# Broad Objectives/Outcomes of the course

- **Course Aims:** Introduces the basic concepts and principles in mobile computing.
  - The major techniques involved, and networks & systems issues for the design and implementation of mobile computing systems and applications.
  - Provides an opportunity for students to understand the key components and technologies involved and to gain hands-on experiences in building mobile applications.
- **Expected Learning outcomes:**
  - **Knowledge**
    - Describe the basic concepts, principles , challenges and evolutions in mobile computing
    - Understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks
    - Explain the structure and components for Mobile IP and Mobility Management
    - Understand the principles of design of embedded systems to support mobile computing from hardware and software perspectives.
    - Understand positioning techniques and location-based services and applications
    - Describe the important issues and concerns on security and privacy
  - **Professional skill**
    - Familiarize with current Android development platform and environment
    - Design and implement mobile applications to realize location-aware computing
    - Design and implement mobile applications to realize desired graphical user interface
  - **Attitude**
    - Recognize the important issues and concerns on security and privacy

# General Course Information

- **COURSE INSTRUCTOR: J K Alwala, Dept. of Computer Science, School of Computing and Informatics, *cell phone*** *0726906954/0734882170*, email: alwala@maseno.ac.ke/ jokalwala@gmail.com
- **PREREQUISITES (Important):**
  - **CCS 207 Analogue and Digital Communications**
  - **CCS 209 Computer Architecture and Organization**
  - **CCS 307 Computer Networks**
- **LECTURES/LABS**
- **Lectures: Thursdays** 9 am to 11 am. First lecture Jan 15, 2015.
- **Lects/LAB Sessions:** Thursdays 2 pm to 4 pm. First Lab Jan 29th, 2015
- **Exams and Assessments**
  - CAT#1, 2 pm to 3.30 pm, 2015. Maximum score 10 %.
  - CAT#2, 2 pm to 3.30 pm, 2015. Maximum score 10 %.
  - Lab exercises reports, continuous, maximum score 10%
  - Semester exams, 2 hours, maximum score 70%. Date TBA.
- **REFERENCES**
  - Mobile Computing systems, 2nd edition by Jochen Schiller
  - Wireless and Communications and Networking, 2nd edition by W Stallings
  - Several .pdf notes in folder ccs312_2015jan

# Locational History of Computing

- Four phases, each with a distinct set of locational imperatives
  - **Phase I: The single user mainframe**, spread over geographical landscape in response to the distribution of demand.
    - Very high fixed costs of computers
    - A highly clustered pattern of users
    - Cost of travel for users not located in large clusters that were low in relation to the cost of computing
  - **Phase II: The Timesharing era**, supported by modern operating systems
    - Massive mainframes still used but users could use terminals, remote and local, through slow communication links and networks.
  - **Phase III: the Workstation era**, due to the emergence of the personal computer and portable and laptop computers
    - Need to travel to mainframe locations removed altogether
  - Phase IV: the Network era, through medium to high speed links and technologies based on copper, microwave, satellite and fiber
    - Client-server computing architectures matured, including Internet and WWW.
    - Connectivity, rather than user locations
    - Wireless links and technologies provide a major paradigm shift towards almost ubiquitous, low cost computing.

# Wireless Sensor Networks (WSN)



- An emerging network of wireless mobile devices (sensors and actuators) that are aware of their environment and can also alter some state of the environment.
- A wireless sensor network is a collection of nodes organized into a cooperative network.
  - Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), may contain
    - multiple types of memory (program, data and flash memories),
    - An RF transceiver (usually with a single omni-directional antenna),
    - A power source (e.g., batteries and solar cells), and
    - Various sensors and actuators.
  - The nodes communicate wirelessly and often self-organize after being deployed in an ad hoc fashion.
  - Systems of 1000s or even 10,000 nodes are anticipated for various types of applications.

- A wireless sensor network comprises low-cost, low-power, multifunctional sensor nodes that are small in size and communicate untethered in short distances.
- These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks based on collaborative effort of a large number of nodes.

