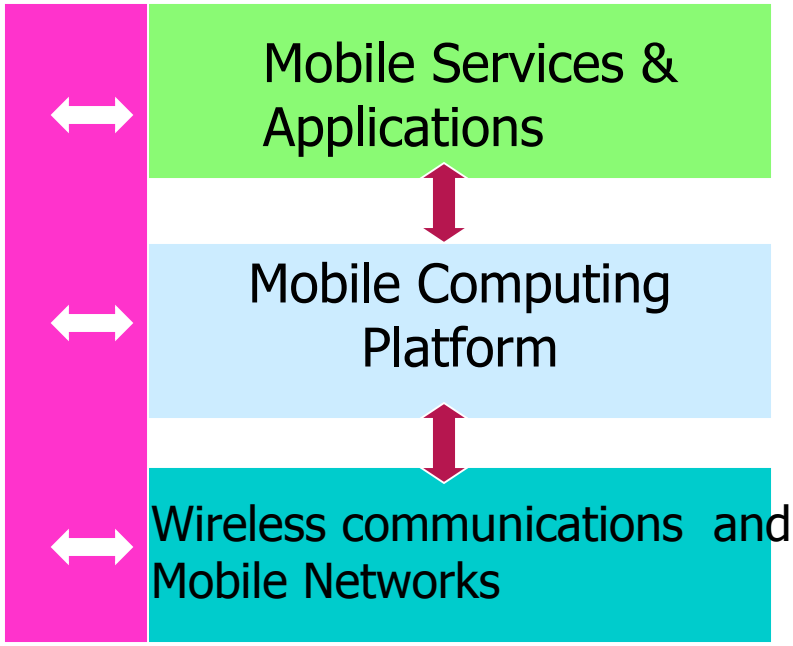
CS 504

Drake Patrick Mirembe

UTAMU

2015

Recap: Mobile computing systems deal with three basic Components



Network management

"Mobility"

We handle this

Mobile phone, Internet, and other new, …, so many

SMS, WAP,I-mode, J2ME&J2EE

Wireless LAN, GSM/GPRS, BlueTooth, Ad Hoc Mobile networks Wireless ATM, …, and Wi-Fi

Fantastic Breakthrough Technology

- **Wireless communication networks**
  - multiple networks “covering” the globe
  - wold-wide deregulation and spectrum auctions
  - standard communication systems and air link interfaces
- **Portable information appliances**
  - laptops, notebooks, sub-notebooks, and MNCs
  - hand-held computers
  - PDAs and Smartphones
- **Internet:**
  - TCP/IP *& de-facto* application protocols
  - ubiquitous web content

New Forms of Computing

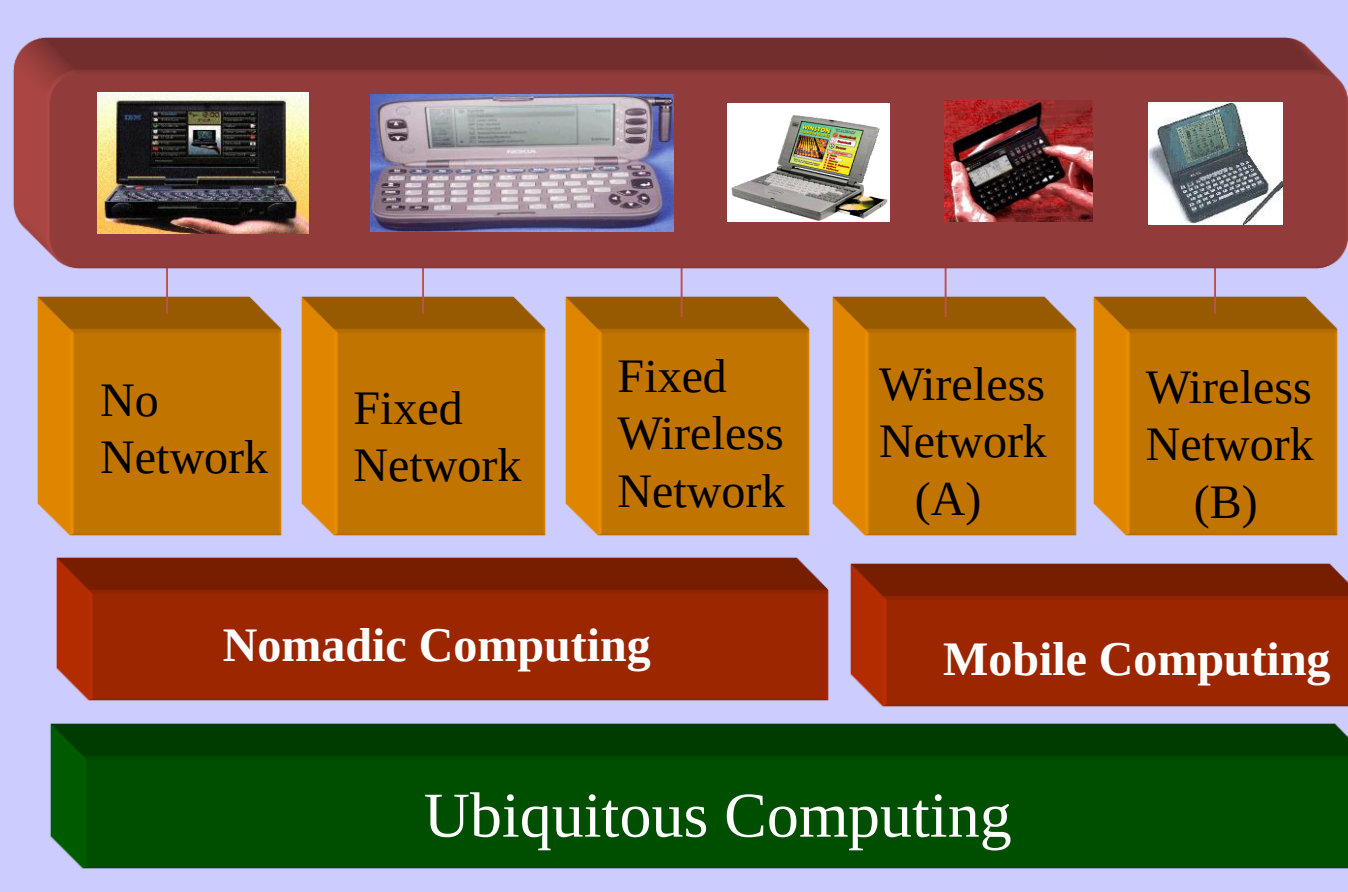
- Distributed Computing (Client/Server)

- Wireless Computing
- Nomadic Computing
- Mobile Computing
- Ubiquitous Computing
- Pervasive Computing
- Invisible Computing

