CENG 577 Advanced Services in Communications

Course Overview

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Outline

- What is this Course About?
- Technology Trends

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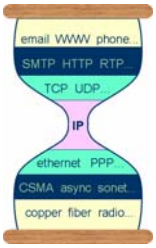
Traditional "Networking" Course (CENG 362)

- All about protocols and the OSI 7 or TCP/IP (4/5) layers
  - Protocol layering
  - Protocol details:, HTTP, FTP, SMTP, POP3, TCP/UDP, IP, link-state vs. distance vector …
  - Multiaccess technology
  - Switching and routing
  - Naming (DNS, MAC addressing, …)
  - Error control
  - Flow control & scheduling
  - Special topics like multicast and mobility



What is New? New *Pervasive Networking* Opportunity

- New things you can do ***inside*** the network
- Connecting end-points to "services" with processing embedded in the network fabric
- Not protocols but "agents" well-specified behavior, executing in places in the network
- Layer violation to enhance awareness acceptable: location, network topology, data format, protocol, subscriber identify, service in execution
- Scalable session and flow-oriented processing: measuring, monitoring, billing, prioritizing
- No single technical architecture likely to dominate: think **overlays, system of systems**

Distributed Service Architectures for Converged Networks

- Converged Networks
  - Public Switched Telephone Network (PSTN)
  - Internet/Public Switched Data Network (PSDN)
  - Mobile Internet
  - Converged Structure?
- Distributed Service Architecture
  - Services
    - » "-Ility" connectivity
    - » New call "features"
    - » Infrastructure services
    - » Enables distributed applications

Services in Converged Networks

Communications Services

Voice	Multimedia	Messaging Low Volume	Messaging High Volume	Telematics
				
• Voice Circuit Switched (CS) • Voice Packet Switched (PS)	• Video Real-time CS / PS • Video Telephony CS / PS • Video Conference CS / PS	• SMS • Chat • Email without appendix	• Emails with attachments: – Powerpoint presentations – Mp3 audio files and ring tones – Mp4 video clips – M-icons	• Machine-to-machine and man-to-machine communications: – Auto.telematics – EFTPOS devices – Street vending machine – Alarm systems

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Services in Converged Networks

Net Access Services

Information Services	Location-based Services	M-Commerce	M-Entertainment	Personal Informa-tion Management (PIM)	Other Internet / Intranet Access
					
• News • Stocks • Financial • Weather • Travel	• The nearest ATM? • The quickest way to East Coast? • The best restaurant? • The nearest available parking?	• M-banking • M-brokering • M-ticketing • M-tailing	• Download-able and interactive entertain-ment services – Mp3 audio files Mp4 video clips – M-icons – Interactive Games	• Address book • Business card • Personal Web Space • Management services	• Corporate Intranet connectivity • General web browsing, not just own portal • Remote secure access for Intranet

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What is this Course About? New Kind of Communications-Oriented Service Architecture

- Emerging, yet still developing, view of a new kind of **communications-oriented service architecture** in a **highly heterogeneous environment**
  - Rapid development/deployment of new services & apps
  - Delivered to radically **different end devices** (phone, computer, info appliance) **over diverse access networks** (PSTN, LAN, Wireless, Cellular, DSL, Cable, Satellite)
  - Exploiting Internet-based technology core: clients/server, applications level routers, TCP/IP protocols, Web/XML formats
  - Beyond traditional "call processing" model: client-proxy-server plus application-level partitioning
  - Built upon a new business model being driven by the evolution of the Internet: traditional "managed" networks and services versus emerging "overlay" networks and services structured on top of and outside of the above

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Some Potential Disruptive Ideas About Network Architecture and Design*

- Where should intelligence in the network reside?
- End-to-end model right conceptual framework?
- How can faults be better isolated and diagnosed?
- Abstractions of topology and performance
- Overlay approach to deploy disruptive technologies

* From "Looking over the Fence at Networks: A Neighbor's View of Networking Research" Computer Science Technical Board, National Research Council, USA

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Course Structure

- Seminar! We learn from each other!
  - Avoid traditional lecture-oriented course
  - Professor and more student-led presentations, discussions
  - Every student will develop materials and lead discussions on selected areas of technology; to be written up by mid-semester as a "**term paper**"
  - **Project: Design and evaluation of a distributed service architecture ?**
  - Project: depending on class size, we will have collaborating and competing teams develop a design and evaluation for future converged network service architecture
  - 30% Class Discussion/Presentation/Contribution
  - 40% Term Paper/Project
  - 30% Final

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Relevant Technologies (Partial List!)