# Mobile Devices: PDAs



- The main purpose of this device was to act as an electronic organizer or day planner that is portable, easy to use and capable of sharing information with your with a computer systems.
  - PDA was an extension of the PC, not a replacement.
  - These systems were capable of sharing information with a computer system through a process or service known as synchronization.
    - Where both devices will access each other to check for changes or updates in the individual devices.
    - The use of infrared and Bluetooth connections enabled these devices to always be synchronized.
- With PDA devices, a user could;
  - browsers the internet, listen to audio clips, watch video clips, edit and modify office documents, and many more services.
  - They had a stylus and a touch sensitive screen for input and output purposes.

# Mobile Devices: Smart Phones



- Smartphone have the capability to run multiple programs concurrently.
  - These phones include high-resolution touch enabled screens,
  - web browsers that can access and properly display standard web pages rather than just mobile-optimized sites, and
  - high-speed data access via Wi-Fi and high speed cellular broadband.
- The most common mobile operating systems (OS) used by modern Smartphones include Google's Android, Apple's iOS, Nokia's Symbian, RIM's BlackBerry OS, Samsung's Bada, Microsoft's Windows Phone, and embedded Linux distributions such as Maemo and MeeGo.
  - Such operating systems can be installed on many different phone models, and typically each device can receive multiple OS software updates over its lifetime.

# Mobile scenario: Kenya (CCK, 4th quarter, 2012).

**Table 16: Internet Subscriptions and Internet Users**

| Internet/Data Subscriptions | Jun-12 | Dec-11 | Quarterly Variation (%) | FY 2011/12 | FY 2010/11 | Annual Variation (%) |
|---|---|---|---|---|---|---|
| **Total Internet Subscriptions** | **7,738,882** | **6,490,080** | **19.2** | **7,738,882** | **4,258,287** | **81.7** |
| Mobile Data/Internet Subscriptions | 7,655,576 | 6,409,254 | 19.4 | 7,655,576 | **4,189,720** | 82.7 |
| Terrestrial Wireless Data/Internet Subscriptions | 21,709 | 28,392 | -23.5 | 21,709 | 29,979 | -27.6 |
| Satellite Data/Internet Subscriptions | 519 | 787 | -34.1 | 519 | 960 | -45.9 |
| Fixed DSL Data/Internet Subscriptions | 11,682 | 11,686 | 0.0 | 11,682 | 15,168 | -23.0 |
| Fixed Fibre Optic Data/Internet Subscriptions | 49,371 | 38,966 | 26.7 | 49,371 | 22,460 | 119.8 |
| Fixed Cable Modem Subscriptions | 25 | 25 | 0.0 | 25 | - | - |
| **Total Internet Users** | **14,032,366** | **11,840,544** | **18.5** | **14,032,366** | **12,538,030** | **11.9** |



