# Opportunistic Times

- **150M PCs shipped in 2000**

- **8 billion embedded processors shipped in 2000**

- **Lots of components of computational infrastructure all around us wherever we go.**

- **We have pieces of ubiquitous infrastructure, but generally not Ubiquitous Computing**

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Forecasts for shipments of MPU and embedded CPU components

Forecast for MPUs Shipped

Forecast for Embedded CPUs Shipped
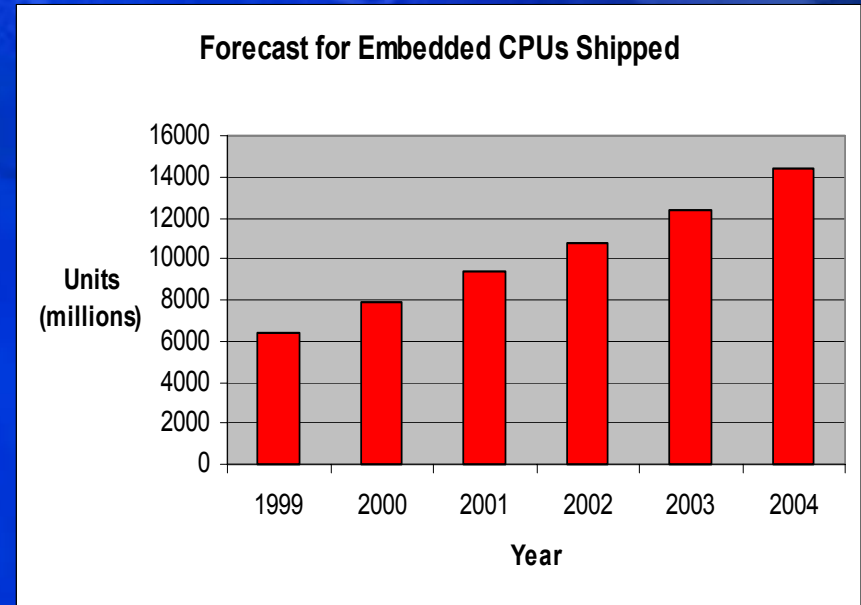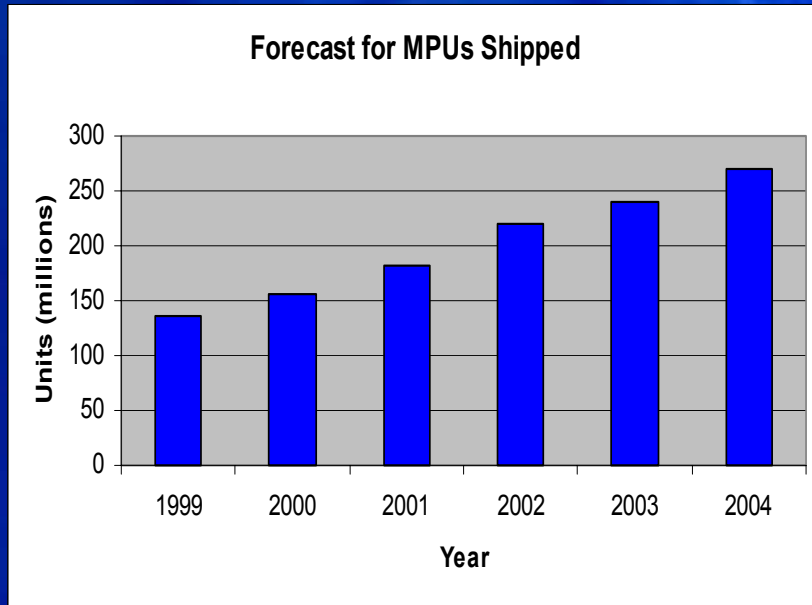
IDC – Gartner group 2001

Computer infrastructure will become even more ubiquitous

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The Opportunity

- **Using the local computational infrastructure to interact with your own data and applications**

- **Overcoming the limitations of small-screen mobile devices**

- **Freeing people from lugging around heavy computing platforms**

- **Increasing the value of mobile computation for the user**

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One Solution:
The Personal Server Concept

