

Mobile Application Architectures

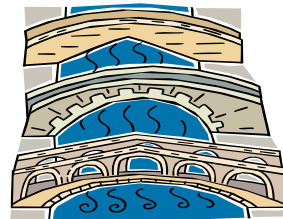
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Slides 6



Mobile Application Architectures



- How should one architect (i.e., organize system to support a mobile application?)
- Basic architecture options
 - Wireless Internet
 - Thin client approach
 - Extend existing applications
 - Smart Client
 - Thick client approach
 - Download code and execute on device
 - Messaging
 - Store and forward technique



Messaging Wireless Internet Smart Client

Increasing Capabilities and Complexity

Mobile Application Architectures



- Architecture adopted for developing and deploying an applications depends on several factors
 - Application Type
 - Mode of interaction
 - Push, Pull, Peer to Peer
 - Device capability
 - Connectivity
 - Mobility
 - System Constraints
 - Bandwidth,
 - Coverage
 - Provider limitations
 - Etc.
- Basic architecture options
 - Messaging
 - Wireless Internet
 - Smart Client



Application Types



- UMTS Forum groups applications into
 - Mobile Internet Access
 - Mobile Intranet/Extranet Access
 - Personalized Infotainment
 - Video, audio, games, etc.
 - Multimedia Message Service (MMS)
 - Location Based Services (LBS)
 - Rich Voice (video telephony, text + audio, etc.)



Application Modes



- Pull
 - Client request info/service from network/host
 - Browsing web, placing phone call, etc.
- Push
 - Network/service “pushes” information/service to user
 - Notify user of traffic jam ahead and present map of alternate route
- Peer to Peer
 - Users exchange info directly over the network
 - Gnutella – file sharing



Device Issues



• Device Capabilities vary greatly

– Characteristics

- startup time
- data storage and integrity
- cpu speed and memory size
- Screen size and resolution
- operating systems
- power supply
- user interface (keypad, stylus, voice, etc.)



– Functionality

- standalone, network dependent



Device Diversity

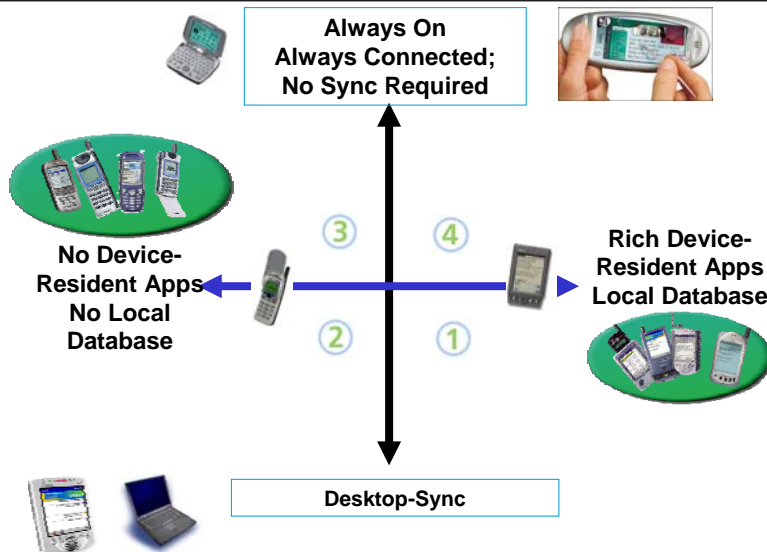


Device	OS	CPU
Nokia 3G phones (6630)	Symbian	T.I.
Samsung Z105u	Proprietary	Qualcomm
Motorola A925	Symbian	Freescale
PDA	Palm OS or Windows CE or Linux	Various (Freescale, TI, Agere, etc)
Handheld PC (HP Jornada)	Windows CE	Intel
Laptop (IBM)	Windows/XP or Linux	Intel

