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A Perspective on Ubiquitous Communications: the MoCCA Project

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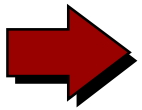
2nd IEEE WS on WLANs

Outline



- ***Introduction and Background***
- **The MoCCA Vision**
- **Technology Barriers and Research Opportunities**
- **Conclusions and Open Issues**

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Why Has the Vision not Flown?

- devices have not displaced other carried items
- lack of clear vertical market focus
- low-performance CPUs, small memories, poor battery life
- inadequate input such as handwriting recognition
- disappointing ease-of-use factors
- inadequate display and keyboard sizes
- lack of seamless and ubiquitous communications
- cost/value!

Device Trends

The industry has entered a period of transition and growing user acceptance.

Relative successes in the consumer market:

- Newton MessagePad 130
- Sharp Zaurus
- Hewlett-Packard OmniGo 100
- Casio Z-7000
- U.S. Robotics Pilot
- Psion 3A

Mainly organizers with limited communications/synchronization means.

Vertical Markets Trends

Some progress in market for mobile devices for vertical applications (inventory control, health care):

- **Telxon**
- **Badger**
- **Fujitsu (pen-based, Windows 95)**
- **Symbol**
- **Norand**

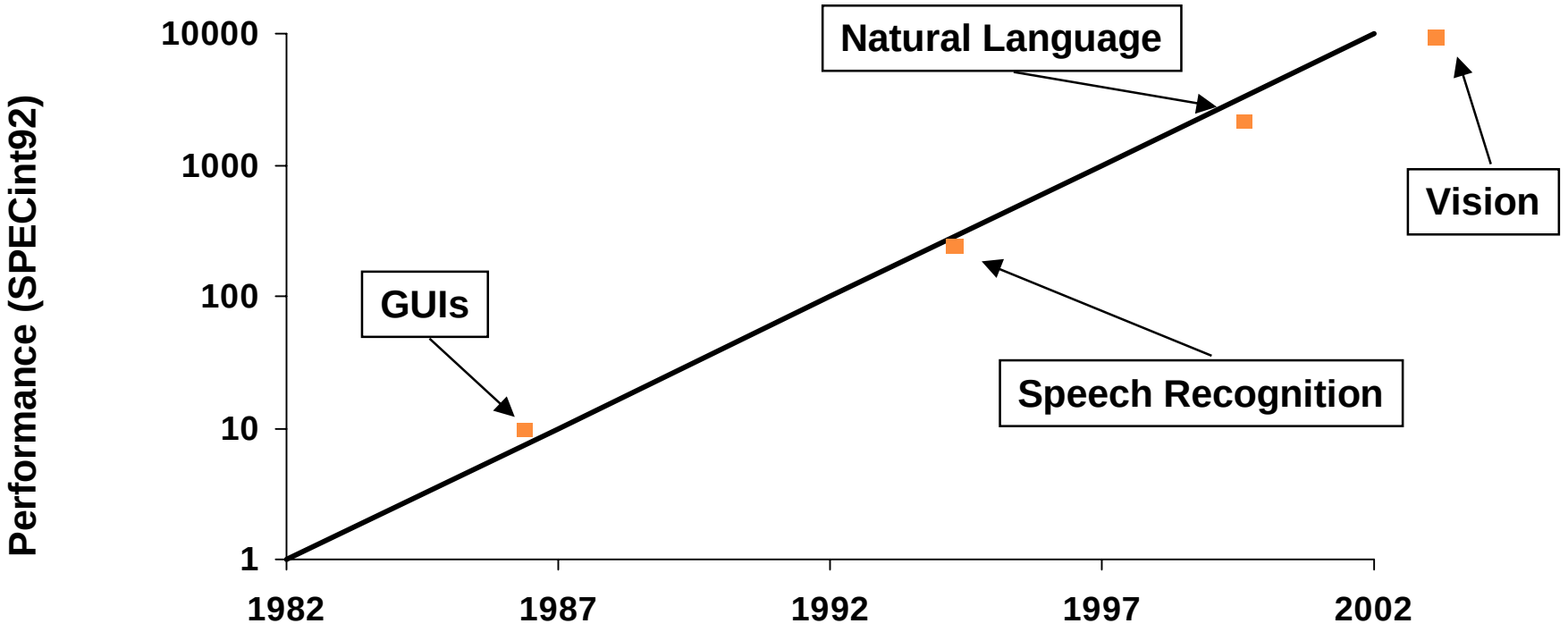
These and other devices are exposing many to the technology.

Microprocessor Technology Trends

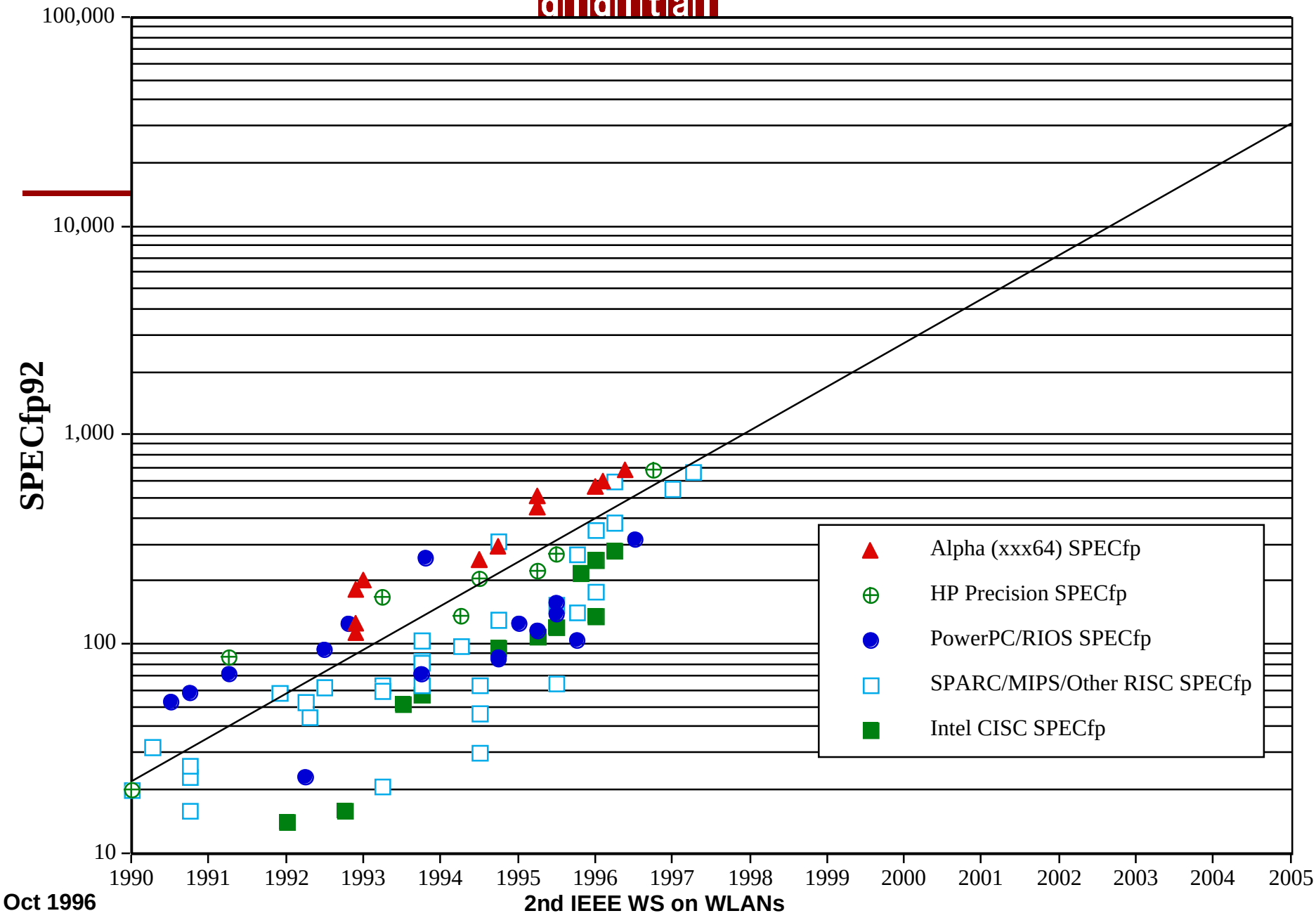
Features size (micron)					
0.5	0.35	0.25	0.18	0.12	0.10
Gates/chip					
300K	800K	2M	5M	10M	20M
DRAM					
16M	64M	256M	1G	4G	16G
SRAM					
4M	16M	64M	256M	1G	4G
Mips					
100	400	1000	2500	5000	10000
Disks					
2GB	8GB	25GB	75GB	200GB	500GB
LAN Bandwidth					
100	1000		10000?		
1992	1995	1998	2001	2004	2007