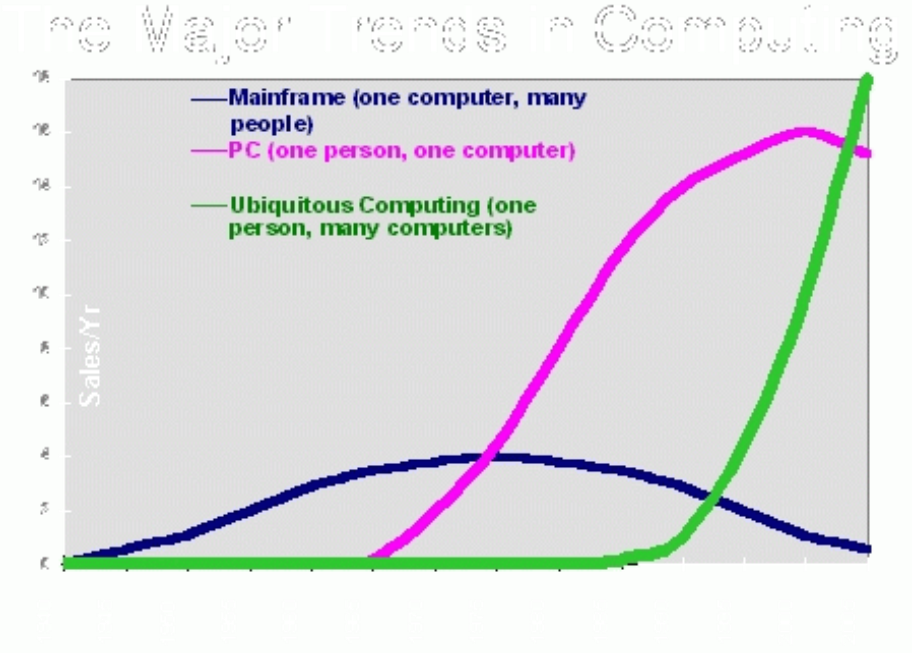
Mobile Computing

- Using:
  - small size portable computers, hand-helds, MNC, and other small wearable devices,
- To run stand-alone applications (or access remote applications) via:
  - wireless networks: IR, BlueTooth, W-LANs, Cellular, W-Packet Data networks, SAT. etc.
- By:
  - nomadic and mobile users (animals, agents, trains, cars, cell phones, ….)

