

# CLOUD COMPUTING

## *Module-6*

### *Using the Mobile Cloud*

## Topics

---

- Working with Mobile Devices
- Working with Mobile Web Services

# Working with Mobile Devices

---

- Cell phones fall into two categories.
- There are feature phones, which are phones with added capabilities.
- Smartphones that run recognized operating systems, install applications, and have persistent Internet connectivity.



# Working with Mobile Devices

---

- Cloud services are having a major impact on cellular phone technology.
- Many smartphones come with native applications that consume Web services, many of which are currently deployed in the cloud.
- Mobile application developers are staging their apps in the cloud, and a number of hosting services provide support for this.
- The five major smartphone operating systems to consider are Google's Android, Apple's iOS (iPhone OS), RIM BlackBerry, Symbian, and Windows Mobile Phone.

# Defining the Mobile Market

---

- As of 2009, the world's population was 6.8 billion people, and the number of mobile phones estimated to be in use was 4.6 billion units.
- The top 3 countries and the percentage of their populations with cell phones in 2009 were as follows:
  1. China, 797 million, 60.8 percent of the population
  2. India, 635 million, 53.8 percent of the population
  3. United States, 286 million, 91.0 percent of the population

# Connecting to the cloud

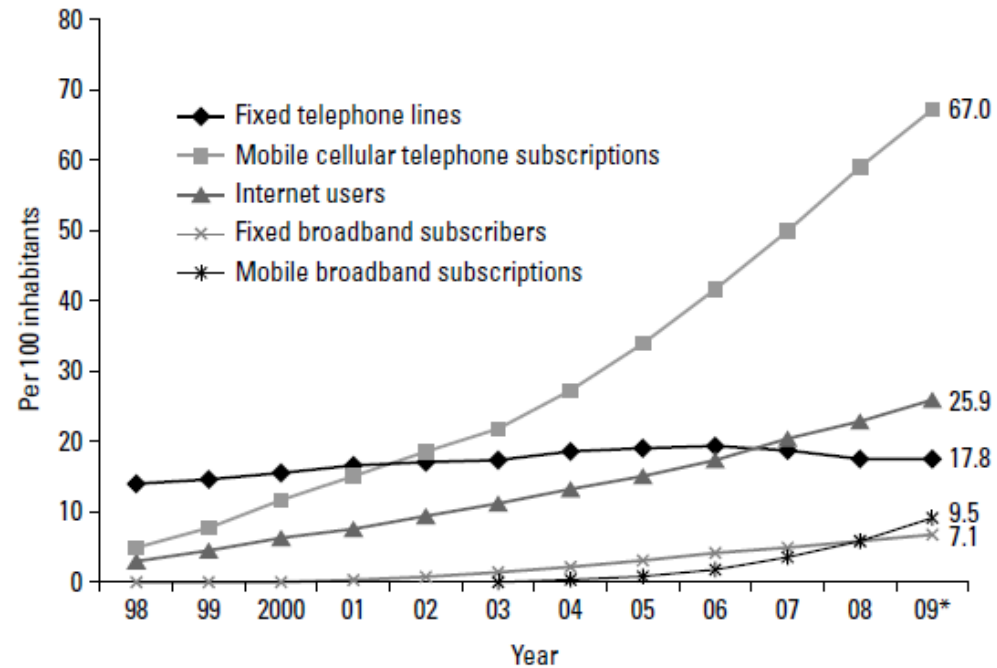
---

- One important trend fueling the rise of pervasive cell phone Internet access is the availability of mobile broadband to the world.



# Connecting to the cloud

Number of broadband mobile subscriptions per 100 users; source: ITU World Telecommunication/ICT indicators database



- 
- In mobile cloud computing,” a model is described where processing is done in the cloud, data is stored in the cloud, and the mobile device serves as the presentation platform or the display.
  - For this model to work a phone, tablet, or laptop requires a reliable Internet connection and the ability to run a browser (a micro-browser, really) or another viewing application. Currently, most of the computing applications that run on mobile devices run on the local device itself, with a few exceptions.
  - Those exceptions include applications such as Google
  - Earth, Google Maps, the major cloud mail services, and applications that provide navigation, among others



# Feature phones and the cloud

---

- Feature phones own 83 percent of the cell phone market in the U.S. as of 2009, and they are categorized by having lower prices, longer battery lives, and simpler APIs.