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Connectivity



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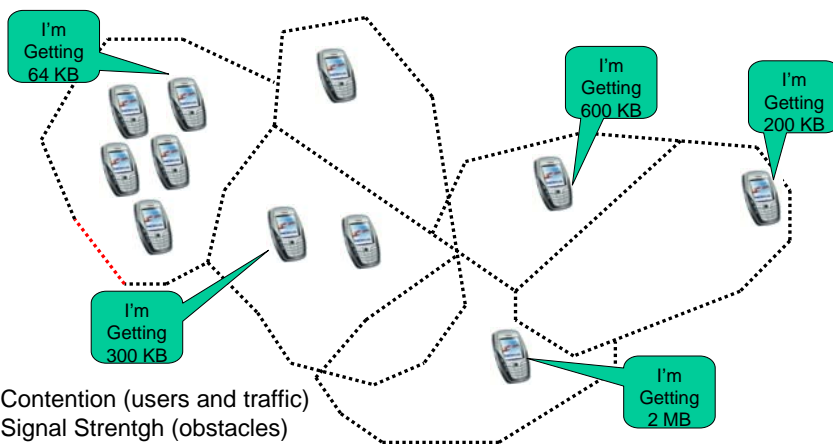
Mobility and System Constraints



- Mobility
 - Coverage: can range from within a WPAN /WLAN hotspot to worldwide WWAN roaming
 - Speed: spans stationary to bullet train speeds
- System Constraints
 - Wireless geographic coverage: WPAN, WLAN, WMAN, WWAN
 - Data rate variability across technologies, within technologies and asymetries in up/down links
 - Security
 - Service provider issues (e.g., billing)



Wireless Networks Data Rates Vary



Example Platform Nokia N95



- **Popular 3G phone in Europe**
- **Multi-Band and Multi-Mode: UMTS, WLAN, GSM, EDGE, Bluetooth**
- **Memory:** Up to 160 MB internal dynamic memory; memory card slot - microSD memory cards (up to 2 GB)
- **Display:** 2.6" QVGA (240 x 320 pixels) TFT – ambient light detector - up to 16 million colors
- **Data Transfer:**
 - UMTS WCDMA 2100 (HSDPA) with simultaneous voice and packet data (Packet Switching max speed UL/DL= 384/3.6MB, Circuit Switching max speed 64kbps)
 - Dual Transfer Mode (DTM) support for simultaneous voice and packet data connection in GSM/EDGE networks - max speed DL/UL: 177.6/118.4 kbits/s
 - EGPRS class B, multi slot class 32, max speed DL/UL= 296 / 177.6 kbits/s
 - Integrated wireless LAN (802.11 b/g 11-54 Mbps)
 - Integrated Bluetooth wireless technology (1Mbps) v.2.0 EDR



Nokia N95



- **Connectivity**
 - USB 2.0 via Mini USB interface and mass storage class support to support drag and drop functionality
 - 3.5 mm stereo headphone plug and TV out support (PAL/NTSC)
 - Nokia PC Suite connectivity with USB, Infrared and Bluetooth wireless technology
 - Local synchronization of contacts and calendar to a compatible PC using compatible connection
 - Remote over-the-air synchronization
- **Video**
 - Send and receive images, video clips, graphics, and business cards via Bluetooth wireless technology
 - Up to 5 megapixel (2592 x 1944 pixels) camera - MPEG-4 VGA video capture of up to 30 fps
 - Video call and video sharing support (WCDMA network services)
 - Video and still image editors
 - Movie director for automated video production



Nokia N95



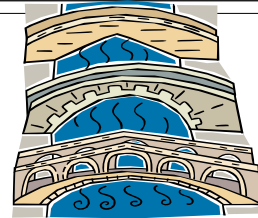
- **Music Features**
 - Digital music player - supports MP3/AAC/AAC+/eAAC+/WMA/M4A with playlists and equalizer
 - Integrated handsfree speaker
 - OMA DRM 2.0 & WMDRM support for music
 - Stereo FM radio (87.5-108MHz /76-90MHz) with Visual Radio support
- **Navigation:** Built-in GPS
- **E-mail:** e-mail client with attachment support for images, videos, music and documents
- Compatible with Nokia Wireless Keyboard
- **Browsing:** Nokia Web Browser with Mini map
- Notice variety of media and connectivity options – may need to have application switch among them on the fly