Nomadic, Mobile & Ubiquitous

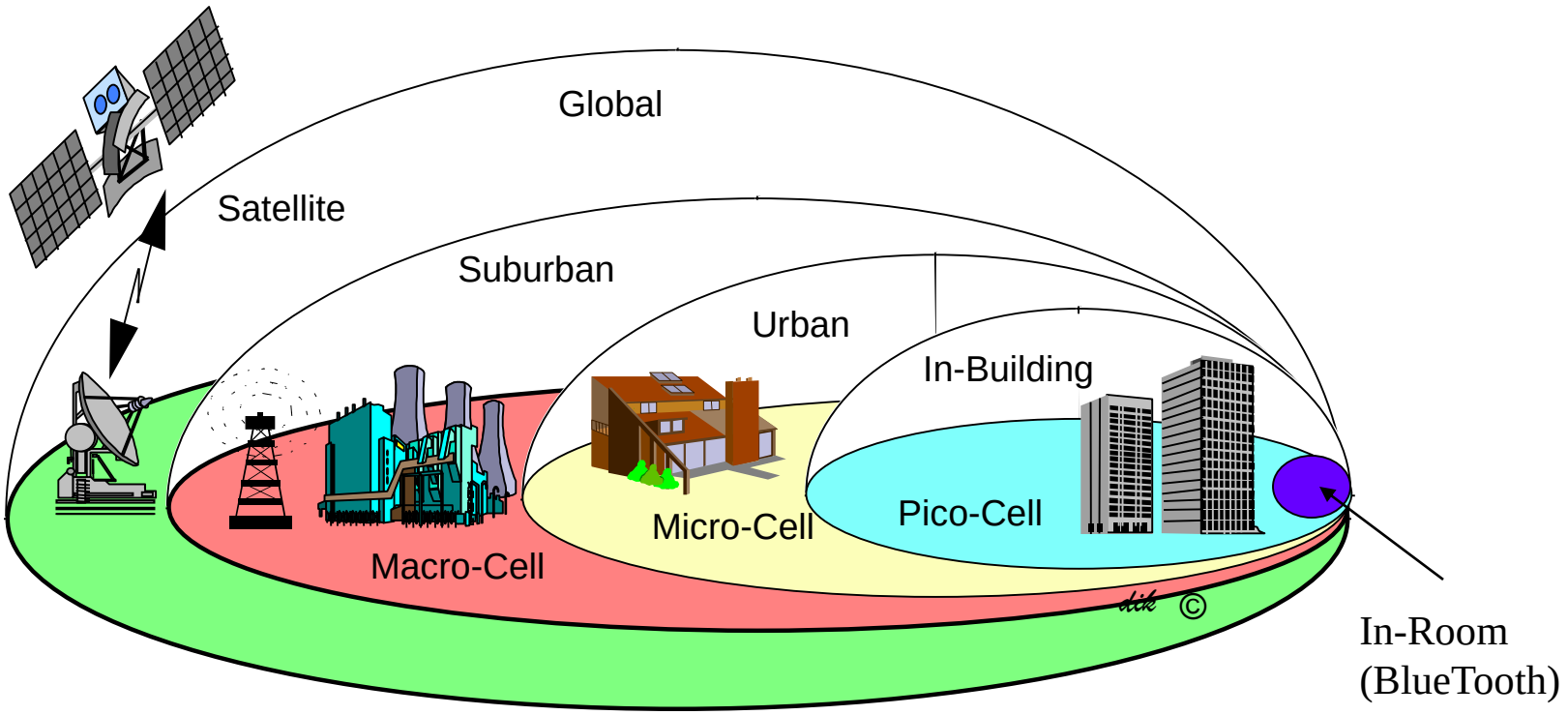


Another View of Ubiquitous Computing

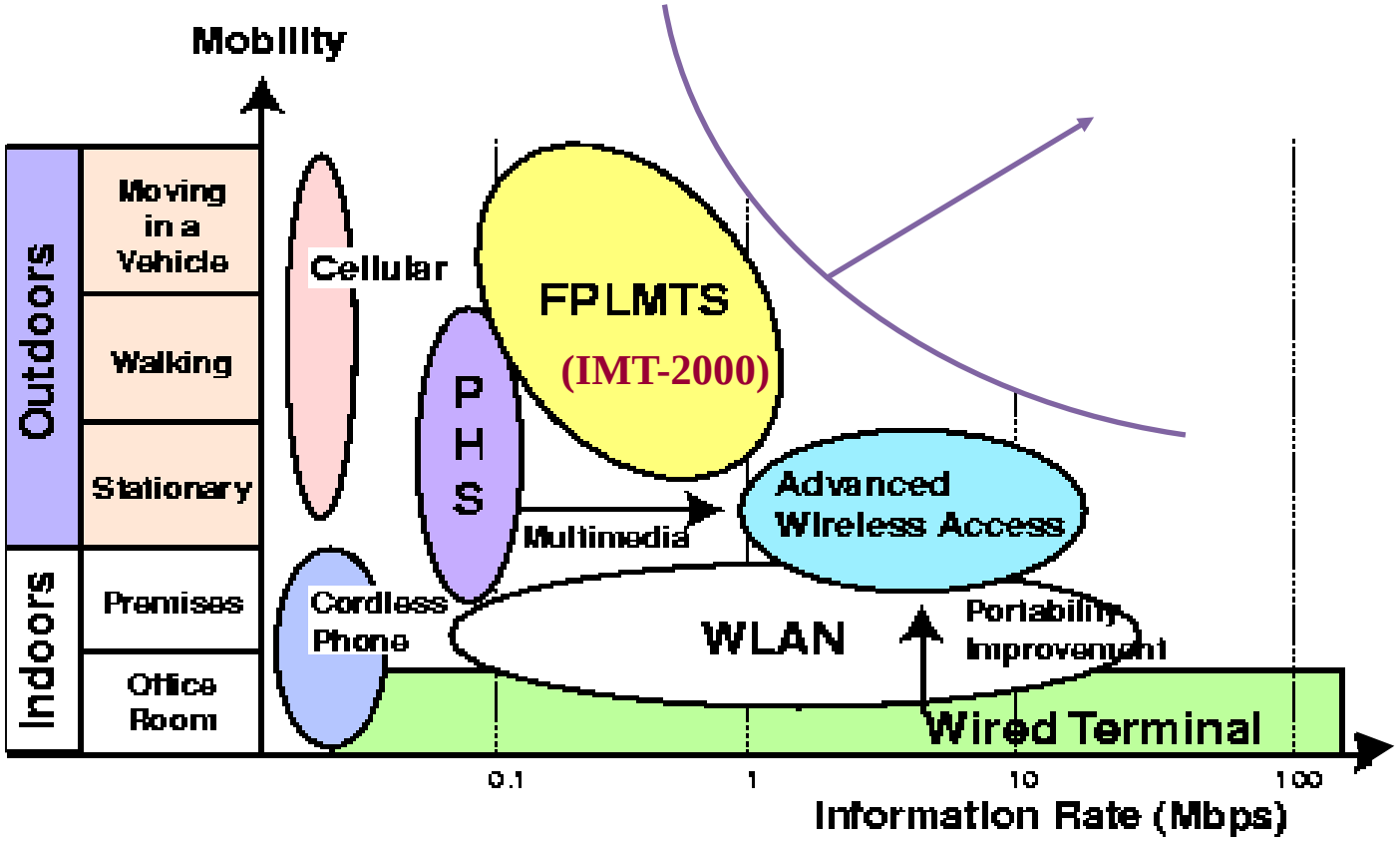


- Mark Weiser's views
- http://www.ubiq.com/hypertext/weiser/UbiHome.html

Impressive Wireless Infrastructure!