1. Nokia 1100 (200 million)

2. Nokia 3210 (150 million)

3. Nokia 5230 (145 million)

The industry is beginning to add to inexpensive feature phones the capability to run lightweight operating systems such as Oracle's (nee Sun's) Java Platform Micro Edition

# Using Smartphones with the Cloud

---

- There are many different ways in which you can define a smartphone, but these are the essential characteristics:
- A smartphone has a recognizable operating system.
- A smartphone can run installable applications.
- A smartphone offers advanced calling features such as video calls or conferencing.

- 
- A smartphone offers messaging features.
  - A smartphone comes with a touchscreen; the bigger the touchscreen the smarter the phone.
  - A smartphone offers keyboard entry, either physically or virtually.
  - A smartphone has a persistent Internet connection.



- 
- If you move smartphone execution to a virtual machine running in the cloud, smartphones are no longer constrained by their processing power, memory, or storage capacity.
  - The only two factors of importance are network bandwidth and display quality.

---

# Working with Mobile Web Services

# Understanding Service Types

---

- Mobile Web services are those in which information is transferred between applications (especially a browser) and services over an Internet connection.
- These types of applications are steadily replacing platform-specific and proprietary native applications.



# Mobile Interoperability

---

- The mobile Web is fractured into many different competing operating systems and proprietary hardware; and it has to support these different products.
- Open-system hardware and software tends to evolve more quickly than proprietary systems as there is a higher emphasis placed on interoperability in open systems.

## Method-1

- W3C Mobile Web interoperable initiative makes web browsing with mobile devices more reliable by setting standards. It helps Web site designers to make their sites mobile-friendly.

- 
- Factors need to be addressed for mobile site optimization are:
    - ✓ Variable screen sizes and resolutions
    - ✓ Slow transmission over the connection and limited performance speeds on the device
    - ✓ Different methods of navigation through the interface

- 
- ✓ Limited use of windows and lack of some standard graphical user interface controls
  - ✓ Exclusion of certain file formats such as PDF, rendering engines such as Adobe Flash, and cookies
  - ✓ Message size limitations
  - ✓ Nonstandard and often high transmission costs



---

### Method-2

- Vendors approach the problem of interoperability by creating individual sites within a Web site for different devices.
- Content is served up to a device based on the device's identity and content negotiation.
- Web pages and applications will take different modes and display option on various devices.

---

### Method-3

- Mobile Web Initiative's Device Description Working Group(DDWG) create a database of device characteristics, called a Device Description Repository.
- This repository is used in concert with the DDR Simple API to modify content so screen size, markup language, and image format support is delivered to a device correctly.

---

#### Method-4

- A specific top-level domain called .MOBI has been created for the producers and consumers of mobile services and products.
- It is maintained as a registry called the Mobile Top Level Domain (mTLD).
- The purpose of [this domain is to create sites that render correctly on mobile devices.](#)



---

### Method-5

- Open Terminal Platform (OMTP) worked in creating universal standards for micro-USB devices, mobile security, position measurements, device management, and standardized APIs.
- They have an initiative called the BONDI API for creating mobile interfaces and subsystems.

# Performing Service Discovery

---

- Web services should be discovered by mobile devices and accessed by those devices by mutually supported protocols.
- If protocols are standard and open, the chances of being able to exchange information is increased.
- Web services are a form of publishing: such as messaging, publish/subscribe metaphor or a broadcast.

- 
- The nature of the protocol supports the mechanism for data transfer that is required.
  - One standard used in cloud computing for publishing a Web service and contributes to the SOA is the **Web Service Description Language (WSDL)**.
  - In WSDL, the service is described in terms of an interface or endpoint that can be accessed to send information to and get information back from the service.



# Context-Aware Services

---

- Each mobile device contains information concerning the condition or state of the device and the user who carries the device.
- When parsed properly, this information can provide intelligent systems about user's identification and the context in which that user finds himself.
- Location is the prime example of context. When we search for something near us, the search engine returns results that are location-based and thus have context.

