

User Interaction: Ubiquitous and Cloud Computing

Assoc. Professor Donald J. Patterson
INF 133 Fall 2012



: What is Ubiquitous Computing?



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ubiq·ui·tous  *adj* \yü-'bi-kwə-təs\
.....

Definition of UBIQUITOUS



: existing or being everywhere at the same time : constantly encountered : WIDESPREAD <a *ubiquitous* fashion>

- **ubiq·ui·tous·ly** *adverb*
- **ubiq·ui·tous·ness** *noun*

 See [ubiquitous](#) defined for English-language learners »
See [ubiquitous](#) defined for kids »

Examples of UBIQUITOUS

- The company's advertisements are *ubiquitous*.
- <by that time cell phones had become *ubiquitous*, and people had long ceased to be impressed by the sight of one>
- Hot dogs are the ideal road trip food—inexpensive, portable, *ubiquitous*. —Paul Lucas, *Saveur*, June/July 2008

[+] more

www.merriam-webster.com

: The origins of Ubicomp as a academic discipline

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The Computer for the 21st Century

Specialized elements of hardware and software, connected by wires, radio waves and infrared, will be so ubiquitous that no one will notice their presence

by Mark Weiser

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

Consider writing, perhaps the first information technology. The ability to represent spoken language symbolically for long-term storage freed information from the limits of individual memory. Today this technology is ubiquitous in industrialized countries. Not only do books, magazines and newspapers convey written information, but so do street signs, billboards, shop signs and even graffiti. Candy wrappers are covered in writing. The constant background presence of these products of "literacy technology" does not require active attention, but the information to be transmitted is ready for use at a glance. It is difficult to imagine modern life otherwise.

Silicon-based information technology, in contrast, is far from having become part of the environment. More than 50 million personal computers have been sold, and the computer nonetheless remains largely in a world of its own. It

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The arcane aura that surrounds personal computers is not just a "user interface" problem. My colleagues and I at the Xerox Palo Alto Research Center think that the idea of a "personal" computer itself is misplaced and that the vision of laptop machines, dynabooks and "knowledge navigators" is only a transitional step toward achieving the real potential of information technology. Such machines cannot truly make computing an integral, invisible part of people's lives. We are therefore trying to conceive a new way of thinking about computers, one that takes into account the human world and allows the computers themselves to vanish into the background.

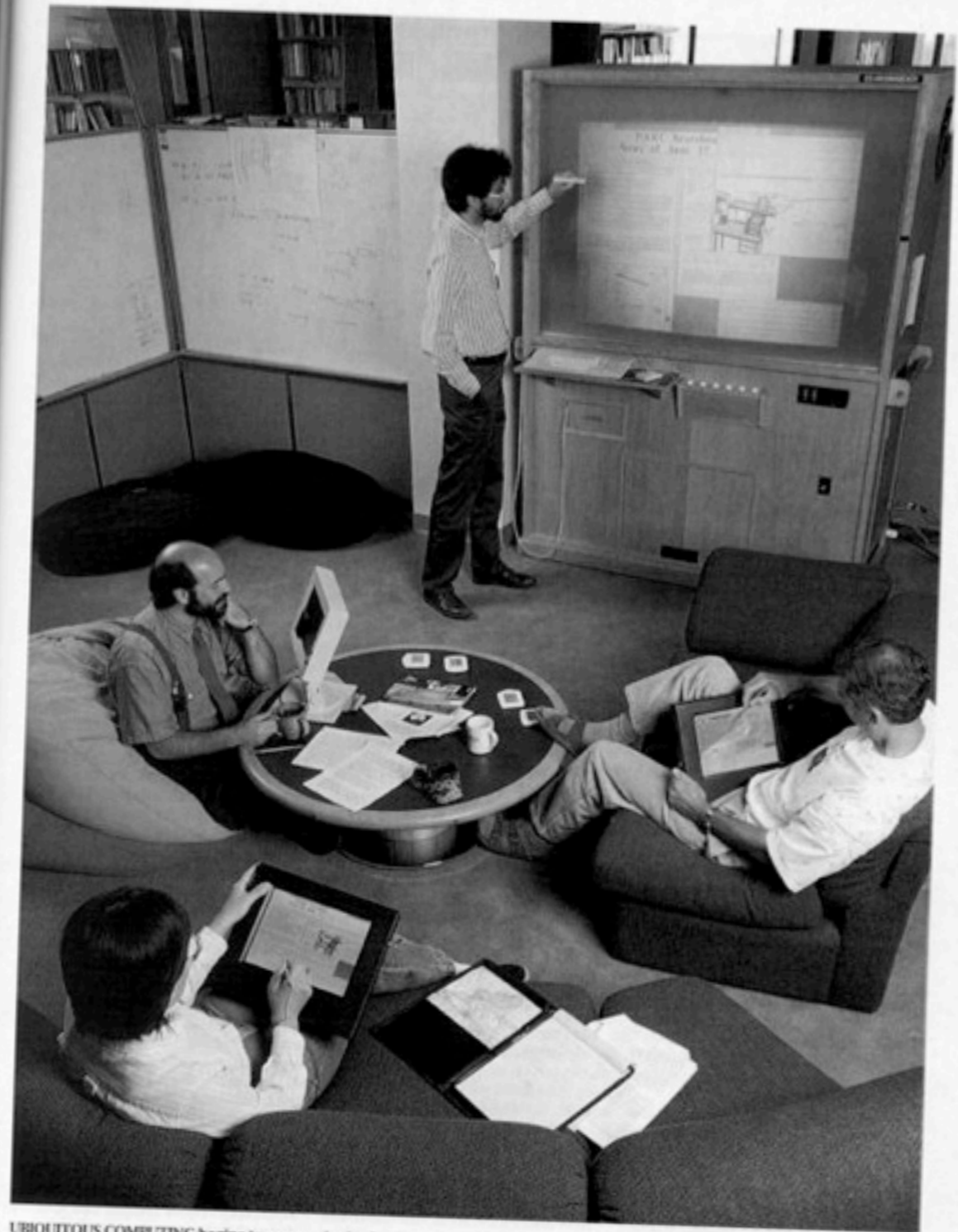
Such a disappearance is a fundamental consequence not of technology but of human psychology. Whenever people learn something sufficiently well, they cease to be aware of it. When you look at a street sign, for example, you absorb its information without consciously performing the act of reading. Computer scientist, economist and Nobelist Herbert A. Simon calls this phenomenon "compiling"; philosopher Michael Polanyi calls it the "tacit dimension"; psychologist J. J. Gibson calls it "visual invariants"; philosophers Hans Georg Gadamer and Martin Heidegger call it the "horizon" and the "ready-to-hand"; John Seely Erown of PARC calls it the "periphery." All say, in essence, that only when things disappear in this way are we freed to use them without thinking and so to focus beyond them on new goals.

The idea of integrating computers seamlessly into the world at large runs counter to a number of present-day trends. "Ubiquitous computing" in this context does not mean just computers that can be carried to the beach, jungle or airport. Even the most powerful notebook computer, with access to a worldwide information network, still focuses attention on a single box. By analogy with writing, carrying a superlaptop is like owning just one very important book. Customizing this book, even writing millions of other books, does not begin to capture the real power of literacy.

Furthermore, although ubiquitous computers may use sound and video in addition to text and graphics, that does not make them "multimedia computers." Today's multimedia machine makes the computer screen into a demanding focus of attention rather than allowing it to fade into the background.

Perhaps most diametrically opposed to our vision is the notion of virtual reality, which attempts to make a world inside the computer. Users don special goggles that project an artificial scene onto their eyes; they wear gloves or even bodysuits that sense their motions and gestures so that they can move about and manipulate virtual objects. Although it may have its purpose in allowing people to explore realms otherwise inaccessible—the insides of cells, the surfaces of distant planets, the information web of data bases—virtual reality is only a map, not a territory. It excludes desks, offices, other people not wearing goggles and bodysuits, weather, trees, walks, chance encounters and, in general, the infinite richness of the universe. Virtual reality focuses an enormous apparatus on simulating the world rather than on invisibly enhancing the world that already exists.