- PSTN architecture: AIN, SS-7
- SLAs
- UMTS/GPRS/Edge
- Voice over IP with SIP
- Internet Multimedia Architecture (RTSP, SIP, SAP, RTP/RTCP, IPv6, IP Mobility, DiffServ, Multicast)
- SyncML
- Parlay, JTAPI
- WAP
- Symbian/Embedded OS
- Sun ONE, J2EE, .Net, CORBA, TINA, RMI, SOA
- SMS/MMS + Other Messaging Platforms
- MGCP
- SIP Instant Messaging + Presence Leveraging
- Mobile Location Services, LBS
- WAP
- Radius/Diameter/Single Sign On
- BGP
- MPLS
- Core vs. Access Networking Technologies
- Mobey Formum
- Operator Wireless LAN
- DRM, PKI
- SCPTP/IETF Sigtran
- Architecture of Internet Data Centers and NAPs

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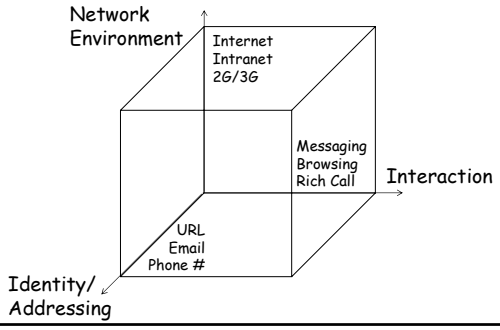
Nokia's Mobile World View



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Nokia's Mobile Service Matrix

Content	Comms	Productivity	Business
Information Entertainment News Banking & Finance Buy & Sell Travel Music TV Lifestyle Fun Games Astrology Dating	Messaging E-Mail FAX Rich Call	Organizers Personal Assistants Tools Misc	Intranet & Extranet Access Info Mgmt Enterprise Comms VPNs Telematics

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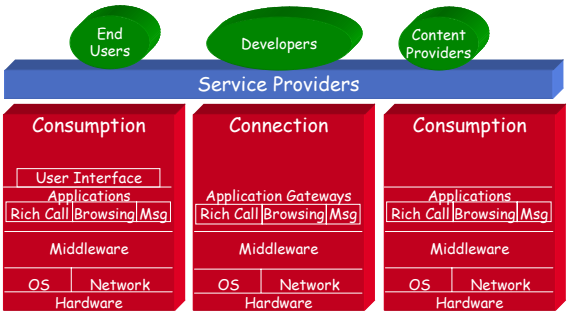
Nokia's Mobile Internet "Business Architecture"



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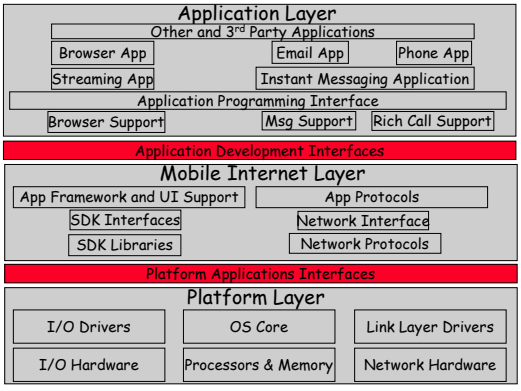

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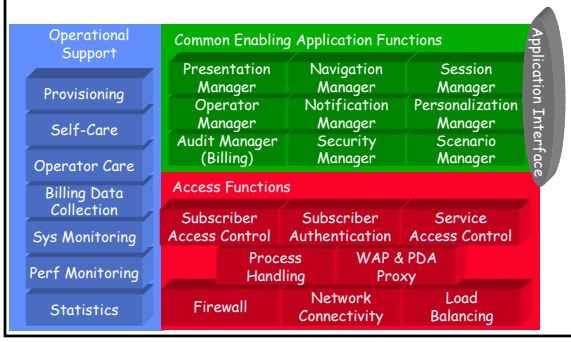
Nokia's mPlatform Architecture



