Smartphone Mobile Computing

CSEP590B/F Winter 2011 (first offering)

1st Lecture, 03 January 2011

Instructor:

Gaetano Borriello

Teaching Assistant:

Temitope Oluwafemi

Who we are

- **Gaetano Borriello**
  PhD UC Berkeley 1988
  Industry experience at Xerox PARC ('80-'85) and Intel ('01-'06)
  Background in VLSI, CAD, embedded systems, ubicomp
  Most recently mobile applications for low-income settings

- **Temitope Oluwafemi**
  Grad student in EE

Overview for Today

- **Mobile computing on smartphones**

- **Capabilities and trends**

- **Applications**

- **Course structure and goals**

- **Group projects**

The Main Questions for this Quarter

- **What makes mobile computing on phones different than mobile computing on laptops or tablets?**

- **What are some of the computer science and engineering concepts that are most relevant?**

- **What are the applications that best showcase the differences?**

- **In what contexts are these applications being used and why?**

- **How do we build these applications?**

Technology Trends

- **Size**
- **Wireless connectivity and bandwidth**
- **Computing power and storage**
- **Sensors**
- **Power**

Size
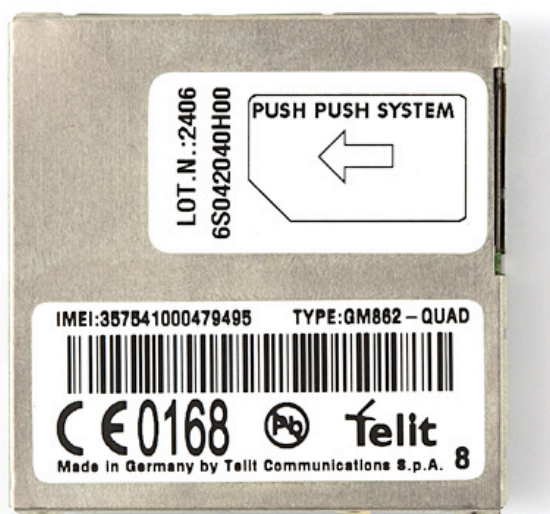
Wireless connectivity and bandwidth

- **1G – early 1980s – voice**

- **2G – early 1990s – GSM, SMS, digital voice**

- **2.5G – stepping stone to 3G, GPRS**

- **3G – early 2000s – faster data transmission, higher capacity**

- **4G – early 2010s – even higher-speed data, no standard**
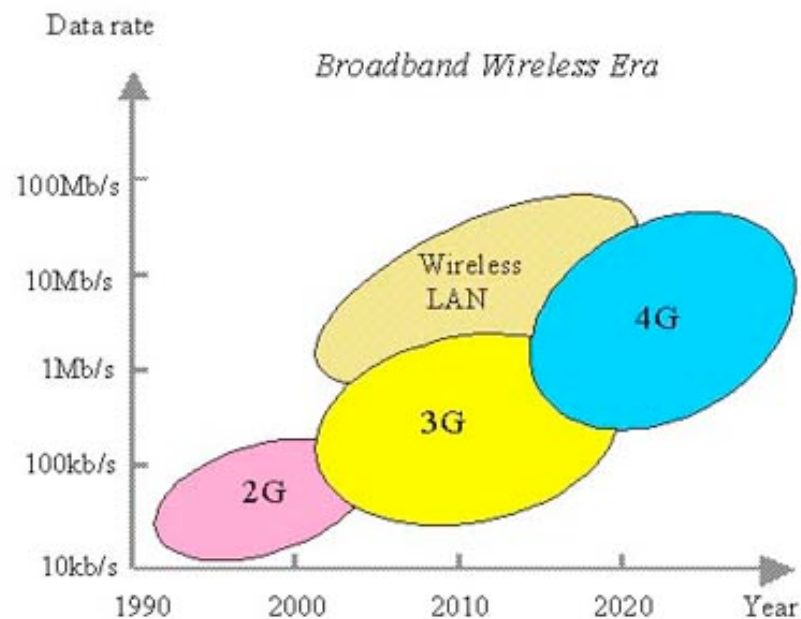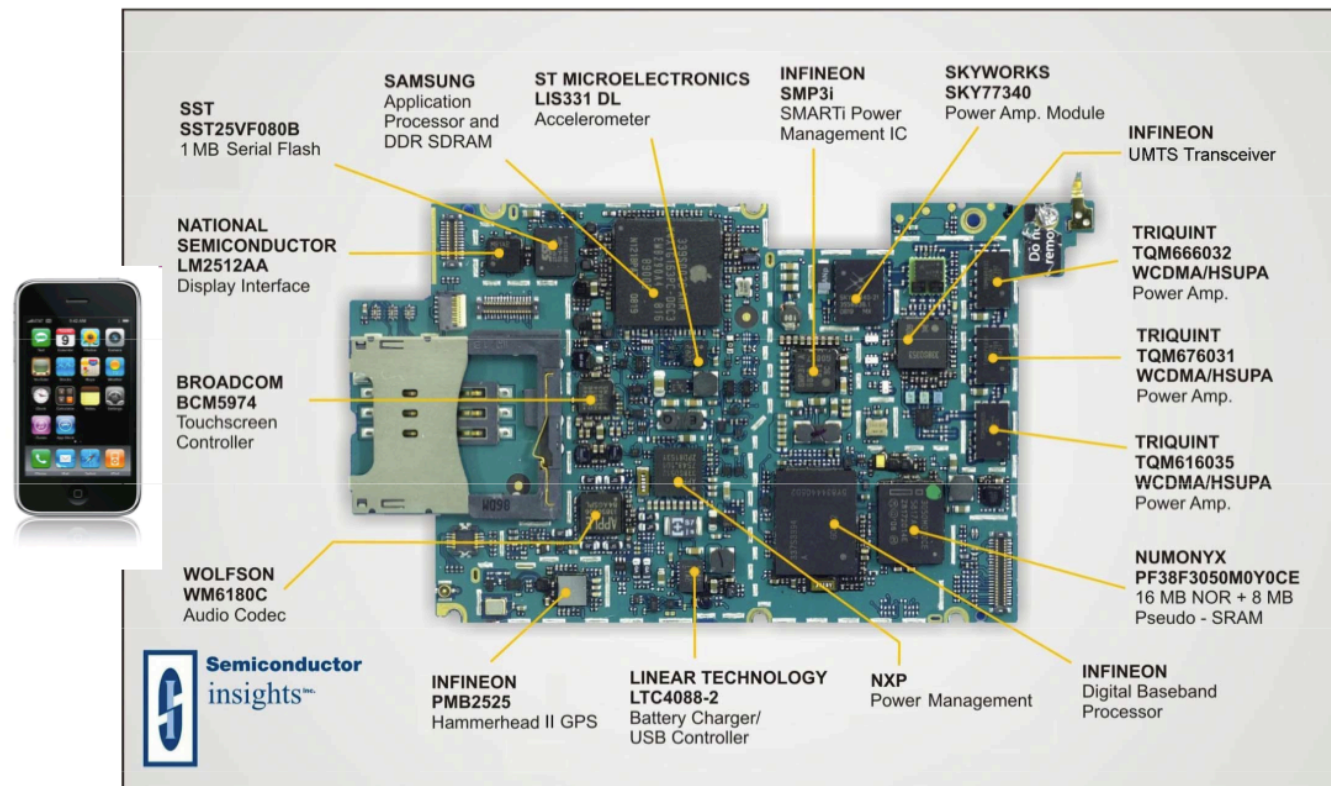
Computing power