Indeed, the opposition between the



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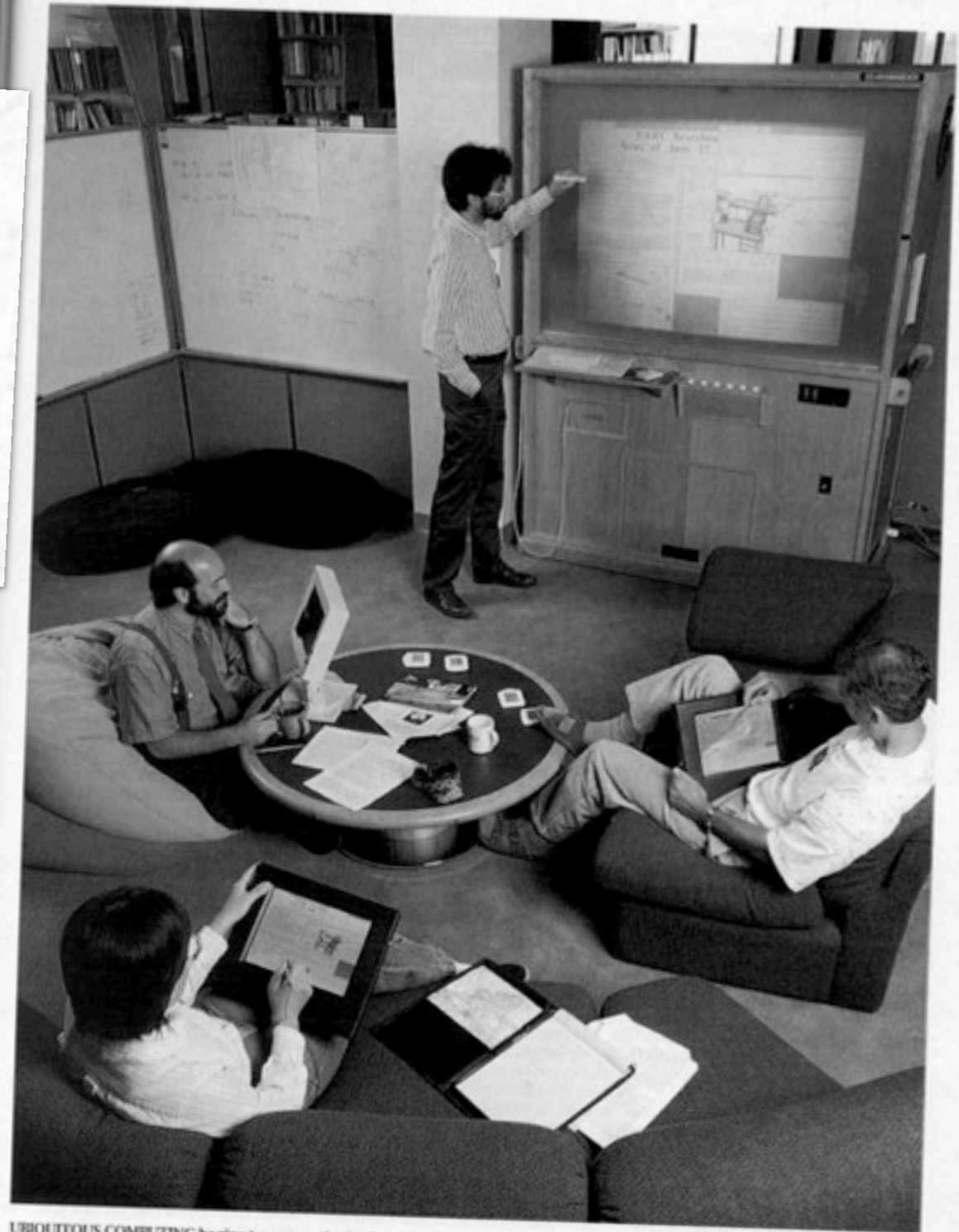
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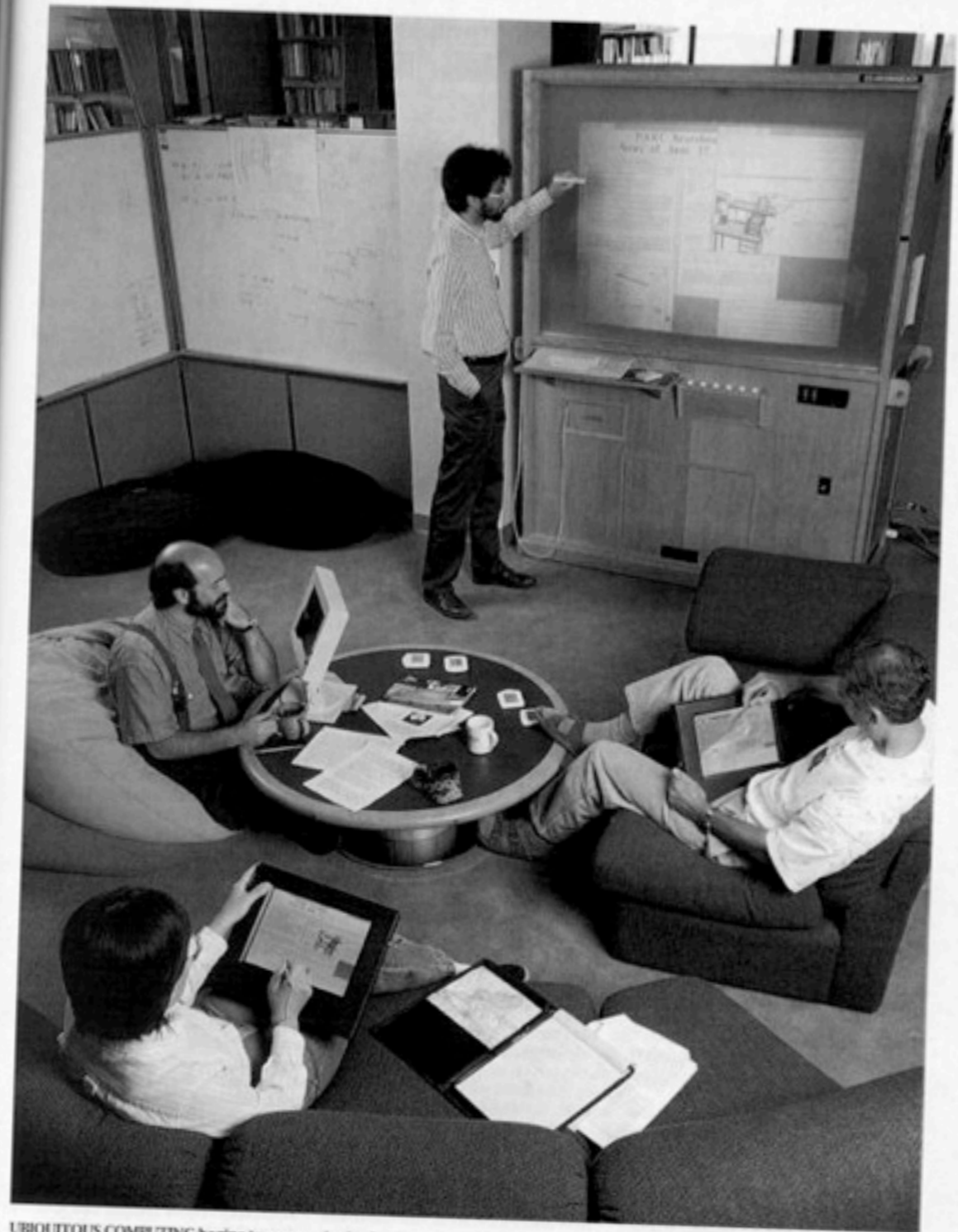
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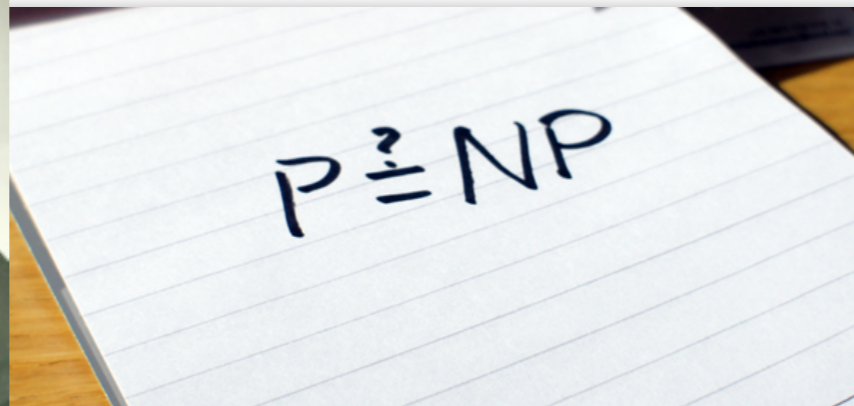
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Zero Wave

- Computerless Computing
 - 1930-1940
 - Computers are theoretical technology
 - Church and Turing establish fundamental limits on computability





First Wave

- Main Frame Computing
 - 1960-1970
 - Massive computers to do simple data processing
 - Few computers in the world





Second Wave

- Desktop Computing
 - 1980-1990
 - Business applications drive usage
 - One computer per desk
 - Computers connected in intranets to a massive global network
 - All wired





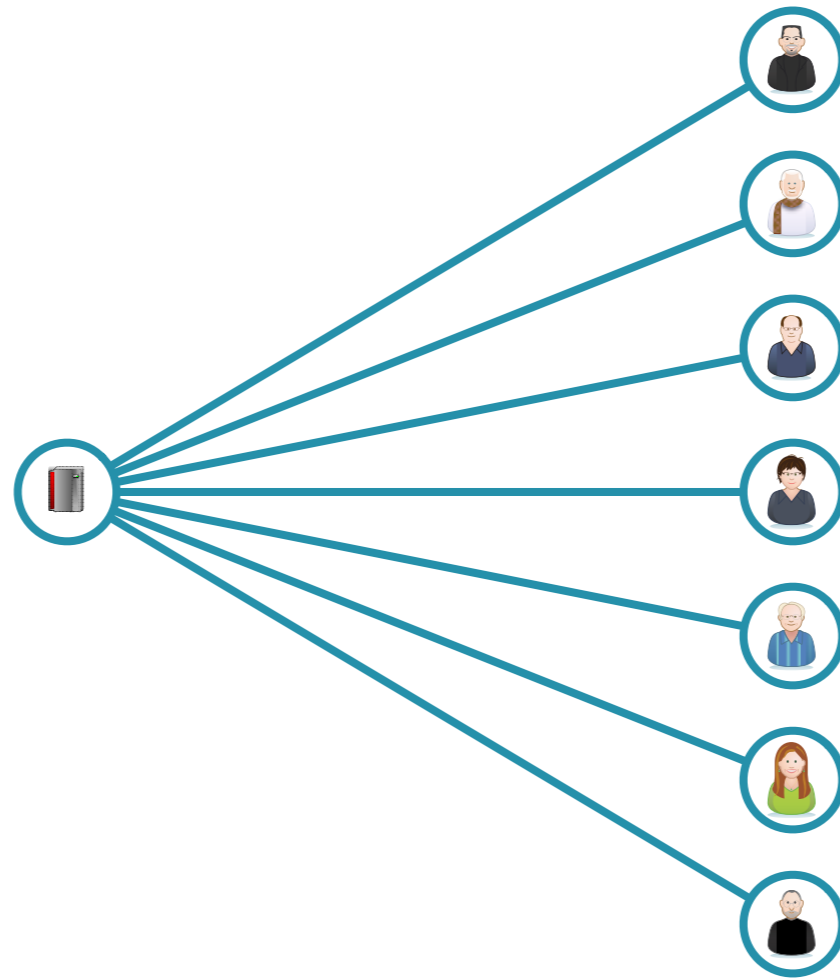
Third Wave

- Ubiquitous Computing
 - 2000 - present
 - Information creation, access, communication drive usage
 - Multiple computers per environment/person
 - WANs, LANs, PANs, ad-hoc networking, wireless
 - Computers disappearing



: Ubicomp is about people's relationship to computers

First Wave



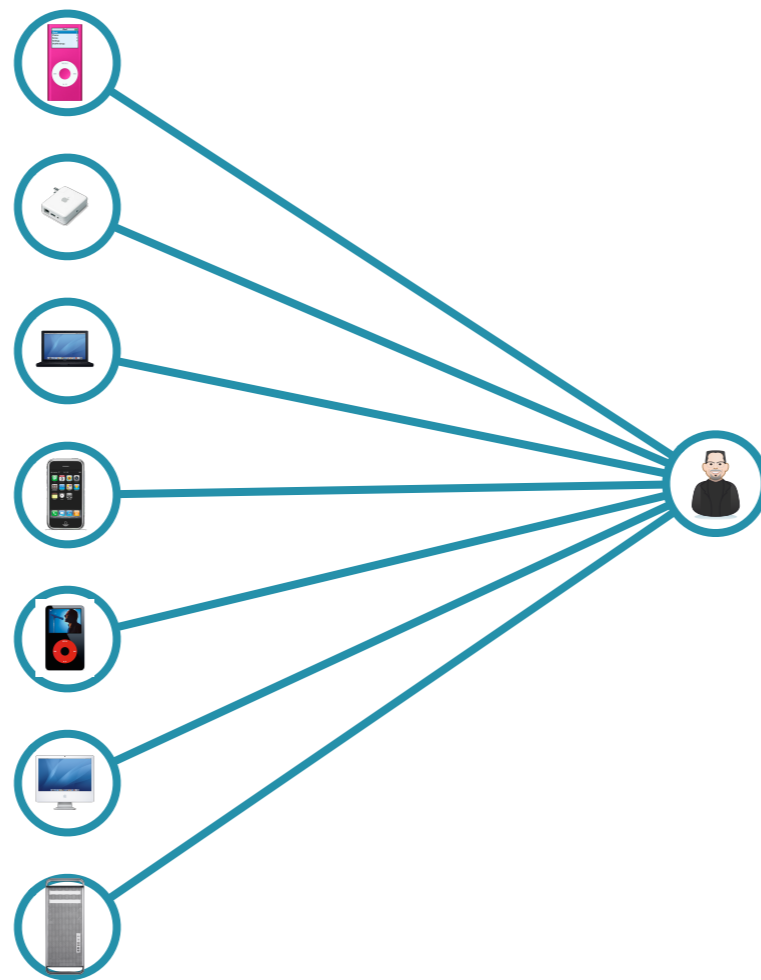
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Second Wave