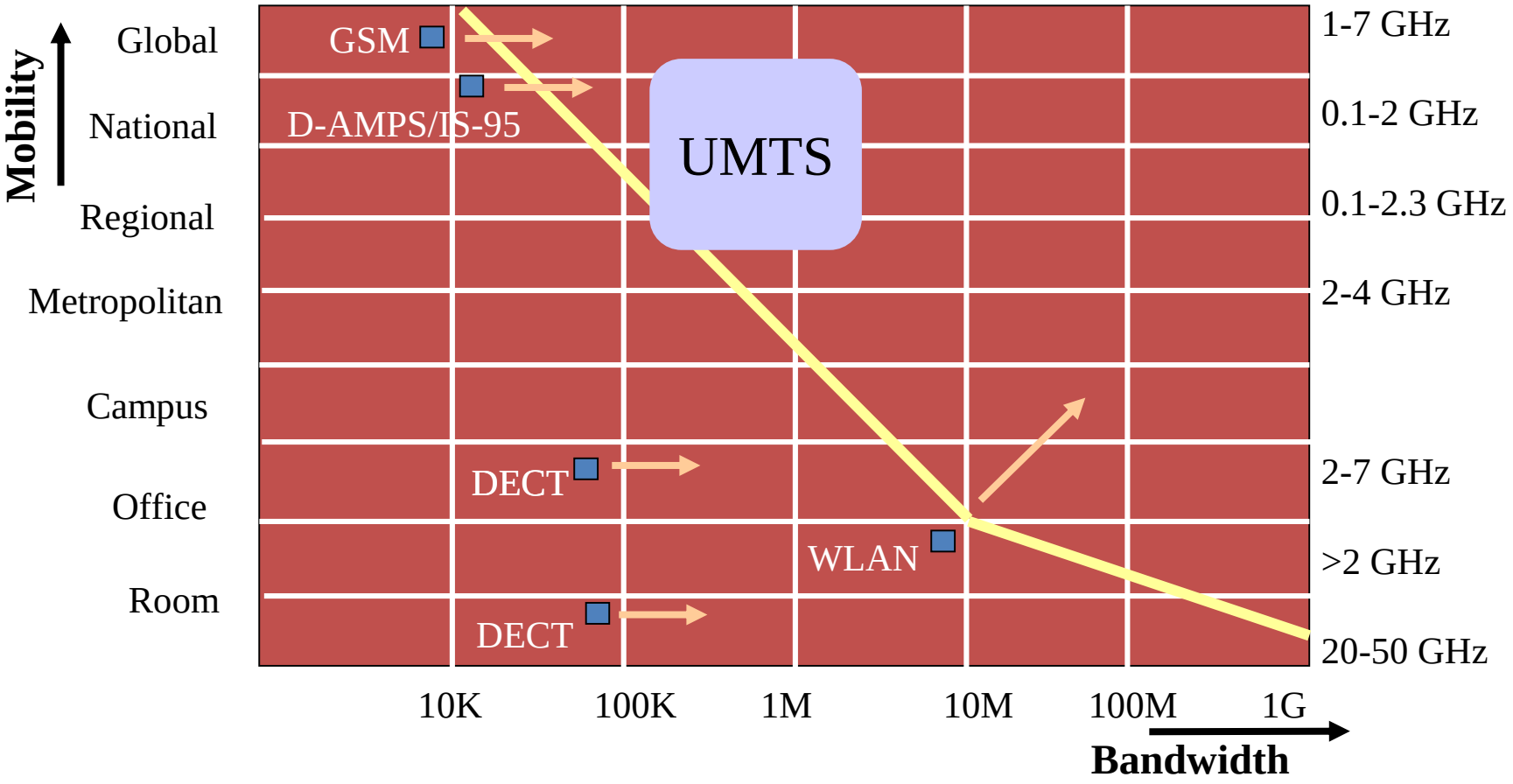


Wireless Communication Technology

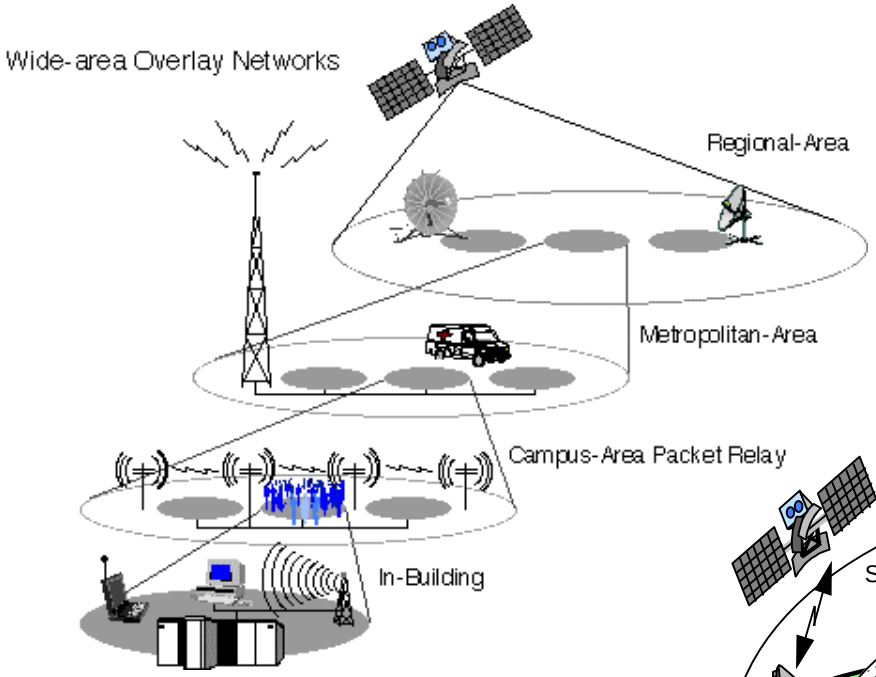


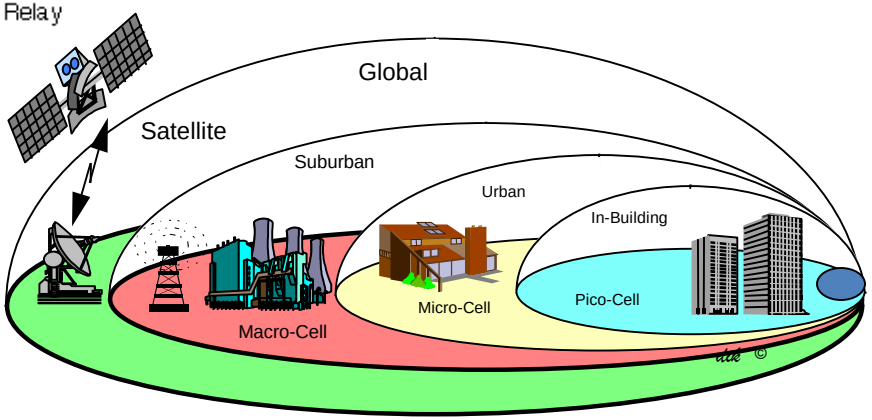
Wireless Network Convergence

2G/3G Mobility-Bandwidth Trade-off

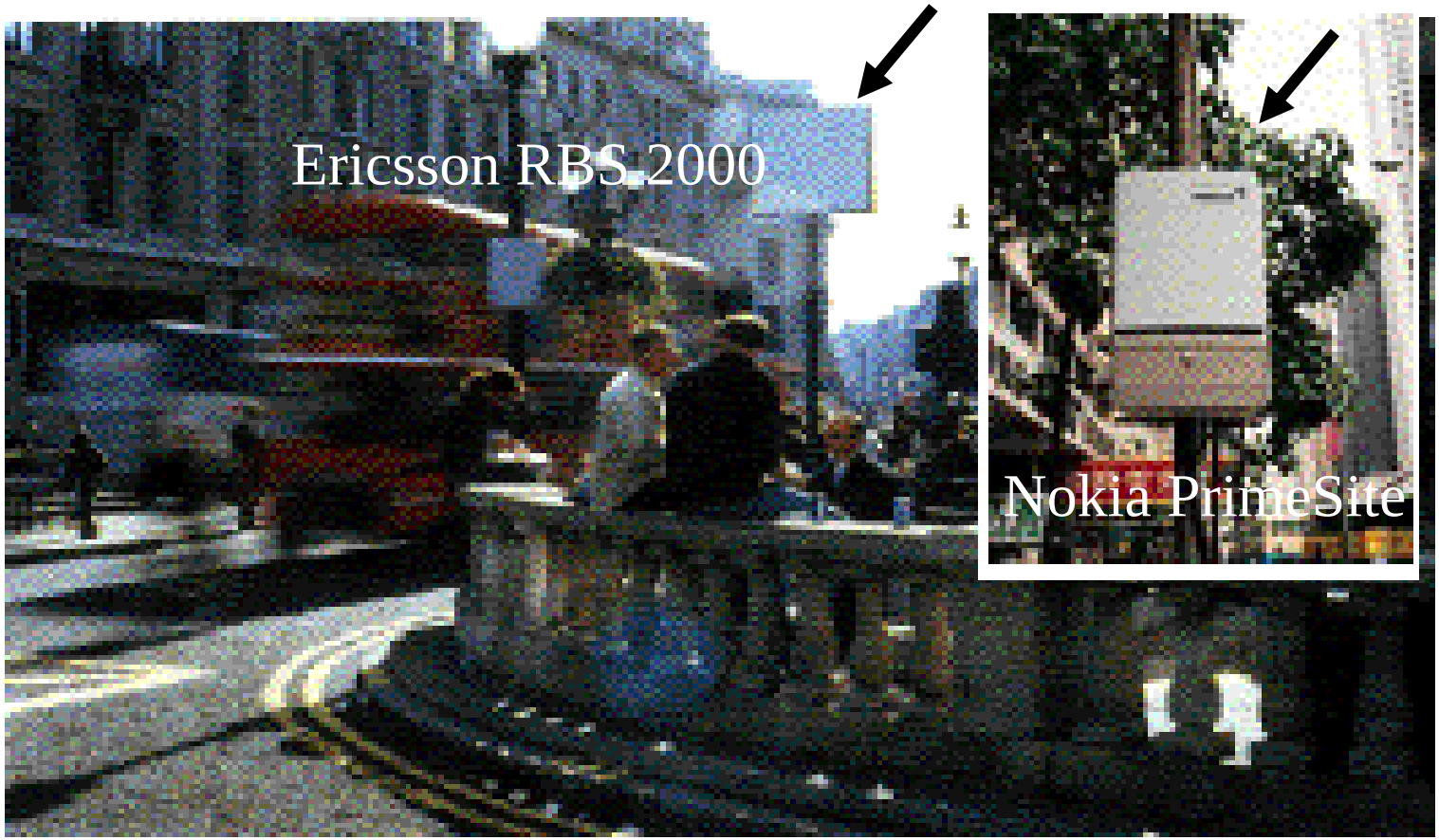


Wireless Network Overlay





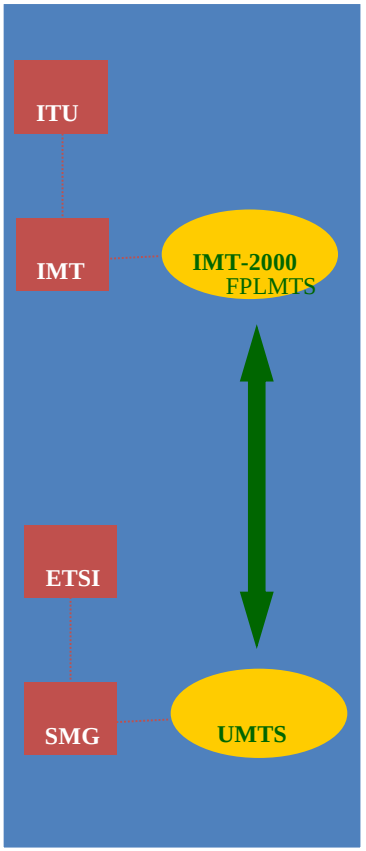
GSM Base Stations in Europe



September 1997

UMTS: Universal Mobile Telecomm. Standard

- Global seamless operation in multi-cell environment (SAT, macro, micro, pico)
- Global roaming: multi-mode, multi-band, low-cost terminal, portable services & QoS
- High data rates at different mobile speeds: 144kbps at vehicular speed (80km/h), 384 kbps at pedestrian speed, and 2Mbps indoor (office/home)
- Multimedia interface to the internet
- Based on core GSM, conforms to IMT-2000. Deployment as early as 2002.