- **Processors**
  - 50MHz to 2GHz
  - multiple processors: baseband processing, networking, apps, I/O, etc.
- **Memory**
  - .5GB ROM
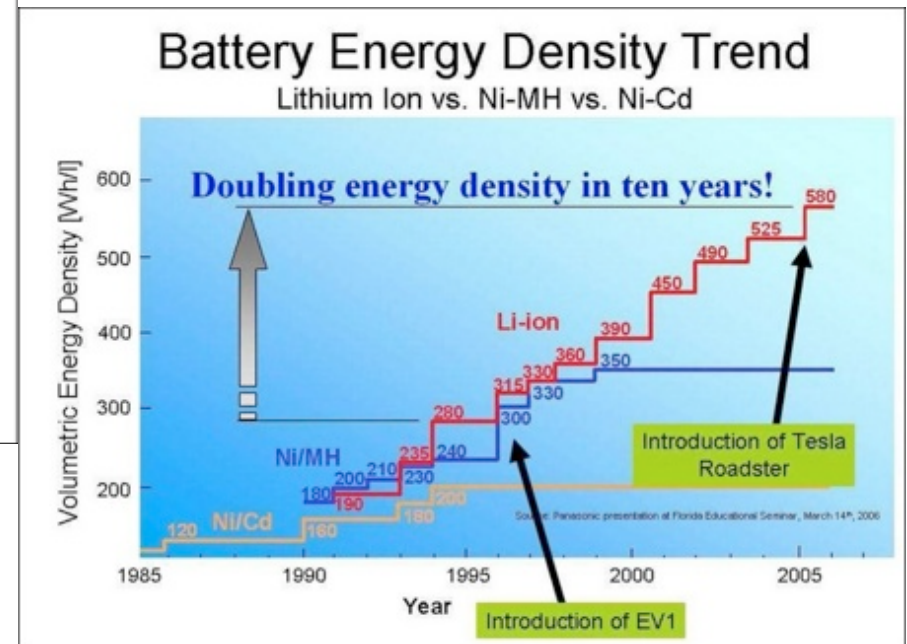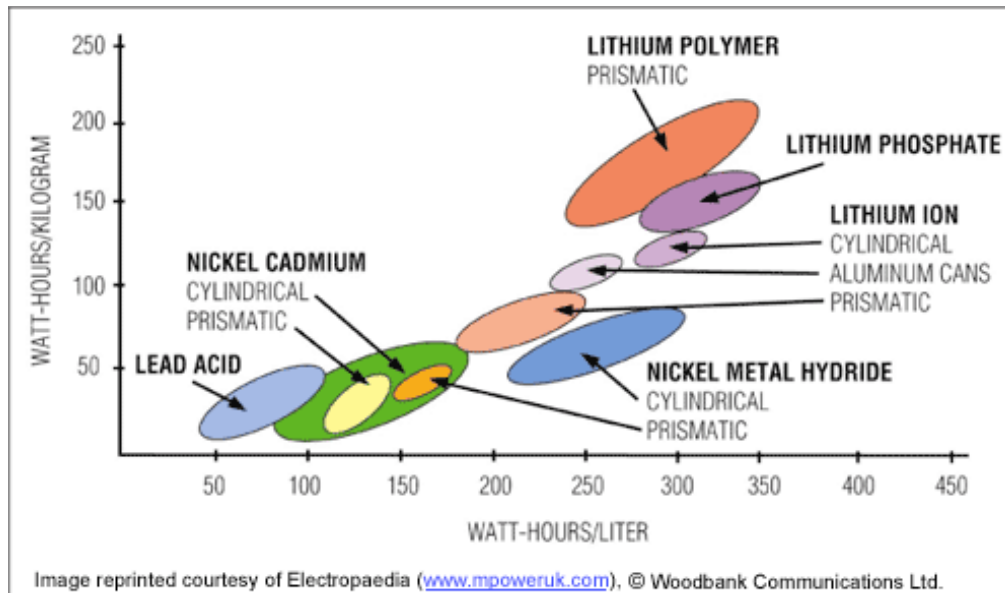 - .5GB RAM
- **Storage**
  - 32GB SD

Sensors and User Interface

- **Camera + flash**

- **Microphone + speakers**

- **Accelerometer**

- **Barometer/altimeter**

- **GPS**

- **Proximity infrared**

- **Ambient light**

- **Compass**

- **Gyroscopes**

- **Touch screens**

- **Depth-ranging IR cameras**

- **Pico-projectors**

Power

- **Typical stand-by time of 10 days, talk time of 8 hrs**
- **Batteries and Moore's Law**

Image reprinted courtesy of Electropaedia (www.mpoweruk.com), © Woodbank Communications Ltd.

