COSF 324: Wireless Networks and Mobile Computing

1 Mobile Computing: Introduction

Learning Objectives

- Introduction to Mobile Computing
- Characteristics of a mobile computing Environment
- Mobile Computing Entities
- Brief overview of the paper

Introduction

Human kind has also undergone several changes since the old stone age. Of many factors contributing to this change, most prominent is advent of computers. It made our life simple. Knowledge got coded into information and intelligence got documented in algorithms. Hence there arised need to share information amongst different computers. Internet was conceived. It made the world smaller and closer. The computer industry then collaborated with telecommunications industry. The convergence was called Information and Communication technology or ICT. At the same time the communication was becoming wireless. Mobility got redefined. Devices started moving so did the information. Diversified devices synchronized amongst themselves got empowered with computing ability, networking capability and storage capacity.

All these developments have generated an environment which has facilitated us with the provision of ***"ANY WHERE ANY TIME"*** services and stay connected round the clock. We have transformed rather than changed under the banner of force called "Mobile Computing".

This is the first introductory lecture of this paper. In this module we will understand the meaning of mobile computing, the characteristics of mobile computing environment, basic entities and security issues in mobile computing environment.

Mobile Computing: Definition

In a formal way Mobile Computing can be defined as "Set of geographically or temporally distributed computing systems service providers, servers that participate, connect, and synchronize through mobile communication protocols"

The goal of any mobile Computing Environment is to provide decentralized computations on diversified devices, systems, and networks, which are mobile, synchronized, and interconnected via mobile communication standards and protocols

Mobile Computing is an umbrella term used to describe technologies that enable people to access network services anyplace, anytime, and anywhere.

Mobile Computing has different names in different context. Some of them are:

- **Ubiquitous Computing:** Refers to the blending of computing devices with environmental objects empowering them with computing capability
- **Pervasive Computing:** As per Oxford Dictionary, the literal meaning of pervasive "exists in all parts of a place or thing". Pervasive Computing is term used for next generation of computing in which information and communication technology is used everywhere, by everyone, and at all times
- **Nomadic Computing:** Mobile may also, however, refer to access in a fixed location via equipment that users can relocate as required, but is stationary while in operation

Characteristics of a mobile computing environment

Any Computing Environment is called Mobile Computing environment if it supports one or all of the following characteristics:

• **User Mobility:** User accesses the same service while on move from one physical location to another in home network or remote network. For eg. An application can be accessed by a person even when he is at home or in office

• **Network Mobility:** This type of mobility can be seen in two context

o User moves from one network to another accessing the service seamlessly. For eg. Opening an email using Ethernet LAN at office and then going home to access it at Wi-Fi and same service used at 4G connection at a cinema hall.

o Network itself is mobile. A typical case is MANET or Mobile ad-hoc network. . In MANET each node act as a host as well as a "router" to forward the traffic to other specified node in the network. As the nodes move, the routers also move implicating movement of network. For eg. VANET : Vehicular adhoc network in which the vehicles on move form a network with each other and communicate with each other.