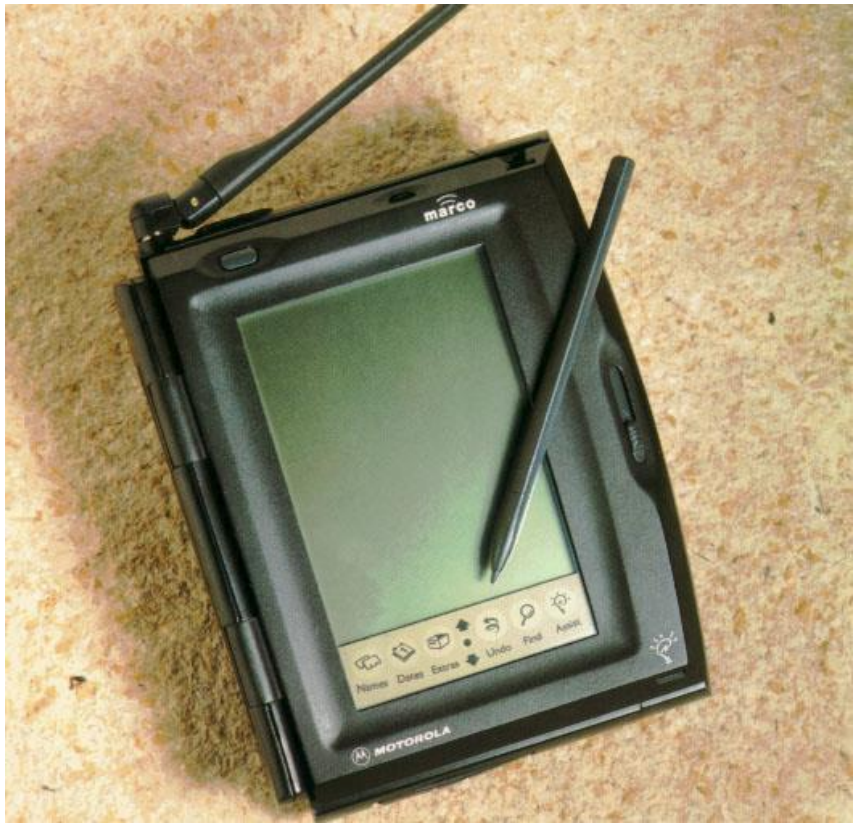
Apple’s Newton

1987

The Palm

1990

Motorola Marco



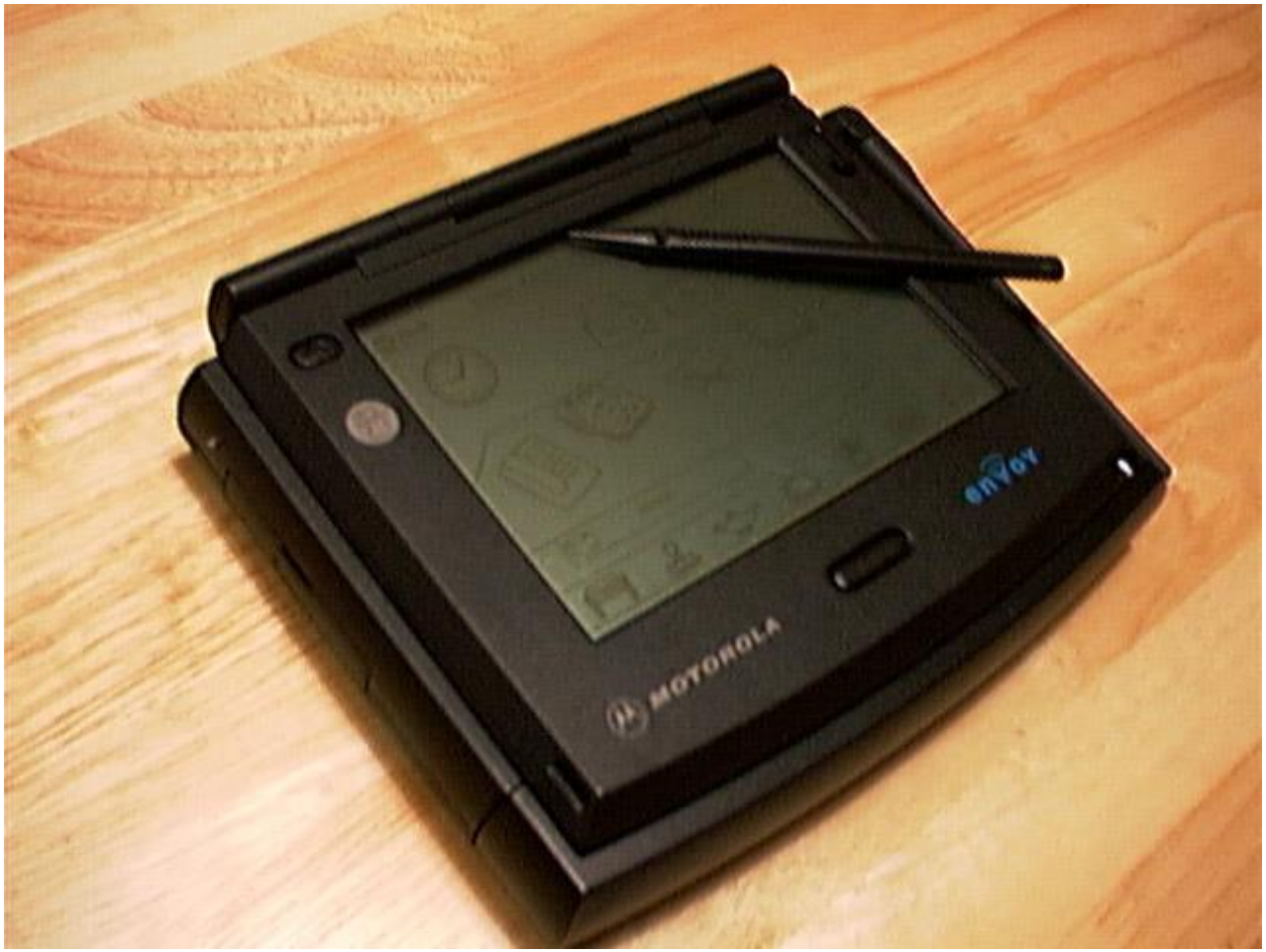
1995

Specs

- Newton OS 1.3
- 4MB ROM
- 687KB Flash RAM
- 320x240 Monochrome LCD resistive touchscreen
- RS422 serial port
- Localtalk support
- 1 PCMCIA Slot (5V or 12V)
- 1 Sharp ASK infrared port
- 4 AA batteries, rechargeable NiCd batteries may be used
- First released January 1995
- It weighs 1.8 pounds and is 7.5 inches high, 5.8 inches wide and 1.4 inches deep
- Street price: USD 900-1400

Motorola Envoy

1996



The Pocket PC

1998

The Nokia 9000 Communicator

1996

The Hand-Held Computer: Sharp Zaurus

1998

The Vadem Clio: Hand-Held?, Tablet? Other?

Clio™

The ideal PC Companion

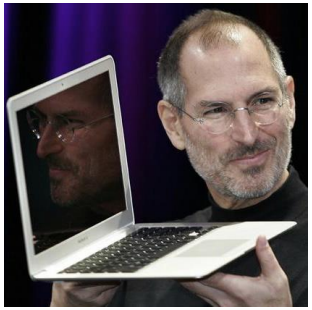
1999

The Tablet PC

Fujitsu Stylistic 2300/3400

2002

Laptops, Notebook, Sub Notebooks & Netbooks



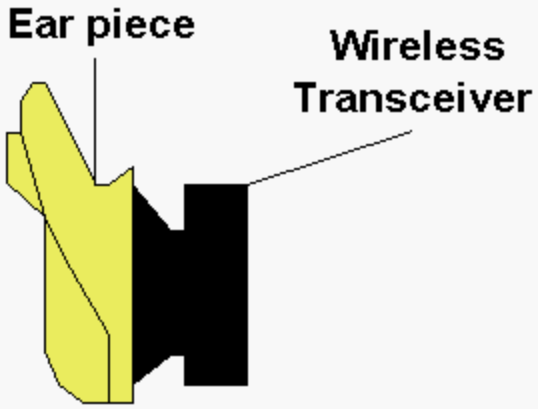
Laptops: 1991
Notebooks: 1996
Netbooks: 2006

The First Wrist PC: Ruputer

Japan’s PHS Phone, Year 2001

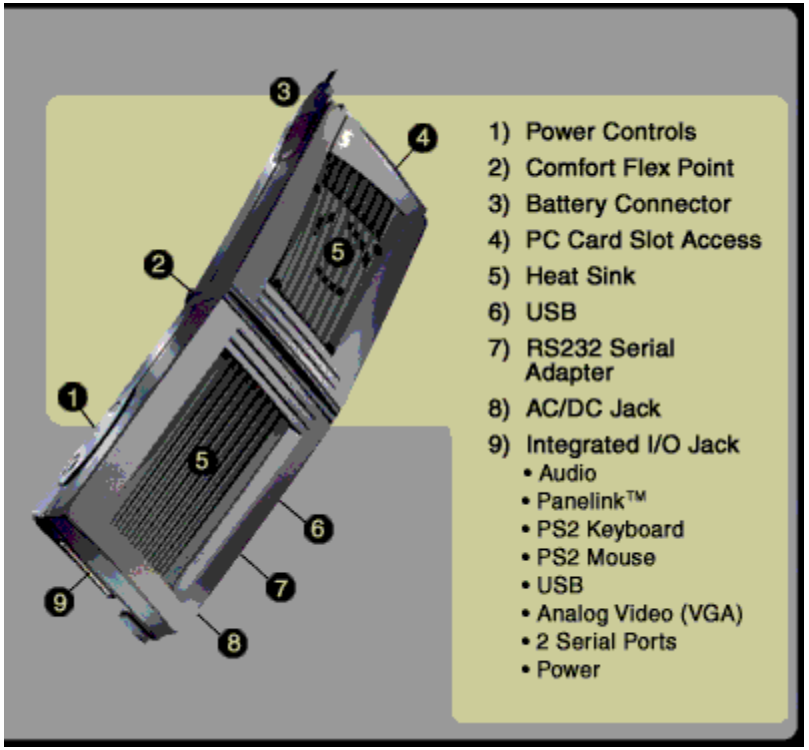
Ear Phone

- Hearing aid form factor
- Integrated microphone & speaker
- Low power / short range RF (like Blue Tooth)
- Embedded IP address
- Voice processing: external to unit, controlled by software agents