Power

- **Power budget of 1400 mAh**

Subcircuit	Average Current Consumption in Talk Mode	Average Current Consumption in Standby Mode
	mA	µA
Digital Base Band + Memory	19 + 6	300 + 40
Analog Base Band	9	150
SIM	1	60
RF	32	50
PA	200	770
PM (Housekeeping)	3	220
Misc. Other	5275	670
Total Current Consumption		2,260

While last unplugged for 13h 50m 44s

Voice calls		36%
Display		20%
Phone idle		15%
Cell standby		12%
Android System		6%
Browser		4%
Gmail		2%
Android OS		2%

2:27 AM
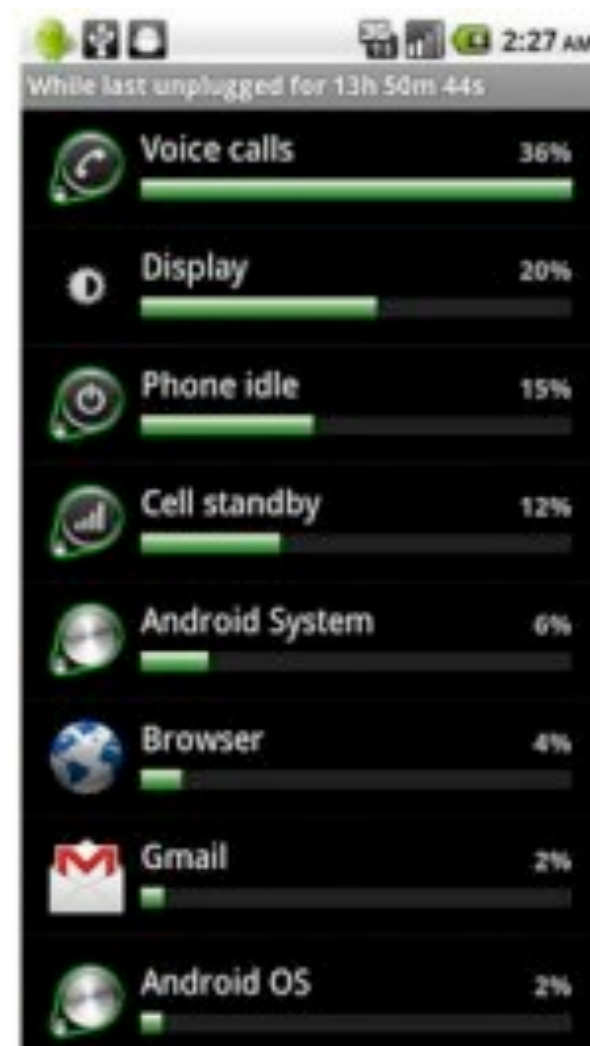
Phone types

- **Basic phones (voice, SMS) – low-tier**
- **Feature phones (basic apps, data comm) – mid-tier**
- **Smart phones (more apps, web, GPS) – high-tier**

Nokia C1 **Nokia C5** **iPhone4** **Nexus One** **BB Torch** **Window7**
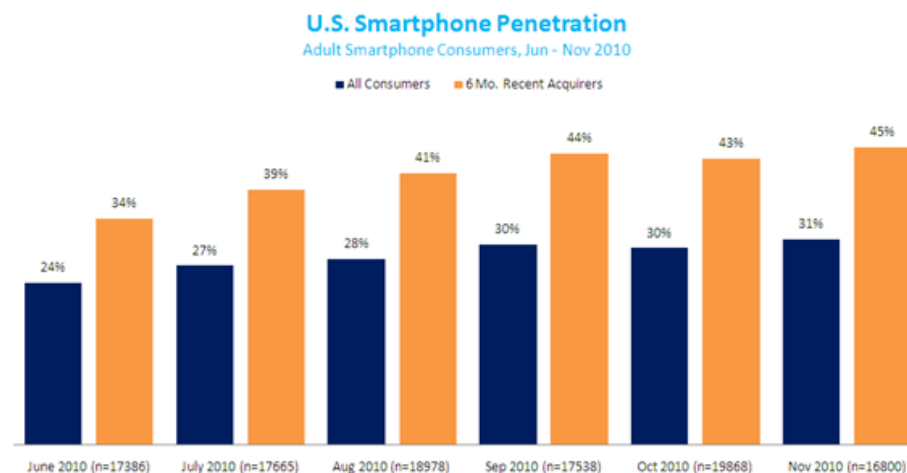
Market Share

■ **In US, about 45% of new phones are smartphones, rest are feature phones, virtually no low-tier phones**

■ **Smartphones currently evenly split between Apple, RIM, and Android – about 25-30% each, Microsoft and Nokia take up remainder**

■ **In emerging economies, low-tier phones are still the largest segment but feature phones are gaining**

U.S. Smartphone Penetration
Adult Smartphone Consumers, Jun - Nov 2010

■ All Consumers   ■ 6 Mo. Recent Acquirers

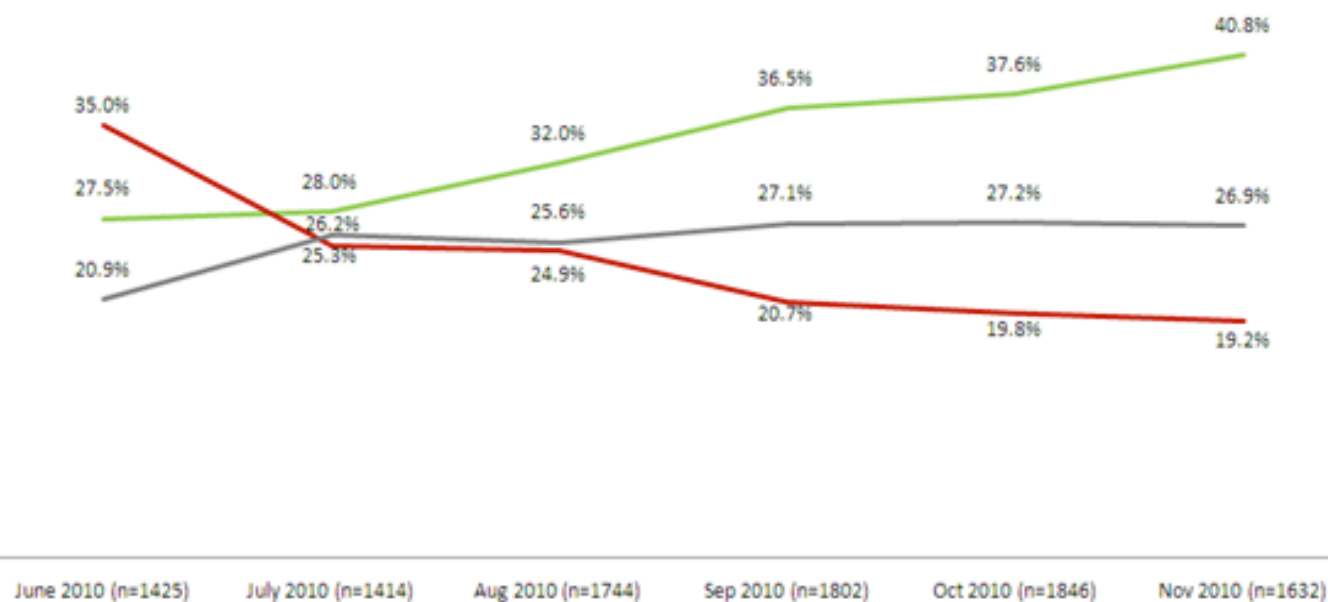| June 2010 (n=17386)	July 2010 (n=17665)	Aug 2010 (n=18978)	Sep 2010 (n=17538)	Oct 2010 (n=19868)	Nov 2010 (n=16800)
24% / 34%	27% / 39%	28% / 41%	30% / 44%	30% / 43%	31% / 45%