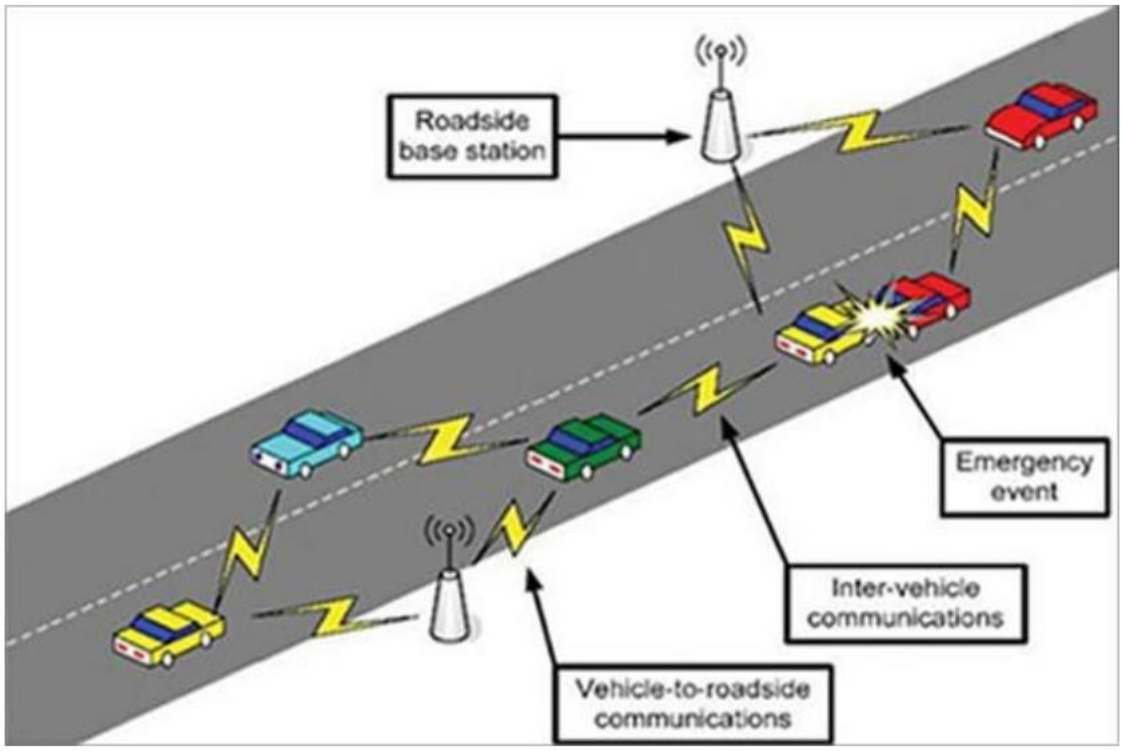


Figure 1 VANET

- **Bearer Mobility:** The user uses the same service while switching the bearer. Examples of bearers are HTTP, TCP/TP SMS, WAP, and Voice. If a user accesses a service on one bearer at a place and then he moves to another place he can switch to another bearer.
- **Device Mobility:** Use the same service while switching from one device to another. For eg. Opening an online shopping application on a desktop and purchasing an item using the application on laptop
- **Session Mobility:** User session should be able to move from one user-agent environment to other. For eg. If a session is interrupted due to some reason on one device/network, it should be able to resume on other device or network
- **Host Mobility:** User device can be either server or host.
- **Agent Mobility:** User-agent or the applications move from node to another. Agents can be browsers, crawlers, aglets etc. They should be able to move when the node moves.

Mobile computing entities

The following entities comprises of Mobile Computing environment:

User with a device

User device is Combination of Hardware device called as User Equipment with software called User Agent embedded inside. A device can be fixed or wireless. It can be a computing device or a Communicating device but use of them is blended

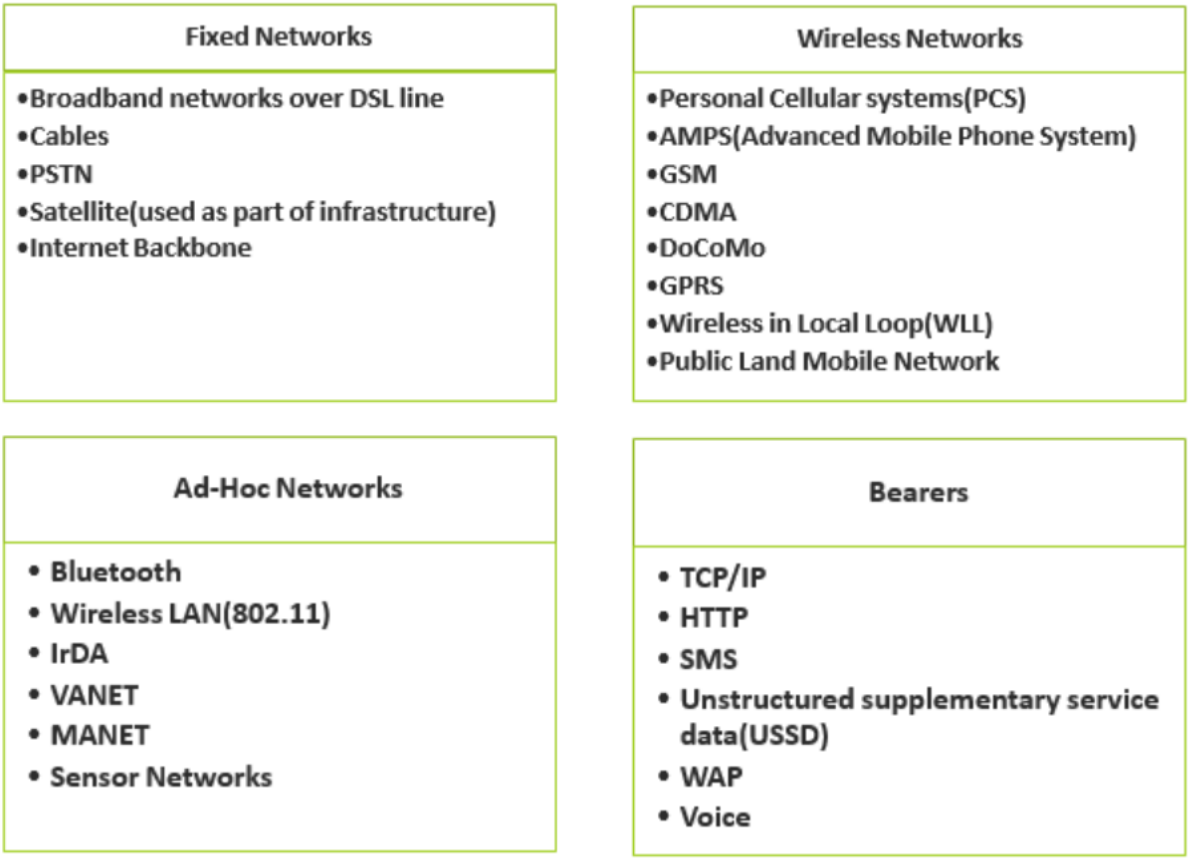
into a task flow that their function is integrated. The examples of devices in their respective category are:

Dialogue Control

The dialogues can be long session oriented dialogues or sessionless dialogues that are short term. The type of dialogue depends on type of device used and input output devices available. For eg. Checking bank balance can be a long session oriented dialogue which comprises of entering the URL, authentication via user name and password, checking balance by entering the account number and then logging out. The same thing can be accomplished via sending a message through mobile phone which would be a short term sessionless transaction.

Networks

The networks used for mobile computing are fixed or wireless, infrastructure or adhoc and bearer. Fixed or wirelined networks are installed with the help of fiber optical cables, coaxial cables. These are generally public networks and cover a large area. WIRELESS NETWORKS do not need wires. The nodes interact with each other via radio interface. Infrastructure LANs need a infrastructure in the form of access point which acts as a central hub through which all the nodes communicate. AD-HOC LANS do not have any access point. They are temporary for a particular time and span over a limited range. They can be easily configured and de-configured. Optical, Infrared and radio communication are helpful for formation of Adhoc LANs. Bearers are used for transportation of data. Different type of networks uses different type of bearers. Examples of different categories of networks are summarized as below



Middleware

Middleware is software entity between user application and operating system or between application and device. In context with mobile different middleware are applicable:

Gateways

Gateways act as interface between transport bearers. For eg. IVR gateway to interface voice with computer or a WAP gateway to access internet over phone or a SMS gateway for sending SMS from application.

Content

Data and information, applications and services all constitute the content. The applications and services run on the origin server known as content servers. Depending on the context, content can be different for different people at different times. For eg. Viewing stock update at one time via one application at the same time using another application to book movie ticket at other time. Looking at current scenario when there are around 2 billion applications on apple store and 2,5 billion

applications on android store, there cannot be any comprehensive classification or listing of mobile applications. Yet some of the common categories and examples of applications in those categories are as follows:

Standards

Standards are documented agreements containing technical specifications or criteria to be used as rules, guidelines or definitions of characteristics". Materials, products, processes and services should comply to these guidelines. Standards are necessary for interoperability of goods and services. The bodies who develop and maintain standards work at regional, national and international level. These standard bodies are formed by governments, professional institutes and industry consortiums. For eg. BSI or Bureau of Indian Standard. Some of the standard bodies related to mobile computing technologies are:

1. **The International Organization for Standardization (ISO)** is a worldwide federation of national standards bodies from more than 140 countries, one from each country. ISO is a non-government organization established in 1947. The mission of ISO is to promote the development of standardization and related activities in the world with a view to facilitating the international exchange of goods and services.
2. **Internet Engineering Task Force (IETF)** is the standard – making body for Internet and related technologies. IETF is an open international community of network designers, operators, vendors and researchers concerned with the evolution of Internet architecture and smooth operation of the Internet.
3. **ETSI (the European Telecommunications Standards Institute)** is an organization whose mission is to produce telecommunication standards that will be used for decades to come throughout Europe and possibly beyond. ETSI unites members from countries inside and outside of Europe, and represents regulators, network operators, manufacturers, service provider's research bodies and users.
4. **The Open Mobile Alliance (OMA)** has been established by the consolidation of the WAP Forum and the Open Mobile Architecture initiative. It intends to expand the market for the entire industry by removing barriers to interoperability and supporting a seamless and easy – to –use mobile experience for end users.
5. **ITU (International Telecommunication Union)** is an organization within the United Nations System. It was founded on the principle of cooperation between governments and the private sector. With a membership encompassing telecommunication policy- makers and regulators, network operators, equipment manufacturers, hardware and software developers, regional standards-making organizations and financing institutions, ITU's

activities, policies and strategic direction are determined and shaped by the industry it serves.