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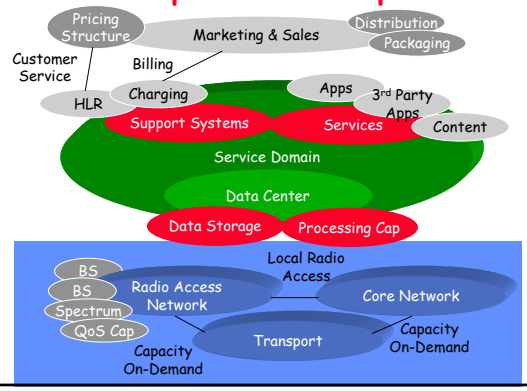
One Operator's Viewpoint



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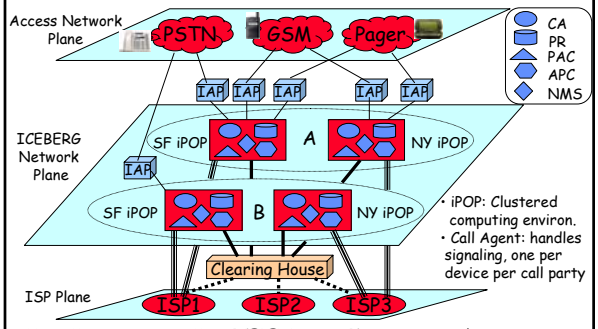
ICEBERG Architecture



- Name Mapping Service: Maps ICEBERG unique ID ⇔ service end point
- Preference Registry / Personal Activity Coordinator: user profile / user tracking
- Automatic Path Creation service: creates transcoding datapath between endpoints

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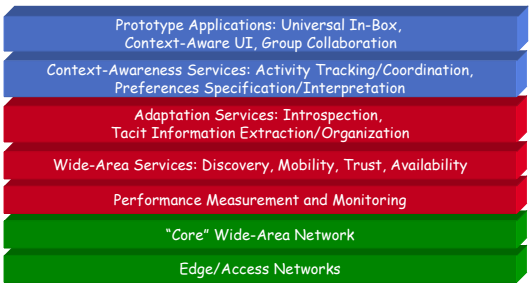
Possible High Level "Layered" View of Service Architecture



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Outline

- What is this Course About?
- Technology Trends

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Technology Trends

- Computing
  - Convergence, Divergence, Scale
- Networks
  - Internet vs. Telephone Network
  - Wireless/Mobile Access
- Services
  - E-commerce, M-commerce/M-transactions (iMode), Content
  - Messaging as a major application (P2P, P2M, M2M)
- Architecture
  - Integrated ("Closed") vs. Composed ("Open") Content, Distribution, Access Architecture
  - Managed vs. Overlay Networks and Services
  - Competitive vs. Cooperative Service Providers

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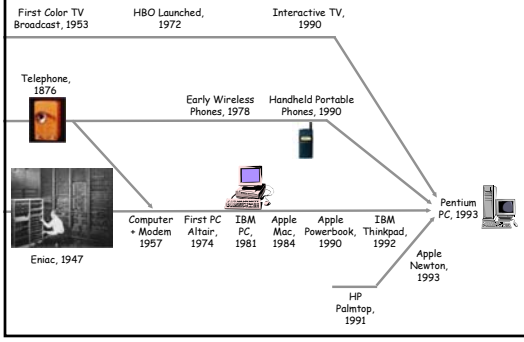
Convergence?



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Divergence?

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The Shape of Things Now: 2006

Sony Ericsson P990

Networks:
P990i Dual mode **UMTS** (2100MHz) - GPRS 900/1800/1900 P990c Dual mode UMTS (2100MHz) - GPRS 900/1800/1900
Screen Display:
240x320 pixels QVGA,262 k color
Memory:
RAM Memory: 64MB, Flash Memory: 128MB Shared memory for storage: Up to 80MB user free memory External memory: Up to 4GB Memory Stick Duo Pro Max JAR Size, Max SIS Size: Unlimited (but depending on available storage)
Symbian OS Technology:
Symbian OS v9.1, UIQ 3.0
Java Technology:
Both CDC and CLDC environments supported: JTWI 1.0 (JSR-185) consisting of Connected Limited Device Configuration (CLDC) 1.1 HI (JSR-139), MIDP 2.0 (JSR-118), WMA 1.1 (JSR-120). •PDA Optional Packages (JSR-75) •Bluetooth (JSR-82) •Wireless Messaging API 2.0 (JSR-205) •Web Services (JSR-172) •Mobile Media API (JSR-135) •Mobile 3D Graphics (JSR-184) •Nokia UI API 1.1 Connected Device Configuration (CDC) 1.0 (JSR-36) •Foundation Profile 1.0 (JSR-46) •Personal Profile 1.0 (JSR-62) •PDA Optional Packages (JSR-75)