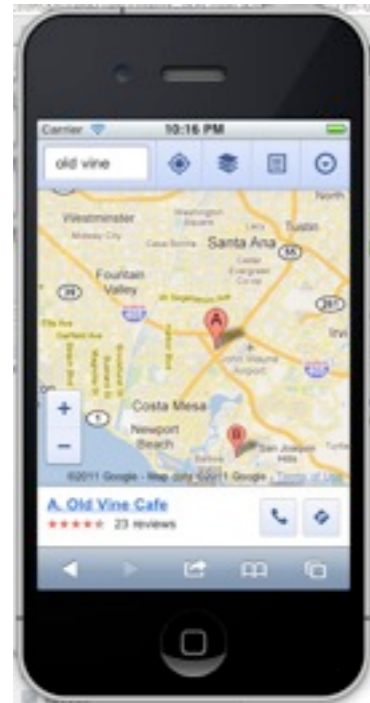
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Third Wave

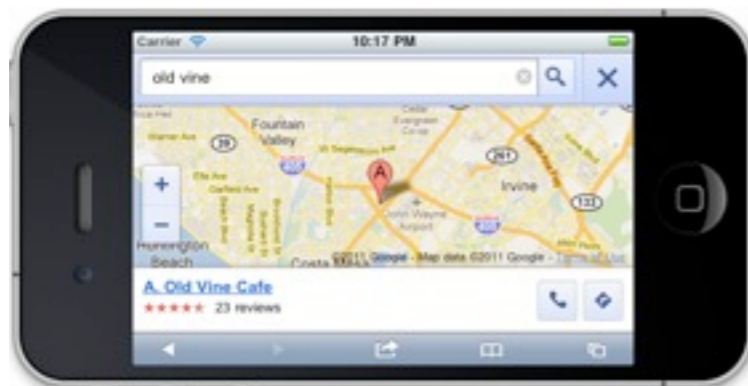


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Ubicomp ——— Augmented Reality ——— Virtual Reality

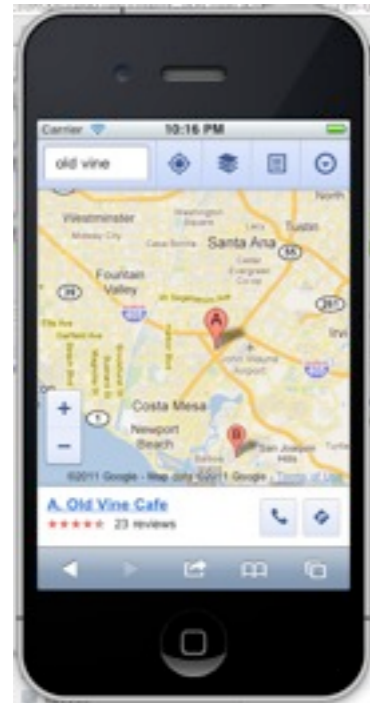


Virtual Worlds
Mirror Worlds

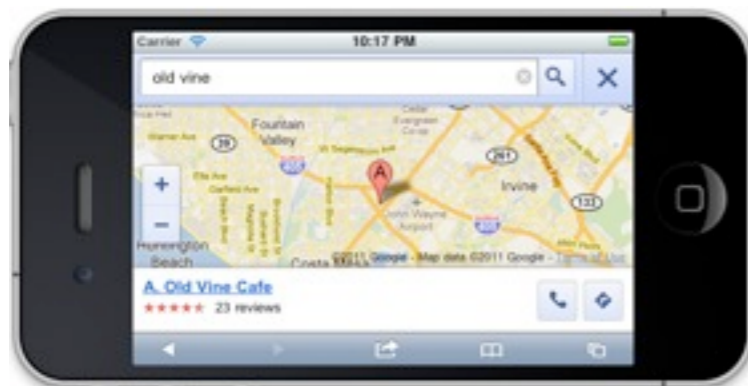


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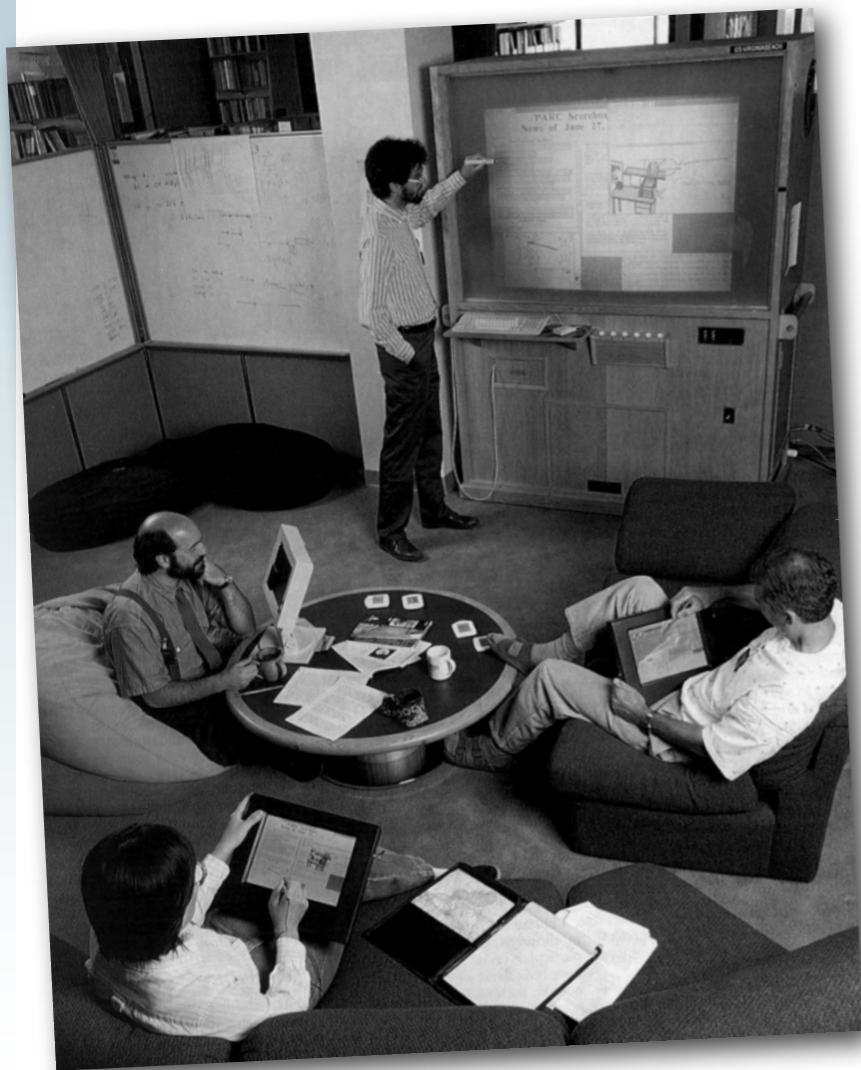


ar photo, vr photo, green photo

Ubicomp is about people's relationship to computers

- virtual reality
 - humans enter the computers world
- ubiquitous computing
 - computers enter the human's world

Challenges to HCI Assumptions



- What do we imagine when we think of a computer?
 - “The most profound technologies are those that disappear.” Weiser
- 1990’s: this was not our imagined computer!
- Single User -> groups -> organizations
- Desktop -> mobile phone -> sensors
- Computing in place -> mobile computing
- Wired -> wireless -> cloud

Synonyms

- Ubiquitous Computing
- Pervasive Computing
- Mobile Computing
- Sensor Networks
- (sort of) Human-Computer Interaction



Variations in Ubicomp

- Embedded Systems
 - Cars
 - Airplanes
 - Smart Control
 - Specialized
 - ASICs
 - Real-time
 - High reliability

Variations in Ubicomp

- New devices
 - Hi-tech
 - Silicone-based
 - gadgets
 - PDAs
 - Cellphones (keitai)
 - mp3 players
 - active displays

Variations in Ubicomp

- New Infrastructure
 - Connecting the existing physical world to a computational scaffold
 - ordinary objects re-envisioned
 - adding computation to the physical
 - adding people to computation
 - Mechanical Turk



Ubiquitous Computing

- Any computing technology that permits human interaction away from a single workstation
- Implications for
 - Technology defining the interactive experience
 - Applications or uses
 - Underlying theories of interaction

Technology: Scales of devices

- Weiser proposed
 - Inch
 - Foot
 - Yard
- Implications for device size as well as relationship to people

Technology: Scales of devices

- Inch
 - smart phones
 - PARCTAB
 - Voice Recorders
- Individuals own many of them and they can all communicate with each other and environment.



Technology: Scales of devices



- Foot
 - notebooks
 - tablets
 - digital paper
- Individual owns several but not assumed to be always with them.



Scales of devices



- Yard
 - electronic whiteboards
 - plasma displays
 - smart bulletin boards
- Buildings or institutions own them and lots of people share them.