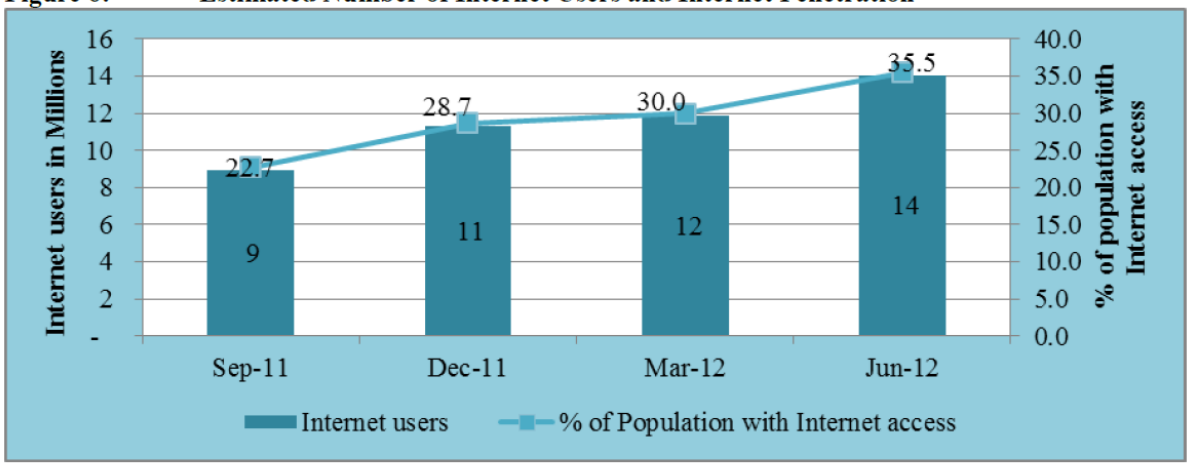
***Source*: CCK, Operators' Returns.**

**Table 17: Mobile Data/Internet Subscriptions by Operator**

| Name of Operator | Jun-12 | Market Share (%) | Mar-12 | Market Share (%) |
|---|---|---|---|---|
| Safaricom Limited | 5,262,307 | 68.7 | 4,552,519 | 71.0 |
| Airtel Networks Kenya Limited | 1,074,764 | 14.0 | 606,079 | 9.5 |
| Telkom Kenya Limited (Orange) | 674,255 | 8.8 | 610,142 | 9.5 |
| Essar Telecom Kenya Limited | 644,250 | 8.4 | 641,482 | 10.0 |

***Source*: CCK, Operators' Returns**

**Figure 6: Estimated Number of Internet Users and Internet Penetration**




***Source*: CCK, Operators' Returns.**

# Wide Range of current and future application Areas



- Vehicles
- Nomadic user
- Smart mobile phone
- Invisible computing
- Wearable computing
- Intelligent house or office
- Meeting room/conference
- Taxi/Police/Fire squad fleet
- Service worker
- Disaster relief and Disaster alarm
- Games
- Military / Security

- Nomadic user has laptop/palmtop
- Connect to network infrequently
- Interim period operate in disconnected mode
- Access her or customer data
- Consistent database for all agents
- Print on local printer (or other service)
  - How do we find it?
  - Is it safe?
  - Do we need wires?

- Does nomadic user need her own hardware?
  - Read/write email on web browser
  - Access data OK too

- Nintendo Gameboy [Advance]: Industry standard mobile game station
- Connectable to other Gameboys
- Can be used as game pad for Nintendo Gamecube

- Cybiko [Extreme] is a competitor that has radio capabilities built in
- Second generation already
- Also email, chat, etc.

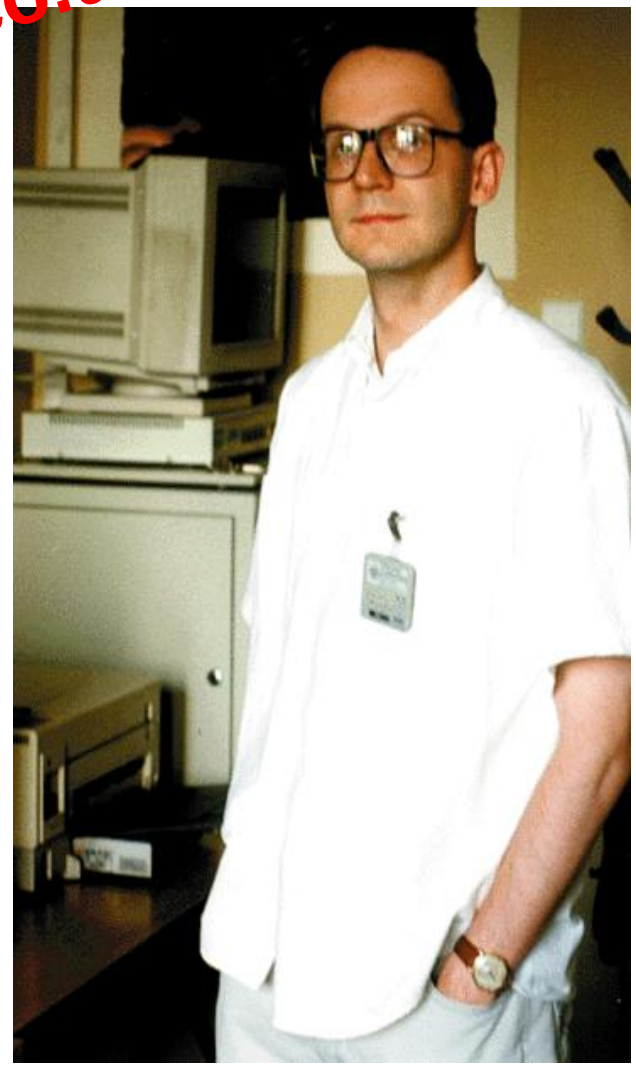
[Cybiko]

Section Five

# UBIQUITOUS COMPUTING AND SMART OBJECTS

# Wearable Computing – Active Badges



- Room has multiple embedded sensors that communicate with active badge to configure devices to the specific user