Mobile Application Architecture Options



- **Wireless Internet**
 - Online access to content
 - Typically used for consumer applications
 - Limited user interface and capabilities
 - Typically Pull mode
- **Smart Client**
 - Incorporates mobile database technology for persistent data storage
 - Updates to data can be synchronized to enterprise systems
 - Allows for offline access to important data
 - Works best in 'occasionally connected' environment
- **Messaging**
 - Store and forward delivery of data
 - Can work in intermittent or always on connectivity modes
 - Can be used on its own, or in addition to other architectures

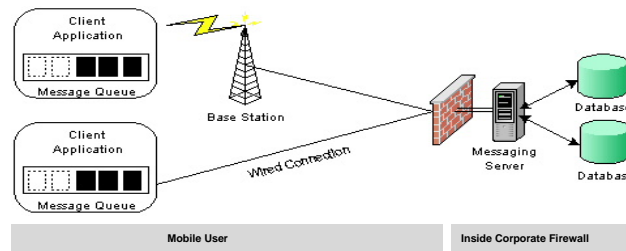




Messaging Architecture



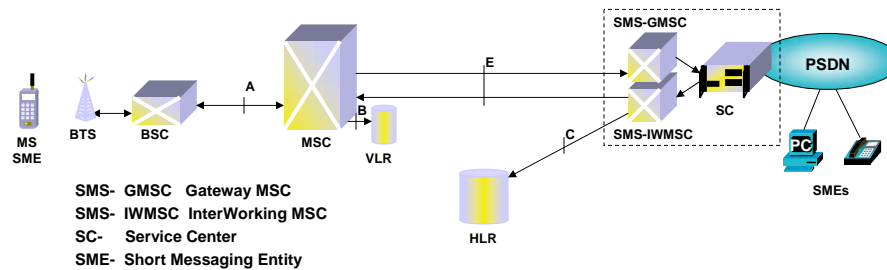
- Messaging Architecture
 - Store and Forward Approach – messages *stored* on device or database – when client connects to network *forward* message
 - Messaging Client
 - Messaging Server
 - Database/Source
- Categories of Messaging
 - User to user (e.g., SMS)
 - Notifications and Alerts (push approach → e.g., notifications, email headers, ads)
 - Application to Application - specialized software on device



Short Message Service (SMS)



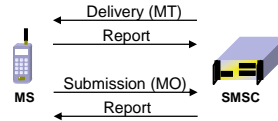
- SMS Short Messaging Service - enables alphanumeric messages to be exchanged between the network and a SMS capable mobiles
- Point-to-Point messaging over *broadcast control* channels or *dedicated control* channels - not traffic channels!
- Message delivery is acknowledged
- SMSC stores-and-forwards SMSs;
- Includes two way messaging and in-call delivery.
- SME is any data terminal or Mobile Station
- Asynchronous Service



SMS



- Basic services :
 - SM MT (Mobile Terminated)
 - SM MO (Mobile Originated)
 - (3GPP2) SM MO can be cancelled, User can acknowledge reception
- SM Service Center (SMSC)
 - relays and store-and-forwards SMSs
- Payload of up to 140 bytes, but
 - Can be compressed (MS-to-MS)
 - And/or segmented in several SMS
- Messages-Waiting
 - SC informs HLR/VLR that a message could not be delivered to MS
- Alert-SC
 - HLR informs SC that the MS is again ready to receive



SMS Example Format



- SMS Submit
 - MTI: Message Type Indicator
 - RD: Reject Duplicates
 - VPF: Validity Period Format
 - SRR: Status Report Request
 - DHI: User Data Header Indication
 - RP: Reply Path Request
 - Message Reference: to distinguish messages
 - Destination address: address (MSISDN, etc.) of message target

7	6	5	4	3	2	1	0
RP	DHI	SRR	VPF	RD	MTI		
Message Reference							
Destination Address (2-12 octets)							
Protocol Identifier							
Coding Scheme							
Validity Period (0, 1, or 7 octets)							
User Data Length							
User Data Header (optional)							
User Data (0-140 octets)							

