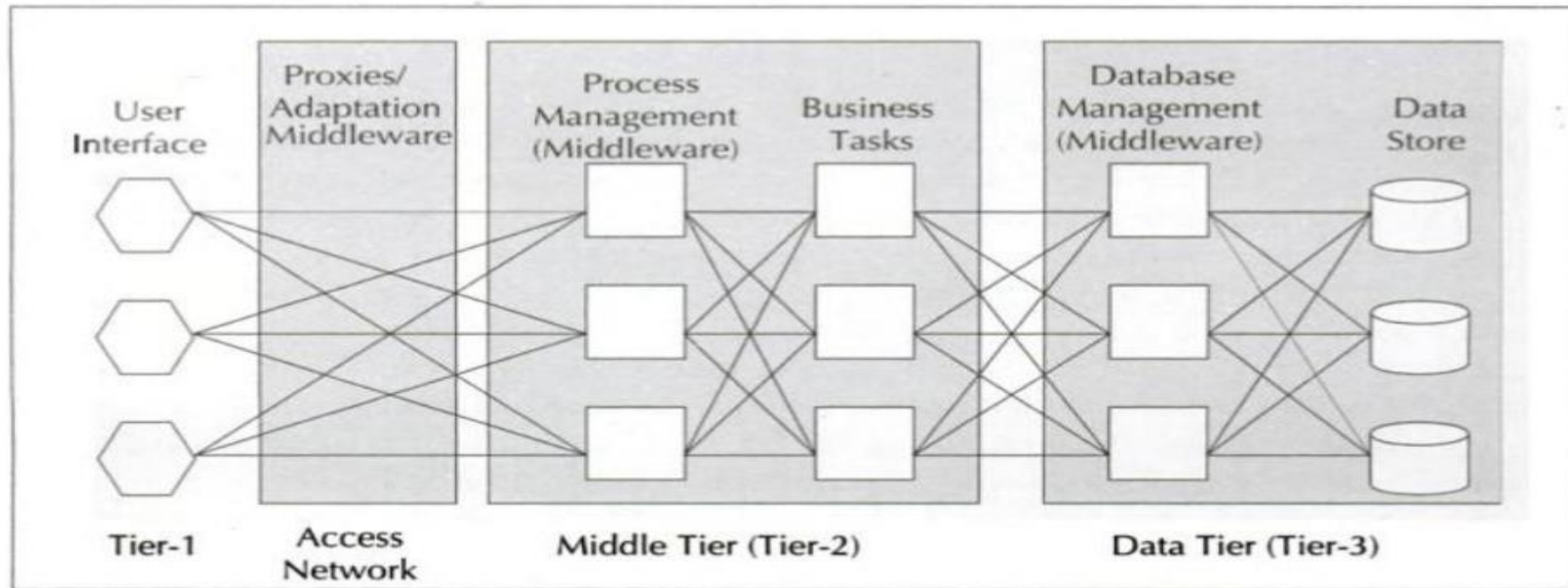


Figure 2.1 Three-tier Architecture for Mobile Computing

Architecture for Mobile Computing (contd.)

1) Presentation Tier (Tier I):

- User facing system tier
- These applications run on the client device and offer all the user interfaces
- Responsible for presenting the information to the end user
- Eg: web browsers, web scrapers etc
- Web scraper picks up part of the data from the web page and filters off the remaining data according to some predefined template

2) Application Tier (Tier II):

- It is the middle tier and acts as the engine.
- It is responsible for processing user input, obtaining data and making decisions
- Tier II functions are implemented using Middleware software
- Types of Middleware are
 - i) Message Oriented Middleware (MOM) – connects different applications through exchange of messages. A temporary message queue is used to store the messages until it can be processed

Architecture for Mobile Computing (contd.)

- ii) Transaction Processing (TP) Middleware – a TP system takes input data to the system at the source and delivers the output of the system at the sink. TP middleware maps client requests to different application tasks
- iii) Communication Middleware – used to connect one application to another
- iv) Distributed Objects and Components – Eg: CORBA (Common Object Request Broker Architecture). It is a distributed infrastructure. It is used in servers which handle large number of clients
- v) Transcoding Middleware – used to transcode one format of data to suit the need of the client. Eg: If we want to access a website through a mobile phone supporting WAP, we need to transcode the HTML page to WML page so that the mobile phone can access it. Transcoding means content adaptation to fit the need of the device

3) Data Tier (Tier III) :

- Used to store data needed by the application and acts as a repository for both temporary and permanent data.
- Database middleware runs between the application program and the database.

Eg: ODBC, JDBC etc.