Personal Server
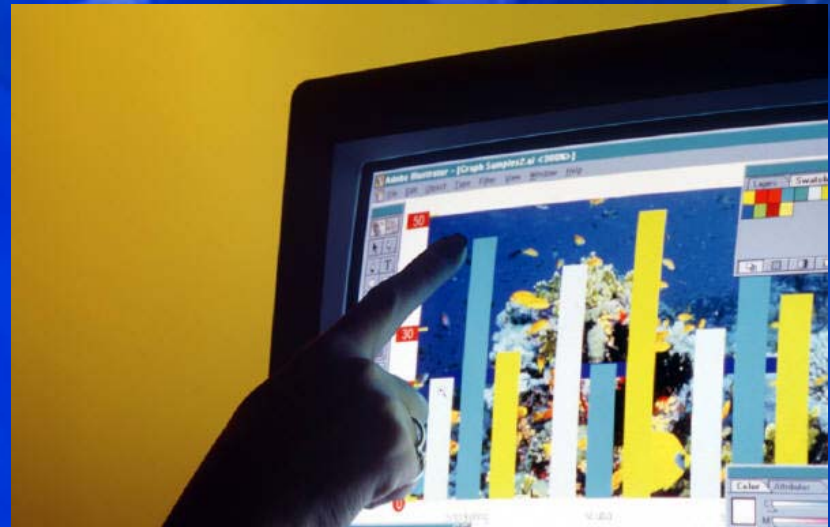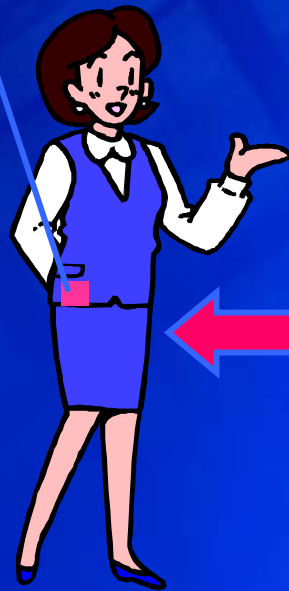
A Personal Computer

but actually only one of many computers being used

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THE PERSONAL SERVER PROVIDING UBIQUITOUS ACCESS THROUGH A UBIQUITOUS INFRASTRUCTURE

Office

Personal Server

Home

Visiting Customers

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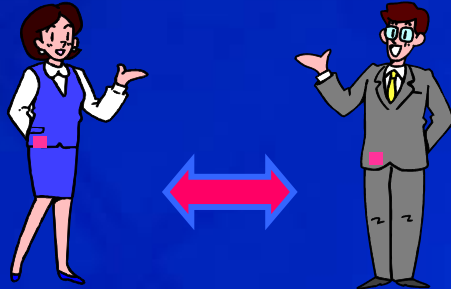# THE PERSONAL SERVER PROVIDING UBIQUITOUS ACCESS IN A MOBILE WORLD

City

Airport

Trade-show

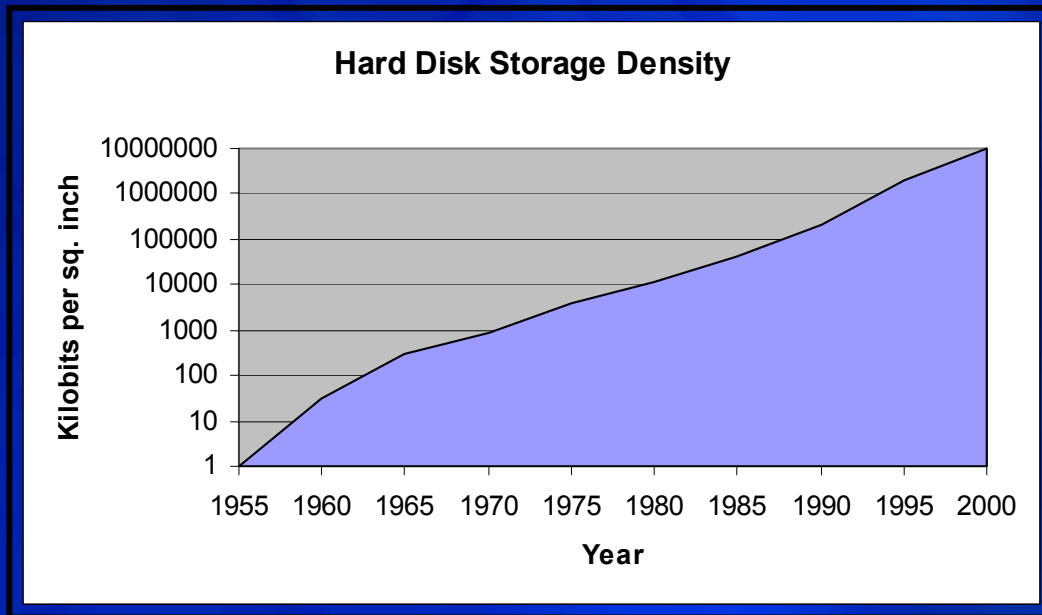Public Spaces

Personal Server

Person-Person

Traveling

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Some Technology Trends
Disk storage density