- 
- When a phone transmits its GPS coordinates to a service, that service may be able to send information appropriate to each environment back to the user.
  - Such tailored and specific information could be incredibly valuable and useful.
  - When a mobile user is connected to mobile service two different sets of information is exchanged:
    - Physical context
    - Logical context

---

### *Physical context*

- Information derived from measurements made from the mobile device or its sensors.
- It provides location, device conditions, device states, and more.

### *Logical context*

- Information derived from the user or from the manner in which the user has interacted with services over time.
- It contains information about the purpose a location serves, a digital identity and its associated attributes, relationships, interests, past searches, Web sites visited, privileges, and preferences.



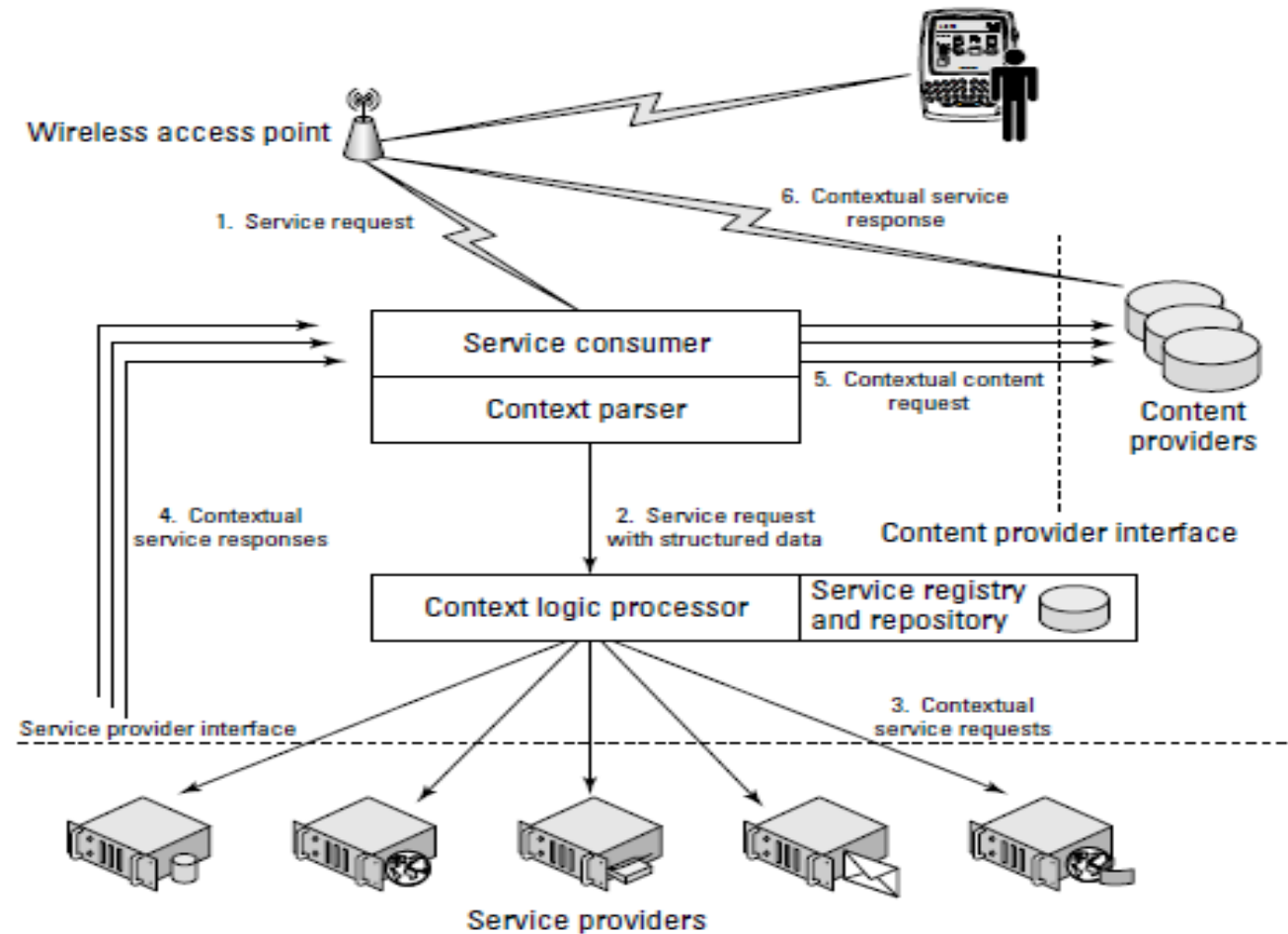
- 
- In a Web service, the mobile client plays the role of a service consumer and the Web service is the service provider.
  - Based on a user's current context, this type of system allows both service providers and content providers to tailor information for a specific user.
  - The Context Logic Processor plays the role of the orchestrator providing programmed logic that works with the data parsed by the Context Parser.