Source: Semiconductor Industry Association -- Semiconductor Technology Workshops Conclusions March, 1993

Microprocessors Technology Trends (Cont.)



Relative Performance: Microprocessors (SPECfp92)



Oct 1996

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Digital-ARM Partnership

- **DS has negotiated an *architecture* license from ARM Ltd.**
  - unique position (others are *manufacturing* licensees only)
- **DS will develop and manufacture a series of standard products (SPs) and application specific SPs (ASSPs) based on the StrongARM core technology**
  - Standard Products are general purpose devices
  - ASSPs are targeted at specific markets and applications
- **DS will develop a family of ARM compliant cores (*the StrongARM family*) which will be made available to ARM Ltd. for sub-license to their manufacturing licensees**
  - cores are enabling technology for ASSPs and CSSPs (customer specific SPs), from other ARM licensees

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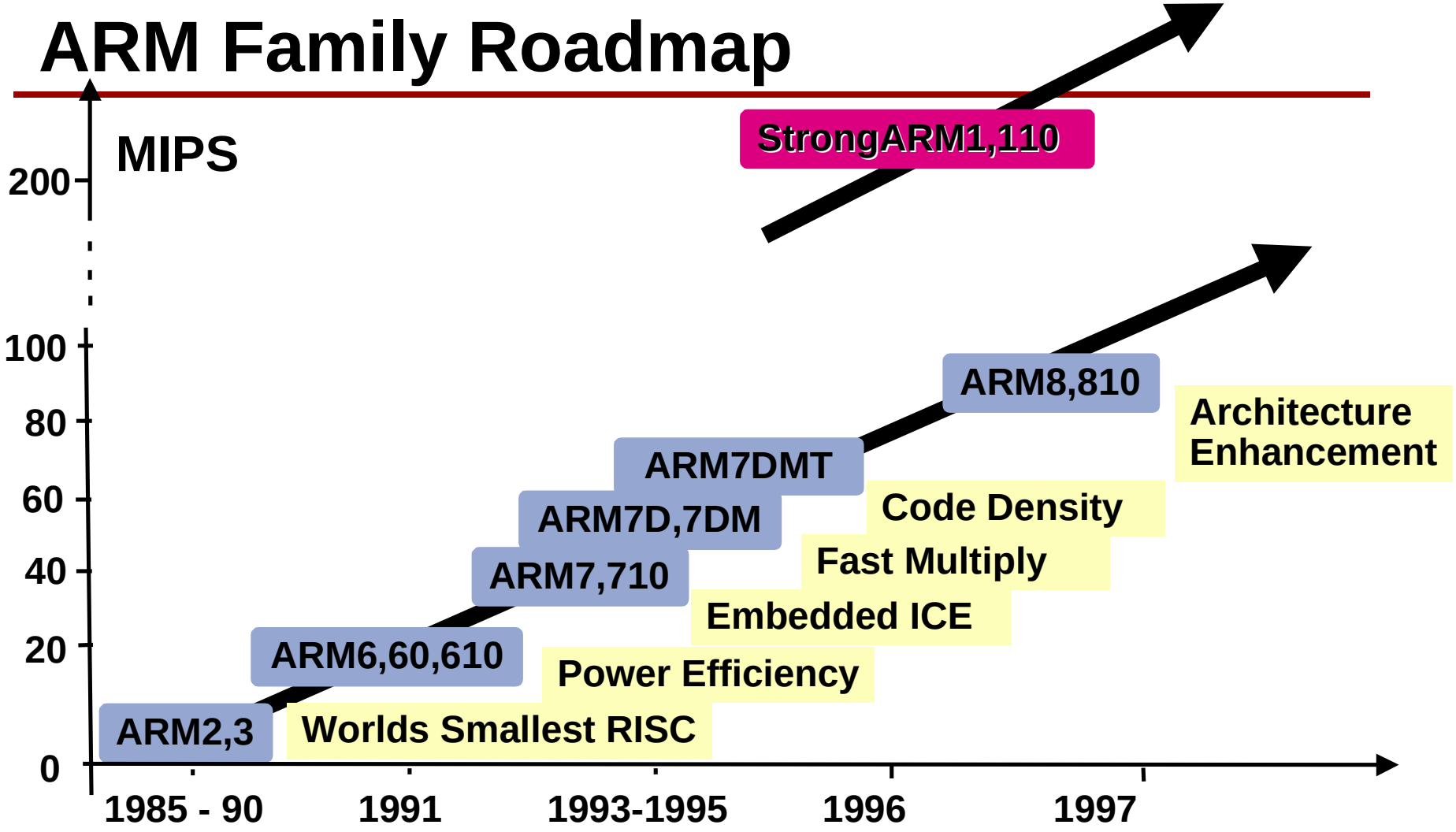
ARM Family Roadmap