The Nielsen Company

Recent OS market share

U.S. Smartphone Operating System Share - 6 Mo. Recent Acquirers
Adult Smartphone Consumers, Jun - Nov 2010

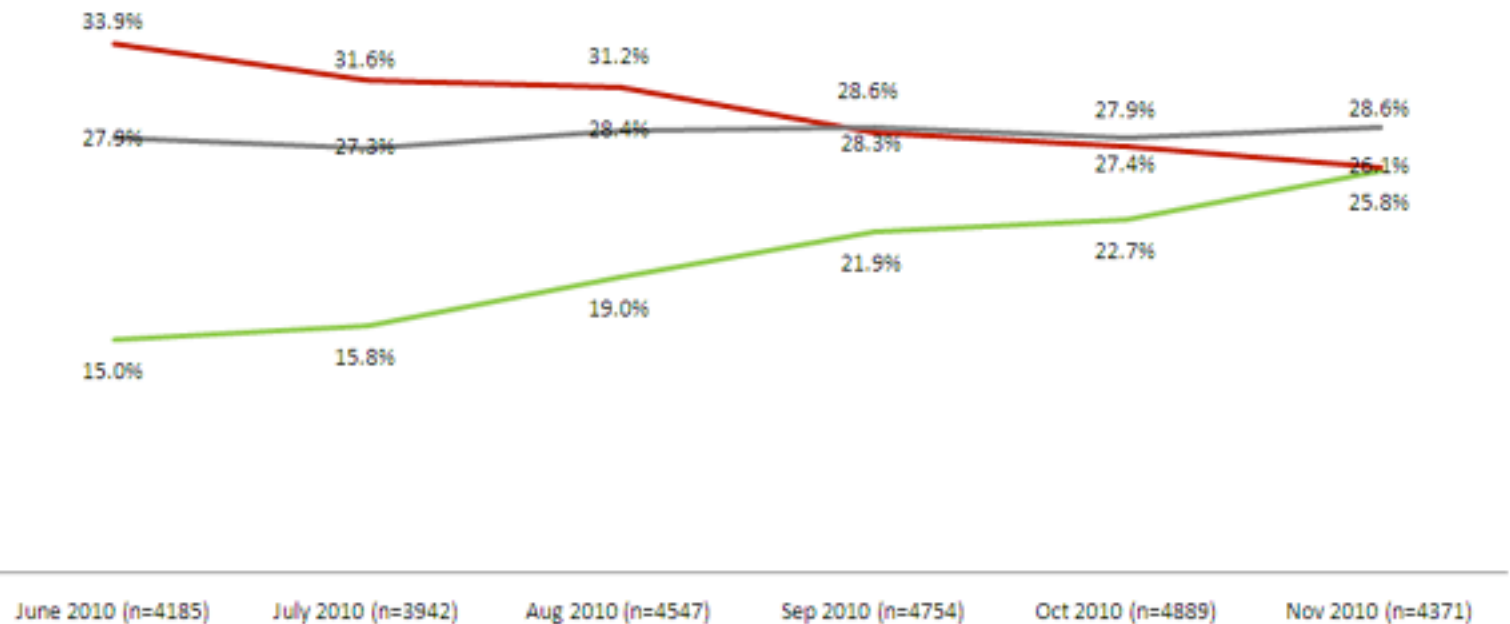— Android   — RIM BlackBerry OS   — Apple iOS

35.0%
27.5%   28.0%
26.2%
20.9%   25.3%   25.6%   27.1%   27.2%   26.9%
32.0%   36.5%   37.6%   40.8%
24.9%   20.7%   19.8%   19.2%

June 2010 (n=1425)   July 2010 (n=1414)   Aug 2010 (n=1744)   Sep 2010 (n=1802)   Oct 2010 (n=1846)   Nov 2010 (n=1632)

The Nielsen Company
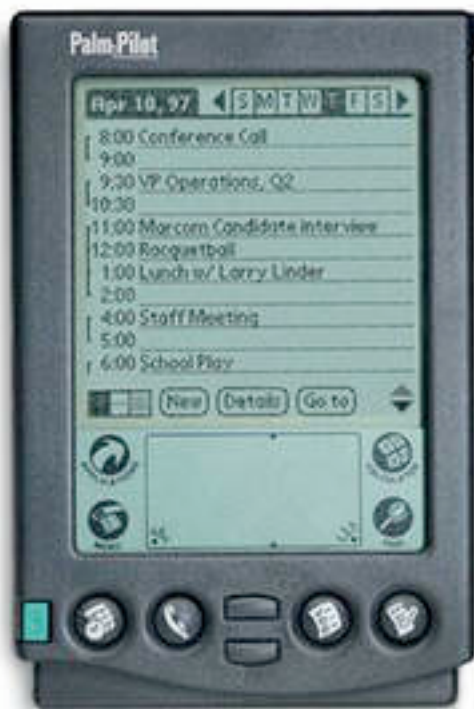
Cumulative OS market share

U.S. Smartphone Operating System Share
Adult Smartphone Consumers, Jun - Nov 2010
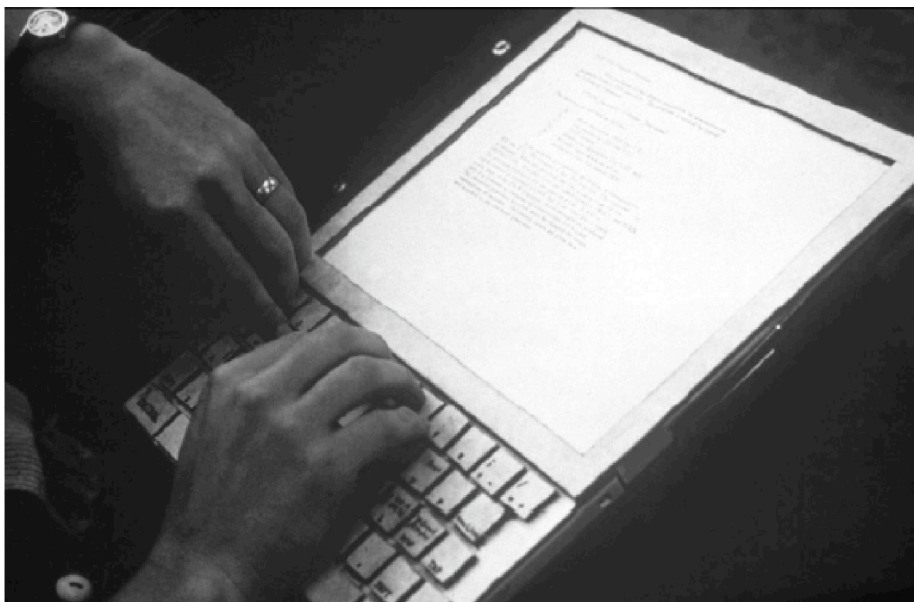
Android — RIM BlackBerry OS — Apple iOS