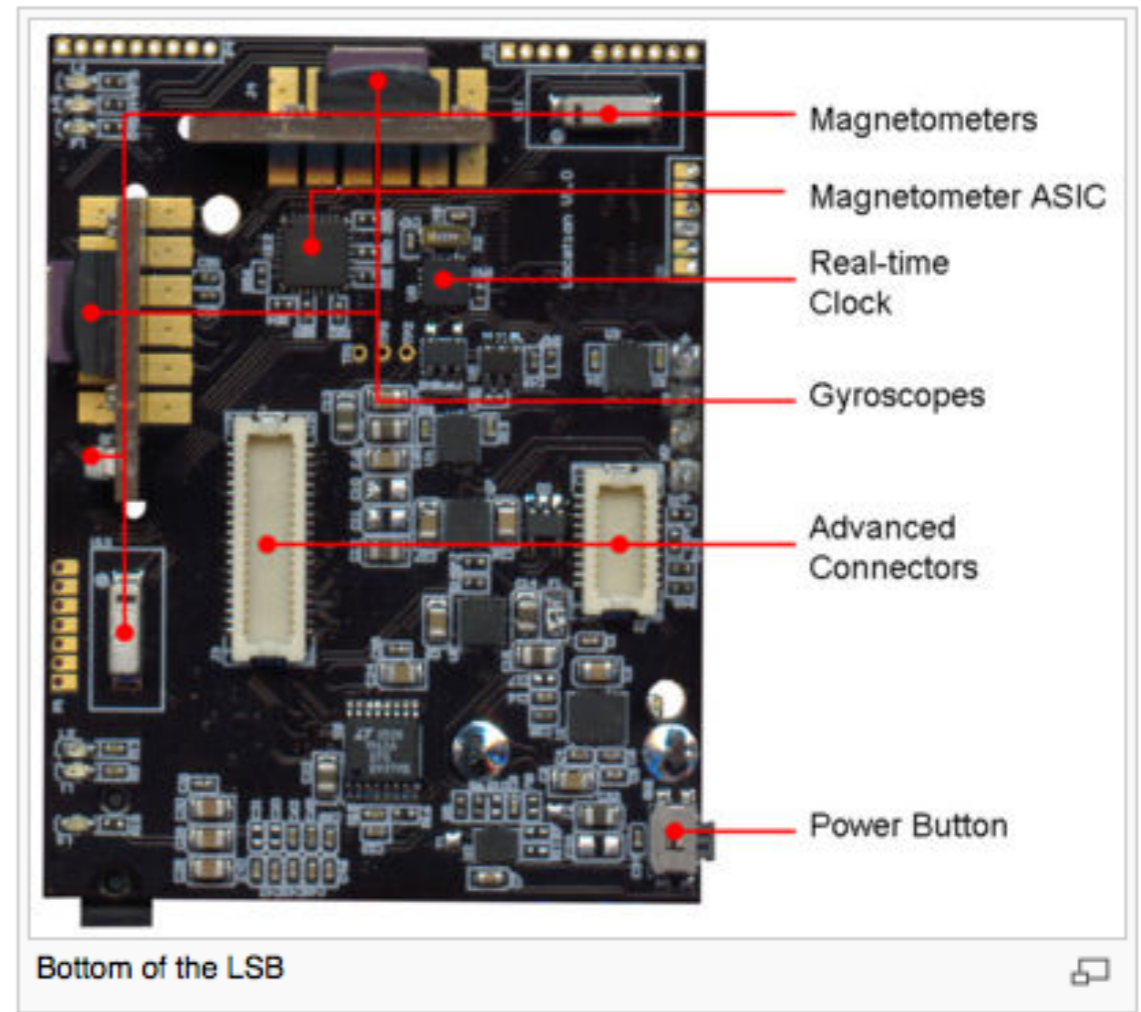
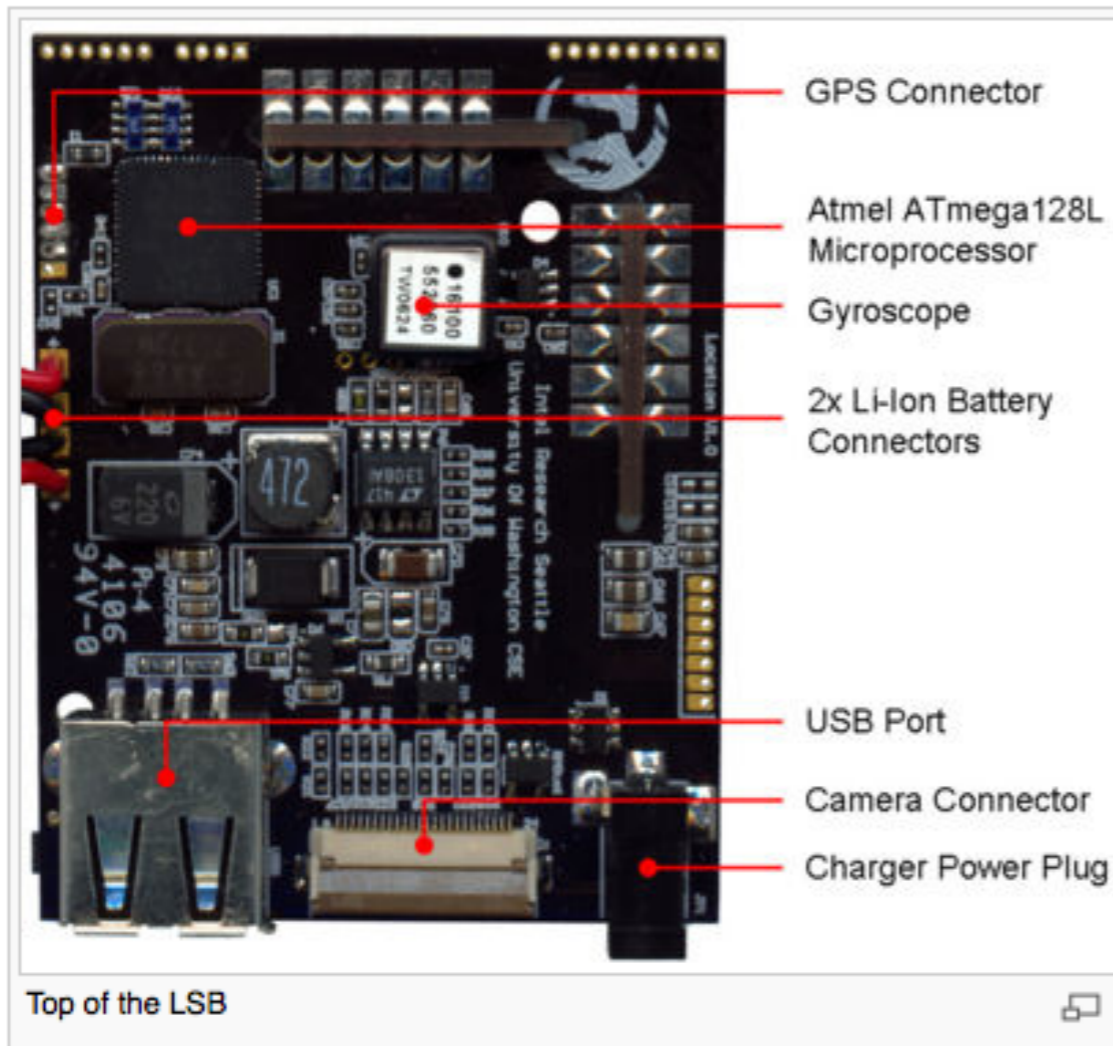
Technology: Redefining the Interaction Experience

- Implicit input
 - Sensor-based input
 - Extends traditional explicit input (e.g., keyboard and mouse)
 - Towards “awareness”
 - Use of recognition technologies
 - Introduces ambiguity because recognizers are not perfect
 - Probabilistic interaction is a new paradigm

Technology: Different inputs

- Large-Screen Touch
 - MS Surface
 - http://www.metacafe.com/watch/618189/microsoft_surface_computing_the_power/
 - <http://www.youtube.com/watch?v=CZrr7AZ9nCY>

Overview Images



Proximity range sensor:

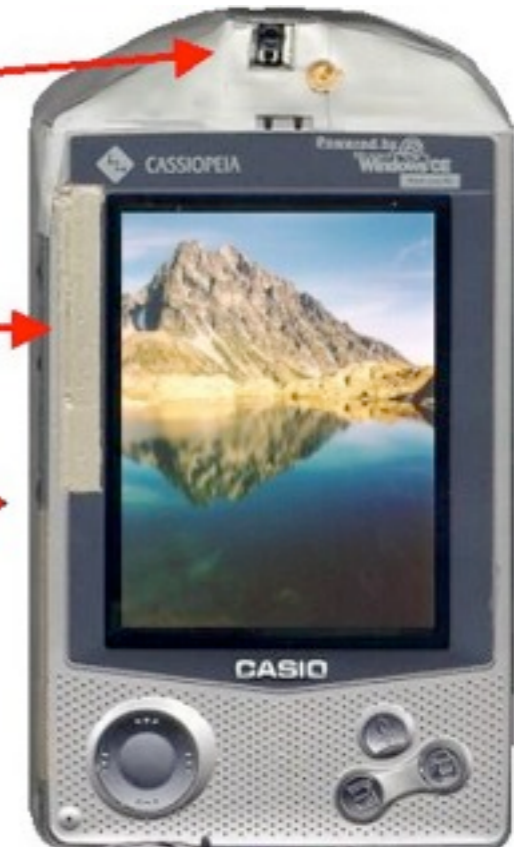
Infrared (IR) receiver
 IR emitter (below receiver to right)

Touch sensitivity:

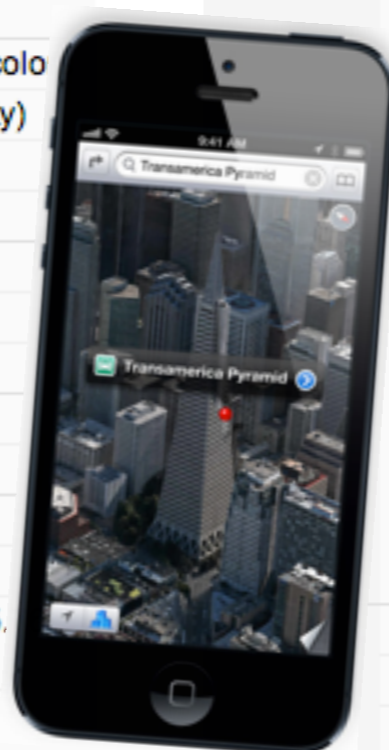
Screen bezel
 On sides & back of device

Tilt sensor:

Inside device, in plane of the display
 2-axis linear accelerometer



GENERAL	2G Network	GSM 850 / 900 / 1800 / 1900 - GSM A1428 CDMA 800 / 1900 / 2100 - CDMA A1429	
	3G Network	HSDPA 850 / 900 / 1900 / 2100 - GSM A1428 CDMA2000 1xEV-DO - CDMA A1429	
	4G Network	LTE 700 MHz Class 17 / 1700 / 2100 - GSM A1428 or LTE 850 / 1800 / 2100 - GSM A1429 LTE 700 / 850 / 1800 / 1900 / 2100 - CDMA A1429	
	SIM	Nano-SIM	
	Announced	2012, September	
	Status	Available. Released 2012, September	
	BODY	Dimensions	123.8 x 58.6 x 7.6 mm (4.87 x 2.31 x 0.30 in)
		Weight	112 g (3.95 oz)
DISPLAY	Type	LED-backlit IPS TFT, capacitive touchscreen, 16M color	
	Size	640 x 1136 pixels, 4.0 inches (~326 ppi pixel density)	
	Multitouch	Yes	
	Protection	Corning Gorilla Glass, oleophobic coating	
SOUND	Alert types	Vibration, proprietary ringtones	
	Loudspeaker	Yes	
	3.5mm jack	Yes	
MEMORY	Card slot	No	
	Internal	16/32/64 GB storage, 1 GB RAM	
DATA	GPRS	Yes	
	EDGE	Yes	
	Speed	DC-HSDPA, 42 Mbps; HSDPA, 21 Mbps; HSUPA, 5.6 Mbps; LTE, 100 Mbps; Rev. A, up to 3.1 Mbps	
	WLAN	Wi-Fi 802.11 a/b/g/n, dual-band, Wi-Fi hotspot	
	Bluetooth	Yes, v4.0 with A2DP	
	USB	Yes, v2.0	
	CAMERA	Primary	8 MP, 3264x2448 pixels, autofocus, LED flash, check quality
Features		Simultaneous HD video and image recording, touch focus, geo-tagging, face detection, panorama, HDR	
Video		Yes, 1080p@30fps, LED video light, video stabilization, geo-tagging, check quality	
Secondary		Yes, 1.2 MP, 720p@30fps, face detection, FaceTime over Wi-Fi or Cellular	