Wearable Computers

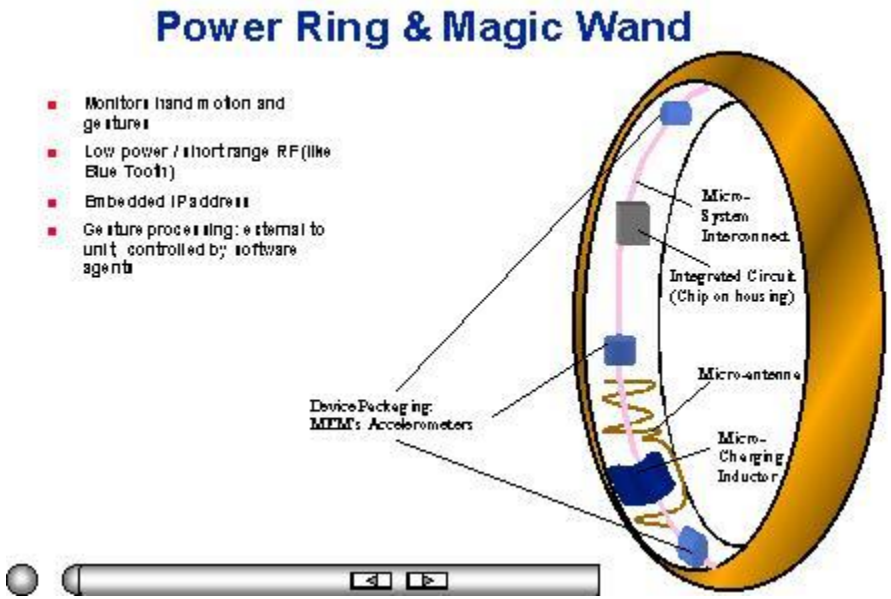
More Wearable -- Via PC



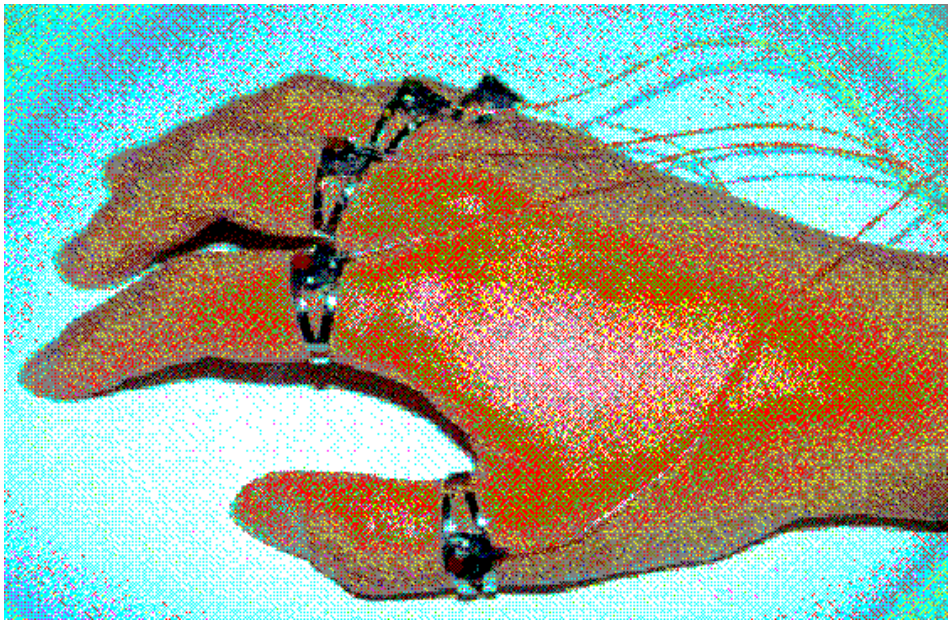
Http://ww.via-pc.com

Wireless Helmet?