33.9%
31.6%
31.2%
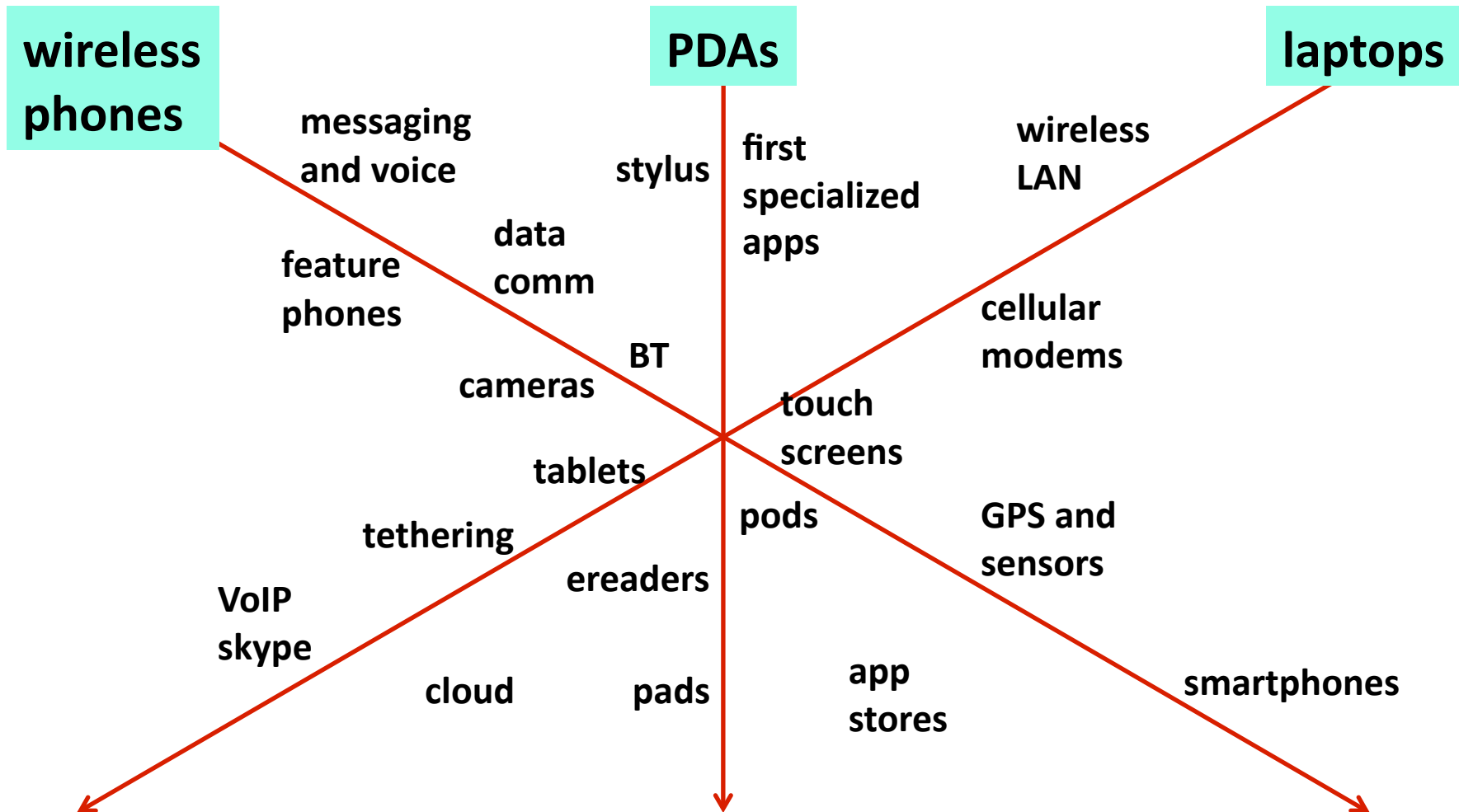28.6%
27.9%
28.6%
27.9%
27.3%
28.4%
28.3%
27.4%
26.1%
25.8%
22.7%
21.9%
19.0%
15.8%
15.0%

June 2010 (n=4185)   July 2010 (n=3942)   Aug 2010 (n=4547)   Sep 2010 (n=4754)   Oct 2010 (n=4889)   Nov 2010 (n=4371)