FEATURES	OS	iOS 6	
	Chipset	Apple A6	
	CPU	Dual-core 1.2 GHz	
	GPU	PowerVR SGX 543MP3 (triple-core graphics)	
	Sensors	Accelerometer, gyro, proximity, compass	
	Messaging	iMessage, SMS (threaded view), MMS, Email, Push Email	
	Browser	HTML (Safari)	
	Radio	No	
	GPS	Yes, with A-GPS support and GLONASS	
	Java	No	
MISC	Colors	Black/Slate, White/Silver	
		- Active noise cancellation with dedicated mic	
		- Siri natural language commands and dictation	
		- iCloud cloud service	
		- Twitter and Facebook integration	
		- TV-out	
		- Maps	
		- iBooks PDF reader	
		- Audio/video player/editor	
		- Organizer	
TESTS		- Document viewer	
		- Image viewer/editor	
		- Voice memo/dial/command	
		- Predictive text input	
		Standard battery, Li-Po 1440 mAh (5.45 Wh)	
		Stand-by	Up to 225 h (2G) / Up to 225 h (3G)
		Talk time	Up to 8 h (2G) / Up to 8 h (3G)
		Music play	Up to 40 h
		SAR US	1.18 W/kg (head) 1.18 W/kg (body)
		SAR EU	0.95 W/kg (head) 0.90 W/kg (body)
	Price group		
	Display	Contrast ratio: 1320:1 (nominal) / 3.997:1 (sunlight)	
	Loudspeaker	Voice 66dB / Noise 66dB / Ring 67dB	
	Audio quality	Noise -91.3dB / Crosstalk -76.5dB	
	Camera	Photo / Video	
	Battery life	Endurance rating 51h	





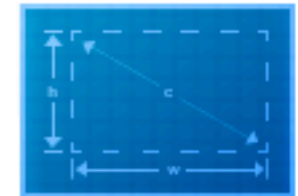
Screen

- 4.7" diagonal
- 1280 x 768 pixel resolution (320 ppi)
- WXGA IPS
- Corning® Gorilla® Glass 2



Dimensions

- 133.9 x 68.7 x 9.1 mm
- 139g





Cameras

- 8 MP (main)
- 1.3 MP (front)





Connectivity

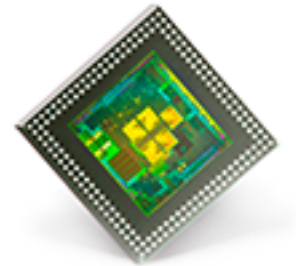
- WiFi 802.11 a/b/g/n
- Bluetooth
- NFC (Android Beam)
- Unlocked GSM/UMTS/HSPA+
- GSM/EDGE/GPRS (850, 900, 1800, 1900 MHz)
- 3G (850, 900, 1700, 1900, 2100 MHz)
- HSPA+ 42
- Wireless charging
- SlimPort HDMI





Processor and memory

- 8GB or 16GB (actual formatted capacity will be less)
- 2 GB RAM
- Qualcomm Snapdragon™ S4 Pro CPU



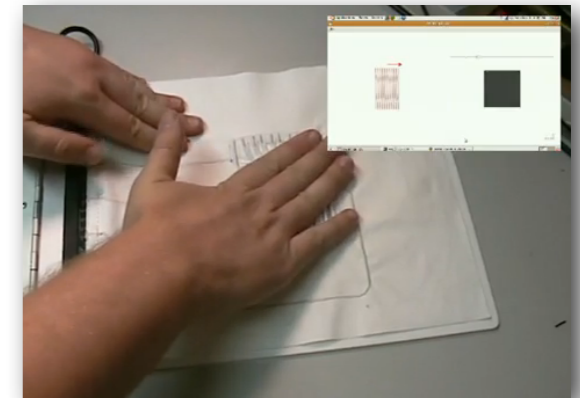
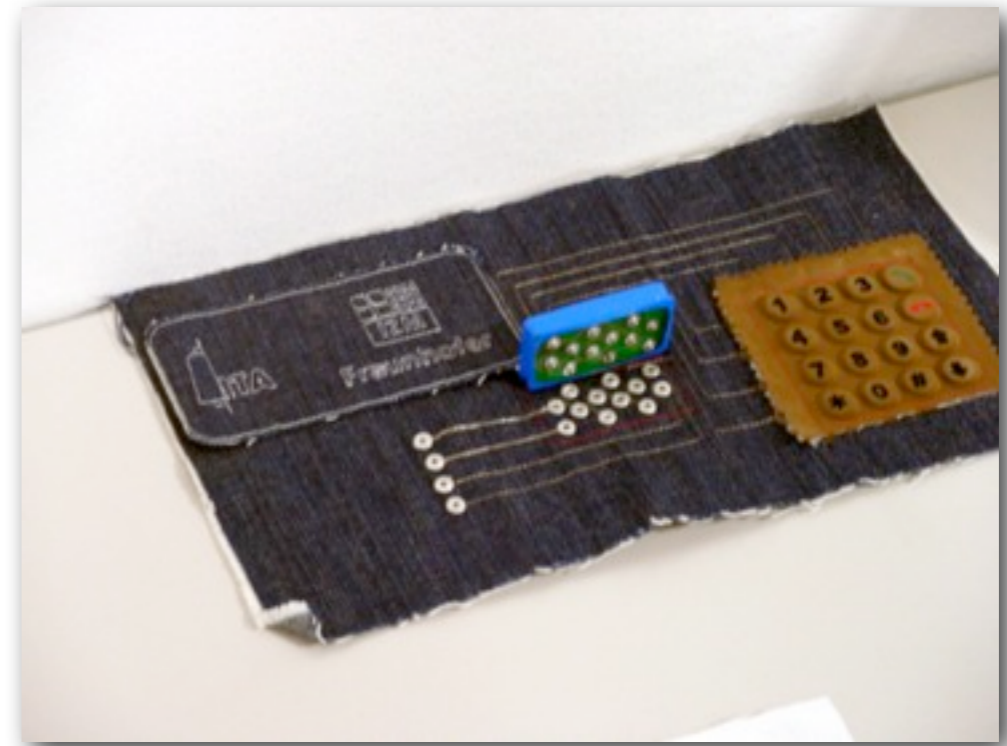


Features

- Android 4.2 (Jelly Bean)
- Accelerometer
- GPS
- Gyroscope
- Barometer
- Microphone
- Ambient light
- Compass



Technology: Different inputs



- Textile Interface Swatchbook
 - <http://www.youtube.com/watch?v=NKWWa6BvUts>
 - <http://www.youtube.com/watch?v=Valtk6pXiHY>

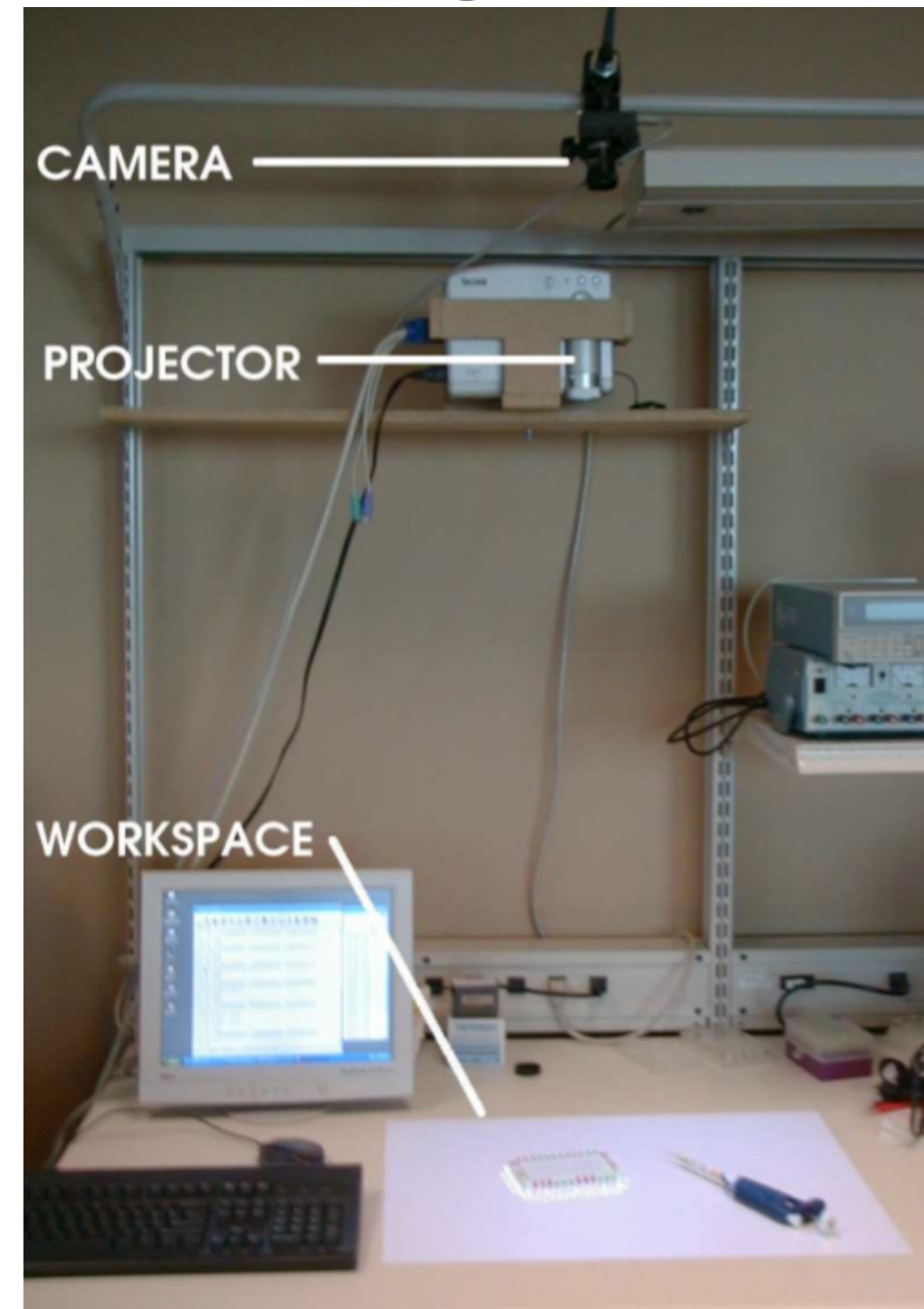
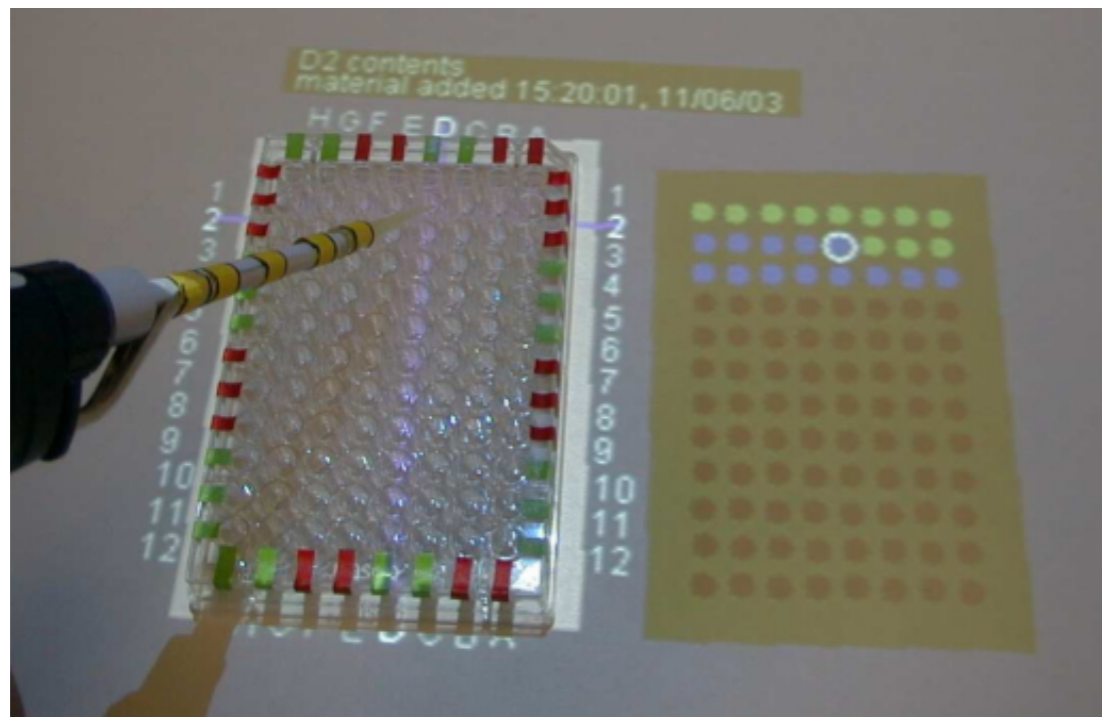
Technology: Different outputs