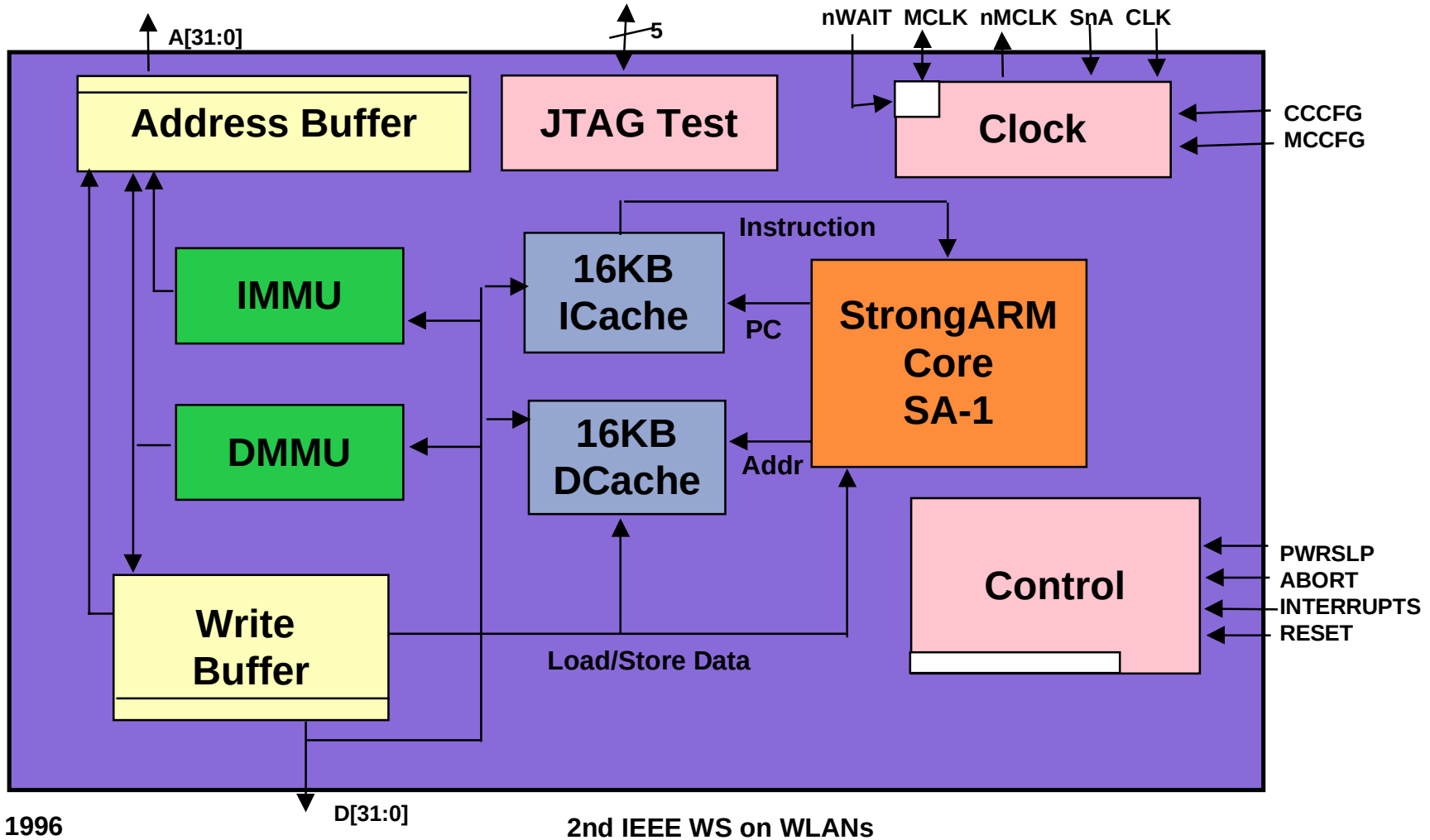
StrongARM Target Market Segments

- **Smart Handheld Devices**
  - PDAs, Electronic Organizers,
  - Digital Cameras, Smart Phones
- **Interactive Digital Media**
  - Digital Set-top devices, Interactive TV, Video Game Players
- **Internet Appliances**
  - Net Browsers, Intranet Devices
- **Embedded Control**
  - Internetworking: Routers, Bridges, LAN Switches
  - Office Automation: Printers, Scanners, Copiers, etc.
  - Telecommunication: PBX, Cellular Base Stations
  - Storage Peripherals: Drive Controllers, RAID Controllers
  - PC Add-Ins: Intelligent I/O Cards, LAN / WAN

SA-110 Details

Process Technology	0.35 um, 3LM CMOS
Supply voltage	Core voltage 1.65 - 2.0 Volts
	I/O voltage 3.3 Volts
Frequency & Power	< 900 mW @ 200 MHz @ 2.00-V
	< 450 mW @ 160 MHz @ 1.65-V
	< 300 mW @ 100 MHz @ 1.65-V
Power-down Modes	- Normal Mode (<300mW@100MHz) - Idle Mode (20mW Average) - Sleep Mode (50uA Average)
Package	144 TQFP
Current Status	Samples at key customers now
Volume	Q3 1996

SA-110 Block Diagram



Establishing New Benchmarks in the Smart Handheld Market

	SA-110 / 100	***SA-110 / 160***
Frequency	100 Mhz	160 Mhz
Performance *(Dhrystone 2.1 MIPS)*	115	185
Power	< 300 mW	< 450 mW
MIPS / Watt	383	**411**
Price *(10k unit volumes)*	$ 29	$ 49
MIPS / $	4.0	3.8

Best performance in SHH market

Leader in power-efficiency

Leader in price-performance

Software Systems Trends

Contenders for next-generation mobile device drivers:

- **Microsoft Windows CE (Compaq, Casio)**
- **JavaOS (Mitsubishi, Motorola, Nokia)**
- **General Magic's Magic Cap (?)**
- **Geowork's GEOS**

These operating systems are also being considered for set-top boxes and Internet appliances.

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Communications Infrastructure Trends

- Next-generation wide-area technology in the U.S. evolving towards PCS in spite of technological confusion;
- GSM will continue to dominate in Europe and other overseas markets;
- CDPD, packet radio (RAM Mobile, ARDIS), one- and two-way paging, will continue to find niche markets;
- emerging: wireless cable, ESMR, satellite, television
- wireless LANs will continue to grow; residential?