The Nielsen Company

Convergence

wireless phones   **PDAs**   **laptops**

messaging and voice

stylus

first specialized apps

wireless LAN

data comm

feature phones

BT

cellular modems

cameras

touch screens

tablets

pods

tethering

GPS and sensors

ereaders

VoIP skype

cloud   pads   app stores   smartphones
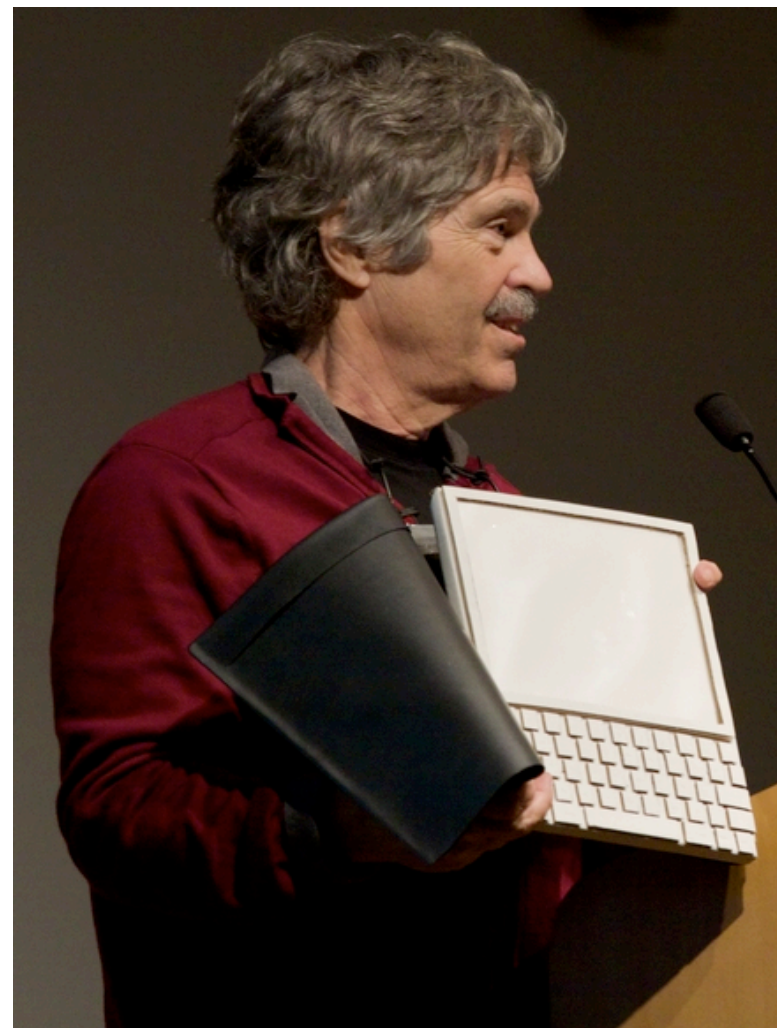
Convergence

- **PDAs + phones = smartphones**

- **Laptop data connectivity now on phones (e.g., email, web)**

- **Diversity of messaging modes**

- **What really distinguishes devices?**
  - computing power?
  - apps?
  - input/output?
  - screen size?
  - usage models?

What devices do we carry around? Why?

Deep vs. shallow web

- **The web through the desktop is a deep web**
  - many steps to get to information we want
  - ample time to sift and collect
  - multi-purpose tools, e.g., browsers
  - we need search engines and bookmarking
- **The web through the phone is a shallow web**
  - information must be ready when needed
  - interactions must be short and direct
  - single-purpose tools, e.g., apps
  - with hundreds of thousands of apps, how do we find what we need?
- **Sharing and disseminating is a need in both spaces**
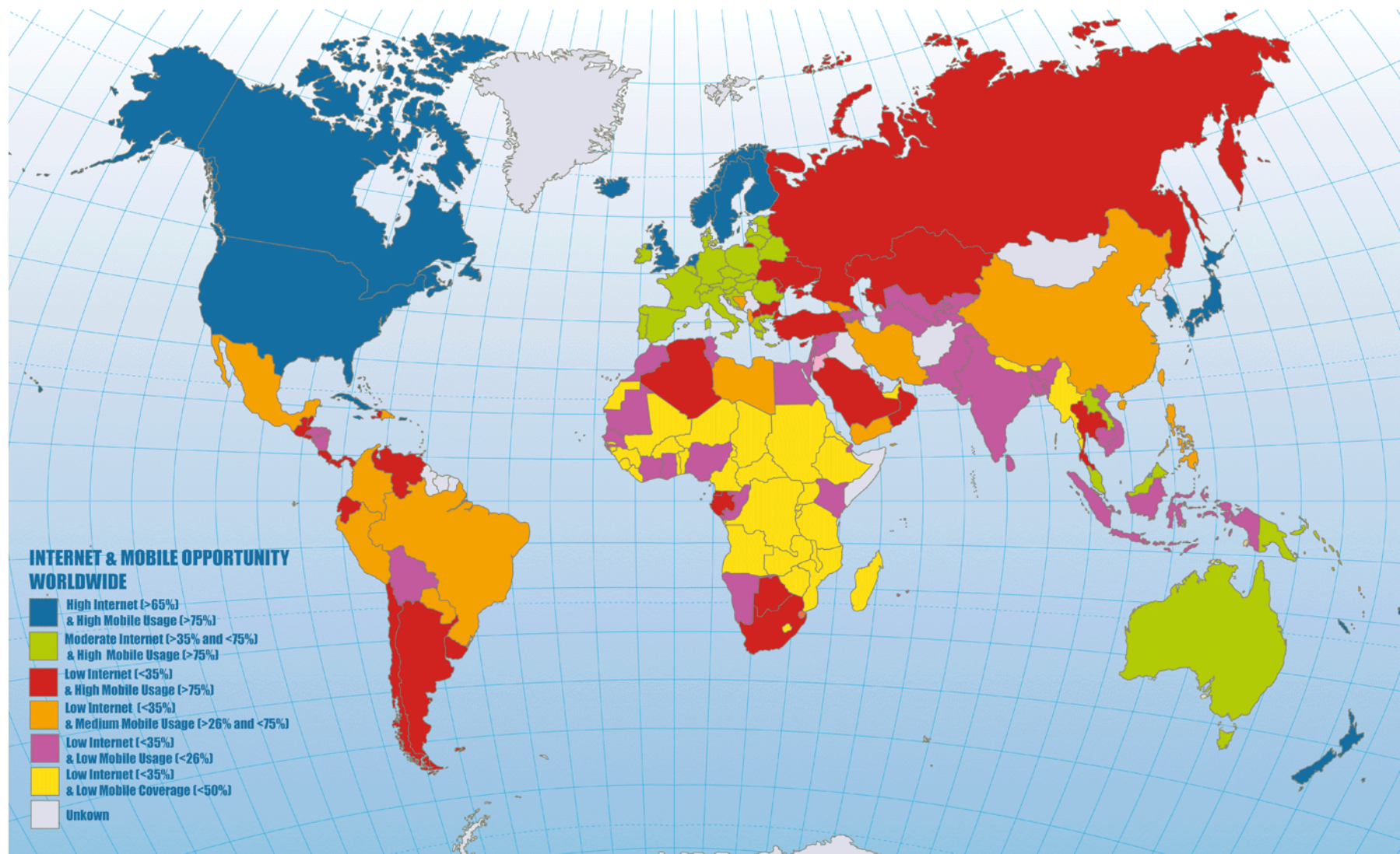
Classification of Applications

- **In what situations is it used?**

- **What context information is needed?**

- **How automatically does the application gather its inputs?**
  - what sensors does the application exploit? is the user involved?

- **Is the application self-contained?**
  - does the application need to connect to web or cloud?