- **Storage density is doubling each year**

- **10Gbits per sq.in is available now**

Hard Disk Storage Density

A 1GB disk drive in
a compact flash card format

Scientific American, May 2000

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Some Technology Trends
Processor Power/Function

POWER-PERFORMANCE COMPARISON
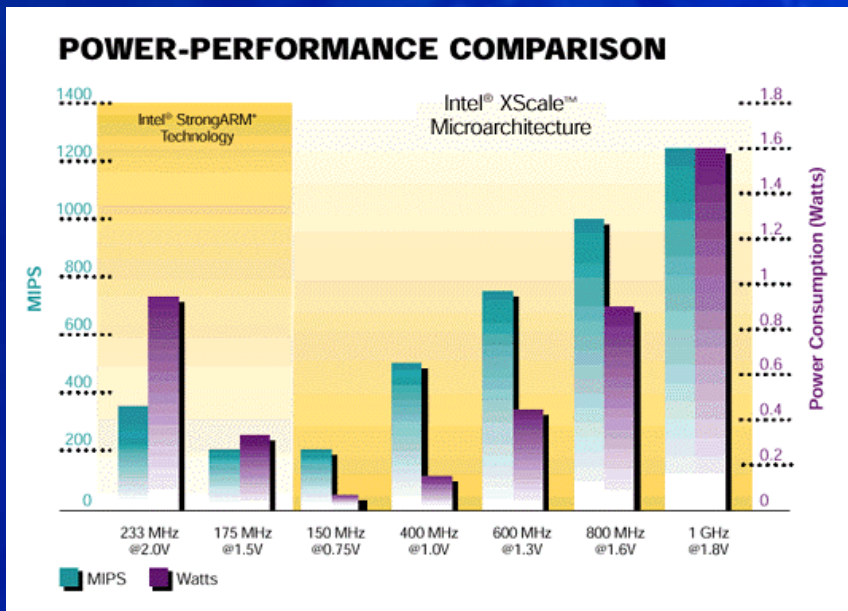
- **Commercial RISC processors**
  - Power efficient
  - Optimized clock speed and supply voltage

- **Intel® StrongARM™ to 350MHz**

- **Intel® XScale™ to 1 GHz (DVM)**
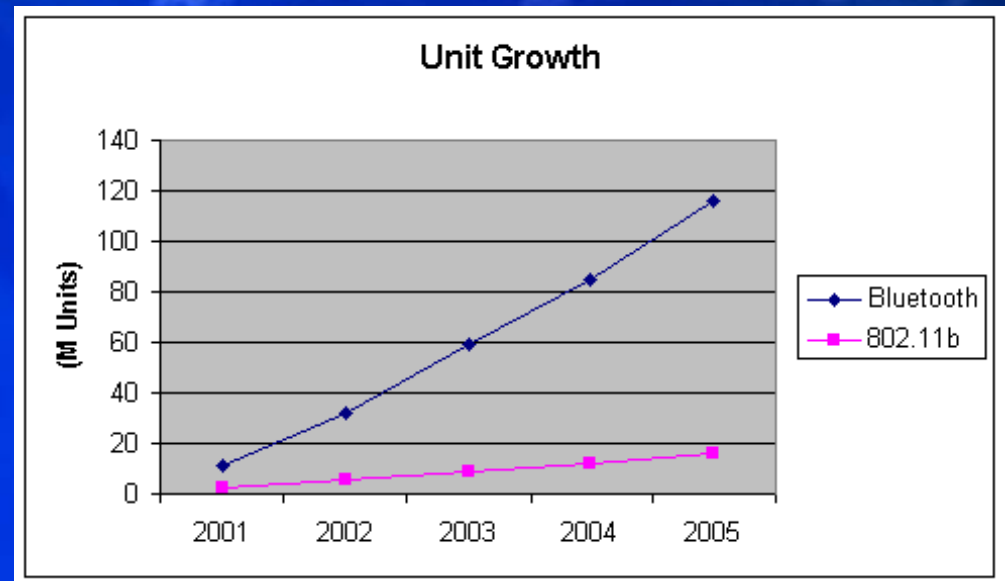
Some Technology Trends
Short Range Wireless Links