Design Considerations for Mobile Computing

- Mobile Computing Environment should be Context-Independent as well as Context-Sensitive
- “Context” means all the information that helps determine the state of an object in the environment
- “Object” can be a person, device, place, surroundings etc
- Because of “mobility”, attributes associated with devices and users will change constantly
- So content and behaviour of applications should be adapted to suit the current situation
- There are many ways in which content and behaviour can be adapted. They are:

1) Content with context awareness – Build different applications for different contexts.

Eg: A bank decides to offer mobile banking applications through Internet, PDA and mobile phone using WAP. Three different applications are used. They are

www.mybank.com/inet.html – contains big pages with text boxes and drop down menus, animated pictures etc

www.mybank.com/palm.html – as the display size is small, the screen is designed to be compact for the PDA, animation is changed

www.mybank.com/wap.wml – user interface is completely different, drop down options are available through option button of mobile phone, graphics and animations are removed

2) Content switch on Context – There user sees only one application www.mybank.com/

A software is used to identify the type of device and the context. At runtime, this software adapts according to the device. Then the client request is routed to /inet.html/ or /palm.html/ or /wap.wml/

3) Content transcoding on Context – Instead of three application programs, there is only one application program. The same code is transcoded according to the device by a middleware

Client Context Manager

- A mobile computing application needs to operate in dynamic situations.
- An adaptation manager or algorithm decides to modify content or behaviour
- A client context manager is used to gather and maintain information about the client device, user, network and the surrounding environment using sensors
- Sensors are called as Awareness modules

Client Context Manager (contd.)

- Different types of Context Information are:
 - 1) Identity – Identity of the device
 - 2) Spatial Information – surrounding space location, orientation, speed, elevation etc
 - 3) Temporal Information – Related to time, day, date, season, time zone etc
 - 4) Environmental Information – temperature, air quality, moisture, wind speed, noise level, natural light, network capabilities
 - 5) Social Situation – whether in meeting, party, nearby people etc
 - 6) Resources that are nearby – accessible devices, hosts etc
 - 7) Availability of resources – about the device like battery power, display, bandwidth, storage etc
 - 8) Physiological measurements – User information like blood pressure, heart rate, respiration rate etc
 - 9) Activity – activity state of user like talking, reading, walking, running etc
 - 10) Schedules and Agendas – user's schedule and agenda

Context Aware Systems

- The Context manager maintains the following information:
 - 1) Location Information – identify the location of user / device. This information is achieved through device (using GPS) or network (when a successful call was made).
 - 2) Device Information – through the user agent parameter of HTTP and EIR (Equipment Identity Register) we can get some information about the device.
 - 3) Network Information – A mobile user moves from network to network. Types of networks vary from GPRS, GSM, WAP, SMS etc
 - 4) User Information – user is identified through authentication. Subscriber information can be obtained from the network
 - 5) Environment Information – in sensor based networks, surrounding information like temperature, moisture etc can be measured

GPS (Global Positioning System)

- GPS gives the exact position on the earth
- It is funded by and controlled by the US department of defence
- GPS satellites orbit above the earth and transmit signals that can be detected by anyone with a GPS receiver
- Using the signals, we can determine the location of the receiver
- GPS has three parts:
 - 1) Space Segment – consists of 24 satellites. Each GPS satellite takes 12 hours to orbit the earth. Each satellite has a clock to broadcast signals with time message
 - 2) User segment – consists of receivers in the user's hand, embedded in a mobile device. It receives the satellite signal which travels at the speed of light
 - 3) Control segment – the difference between the time the signal is sent and the time it is received, multiplied by the speed of light gives the distance between the receiver and the satellite. If we know our exact distance from 4 satellites, we know precisely where we are on the surface of the earth

Mobile Computing Through Internet

- For mobile computing, the access network will be both wireless and wired networks
- In the case of wireless access network, it could be Infrared, Bluetooth, WiFi, GSM, GPRS etc
- For wired access network, it could be a LAN
- For wired network,
 - bandwidth is higher and stable
 - device has large memory and display
 - there is no limitation in battery power
 - complexity and challenges are less
- But wireless access network has many constraints

Making Existing Applications Mobile Enabled

- Existing applications running on fixed networks will be used by limited number of users
- But mobile applications need to be ubiquitous (everywhere at the same time)
- There are many ways to achieve this:
 - 1) Enhance existing application – make changes in the code to support mobile environment
 - 2) Rent an application from an ASP (Application Service Provider) – many organizations develop mobile applications and give them for rent
 - 3) Write a new application – develop new application to meet mobile environment
 - 4) Buy a packaged solution – solutions for various business areas like manufacturing, sales, marketing etc are offered by many companies
 - 5) Bridge the gap through middleware – use middleware techniques to convert the existing application to suit the mobile environment