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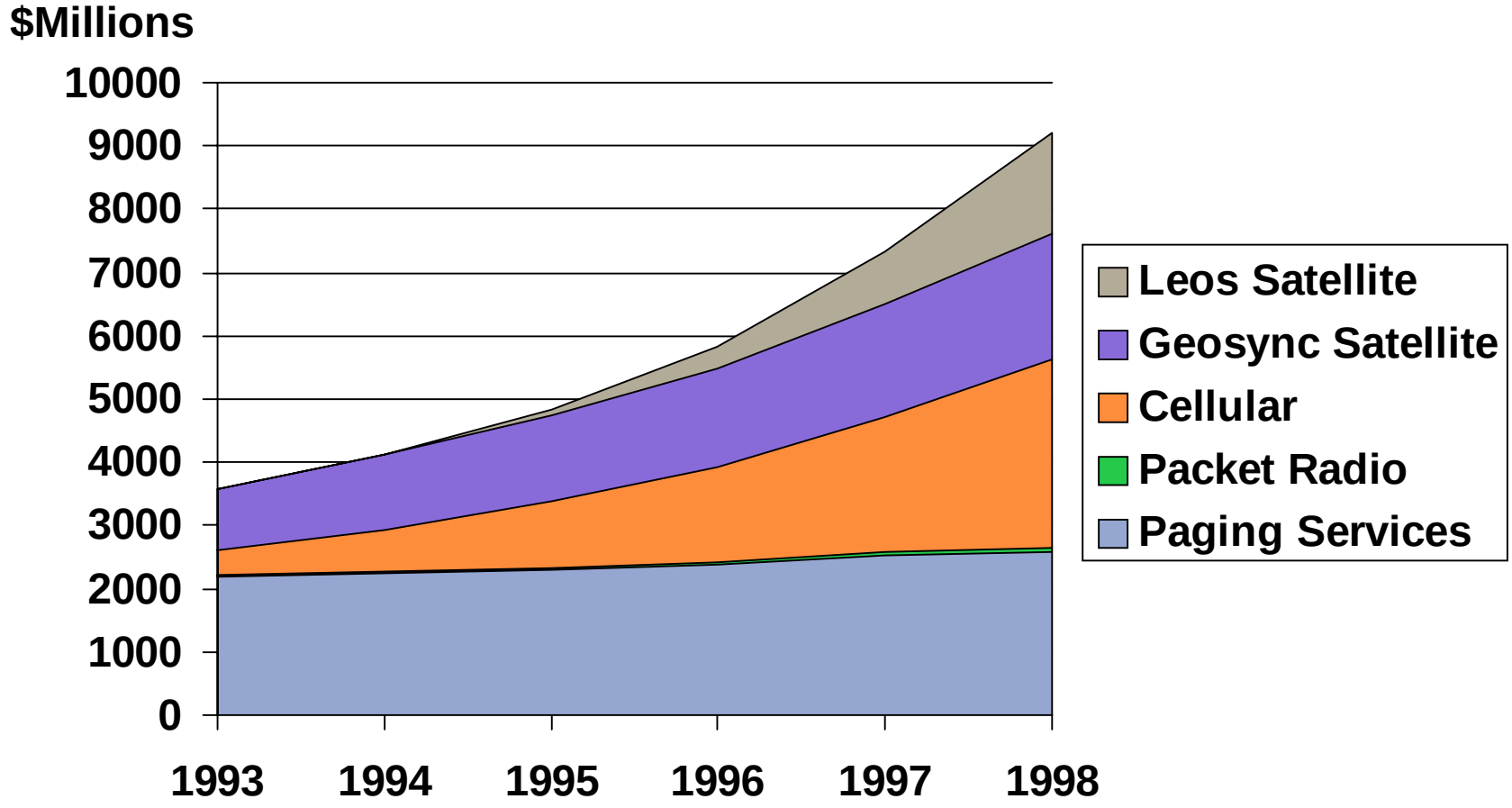
Market Projections

The installed base of wireless data subscribers in the U.S. is expected to grow from 500,000 in 1994 to nearly 10M in 2000.

Driving factors:

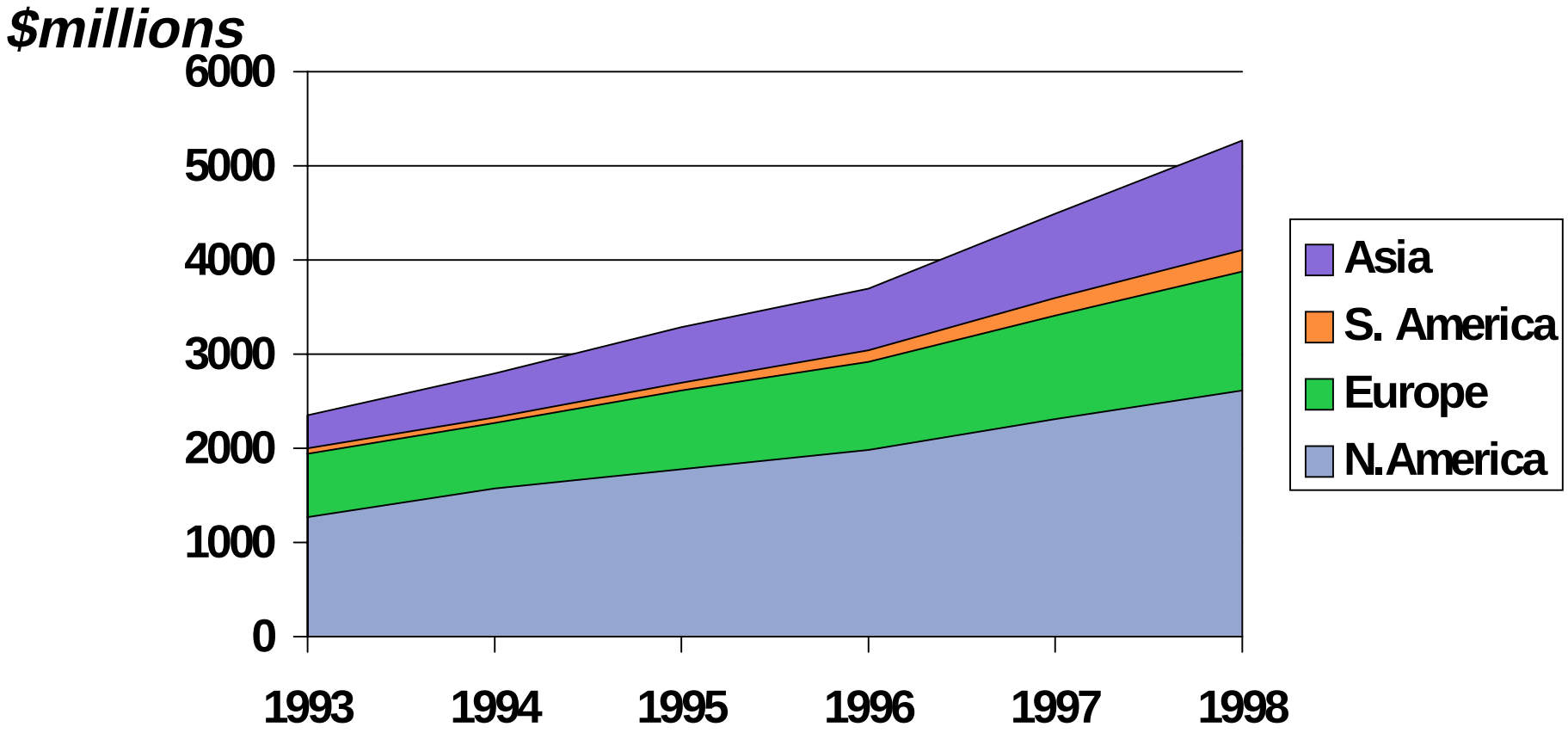
- **move towards the untethered, mobile workforce;**
- **gradual build-out of the wireless infrastructure;**
- **deregulation and spectrum auctions;**
- **emergence of end-user client-server business applications and middleware.**