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The Shape of Things Now: 2006

Sony Ericsson P990

Browser:
Opera version 8: HTML 4.01, xHTML 1.0, CSS, Javascript (ECMAScript)
Messaging:
SMS, EMS, MMS, e-mail
Digital Rights Mgmt.:
OMA DRM v1.0
Multimedia Support:
Video: MP4 (MPEG4 and AAC-LC), 3GP (H.263 AMR NB/WB and AAC) and Real Audio Video *Sound*: AU, iMelody, AAC, AMR, MP3, RMF, DLS, Real Audio, G-MIDI level 1 with 40 voices polyphonic MIDI, WAV (up to 16 KHz sample-rate), XMF
Local Connectivity:
Infrared Bluetooth USB **WiFi (802.11 WLAN connectivity on the Phone !)**
Extra features:
2 Megapixel camera with autofocus Video recorder/player QWERTY, QWERTZ, AZERTY and Russian keyboard options Jog Dial QuickShare MusicDJ PlayNow **4GB Memory Stick Duo Pro** Flight mode FM radio

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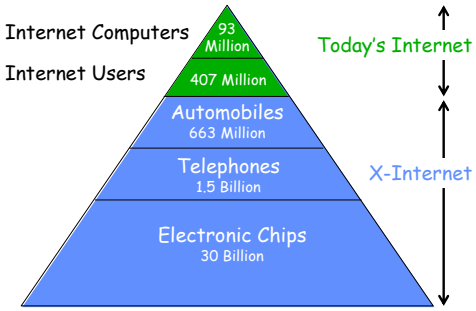
"X-Internet" Beyond the PC



Forrester Research, May 2001

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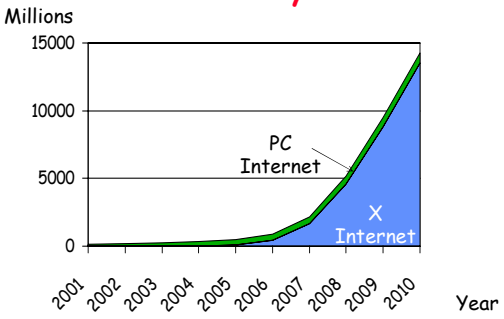
"X-Internet" Beyond the PC



Forrester Research, May 2001

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The Shape of Things to Come

- Toyota Pod Concept Car
  - Co-designed with Sony
  - Detects driver's skill level and adjust suspension
  - Detects driver's mood (pulse rate, perspiration), compensates for road rage and incorporates a mood meter (happy vs. angry face)
  - Inter-pod wireless LAN to communicate intentions between vehicles, such as passing
  - Individual entertainment stations for each passenger

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Shape of Things to Come (2002): Sensor Networks

- Embedded processing, time synchronization mechanisms, real-time event handling, multihop network routing, application development tools and environments

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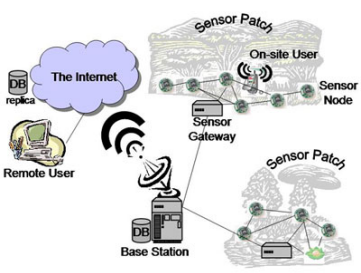
Environmental Sensing: Sensor-to-Remote Researcher



- Great Duck Island
  - Remote investigation of microhabitats
  - David Culler, Alan Mainwaring, Intel Berkeley Laboratories

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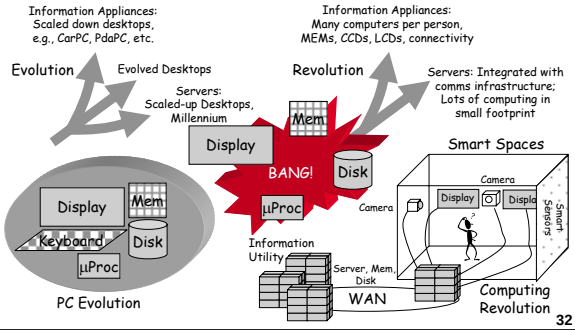
Devices in the eXtreme



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Pervasive Computing = "Convergence" Via Services in the Network