6. **IEEE Standards Association (IEEE-SA)** is an organization that produces standards, which are developed and used internationally. Standard for Wireless LAN are created, maintained and managed by IEEE. These are defined through different 802.11 standards.
7. **The Electronic Industries Alliance (EIA)** is a national trade organization within the US that includes the full spectrum of its electronics industry. The Alliance is a partnership of electronic and high-tech associations and companies whose mission is promoting the market development and competitiveness of the US high-tech industry through domestic and international policy efforts.
8. **World Wide Web Consortium (W3C)** develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication and collective understanding. By promoting interoperability and encouraging an open forum for discussion, W3C is committed to leading the technical evolution of the Web.
9. **3GPP** is to produces globally applicable technical specifications and technical reports for 3rd Generation Mobile System based on evolved GSM core network and radio access technologies that they support, i.e., Universal Terrestrial Radio Access (UTRA) both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes. The scope was subsequently amended to include maintenance and development of the Global System for Mobile communication (GSM) technical specifications and technical reports including evolved radio access technologies (e.g., General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE)).
10. **The American National Standard Institute (ANSI)** is the national standard organization
    in the United States. ANSI Standard X3.4- 1968 defines the 'America n National Standards Code for Information Interchange (ASCII)' character set. ASCII character set is used in almost every modern computer today.
11. **Universal Mobile Telecommunications system (UMTS)** represents an evolution in terms of services and data speeds from today's second-generation mobile networks life GSM. As a key member of the global family of third generation (3G) mobile technologies identified by the ITU, UTMS, is the natural evolutionary choice for operators of GSM networks.
12. **Bluetooth** wireless technology is a worldwide specification for a small –form factor, low-cost radio solution that provides links between mobile computers, mobile phones, other portable handheld devices, and connectivity to the Internet. The standard and specification for Bluetooth are developed, published and promoted by the Bluetooth Special Interest Group.
13. **The CDMA Development Group (CDG)** is an international consortium of companies who have joined together to lead the adoption and evolution of

CDMA wireless systems around the world the world. The CDG comprises the world's leading CDMA service providers and manufacturers. By working together, the members will help ensure interoperability among systems, while expediting the availability of CDMA technology to consumers.

14. **The Public-Key Cryptography Standard (PKCS)** are specifications produced by RSA Laboratories in cooperation with secure systems developers worldwide for the purpose of accelerating the deployment of public-key cryptography.
15. **The Presence and Availability Management (PAM) Forum** is an independent consortium with a goal to accelerate the commercial deployment of targeted presence and availability applications and services that respect users'. Preferences, permissions and privacy
16. **The Parlay Group** is a multi-vendor consortium formed to develop open, technology- independent application programming interfaces (APIs). Parlay integrates intelligent network (IN) services with IT application via a secure, measured, and billable interface. By releasing developers from underlying code, networks and environments, Parlay APIs allow for innovation within the enterprise
17. **DECT stands for Digital Enhanced Cordless Communications.** It is an ITSI standard for portable phones. DECT is known in ITU as a 3G system and is commonly referred as IMT- FT (IMT Frequency Time).
18. **WiMAX Forum** is Worldwide Interoperability for Microwave Access Forum dedicated to certifying the operations of interconnecting devices. WiMAX aims to provide wireless data over long distances in different forms ranging from point-to-point links to full scale mobile access networks for wireless broadband communication.
19. **TTA is Telecommunications Technology Association**. TTA is an IT standards organization catering to development of new standards based in Korea. It provides one-stop services for comprehensive IT standards.
20. **Wi-Fi owns trademark to Wi-Fi alliance**. It was previously known as Wireless Ethernet Compatibility Alliance. It is focused on interoperability and compatibility of Wireless LAN devices and committed to continuous improvements in design and better user experience.
21. **Association of Radio Industries and Businesses (ARIB)** is an institution, based in Japan, dedicated to efficient use of radio spectrum and its implications in businesses. China Communications Standards Association (CCSA) is an attempt of Chinese Ministry of IT to reform telecommunications industry and market. It aims to become a nationally unified standards organization in china.
22. **Digital Living Network Alliance (DLNA)** is a cross-industry association of consumer electronics, computing industry and mobile device companies. The objective of DLNA is to establish a conglomeration of wired and wireless interoperable network of personal computers, consumer electronics and

mobile devices in the home and outside in order to enable a seamless environment.

Summary

- This is the introductory lecture of the paper
- Mobile computing is a paradigm to describe technology which provides access to services on move. Also known as ubiquitous, pervasive or nomadic computing.
- Any computing environment involving user, device, network, bearer, session, host and agent mobility can be called mobile computing environment

User device, networks, gateways, middle-wares, dialogue control and content servers and applications and standards form components of mobile computing infrastructure

you can view video on Mobile Computing: Introduction

Suggested Reading:

1. Mobile Communication 2nd edition by Jochen Schiller, Pearson education
2. Mobile Computing by Asoke Talukder, Roopa Yavagal (Tata McGraw Hill)
3. "Wireless communication and networking" by William Stallings
4. Mobile Cellular Telecommunications — W.C.Y. Lee, Mc Graw Hill
5. Wireless Communications – Theodore. S. Rapport, Pearson Education
6. Reza B'Far (Ed), "Mobile Computing Principles", Cambridge University Press.