- **How much communication does it require? and in which direction?**

- **How much storage does it use? where?**

Exercise: some examples applications

- **Choose two of your favorite applications and fill-in columns**

App	Use	Context	Sensors	Self-contained	Comm requirements	Storage requirements
Shazam	Identify and purchase music	None	Recording initiated by user	No, server does song matching	Synchronous to server	Just for recording
OneBusAway	When next bus will arrive	Current location	GPS/WiFi	No, server provides bus data	Synchronous	MInimal
Twitter	Status updates	None	None	No, server propagates message	Asynchronous	Message queue
Bar code scanner	Read barcodes	None	Camera, scan positioned by user	Yes, to read; No, to get reviews/buy	Synchronous	None
Pedometer	Count steps and calories	Motion throughout the day	Accelerometry, location	Yes, eventually upload data	Asynchronous	Sensor samples

Around the world

INTERNET & MOBILE OPPORTUNITY WORLDWIDE

- High Internet (>65%) & High Mobile Usage (>75%)
- Moderate Internet (>35% and <75%) & High Mobile Usage (>75%)
- Low Internet (<35%) & High Mobile Usage (>75%)
- Low Internet (<35%) & Medium Mobile Usage (>26% and <75%)
- Low Internet (<35%) & Low Mobile Usage (<26%)
- Low Internet (<35%) & Low Mobile Coverage (<50%)
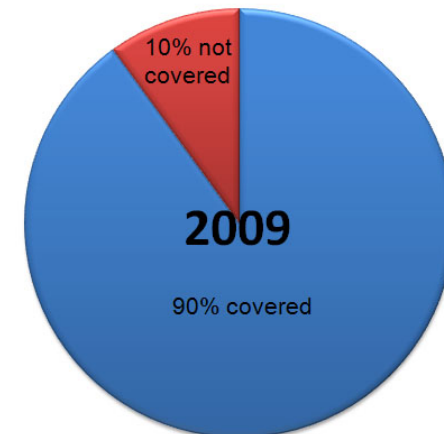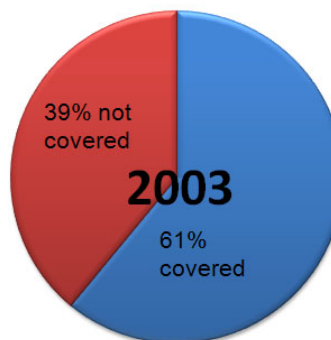- Unkown

Around the world

- **Phones are the personal computing device**
- **Most of the world's population will reach the web through phones, not desktops**
- **What new models will emerge?**
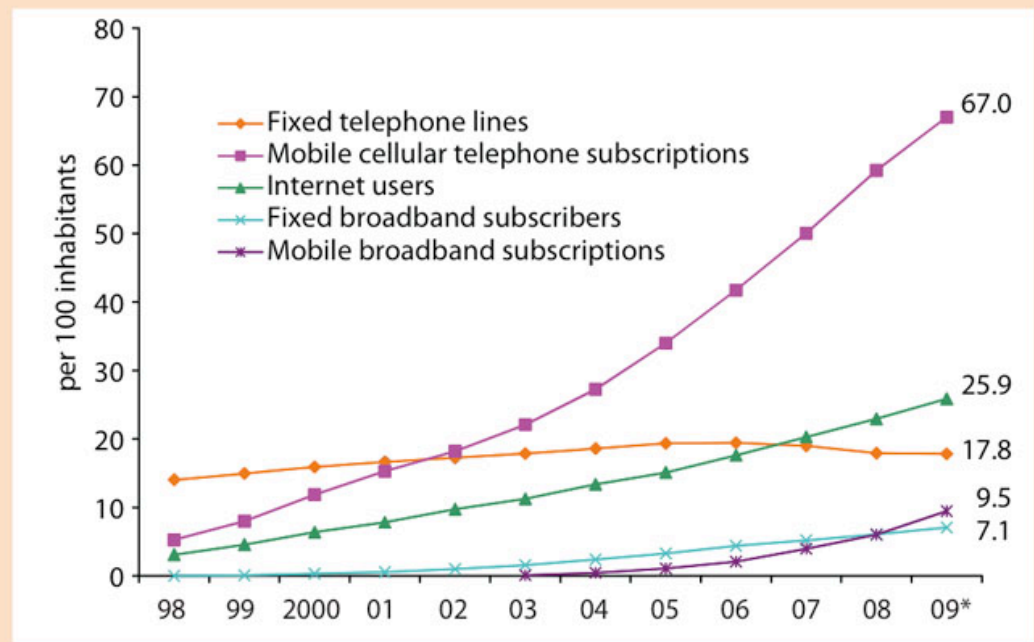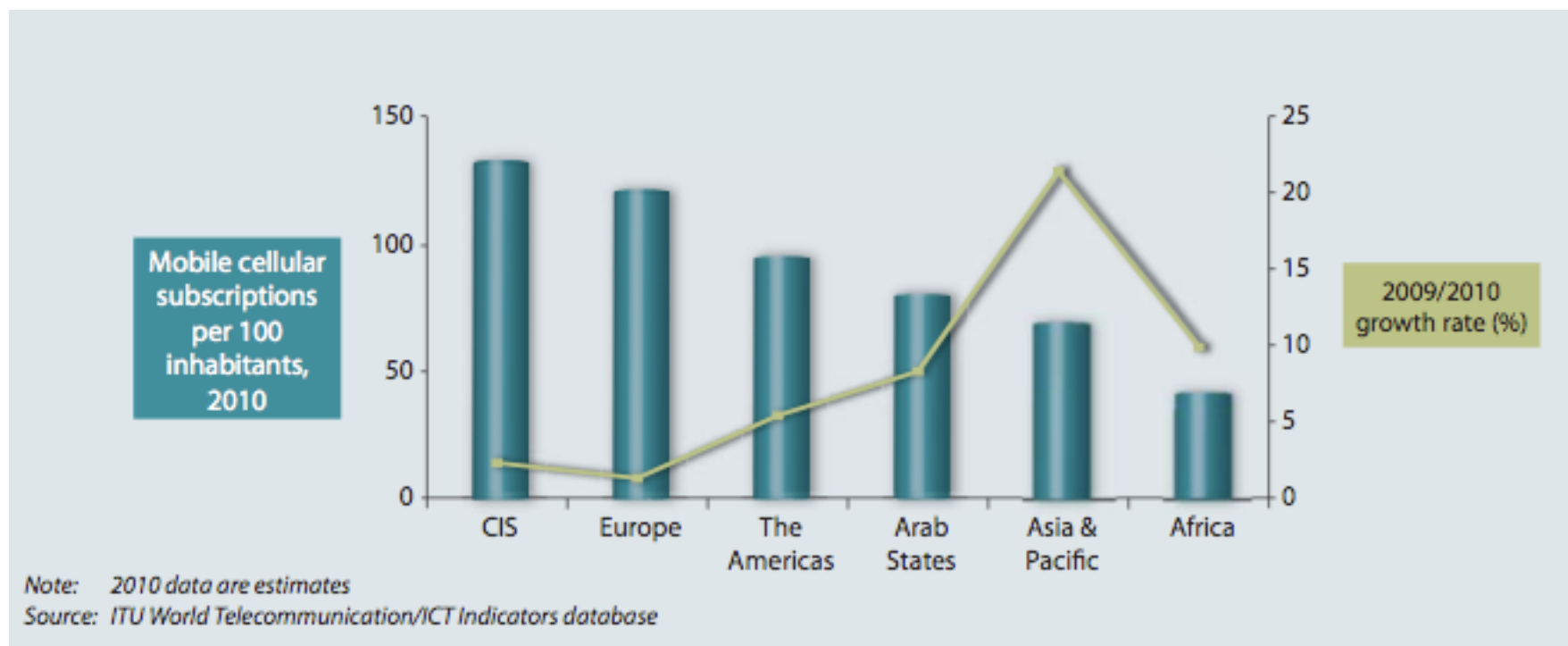