EMS Principles



- Enhanced Message Service
- Leverages SMS infrastructure
- Formatting attributes in payload allow:
 - Text formatting (alignment, font size, style, color)
 - Pictures (e.g. 255x255 color) or vector-based graphics
 - Animations
 - Sounds
 - Concatenated messages
- Interoperable with 2G SMS mobiles
 - 2G MS ignore special formats



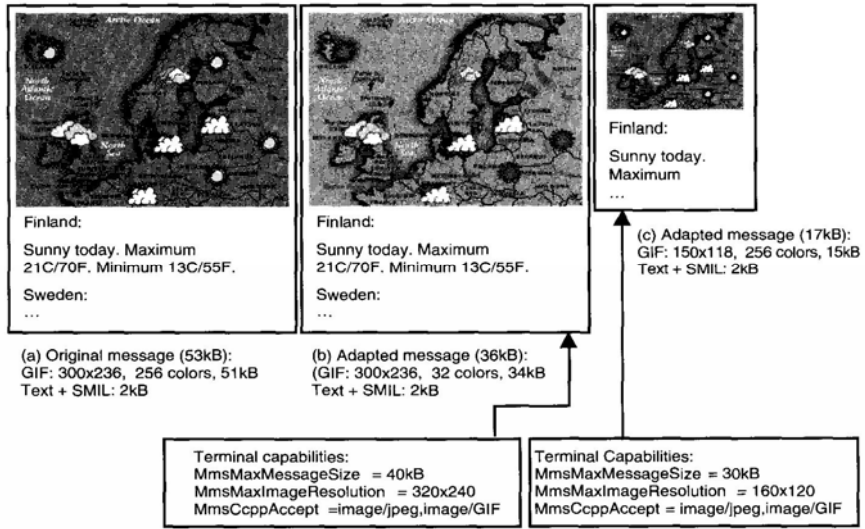
MMS Messaging



- Multimedia Messaging Service (MMS)
 - Non real-time multi-media message service
 - Text, Speech
 - Audio (MP3, MIDI)
 - Image (JPEG, GIF)
 - Video (MPEG4, H.263)
- Uses IP data path (cdma 2000) or WAP (GPRS, UMTS)
- Adapts to terminal capabilities
 - (media format conversions)
- Addressing by phone number or email address
- Supports MMBx – multi-media mail box



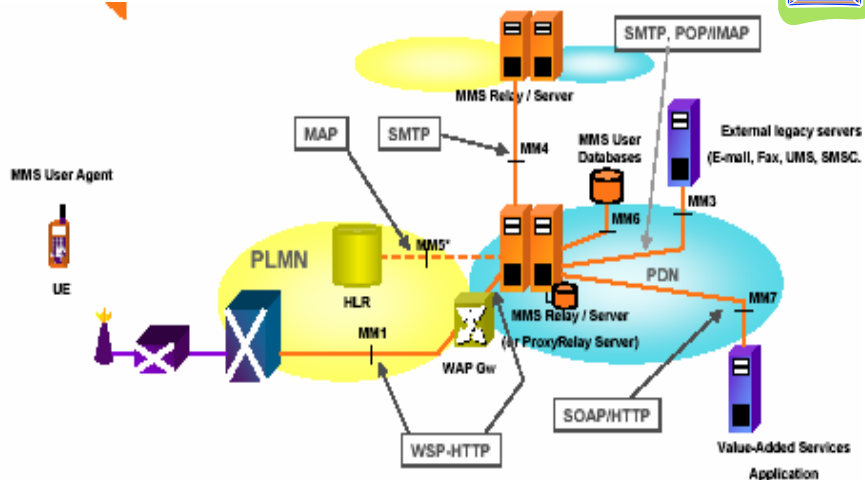
MMS Content Adaptation Example



MMS Messaging



Architecture similar to SMS - New server in backhaul
 Uses packet data traffic channel for message transmission