- **Wireless communication technologies are becoming standardized**

    - Bluetooth* 1.2Mbps (symbol rate)

    - IEEE 802.11b* 11Mbps (symbol rate)

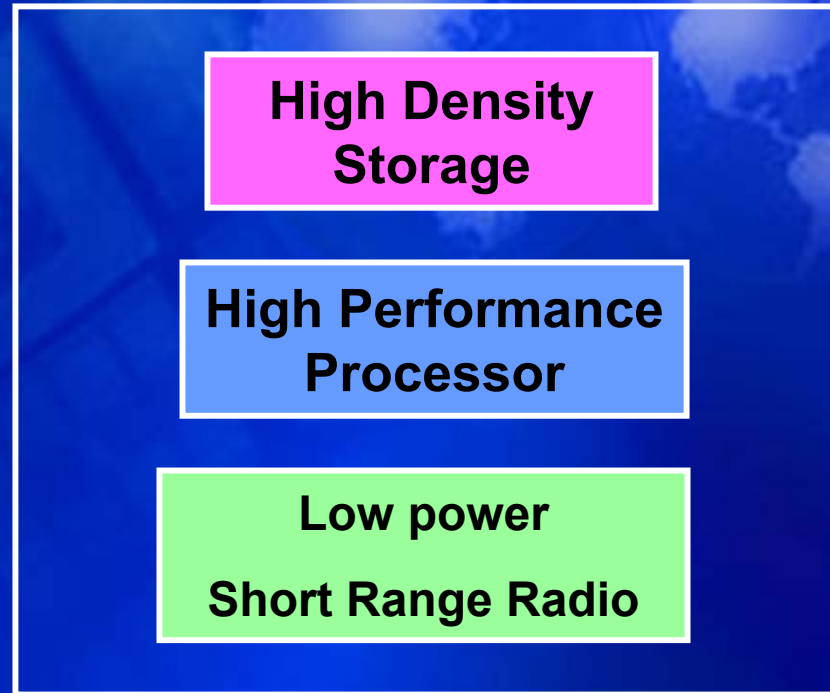- **Bluetooth volumes are likely to be driven by GPRS and 3G cell phones**

    - Low power

    - Physically small implementation

Unit Growth

	2001	2002	2003	2004	2005
Bluetooth	12	32	60	85	116
802.11b	3	5	9	12	16

(M Units)