Global Wireless Data Networks Revenues



Source- 1995 Wireless Directory

Worldwide Wireless Infrastructure Forecast



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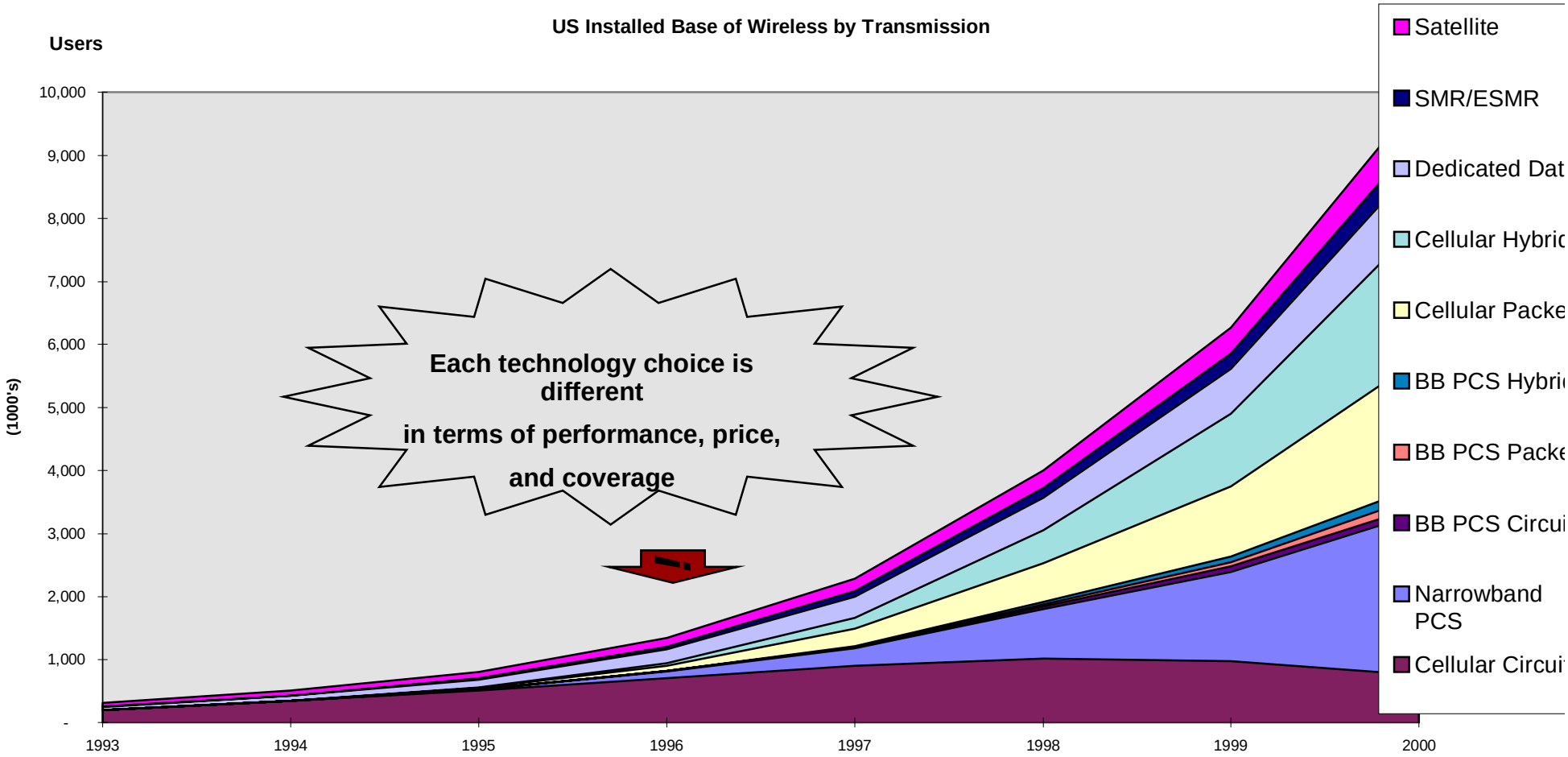
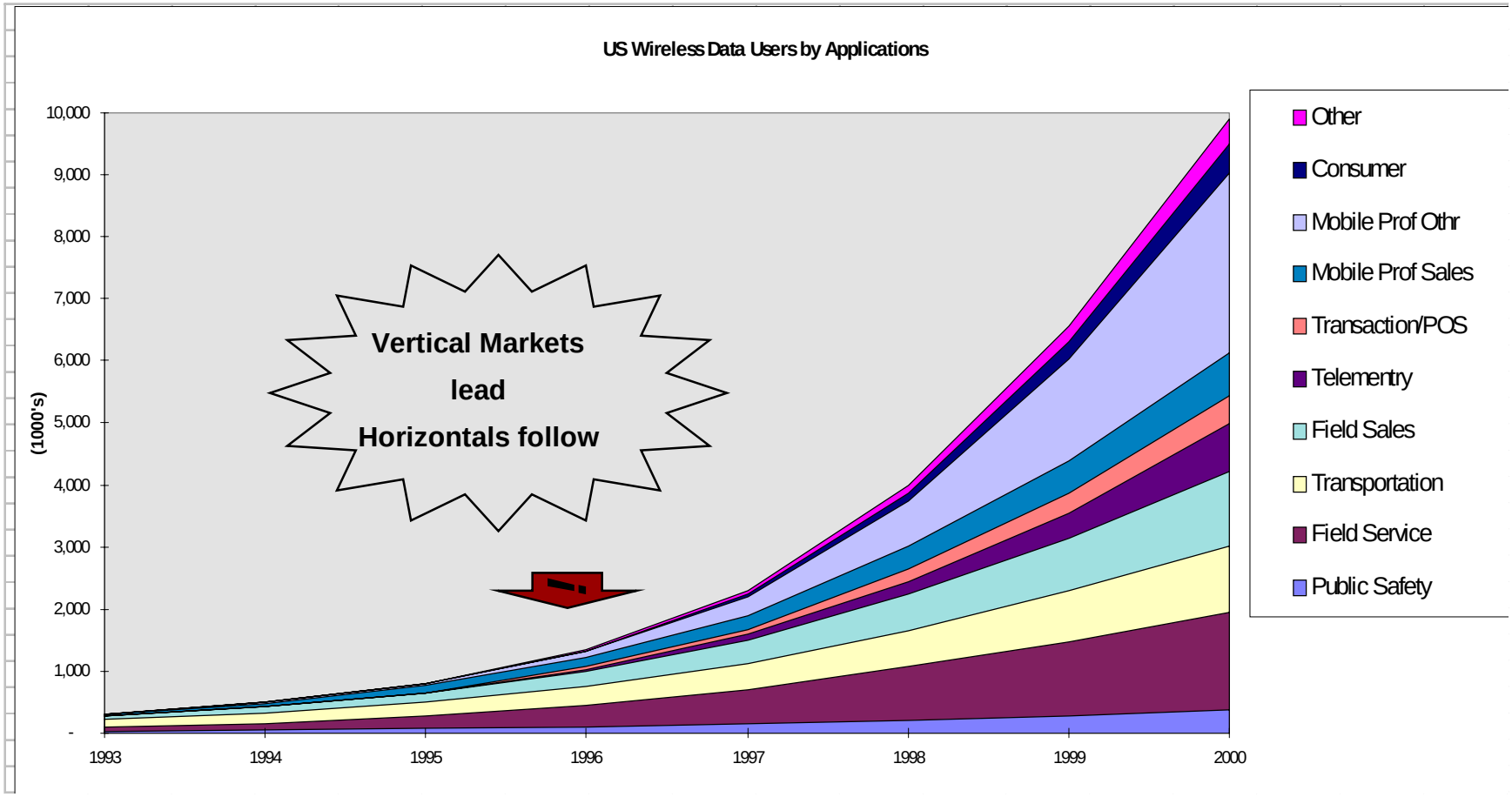
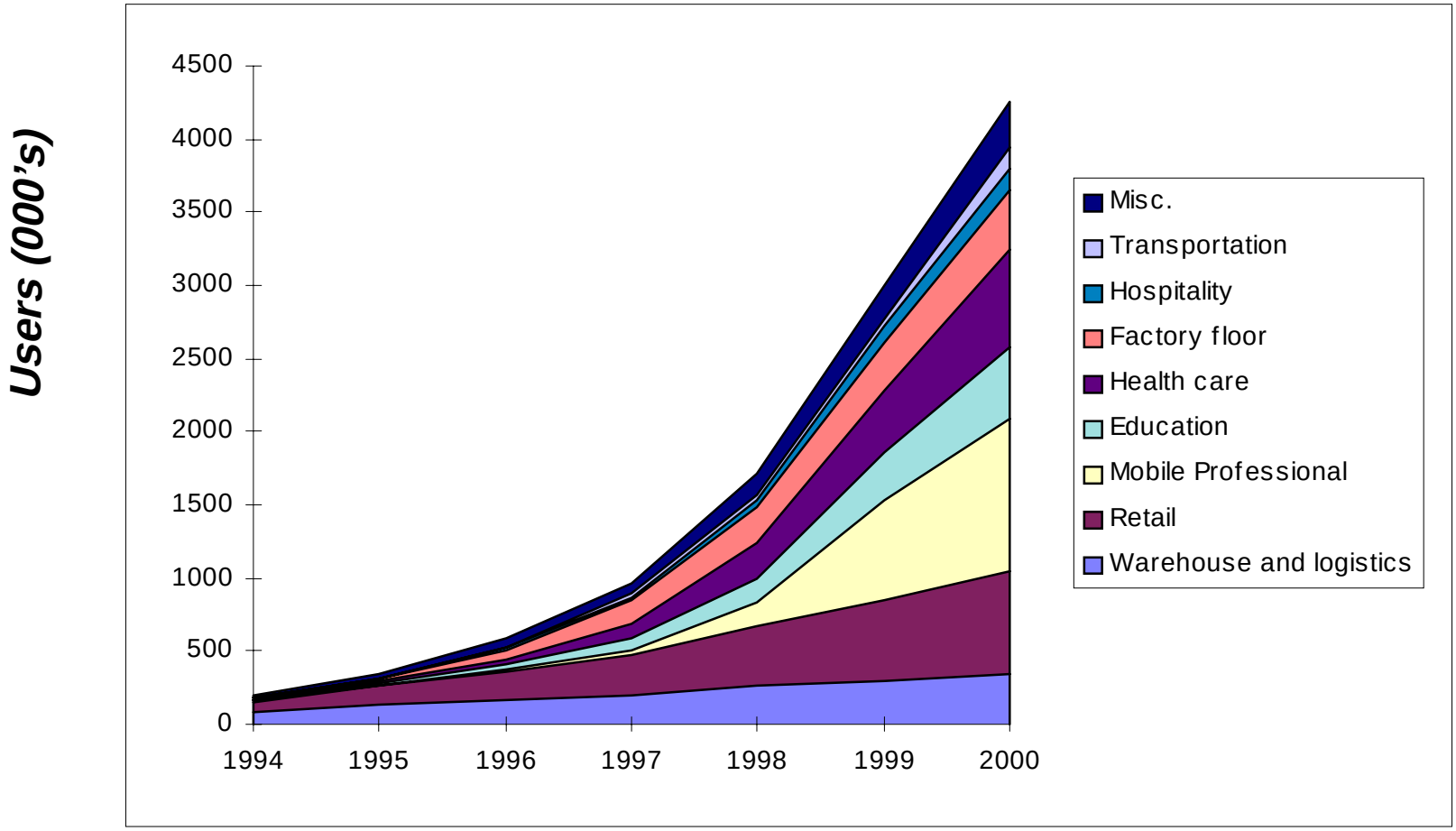
US Mobile-Wireless Data: Technology Trends