The Power Ring



NTT Key Fingers



The Projection Keyboard

http://www.canesta.com

Today

The iphone

The iPad

Andriod

MyVu

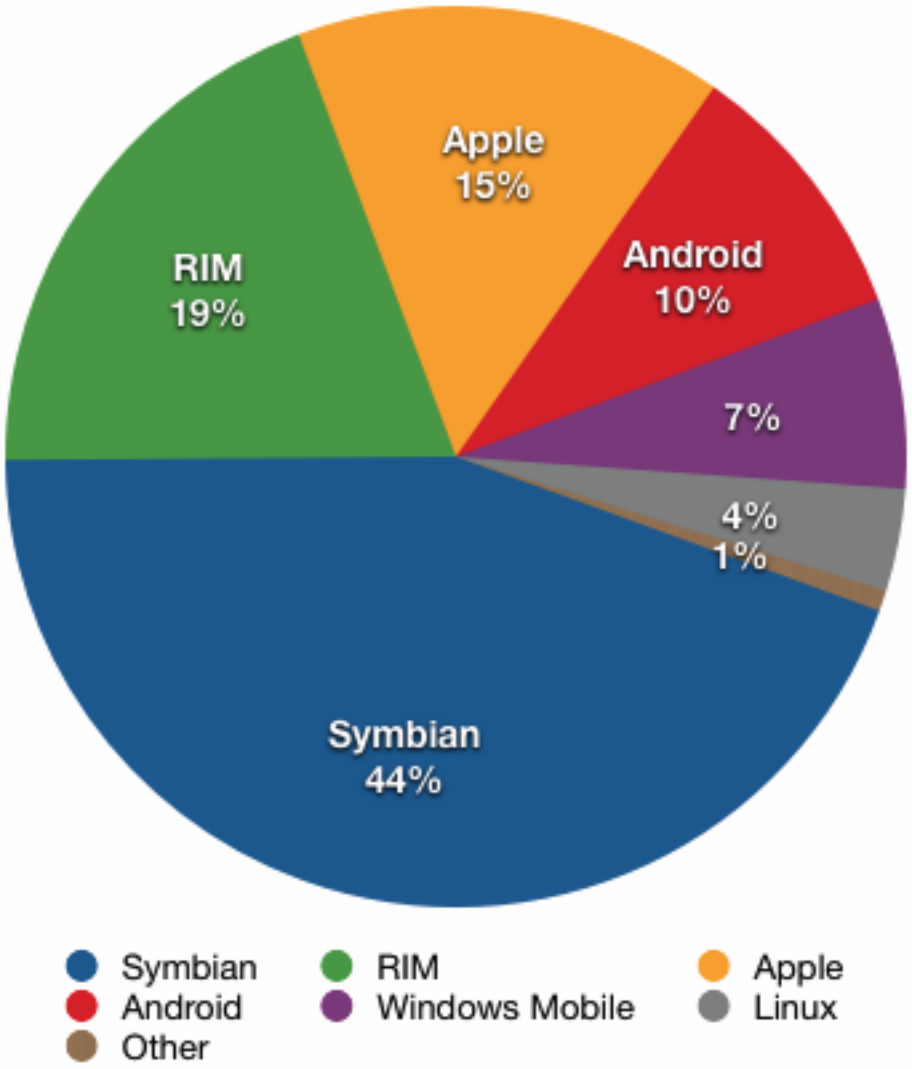
Portable projectors

Plastic Logic QUE

22Moo

Mobile Technology Wars
The Smart Phone
The Pad

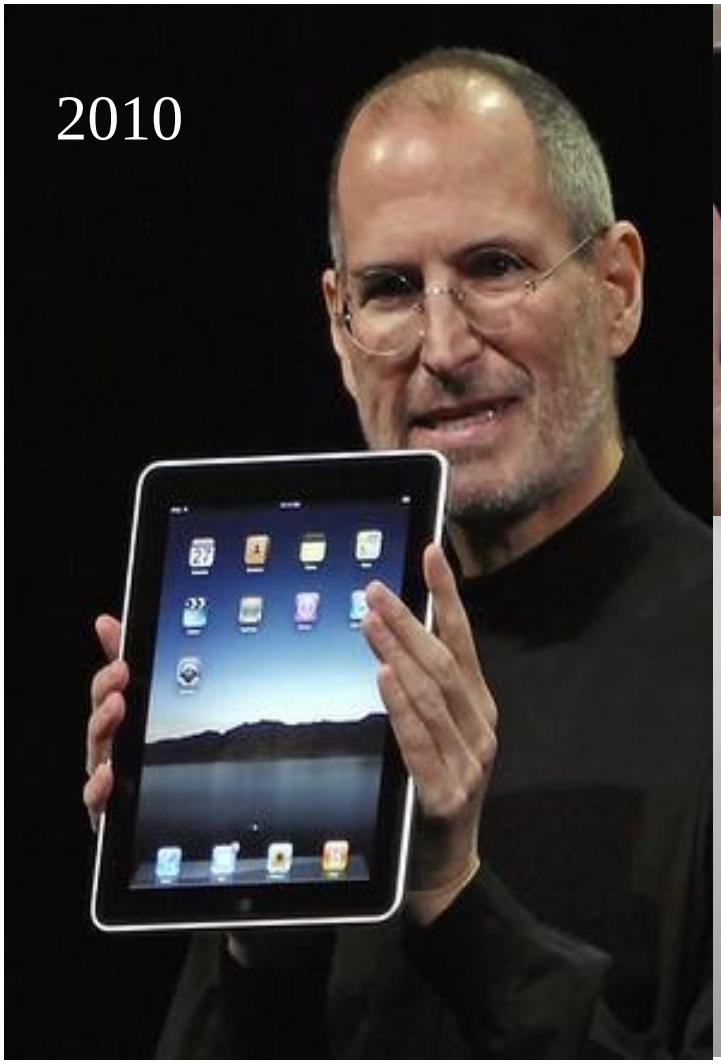
Smart Phones


Apple
15%
RIM
19%
Android
10%
7%
4%
1%
Symbian
44%
Symbian
RIM
Apple
Android
Windows Mobile
Linux
Other

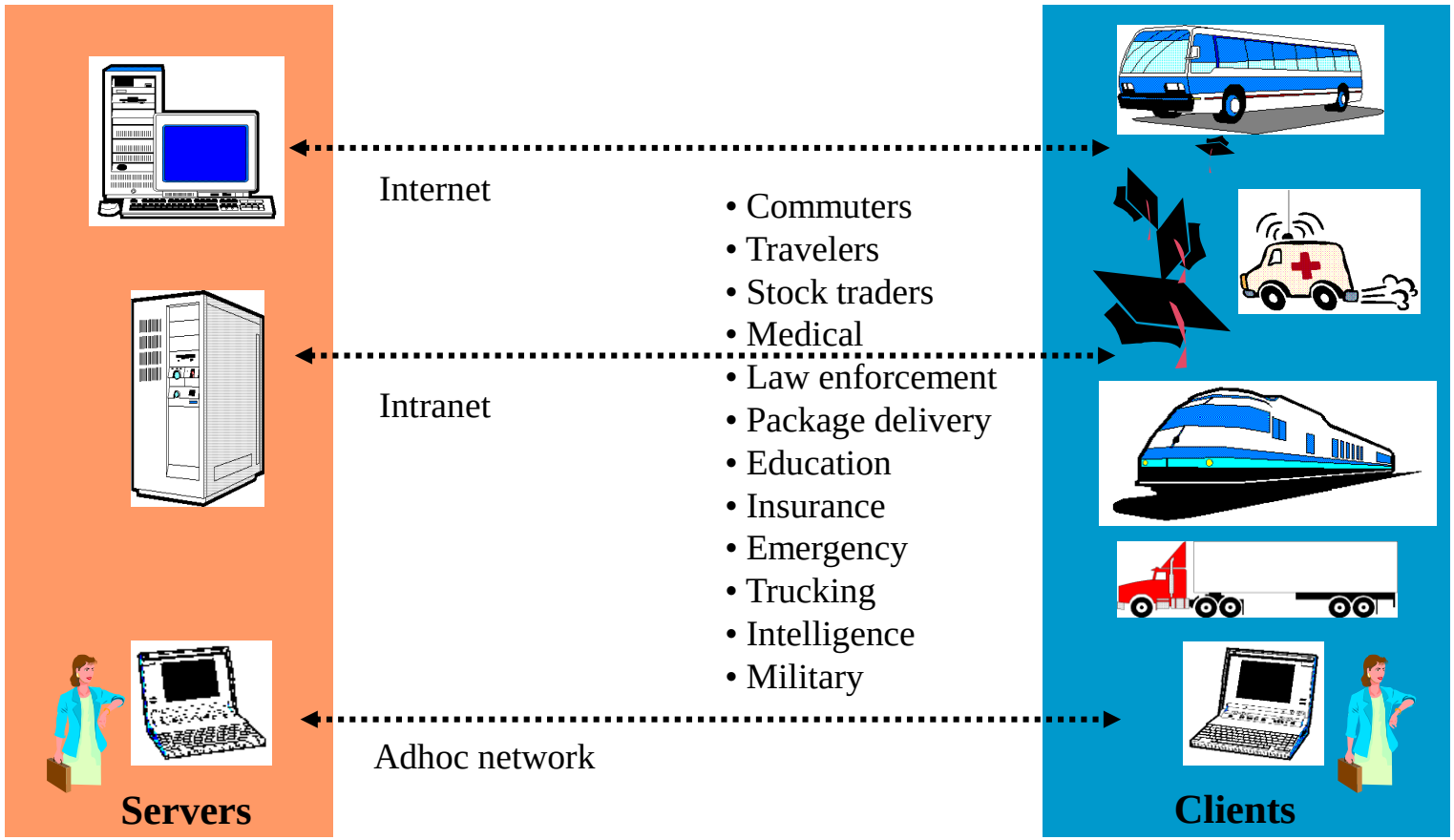
2009

Re-Inventing the Tablet:

The New War of the PADs



Beneficiaries of Ubiquitous Computing



Limitations of the Mobile Environment

- Limitations of the Wireless Network
  - heterogeneity of fragmented networks
  - frequent disconnections
  - limited communication bandwidth
- Limitations Imposed by Mobility
- Limitations of the Mobile Computer

Frequent Disconnections

- Handoff blank out (>1*ms* for most cellulars)
- Drained battery disconnection
- Battery recharge down time
- Voluntary disconnection (turned off to preserve battery power, also off overnight)
- Theft and damage (hostile environment)
- Roam-off disconnections

Limited Communication Bandwidth

- Orders of magnitude slower than fixed network
- Higher transmission bit error rates (BER)
- Uncontrolled cell population
  - Difficult to ensure Quality of Service (QoS)
  - Availability issues (admission control)
- Asymmetric duplex bandwidth
- Limited communication bandwidth exacerbates the limitation of battery lifetime.

Limitations of the Mobile Computer

- Short battery lifetime (max ~ 5 hours)
- Subject to theft and destruction => unreliable
- Highly unavailable (normally powered-off to conserve battery)
- Limited capability (display, memory, input devices, and disk space)
- Lack of *de-facto* general architecture: hand-helds, communicators, laptops, and other devices

Caesar and Brutus

Limitations Imposed by Mobility

- **Lack of mobility-awareness by applications**
  - inherently transparent programming model (object-, components-oriented, but not aspect-oriented)
  - lack of environment test and set API support
- **Lack of mobility-awareness by the system**
  - *network*: existing transport protocols are inefficient to use across heterogeneous mix of fixed/wireless networks
  - *session and presentation*: inappropriate for the wireless environment and for mobility
  - *operating systems*: lack of env. related conditions and signals
  - *client/server*: unless changed, inappropriate and inefficient

Reading Assignment

Pervasive Computing: Vision and Challenges, M. Satyanarayanan, Carnegie Mellon University, IEEE Personal Communications, August 2001