Bluetooth: Sullivan & Frost 2001
IEEE802.11: Gartner Group

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The Personal Server

High Density Storage

High Performance Processor

Low power

Short Range Radio
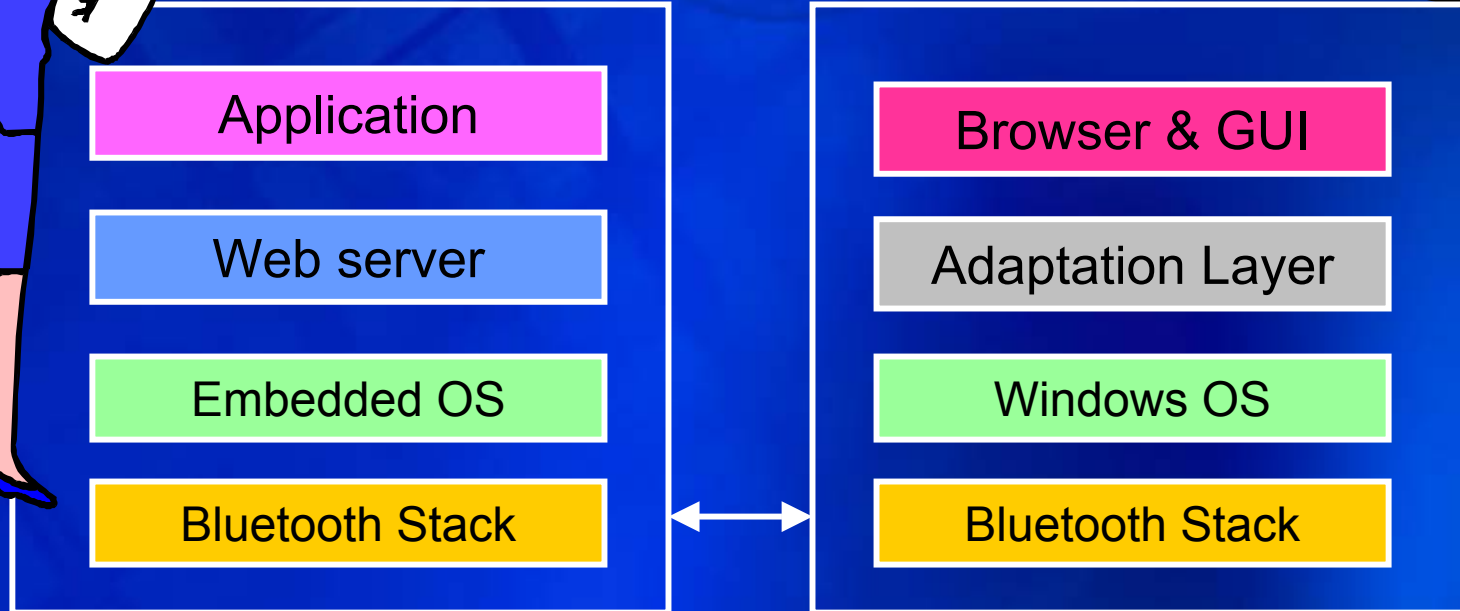
Physically Small Form Factor

- **No real display or keyboard**

- **The interface is only accessible via the wireless link**

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Software Infrastructure – first approach

Application

| Web server |

| Embedded OS |

| Bluetooth Stack |

Browser & GUI

| Adaptation Layer |

| Windows OS |

| Bluetooth Stack |
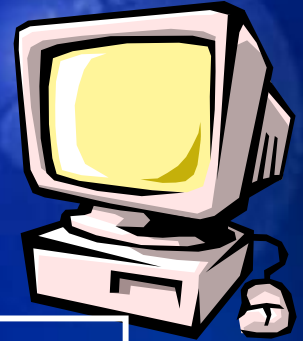
■ **Adaptation layer enables use of legacy systems**

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Software Infrastructure – first approach

SDP Server

| Application CGI |
| Apache web server |
| Intel PAN Layer |
| **Qualcomm Bluez Bluetooth Stack** |
| Linux OS |
| Radio/Module USB Driver |