Messaging



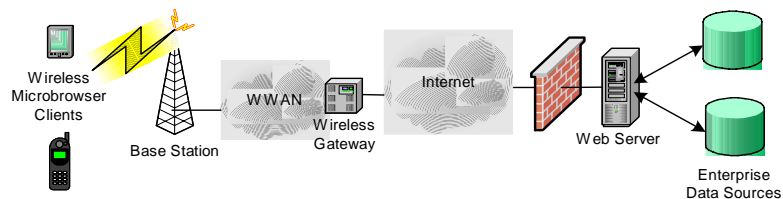
- Advantages
 - Simple (messaging client, server, data source)
 - Low cost, easy to use
 - Push capabilities
 - Store and Forward – personalized data delivery
 - SMS → voice, voice mail → SMS, etc.
 - Application to application messaging possible
- Disadvantages
 - Limited means of communications
 - Asynchronous
 - Largely controlled by network operator
- Instant Messaging is planned/rolled out
 - not store and forward – peer to peer through a server more like a smart client architecture
 - Uses a traffic channels not control channels



Wireless Internet Architecture



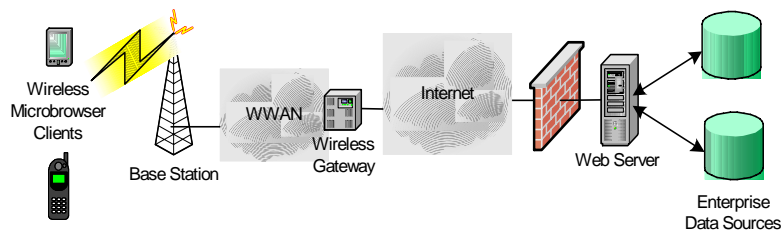
- Extend Architecture of wired Internet to include wireless endpoint
- Components
 - Microbrowser (thin client),
 - Content/data source (e.g., web server)
 - Possibly a proxy enhancing performance gateway



Content Adaptation



- Content must be created specifically for mobile device (e.g., WML pages) or content adaptation needed to deal with device heterogeneity
- Several options for where content adaptation occurs
 - Server (e.g., multiple versions of content)
 - Portal between server and wireless gateway (portal approach)
 - Gateway to WWAN (WAP approach)
 - Client device (Opera browser approach)



Example Image Quality



4 seconds at 150Kbps
original JPEG 50k bytes

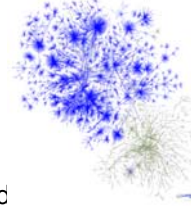


4 seconds at 30kbps
Compressed JPEG 10k bytes

Wireless Internet Architecture



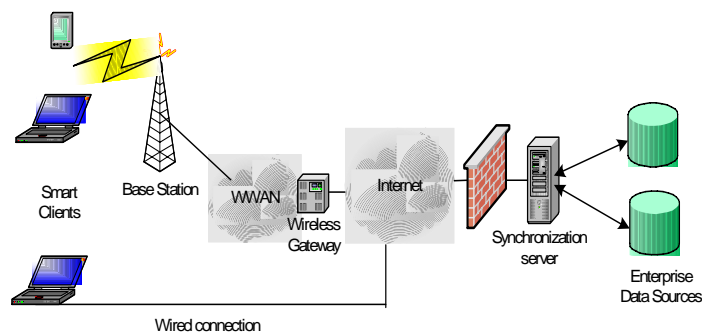
- Advantages
 - no software deployment
 - easy enterprise integration
 - fresh data
 - easy to use
 - broad deployment
 - application developer/content provider can d
 - Set of software development tools (WML, XHTML-MP)
- Disadvantages
 - Wireless connectivity
 - limited user interface
 - heterogeneous devices (content adaptation needed)
 - application performance and testing
 - More difficult to provide advanced service (e.g., location based services)
 - Cost



Smart Client Architecture



- Custom software executes on Devices
- Components:
 - Smart clients
 - Synchronization server
 - data/content source
 - may include proxies or gateways



Platform Independence



- Biggest problem in smart client development is wide variety of mobile devices
- Different operating systems, different CPUs, memory, displays, etc.
- If develop application in native code (e.g., assembly language) for a specific platform (e.g., Nokia 655) will likely not work on another platform
- Will need to develop multiple versions of the same application for various platforms
- Better approach is to use virtualization to strive for platform independence