- Not just about gadgets or access technologies, which are becoming ever more diverse
- But *services* and *applications*, and how the net can best support them anywhere, anytime
- Bottlenecks are near the edge, not the core
- Enabled by:
  - Computing embedded in communications fabric: distributed, wide-area, topology-aware
  - Per session characterization, processing, prioritization, monitoring, management, billing

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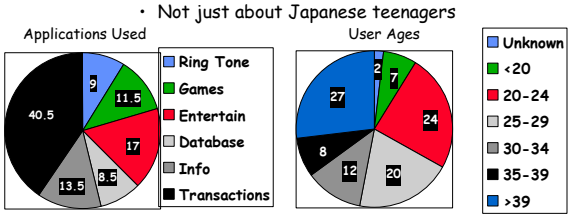
The iMode Story: It is About Services

- Wireless Internet service popular in Japan and is increasing in popularity in other parts of the world
- 27M Internet-capable cell phone sub-scribers (10/01); 50K iMode Web Sites
- World's largest ISP, first to deploy 3G "Freedom of Multimedia Access" (FOMA)
- Not just about Japanese teenagers



Economist Magazine, 13 Oct 2001

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After the PC … True "Convergence"

- Not just about gadgets or access technologies
- About ***services*** and ***applications***, and how the network can best support them
- Increasing, not decreasing, diversity
- Bottlenecks moving from core towards edge
- Enabled by **computing embedded in communications fabric**: wide-area, topology-aware, distributed computing

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Telephony Evolution

- Mobility/Wireless driving end-to-end digitization of the telephony system
  - Shift towards IP-based infrastructure (Nokia "All-IP" Architecture)
- Converged Services
  - AT&T
    - » Cell Phone, Telephone, ISP, Video on Demand (Cable)
    - » Universal Billing Systems
  - Sprint: $0.05/min local/long distance, wired/wireless
- Computer-Telephony Integration
  - Call Centers, Software-based PBXs, PSTN By-Pass
  - Consumer-to-Business E-commerce (e.g., Lands End)
  - Speech-Enabled Services (e.g., "Concierge")

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Internet vs. Telephone Net

- Strengths
  - Intelligence at ends
  - Decentralized control
  - Operates over heterogeneous access technologies
- Weaknesses
  - No differential service
  - Variable performance delay
  - New functions difficult to add since end nodes must be upgraded
  - No trusted infrastructure

- Strengths
  - No end-point intelligence
  - Heterogeneous devices
  - Excellent voice performance
- Weaknesses
  - Achieves performance by overallocating resources
  - Difficult to add new services to "Intelligent Network" due to complex call model
  - Expensive approach for reliability

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Cellular Services Most Often Requested

After basic wireless telephony service

• Call Forwarding	37%	
• Paging	33%	
• Internet/E-Mail	24%	Data Applications
• Traffic/Weather	15%	
• Conference Calling	13%	
• News	3%	

Source: CTIA Web Page
Peter D. Hart Research Associates, March 1997

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Services and Applications: E-Commerce

- Consumer Services
  - Consumer-driven QoS: improved Web access "experience"
  - Converged digital video + web content (e.g., HVML)
  - Unified billing: pay-per-view movie plus ad-induced pizza purchase
  - Content delivery: file mover/software upgrades/digital audio/video
  - Infrastructure storage: back-up, photos, mp3s, videos, TV tapings
- Consumer-to-Business Services
  - Web-based + (IP-based) Telephone
  - New kinds of integrated call centers: e.g., Lands End
- M-Commerce
  - Location-sensitive ad insertion
  - Unified billing for telecom access + purchases

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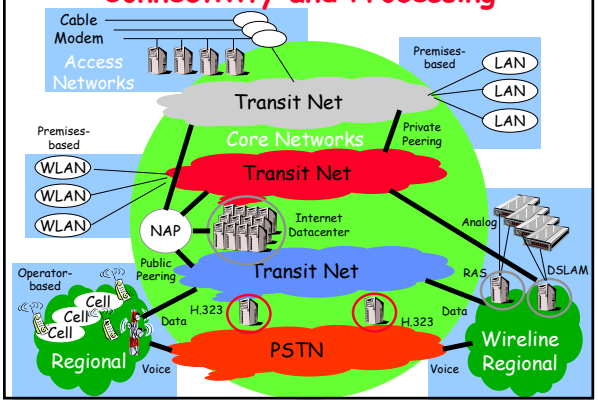
Connectivity and Processing



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