SDP Client

| Browser & GUI |
| Intel PAN Layer (win) |
| Intel Ambler Bluetooth Stack |
| Windows OS |
| Radio/module USB Driver |
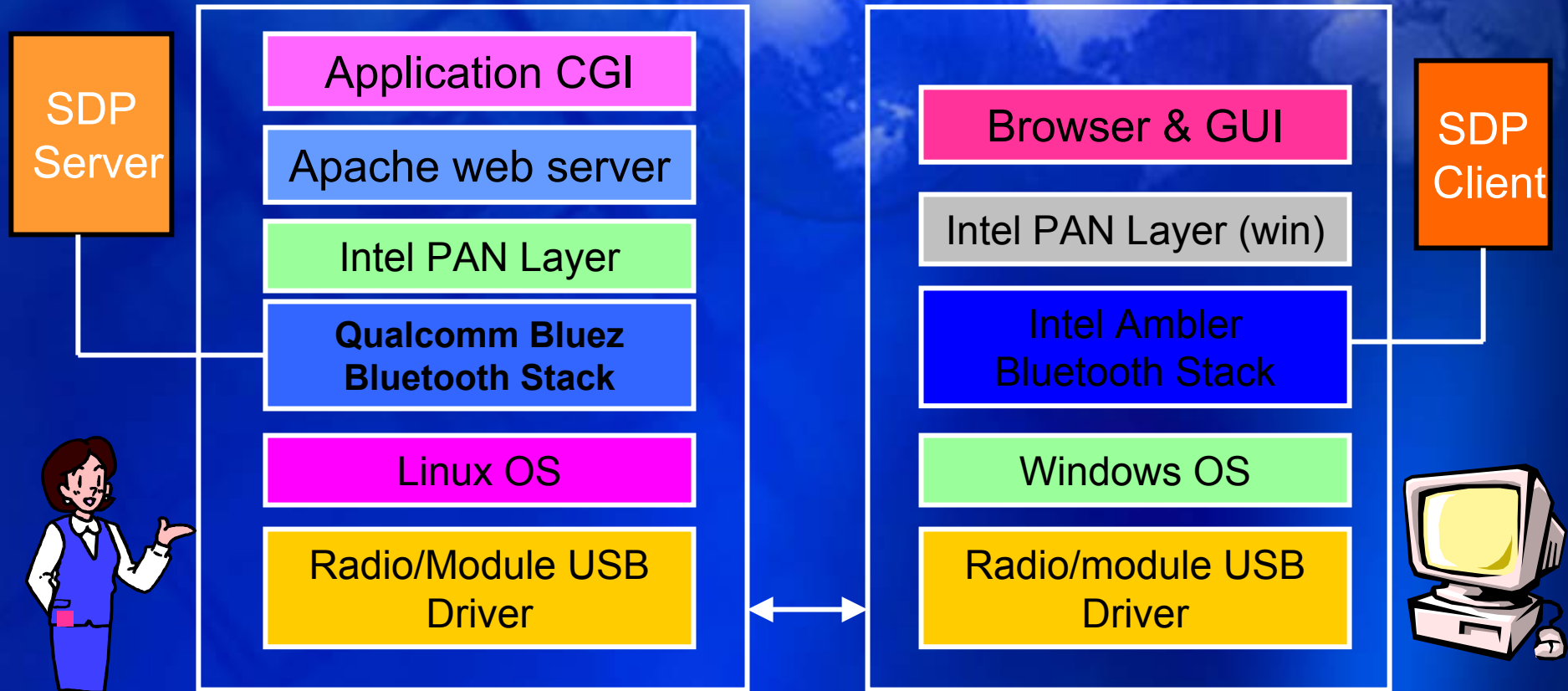
Standard (IP) Pan layer interface enables use of legacy systems

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Mobile Storage Application

- **Wireless Disk Drive**

- **Working Data Set Cache**
  - Most recently used documents
  - Work group documents
  - Reference material

- **Lifetime data storage system**
  - Continuously collecting data, filtering and discarding