US Mobile-Wireless Data: Industry Trends

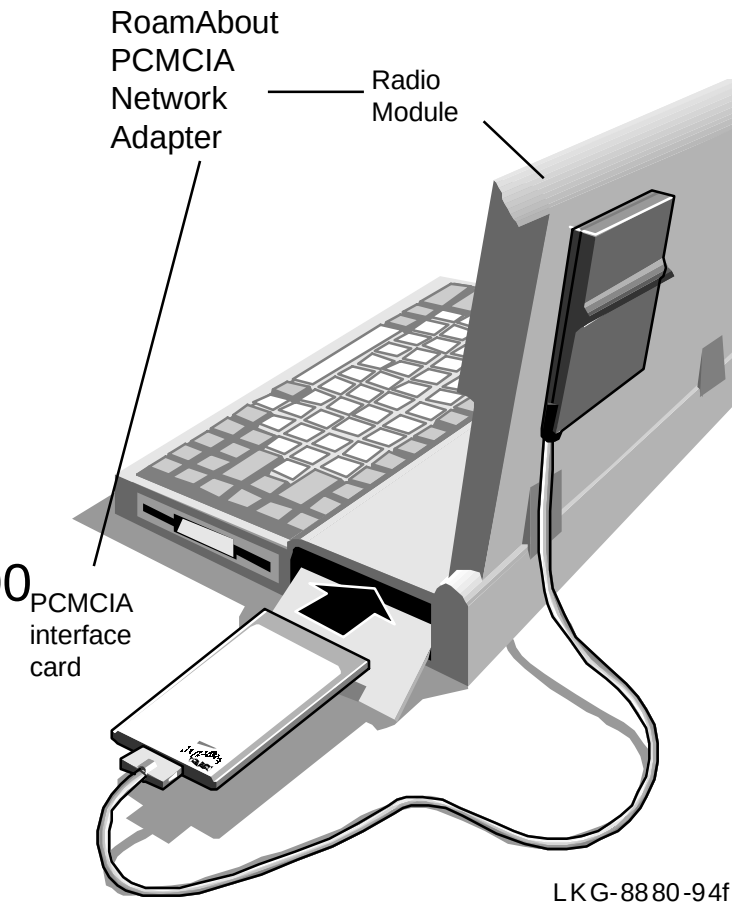


US Wireless LAN Market Trends



RoamAbout PC Cards for Portable Devices

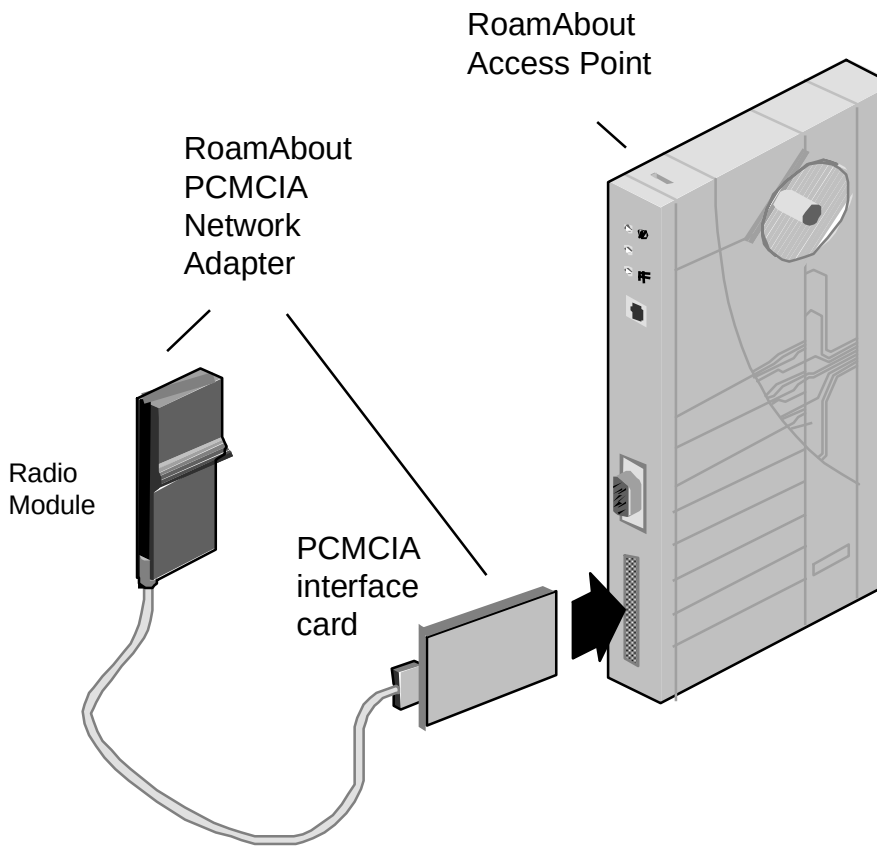
- High performance, credit card sized, wireless modems and attached radio modules
- Available in three variations:
  - RoamAbout 2.4 GHz frequency hopping (FH)
  - RoamAbout 2.4 GHz direct sequence (DS)
  - RoamAbout 915 MHz direct sequence (DS)*
- Uses inherently secure spread-spectrum RF
- No FCC license required
- Coverage up to 650 ft for 2.4 GHz MHz devices, 800 ft for 915MHz devices
- Drivers for any PC network operating system using ODI or NDIS network interfaces
- Gives wireless users access to wired Ethernet networks via RoamAbout Access Point



RoamAbout Access Point

--- the most robust, reliable and highest-performing wireless bridge in the Industry

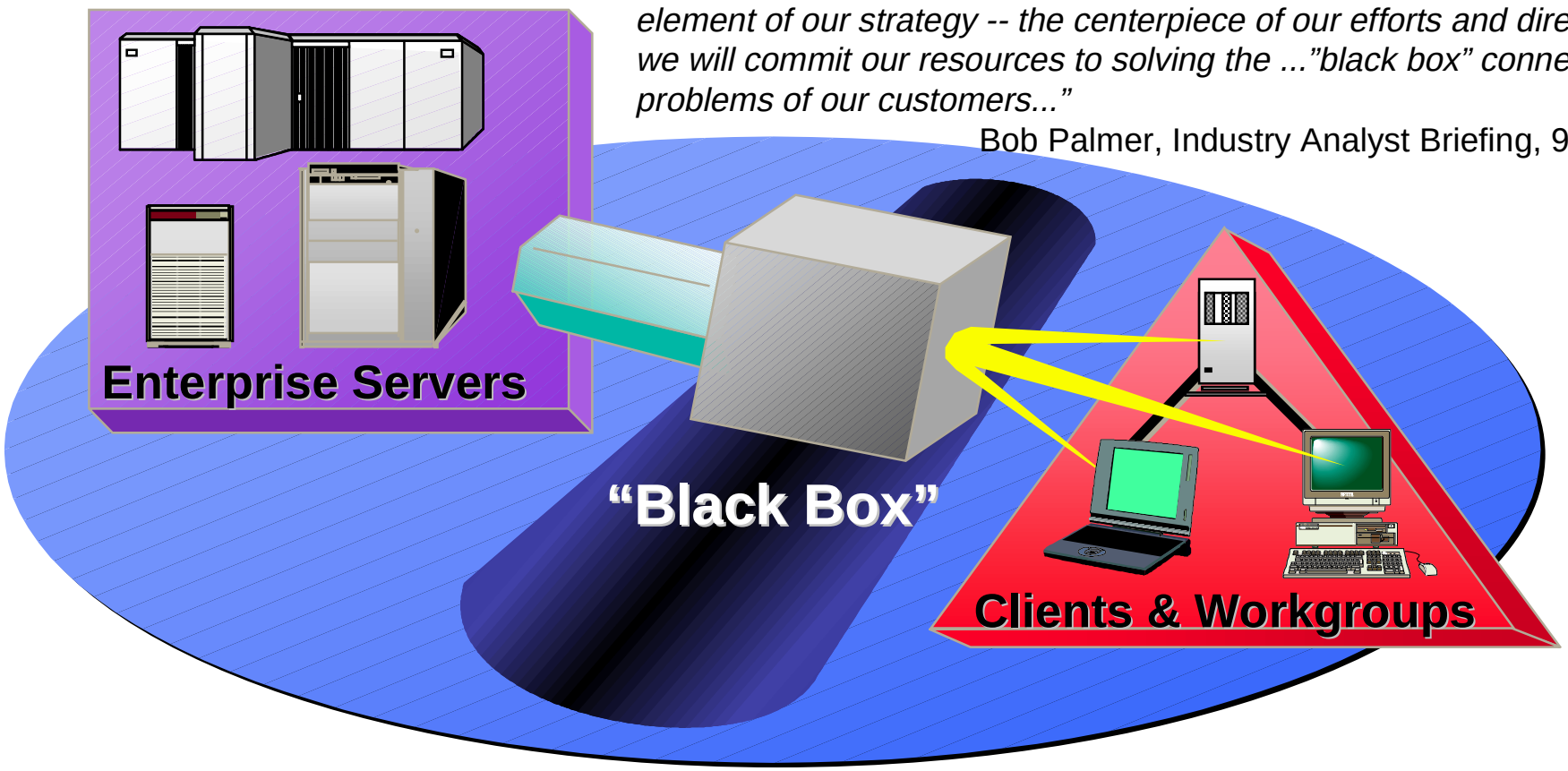
- A superior, ***full-featured*** wireless bridge
  - Multiple wireless technologies
    (direct sequence or frequency hopping)
  - Multiple frequency bands
    (2.4 GHz or 915 MHz)
  - In-building “cell-to-cell” roaming
- Point-to-point diagnostics
- Software upgrade capabilities
- Standard UTP and ThinWire connections
- Network management via SNMP or tools such as HUBwatch
- Local console management port