- More than eye-grabbing raster displays
 - Ambient: use features of the physical environment to signal information
 - Peripheral: designed to be in the background
- Examples:
 - Dangling String
 - Osaka Ferris Wheel
 - image



Technology: Merging Physical and Digital Worlds

- How can we remove the barrier?
 - Actions on physical objects have meaning electronically, and vice versa
 - Output from electronic world superimposed on physical world



Microbiology Tray and Pipette Tracking as a Proactive Tangible User Interface, Hile et.al.

Application Themes

- Context-aware computing
 - Sensed phenomena facilitate easier interaction
- Automated capture and access
 - Live experiences stored for future access
- Toward continuous interaction
 - Everyday activities have no clear begin-end conditions

New Opportunities for Theory

- Knowledge in the world
 - Ubicomp places more emphasis on the physical world
- Activity theory
 - Goals and actions fluidly adjust to physical state of world
- Situated action and distributed cognition
 - Emphasizes improvisational/opportunistic behavior versus planned actions
- Ethnography
 - Deep descriptive understanding of activities in context

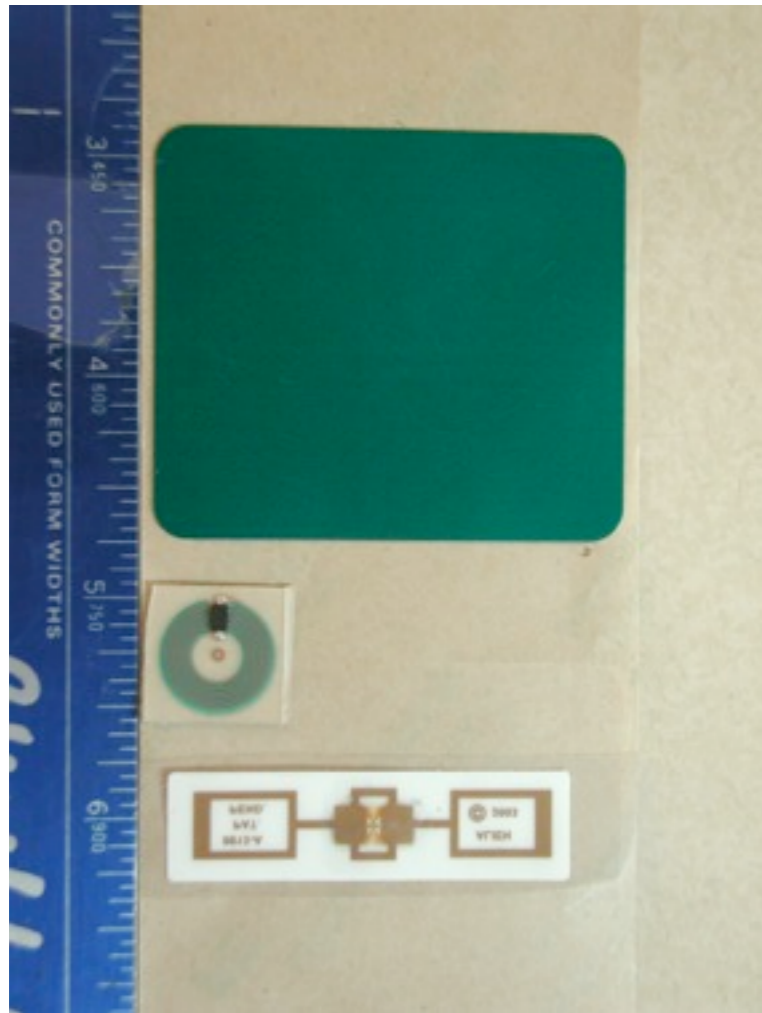
Simultaneous Multi-Scale Input and Output

- Screens
 - Of many sizes
- Distributed in space, but coordinated



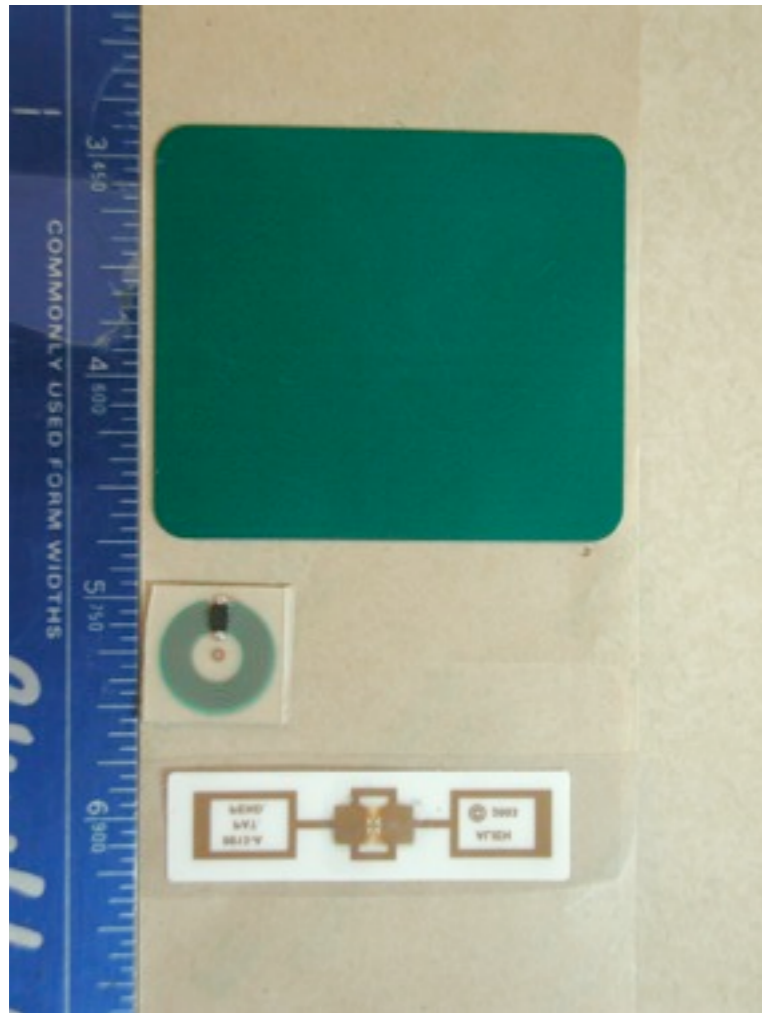
- Nokia Morph Concept
 - <http://www.youtube.com/watch?v=IX-gTobCJHs>

RFID (now "NFC")

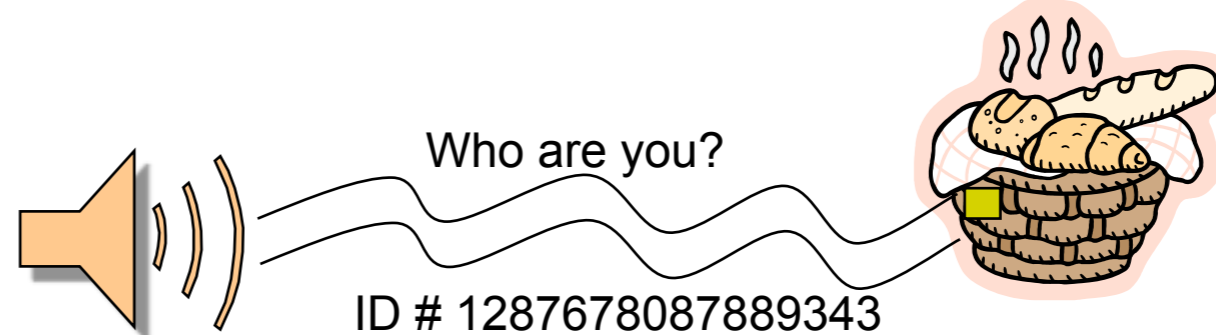


- Radio Frequency IDentification tags
 - are small, durable, cheap
 - have no batteries
 - are designed to replace barcodes
 - GUID