Note: * Estimates.
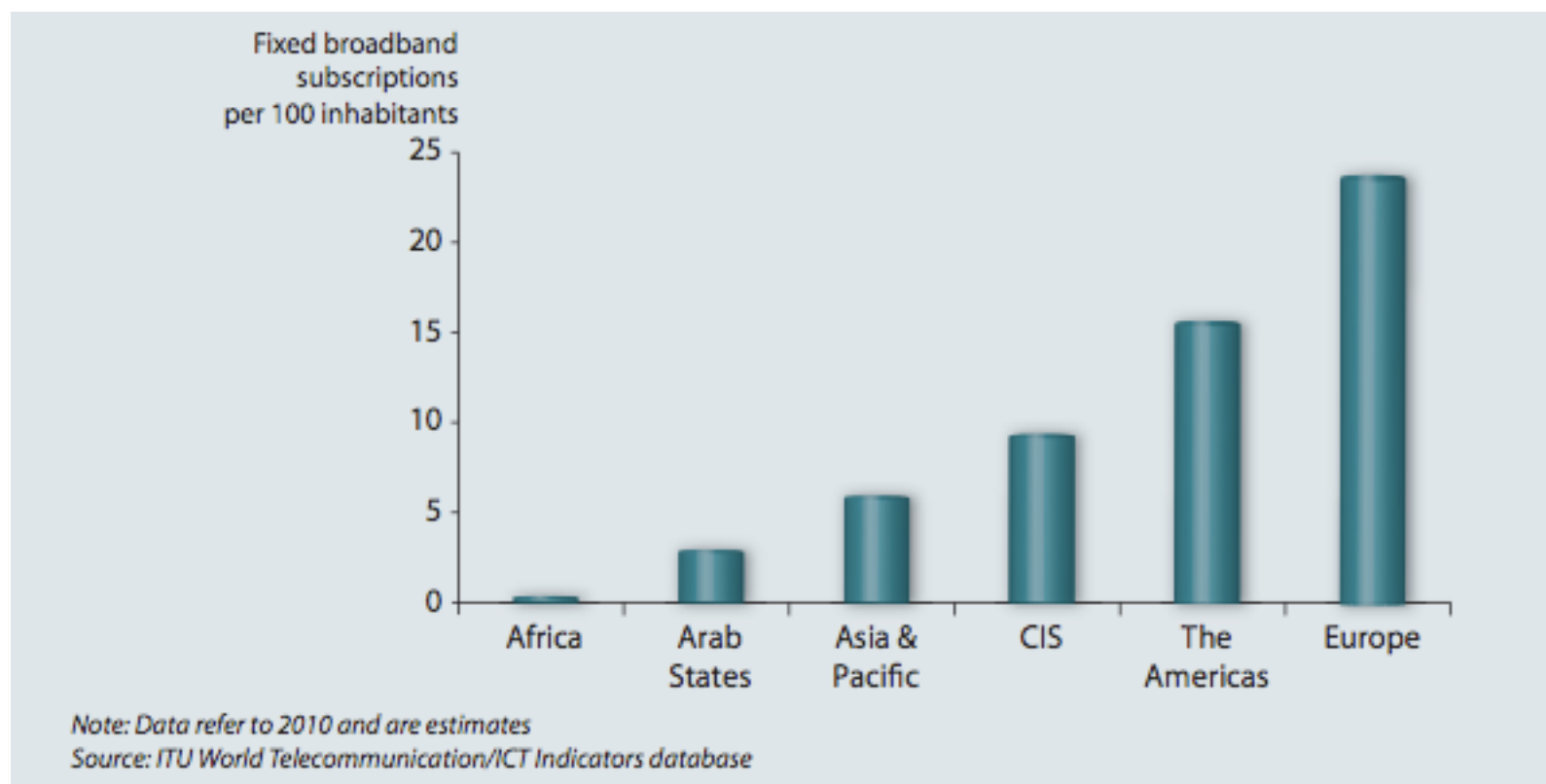Source: ITU World Telecommunication/ICT Indicators database.

Percentage of the world's population covered by a mobile cellular signal, 2003 compared to 2009

Mobile still rising

Broadband gap

Fixed broadband subscriptions per 100 inhabitants

Note: Data refer to 2010 and are estimates
Source: ITU World Telecommunication/ICT Indicators database

Course Logistics

- **Lectures/discussions**
  - we only have 8 of these (MLK and Presidents' Day)

- **Readings**
  - a couple of hours per week

- **Project (weekly assignments**
  - email/phone interactions to converge on topics
  - individual research paper as possible alternative

- **Web site has (or will have) the information you should need**
  - http://www.cs.washington.edu/csep590b/11wi/

About you

Gaetano Borriello

Professor for 23 years
University of Washington
Hometown: Napoli, Italia

Hobby:
Walking around (smallish) islands.

Interests:
How to use mobile phones to improve the lives of people in low-income settings.
Understanding how technology trends will lead to different usage models.
Working with a larger team to put these ideas and technologies into practice and everyday use.

Your 3 favorite mobile apps

■ **Find apps on Android Market and Apple's AppStore if you don't have them already**

■ **Ideally download and experiment with them**

■ **Describe them as we did tonight with the taxonomy**

■ **Explain why they are truly "mobile" apps**

Declare your interests and brainstorm