- 
- The Context Parser takes all the input data and applies a logical schema to create the needed structured objects for the Logic Processor's use.
  - This infrastructure can be placed in the cloud.

- 
- The concept of creating a structured representation of concepts and their relationship in a domain is referred to as ontology.
  - Ontology is a formal way of specifying a shared abstraction.
  - Ontologies are used to create the Semantic Web, artificial intelligence, library classification scheme, and so on.
  - The specific ontology that applies to a mobile SOA is the Web Ontology Language(OWL).



A Service Oriented Architectural approach to processing requests using contextual data from mobile users



# MEMS

---

- MEMS stands for microelectromechanical systems and is a class of very small sensor or actuator devices where small mechanical systems are driven by electricity to indicate a position.
- MEMS size can be between 1 and 1000 micrometers, and they are packaged into components that often include a microprocessor, memory, and others.
- Several MEMS are packaged in smartphones, and their numbers and complexity are growing over time.

---

- Sensors built into the latest cell phones:

- ✓ Global Positioning System (GPS)
- ✓ Accelerometers (for measuring relative motion changes)
- ✓ Gyroscopes
- ✓ Image sensors
- ✓ Thermistors



- 
- ✓ Proximity sensors
  - ✓ Light sensors
  - ✓ Sound sensors
  - ✓ Compasses
  - ✓ Pressure sensors

- 
- These sensors have the ability to measure the physical world around the user and translate an analog signal into a digital one that can be used to enhance a cloud-connected user's experiences.
  - These types of devices are called Micro-Electro-Mechanical systems or MEMS.

# Location Awareness

---

- Location awareness helps in delivering services based on the location of user.
- In context-aware services your device is constantly being polled for sending data from its sensors which indicates the condition of the device.
- Location-aware services are usually based on GPS data, with location accuracy of a few feet through the triangulation of three or more overhead satellite distances and positions.
- Eg: Skyhook: Skyhook services are based on a Wi-Fi Positioning System (WPS).



- 
- Skyhook has a hybrid positioning system called XPS, which uses several location technologies in like WPS, GPS, and cellular tower triangulation to obtain accurate user location to within a few feet and taking just a few seconds.
  - Skyhook uses a large reference database of Wi-Fi access points and cell tower IDs, raw position data from each location source (a signal), and an algorithm to locate the device.
  - The XPS system is constantly polling locations to update them and recalibrating data points to improve accuracy over time. If it fails, the system performs a location analysis based on your IP address and your known service provider.

# Push Services

---

- Push services are a technology where the transaction is initiated on a server and sent automatically to the client.
- The opposite of a push is a pull technology, in which the client polls for and requests a transaction.
- The following services are examples of push technologies:
  - ✓ Automated software updates
  - ✓ Instant Messaging

*Continue..*

- 
- ✓ e-mail
  - ✓ HTTP streaming (also known as HTTP server push)
  - ✓ Java pushlet
  - ✓ RSS services
  - ✓ Software installations
  - ✓ Teleconferencing

Email:

- In push e-mail, the service is always connected to the client.
- It sends to the client any new e-mail that arrives at the server immediately.



- 
- The active transfer process is referred to as “push,” the server is called the Mail Delivery Agent (MDA), and the client is called the Mail User Agent (MUA).
  - The concept of push is that the mail is sent without the client asking for it, whereas the process of sending mail when the client asks for mail is referred to as “polling.”
  - POP3 e-mail protocol is a polling protocol. IMAP support both push and polling.
  - But, polling requires the client and the server to engage in handshaking, so it imparts lots of overhead to mail transfers.