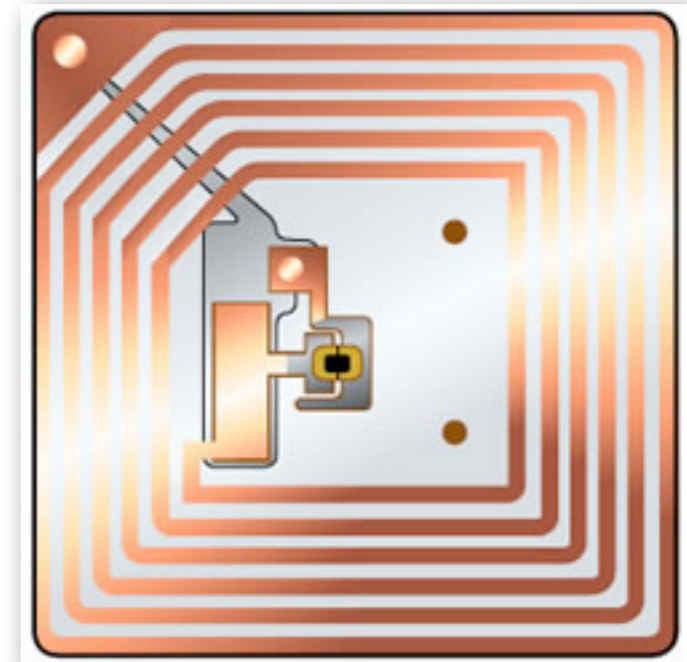
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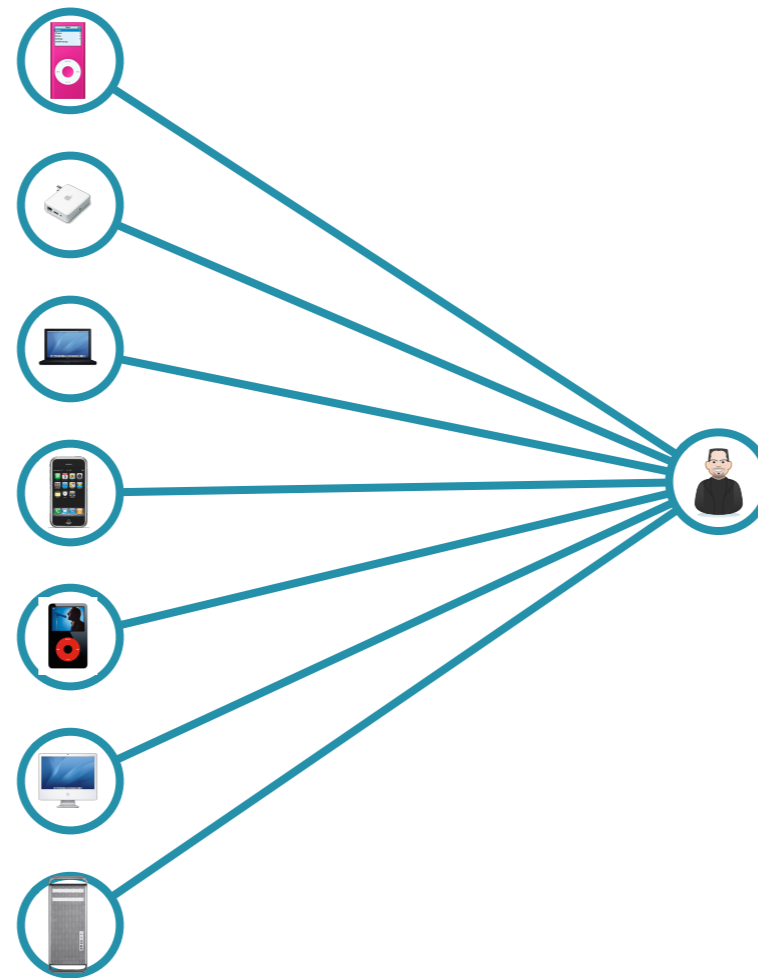


- The biggest challenges for technology engineering in UBICOMP:
 - Creating reusable libraries
 - Creating reusable patterns
 - Creating reusable infrastructure
- That work in more than one deployment



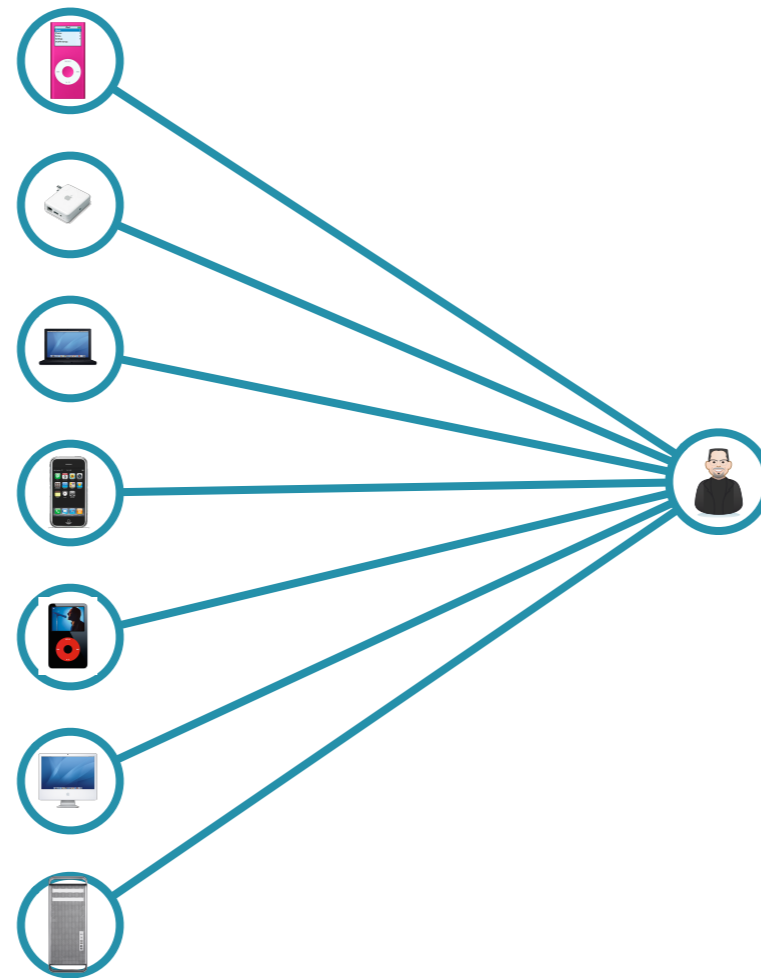
: Ubicomp is about people's relationship to computers

Third Wave



: Ubicomp is about people's relationship to computers

Third Wave



How are we going to manage all of these devices?

Who is going to manage all of these devices?

Who is going to manage the infrastructure when the computers enter the human's world?

Who is going to manage all of these devices?

Who is going to manage the infrastructure when the computers enter the human's world?

The professionals!

Who is going to manage all of these devices?

Who is going to manage the infrastructure when the computers enter the human's world?

The professionals!

Enter cloud computing....

Cloud computing

is several

{visions, architectures, infrastructures}

that transform computing from a

{capital investment, product}

into a

{utility, service}

Cloud computing

is several

{visions, architectures, infrastructures}

that transform computing from a

{capital investment, product}

into a

{utility, service}



Why now? What has changed?

- Connectivity
- Smart phones
- System Virtualization
- Security Threats
- Sentient browser applications

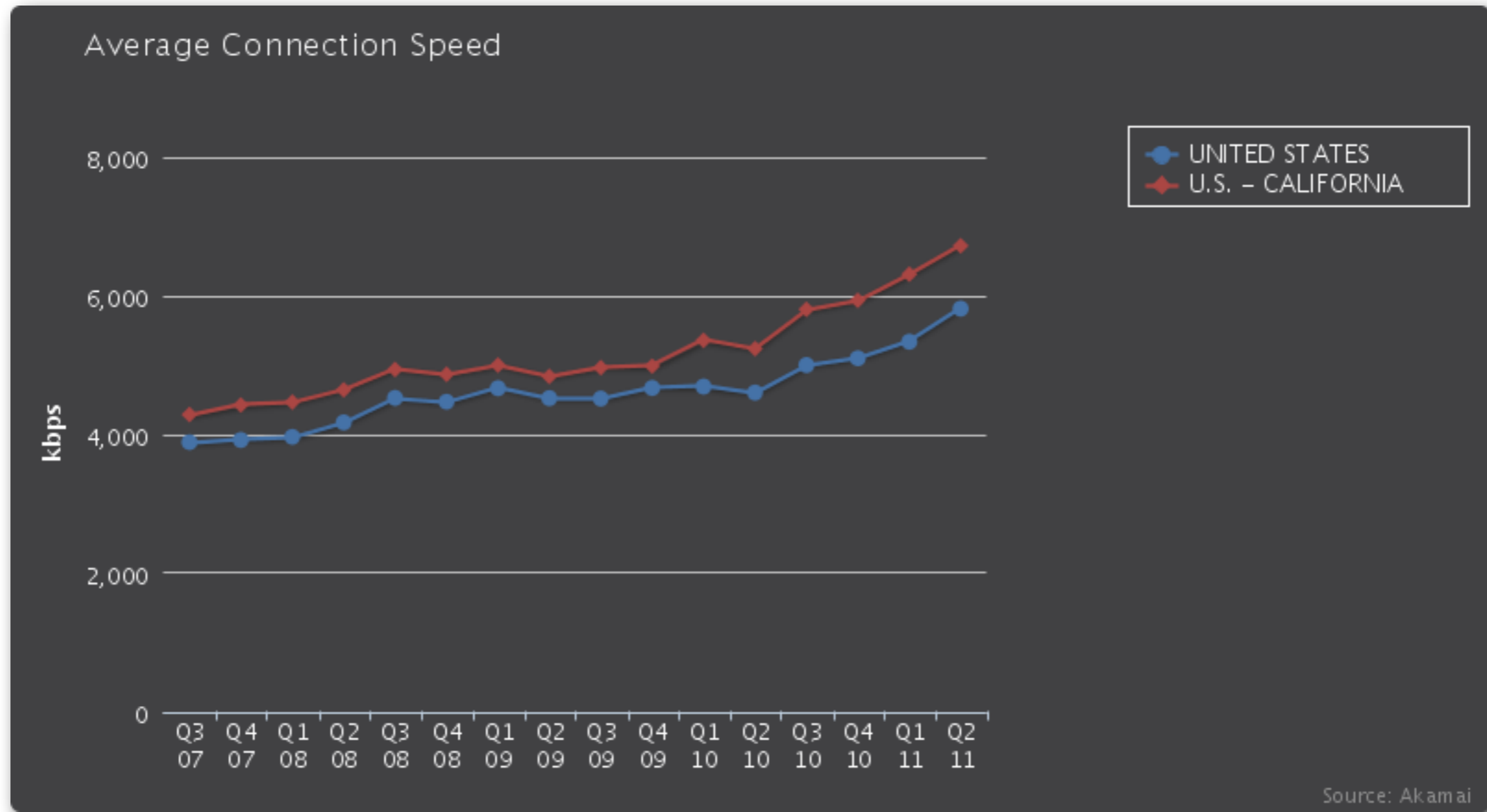


Why now? What has changed?

