# Mobile Computing Architecture– an overview

## Lesson 07

## Limitations of Mobile Devices and Systems

# Limitations to mobile computing

- Resource constraints: Battery
- Interference: the quality of service (QoS)
- Bandwidth: connection latency
- Dynamic changes in communication environment: variations in signal power within a region, thus link delays and connection losses

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# ...Limitations to mobile computing

- Network Issues: discovery of the connection-service to destination and connection stability
- Interoperability issues: the varying protocol standards
- Security constraints: Protocols conserving privacy of communication

# Quality of Service constraints

- Technical restrictions and practical considerations— difficulties in mobile device uninterrupted operations
- Maintaining quality of service along with the provisioning of seamless access to all users

# Accessibility constraints

- Example: Smart labels on packages limited access– transmitted signals low power
- Labels can only be read from very short ranges

# Accessibility constraints

- Example: RFID access limited to ranges within line of sight
- RFID transmissions require hotspots close by due to low transmitted signal strength. (A hotspot is an access point an interface for mobile systems, sensing systems, and embedded systems to connect to a mobile network, wireless LAN, or the Internet.)

# Range Constraint

- Signal strength inversely proportional to the square of the distance
- Greater reduction in signal strengths due to multi-path propagation
- Degradation of signal quality due to reflection, scattering, and diffraction

# Range Constraint

- Access range limited to the range up to which the signal strength is such that it can be separated from the noise
- Up to which multi-path delays can be compensated for by digital signal processing techniques to restore signal quality

# Connectivity

- Connectivity loss or intermittent connectivity in certain situations
- The atmospheric conditions change environment which affects signal strength
- Attenuation of UHF and near microwave in water; heavy rain complete loss of connectivity

# Security Constraints

- Unsolicited advertisements and unwanted messages
- Virus attacks
- Hackers render it functionless or threaten integrity and security of the data stored on the device
- Noise signals transmitted by an attacker can jam a mobile device

# Security Constraints

- Repeated transmission of unwanted signals by an attacker draining the device resources
- Energy resources depleted fast when computations are forced and authentication algorithms are run repeatedly

# Mobility constraints

- *Non-availability of an access point* or base station
- Infrastructural issues
- No base stations or Wi-Fi hotspots providing connectivity and access to the Internet to sensors, labels, automotive systems, RFID tags, and cell phones

# Mobility constraints

- Use of different standards in different regions limits the operability
- a GSM phone may not be operable in all continents hence hampering global roaming for the user
- Some service providers may not be able to provide connectivity in all parts of the country or in other continents, etc.

# Energy Constraints in Devices

- Limited energy in battery
- Battery size and power limited due to considerations such as size, weight, and bulk of mobile devices
- The devices need to be recharged after short periods of time. In this way energy availability also limits device mobility.

# Energy Constraints in Devices

- Some devices such as smart cards, smart labels, remote sensors, and actuators do not even have a battery of their own. They derive their energy from the radiation received from a wireless source in vicinity. Such devices, therefore, require these sources to operate

# Mobile Computing Strategy in view of constraints

- Processor circuit dissipates higher energy when its clock frequency higher
- Computational speed higher at higher clock frequency
- A device is, therefore, programmed so that only computations such as graphic image processing run at full processor speed

# Mobile Computing Strategy in view of constraints

- The clock frequency reduced for the other computations to save power.
- The clock is activated only when a device interrupts or starts processing instructions.
- Many innovative mobile computing strategies adopted to mitigate the effects of energy constraints on mobile computing

# Mobile Computing Strategy in view of constraints

- Use ZomBee protocol– a lesser stack size as compared to Bluetooth so less energy dissipation due to lesser computational requirements
- Use of a communication protocol that has less protocol stack overheads reduces the energy requirement.

# Mobile Computing Strategy in view of constraints

- When a host or hotspot seek certain data from a device frequently, program adapts itself so that the frequently required data is calculated and stored in a buffer from where it can be sent at slow clock frequencies on demand from the host
- A program can also just transmit any changes in the data with respect to previous data

# Mobile Computing Strategy in view of constraints

- Communication scheduling strategies are adopted
- Frequently required data transmitted as per a schedule
- This saves the host energy which would otherwise be required for sending commands and also saves the devices energy that would be dissipated in processing the commands

# Processor Design

- Innovative circuits of mobile device processors have been designed and are continuously improved upon so that the same program instructions process with lesser energy dissipation per unit computational speed
- Examples of energy efficient processors—ARM and TigerSharc

# Transceiver Design and Programming Strategy

- Designed such that signals of just sufficient strengths transmitted to the receiver
- Just sufficient strength means that the signal strength is low but clearly distinguishes noise and maintains message integrity

# Transceiver Design and Programming Strategy

- Control commands from the host are sent at lower signal frequencies
- Once the device is ready and gets powered up, the transceiver transmits the data for operation
- Multi-hop routing– reduce the distance up to which a signal is required to travel

# Hardware Limitations

- Constraints memory for video, large files
- Innovative forms of memory designed and continuously improved upon
- Internal flash drives and the card slots for external memory used

# Hardware Limitations

- Memory cards used to enhance the memory in the device
- Large memory capacity– 32, 64 GB microSD memory in mobile devices in a recent enhancements

# Bandwidth Constraints

- Limited by the frequency spectrum that a regulator allots to a service provider
- The service must use the frequency spectrum allotted to it in an efficient manner

# Bandwidth Constraints

- Multiplexing and coding techniques help in achieving efficient transmission.
- The technology in use also limits the spectrum efficiency
- For example, CDMA has higher spectrum efficiency as compared to GSM

# Bandwidth Constraints

- Limited bandwidth
- An obstacle to seamless connectivity and quality of signals aired, when a large number of mobile devices simultaneously demand network connectivity

# Summary

- Number of constraints in mobile devices and systems
- Quality of service
- Security
- Connectivity
- Accessibility
- Range

# Summary

- Energy dissipation and availability
- Memory
- Hardware
- Appropriate computing and communication strategy

# End of Lesson 07

# Limitations of Mobile Devices and Systems