# The BlackBerry Push Service

---

- Developers use the BlackBerry Push Service to push application updates, images, text, audio, and other content to BlackBerry users using java applications or blackberry widgets that they develop using the service.
- The Push Service transfers up to 8KB messages directly; Otherwise, the notification will be send as a push service and the device downloads the data from the content provider.

- BlackBerry Push Service uses the following steps:

- 
1. Content provider sends a push request to the server.
  2. BlackBerry servers send a response back to the content provider.
  3. BlackBerry servers push the data out to BlackBerry clients.
  4. BlackBerry clients send a response to the BlackBerry server that the message was received.
  5. BlackBerry servers forward the acknowledgement to the content provider.
  6. The content provider sends a read notification to the BlackBerry server.



# The Lemonade Profile

---

- This mechanism is an alternative to a Push-IMAP specification.
- The Lemonade Profile uses a set of e-mail extensions to provide access to mobile devices.
- It builds on the IMAP(Internet Message Access Protocol) for delivery and on the Message Submission SMTP(Simple Mail Transfer Protocol) profile.
- Lemonade Profile is a set of protocols that provides email access to diverse environments, including mobile handsets and other resource constrained devices

- 
- The Lemonade Profile is an alternative mechanism for push e-mail.
  - When a message is available, a timely notification is provided and the Mail Submission Agent (MSA) used in SMTP can be used to retrieve the e-mail from an IMAP data store.
  - The advantage of the Lemonade Profile is that it uses both IMAP and SMTP and can be used by any IMAP client.

# Using Short Message Service (SMS)

---

- The (SMS) is a text-notification service for near-real-time message passing.
- SMS, or texting, forms a secondary method for mobile users to communicate with one another.
- Maximum size in characters is as follows:
  - For 7-bit characters (upper ASCII), the limit is 160 characters.
  - For 8-bit characters (full ASCII), the limit is 140 characters.
  - For 16-bit character representations, the limit is 70 characters.



- 
- Concatenated SMS or Long SMS allows longer messages to be sent using multiple packets containing a User Data Header that contains the segment number.
  - SMS was designed to operate over the control channel during times of low traffic.
  - A control channel is sending and receiving handshake information so the connection is maintained correctly.
  - It is also used to send messages with commands that control phone features.
  - SMS is a store-and-forward system for communications.

- 
- In a Short Message Service Point-to-Point (SMS-PP) system, when an SMS message is sent, the control channel sent that message to a Message Controller, and then onto a Short Message Service Center (SMSC).
  - The SMSC forwards that message to the recipient's Message Controller, and then the SMS message is sent onto the recipient.
  - If the recipient moves to another location, the SMSC can send the SMS message to the appropriate SMS controller.
  - The SMSC keeps trying to send the message until it receives a response from the receiving party that the message was received.

- 
- An SMS message can be retained at the SMSC for many days until the message reaches its intended recipient.
  - Versions of SMS:
    - ✓ *Enhanced Messaging Service (EMS)*: EMS allows you to attach sounds, pictures, icons, and even formatted text with your message.
    - ✓ *Multimedia Messaging Service (MMS)*: MMS supports the sending of audio, video, and even animation with the SMS text.



# Wireless Application Protocol (WAP)

---

- The WAP is an application-layer network protocol that allows a WAP browser on a mobile device to communicate with a WAP-enabled Web site.
- Created by the WAP Forum in 1997.
- Data is transferred between the two in the form of the **Wireless Markup Language** and is specially formatted to fit on that mobile device.
- Web sites can be composed in WML, or the data can be automatically converted to WML.

## WAP 1.2

---

- WAP 1.2 is a protocol suite that consists of a number of different technologies that are designed to work over different wireless networks such as GSM or CDMA.
- WAP Push is a form of WAP that allows content to be pushed from content providers to mobile clients using a gateway service.