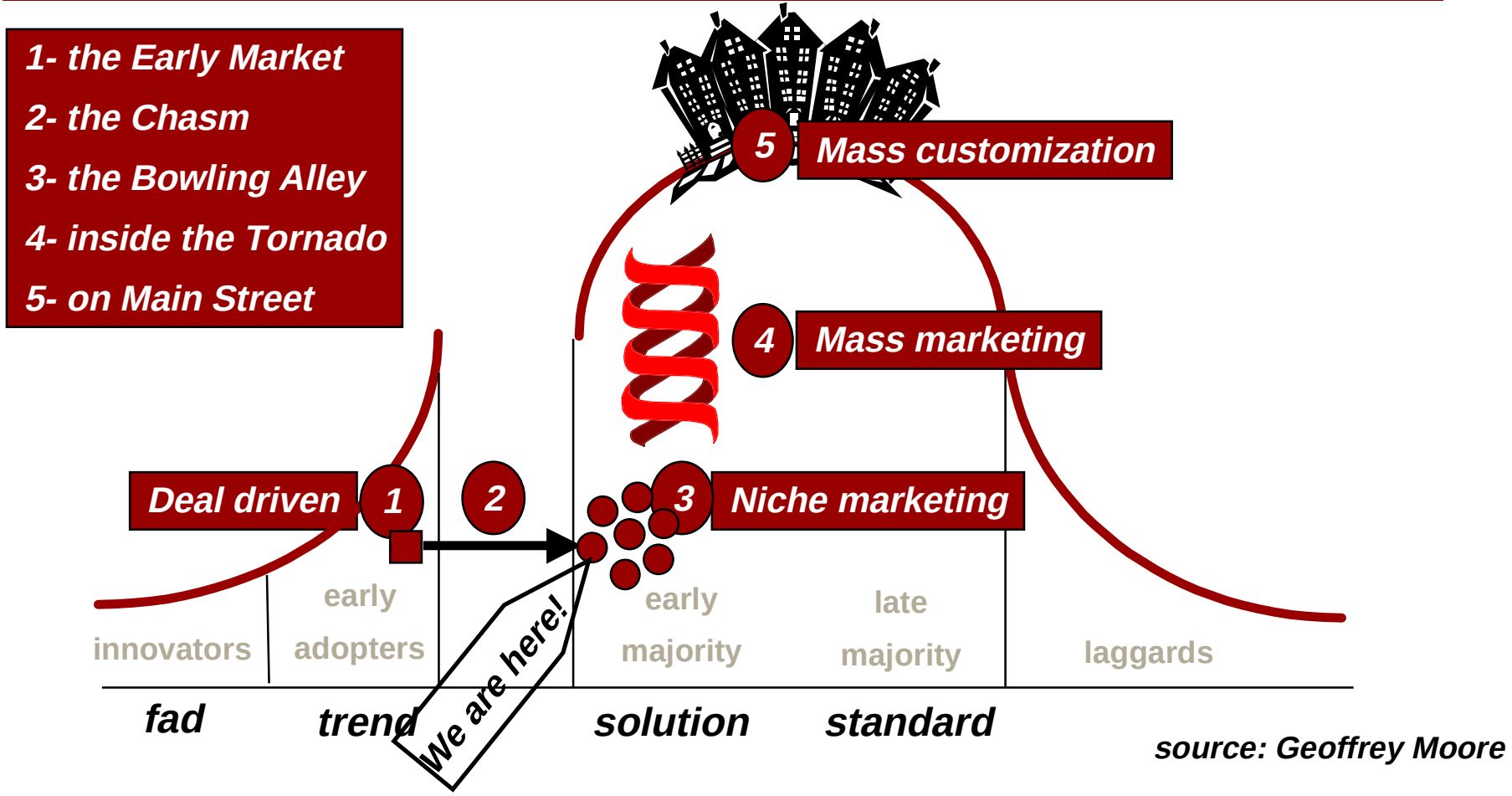
The Connectivity Chasm

"What customers want is a "black box" - metaphorically speaking -- that allows them to integrate all of the enterprise resources....The third major element of our strategy -- the centerpiece of our efforts and direction--is tha we will commit our resources to solving the ..."black box" connectivity problems of our customers..."

Bob Palmer, Industry Analyst Briefing, 9/95

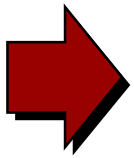


From an Early Market to Main Street



source: Geoffrey Moore

Outline



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The MoCCA Vision

Harness a powerful, wearable *communications* processor to high-speed voice and data networks for distinct vertical markets.

Functions:

- **find and connect the user to one or more team members or customers via voice and video;**
- **provide voice- or tactile-based mailbox management (voice mail, e-mail, FAX, etc.);**
- **handle info./data queries to remote private/public databases;**
- **manage appointment book, action-item list, etc.**

Product Characteristics

- Modularity and compatibility:
  - wireless earpiece/microphone
  - wireless and/or wireline docking to PC
  - compatibility with industry-standard software
  - PCMCIA-like configuration management
- Displace cell phone, pager, PDA devices
- Network agility among CDPD, CSC, WLAN, etc.;
- As intuitive to learn and use as a cellular phone (?);
- Non-tactile input such as voice.

Product Characteristics (Cont.)

- Physical characteristics:
  - wearable
  - weigh less than 16 ounces
  - normal battery lifecycle of 7 days minimum with overnight or continuous recharge
- The device should be fashionable and practical enough to encourage usage.

Program Overview

The program will be driven by blending

real vertical market needs

with

soon-to-market technological innovation

Rapid-prototyping, scenario-based project philosophy, with Carnegie Mellon University as the enabler.

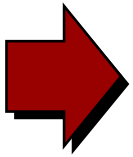
The Cambridge Research Laboratory (CRL)

- Digital's primary U.S. East Coast research site
- located near MIT and Harvard
- main focus: applications technology
  - speech and speaker recognition
  - video coding
  - conversational systems
  - computer vision
  - distributed systems and scalable computing
  - Internet applications

Program Operating Model

- Three facets:
  - applied research
  - system prototyping
  - business development
- Core research group at CRL to advance technology and pursue specific opportunities;
- Advanced development team will form the nucleus of commercialization teams;
- One technical leader and one business leader.

Outline



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Developments That Make This Possible

- ubiquity of wireless technology from WLAN to satellite-based;
- emergence of low-power, high-performance RISC microprocessors; storage devices, DSPs, etc.;
- innovations in display technology for portability and wearability;
- advent of WWW, popularity of corporate intranets;
- first wave trials and errors of mobile devices.

Mobile Computing Barrier Areas

- Human Interface
  - display
  - input means
- Power/Battery/Display Issues
- Performance (for speech, video)
- Communications Infrastructure
- Form Factor/ Heat Dissipation
- Applications

Technology Barriers

- Bandwidth, capacity, reliability, latency, coverage, and cost of wide-area networks
  - protocols for handling data transfers efficiently
  - caching strategies
  - security issues
  - connectivity management in overlay networks
  - Very-Local Area Networks (BodyLAN) and mobile WLANs
  - ad-hoc networking
  - incorporation of video
  - new WAN media

Technology Barriers (Cont.)

- Input limitations for mobile/wearable devices
  - speech capture, recognition, understanding
  - speaker identification and verification
  - handwriting capture and recognition
  - real-time digital voice multicasting
  - video
- Architecture
  - hardware/software architectures for mobile systems
  - OS design (?)
  - compilers for low-power devices

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Technology Barriers (Cont.)

- Human-computer interaction
  - new techniques for mobile I/O: gesture based, augmented-reality displays
- System design and packaging
  - form factors for mobile systems (ID group)
  - wireless headmounted I/O, including video capture
- Applications and user interfaces

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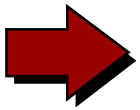

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