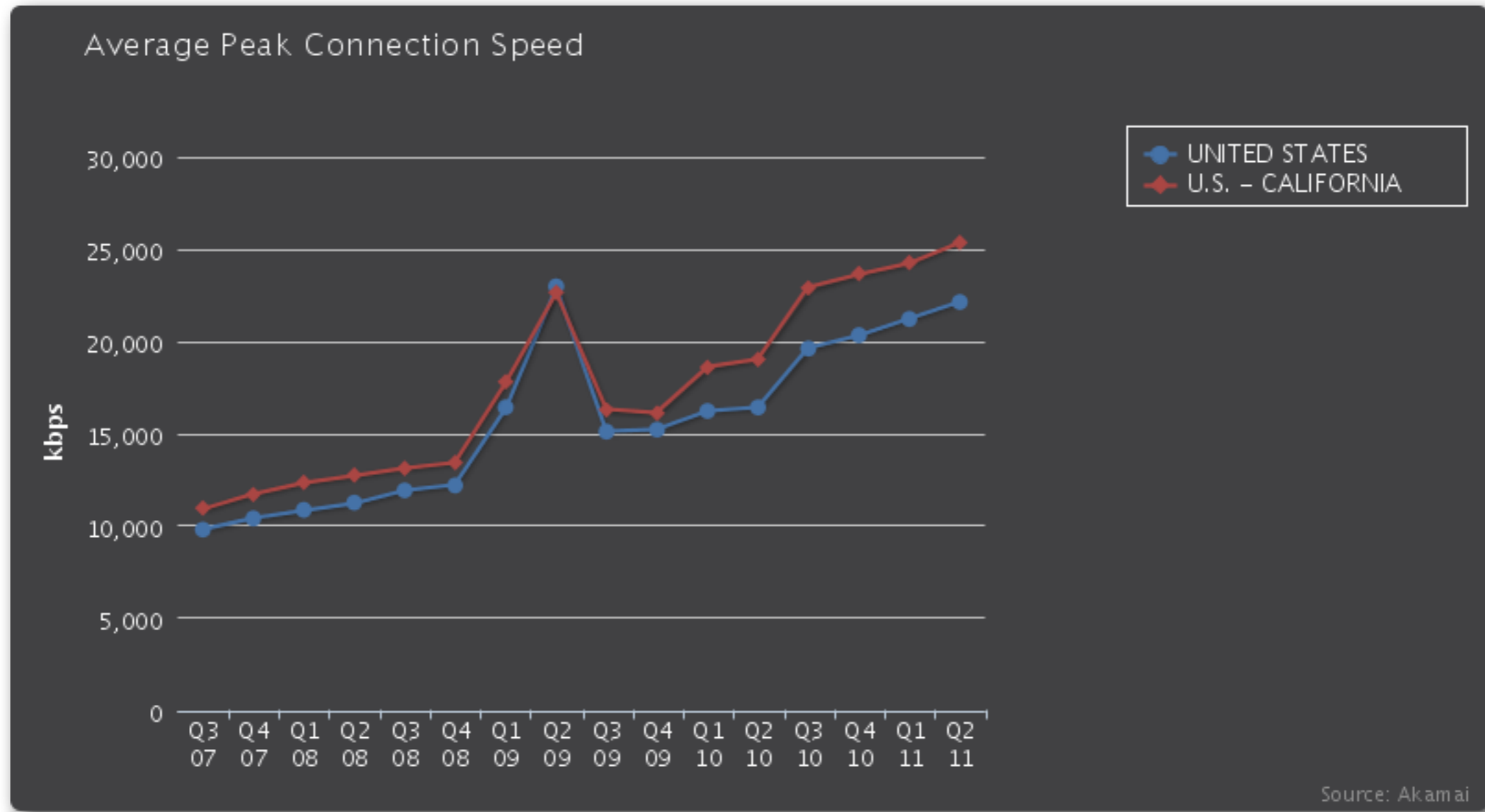
- Connectivity
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Connectivity



Connectivity



Which country has the fastest mobile broadband?

Which country has the fastest mobile broadband?

Greece

(5.3 mbps average)

Which country has the fastest mobile broadband?

Greece

(5.3 mbps average)

Austria

(23.4 mbps highest average peak connection speed)

Which country has the fastest mobile broadband?

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“average connection speeds increased by more than 100% year-over-year at 22 mobile providers”

-akamai

Why now? What has changed?

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Why now? What has changed?

- Connectivity
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The mobile penetration divide

In some parts of Africa, five people share the same phone. In Italy, almost every adult has at least two mobile devices. How penetration varies by region, data represents the average number of people per SIM card subscription in 2010¹.

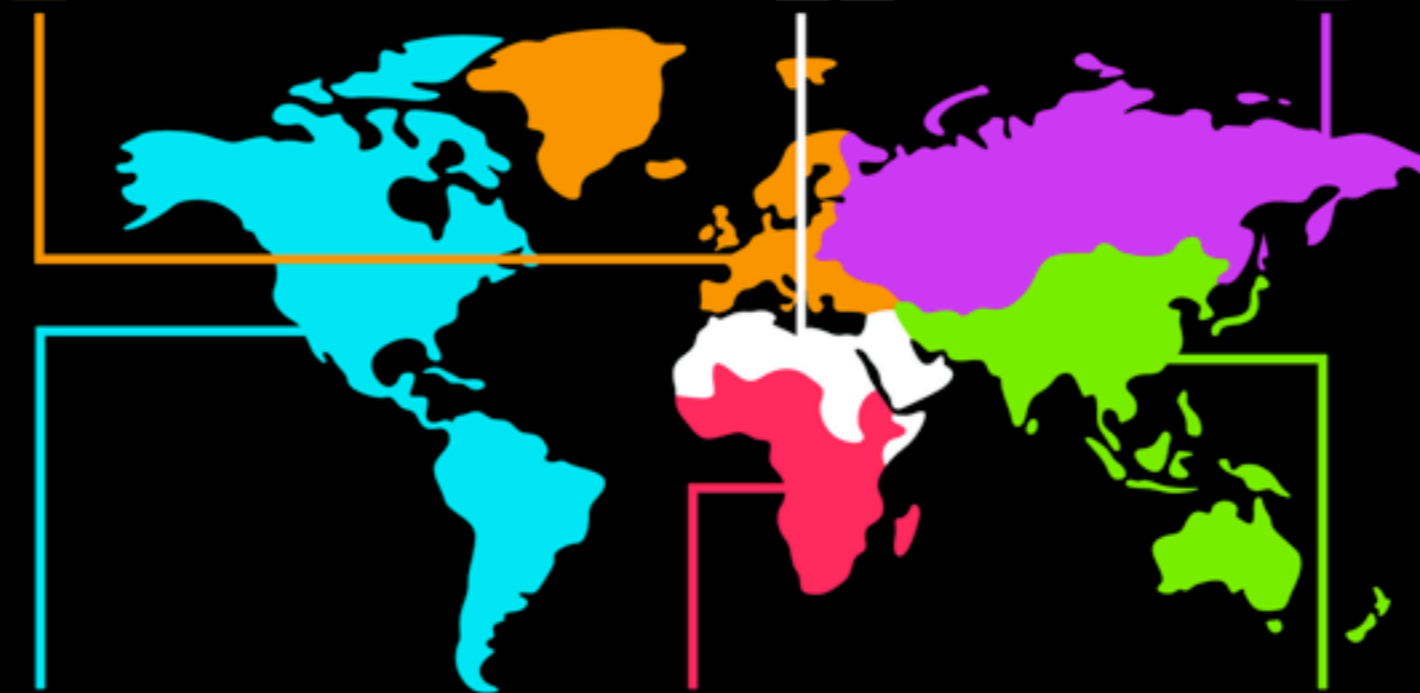
Europe: 0.8



Arab States: 1.3



CIS²: 0.8



The Americas: 1.1



Africa: 2.4



Asia & Pacific: 1.5



blog.nokia.com

SOURCE: International Telecommunications Union (<http://www.itu.int>)
Notes: 1. Estimate 2. Commonwealth of Independent States

Nokia Conversations
The Official Nokia Blog

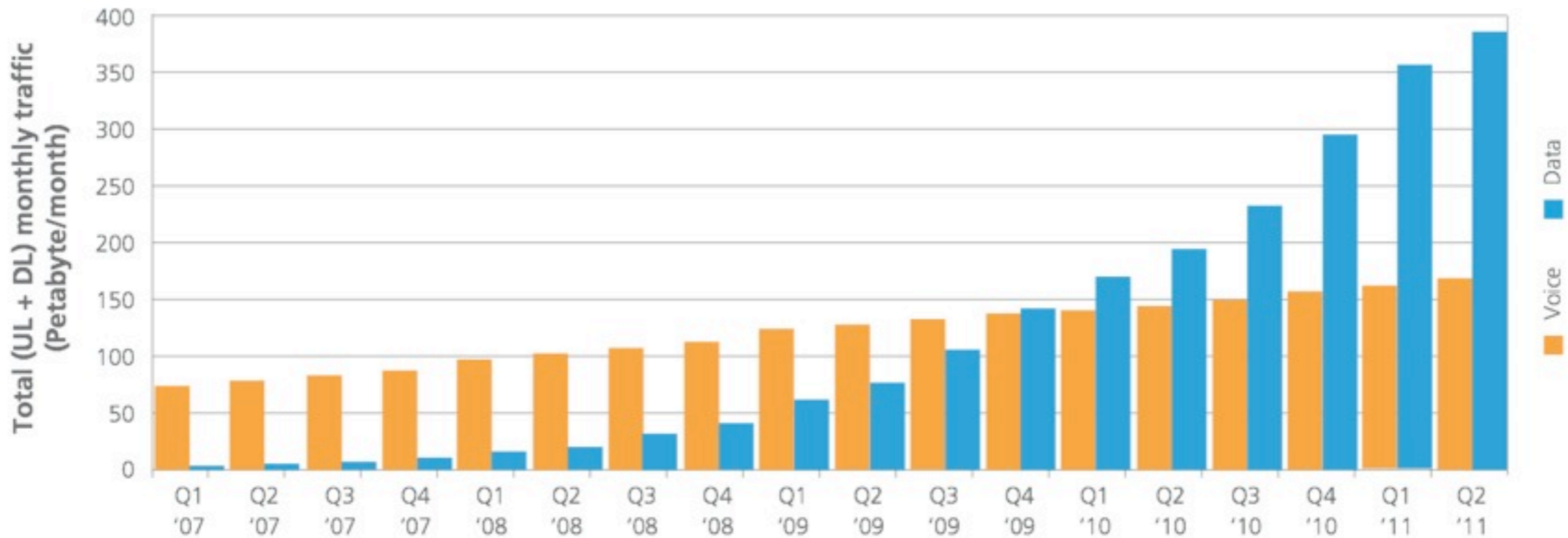
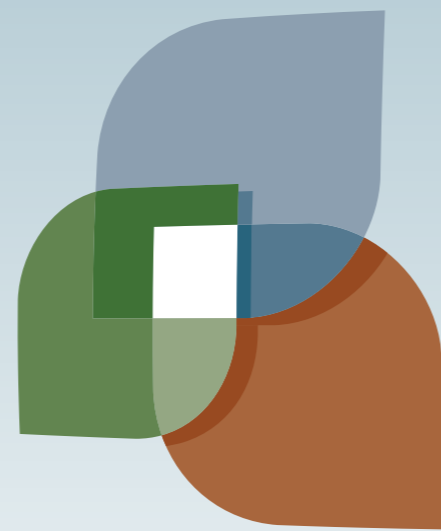


Figure 40: Total Monthly Mobile Voice and Data as Measured by Ericsson [Source: Ericsson]



L U C I