- 
- WAP 1.2 protocol serves the role of a gateway which includes the following:
    - ✓ *Wireless Application Environment (WAE)*: A set of application specific markup languages like WML
    - ✓ *Wireless Session Protocol (WSP)*: Similar to a compressed version of HTTP
    - ✓ *Wireless Transaction Protocol (WTP)*: A transaction monitoring service based on a request/response mechanism
    - ✓ *Wireless Transport Layer Security (WTLS)*: A public-key encryption method
    - ✓ *Wireless Datagram Protocol (WDP)*: Provides unreliable data transport data formatting
    - ✓ *Wireless Data Network, GSM, CDMA, or another network type*



## WAP 2.0

---

- WAP version 2.0 released in 2002.
- WAP 2.0 uses the lightweight eXtensible Hypertext Markup Language Mobile Profile (XHTML MP).
- In WAP 2.0, HTTP is used for complete transport and the gateway and protocol stack used in WAP 1.2 is eliminated.

# Performing Synchronization

---

- Data synchronization is an important Web service for mobile devices.
- Data on devices often need to be synchronized between multiple systems.
- Windows Mobile use a technology called *ActiveSync* for synchronization.
- The most commonly used standard for performing synchronization is SyncML (Synchronization Markup Language).

- 
- Bookmarks, Calendar, Contacts, E-mail, Files, Music, Photos, SMS etc can be synchronized by SyncML.
  - SyncML is implemented using a SyncML server or alternatively as a SyncML hosted service.



- 
- The client portion of SyncML is either a browser plug-in or client connector software.
  - Windows Mobile Device Center; the desktop-to-mobile sync application allows a mobile client to synchronize to a desktop or Microsoft Exchange Server.

# Microservices Architecture

---

- Microservice architecture, or simply microservices, a method of developing software applications as a suite of independently deployable, small, modular services in which each service runs a unique process and communicates through a well-defined, lightweight mechanism to serve a business goal.
- Websites like Netflix, eBay, Amazon etc uses Microservice architecture.
- Software built as microservices can, be broken down into multiple component services.

- 
- This helps the services to be deployed, fine tuned, and then redeployed independently without compromising the integrity of an application.
  - The microservices architecture style is usually organized around business capabilities and priorities.
  - Microservices services receive requests, process them, and generate a response accordingly.
  - Decentralized governance is favored because its developers strive to produce useful tools that can then be used by others to solve the same problems.
  - Microservices are designed to cope with failure.

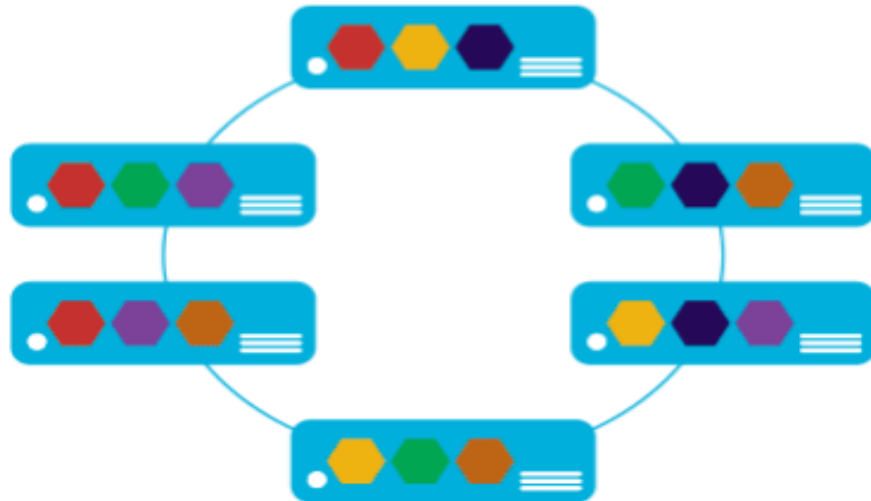


## Benefits of Microservice Architecture

### Microservices Approach

A microservice approach segregates functionality into small autonomous services.

And scales out by **deploying independently** and replicating these services across servers/VMs/containers.



### VS. Traditional Approach

A traditional application (Web app or large service) usually has most of its functionality within a single process (usually internally layered, though).

And scales by cloning the whole app on multiple servers/VMs/containers.



To sum up:

---

“*Microservice architecture uses services to componentize and is usually organized around business capabilities; focuses on products instead of projects; has smart end points but not-so-smart info flow mechanisms; uses decentralized governance as well as decentralized data management; is designed to accommodate service interruptions; and, last but not least, is an evolutionary model.*

”