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Virtualization



- Virtualization of resources: a powerful abstraction in systems engineering:
- Computing examples: virtual memory, virtual devices
 - Virtual machines: JAVA
- Layering of abstractions: don't sweat the details of the lower layer, only deal with lower layers abstractly
- In mobile devices virtualize using
 - Sun's Java 2 Micro Edition (J2ME)
 - Run java apps on a java virtual machine (JVM)
 - Microsoft .NET Compact Framework (.NET CF)
 - Run on C# on Microsoft's Common Language Runtime (CLR) platform
 - Qualcomm's Binary Runtime Environment for Wireless (BREW)
 - Run C, C++, Java on BREW for Qualcomm chip set based phones

Applications

Profile
(MIDP)

Configurations
(CDC, CLDC)

Java Virtual Machine
(JVM, KVM)

Operating system
(Symbian, Palm, WinCE)

Hardware
(SH4, ARM, 68k, ...)

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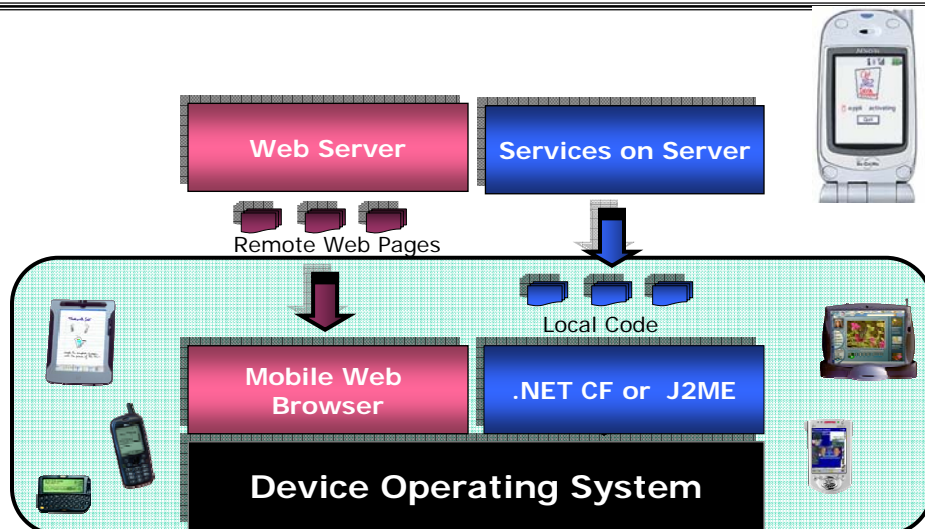
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Smart Client Architecture



- Advantages
 - Available data
 - Rich user interface
 - Distributed computing
 - Security
 - application developer/content provider maybe able to deploy
 - Can off load bandwidth requirements with local client processing
- Disadvantages
 - Enterprise integration
 - Application development and deployment
 - Application complexity and testing
 - Cost

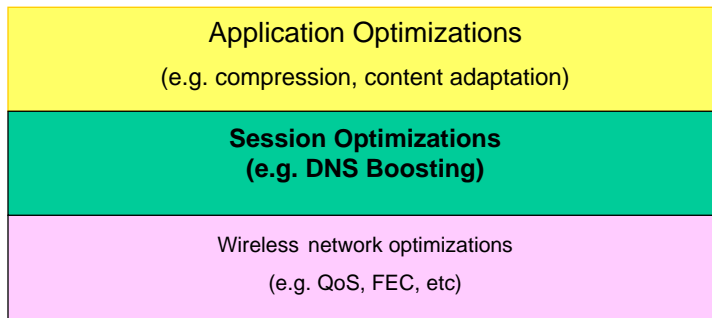
Wireless Internet Vs. Smart Client



Wireless Data Accelerators



- Regardless of Application architecture used
- Would like to Speed up user's wireless data experience
 - "Wireline Experience over Wireless"
- Decrease amount of data sent through Wireless interface
 - Boosts Network Capacity
- Different levels of optimizations:



Summary



- Looked at Issues affecting choice of application architecture
 - Device capabilities, application type, mode, connectivity, etc.
- Overview of types of application architectures
 - Messaging
 - Thin Client (wireless Internet)
 - Smart Client
- Each architecture has pluses and minuses
 - All are being used in practice.
- Applications may need to make use of all architectures