Personal Server

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Virtual Devices

- **Emulation of common devices on the screen of a PC**

  - Your Palm*, Compaq iPac*, Cell Phone

- **New ways to interact with the data contained in portable devices**

  - Make full use of the screen

  - Expand the scope of the operations you would expect to find on a portable
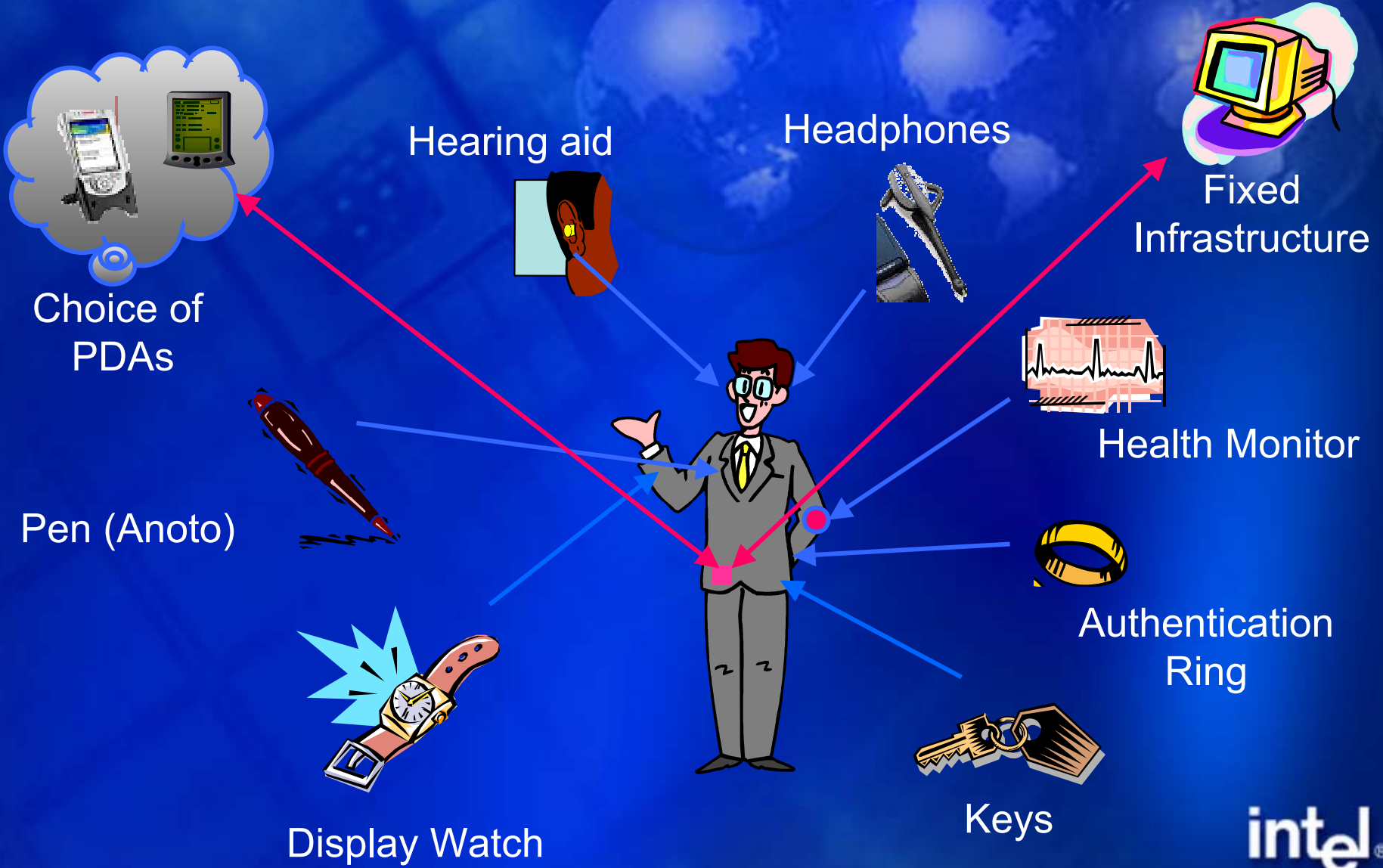
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Challenges

- **Providing an excellent mobile user experience**

- **Integration with Legacy Systems**

- **Dynamic User Interfaces**
  - Device independent UI descriptions
  - Use of available machine resources (e.g. input peripherals)

- **Mobile Code**
  - Code migration from Personal Server to target resource to take advantage of superior computation engine
  - Reduce power consumption on mobile component

- **Building a Personal Server Platform**
  - Providing enough speed and connectivity to support personal computation
  - Optimizing the design for low-power, size, and weight
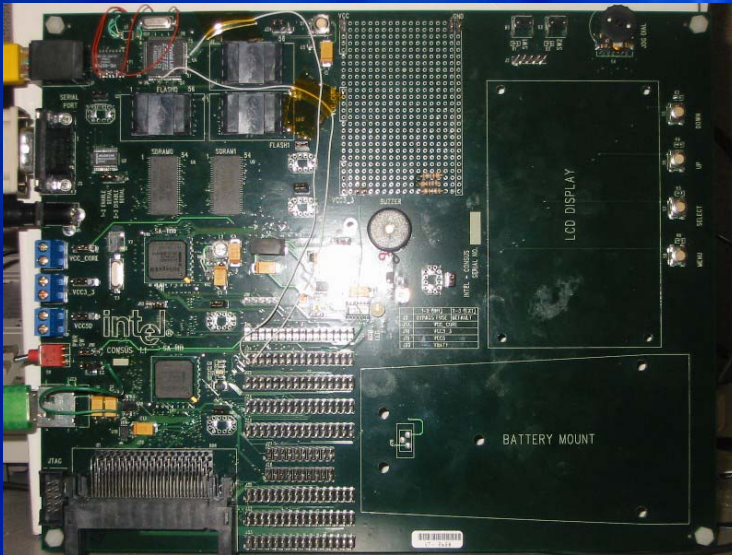 - Acceptable battery lifetime

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Not your average wearable computer

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Personal Server: Supporting a Personal Computing Environment

Choice of PDAs

Hearing aid

Headphones

Fixed Infrastructure

Pen (Anoto)

Health Monitor

Authentication Ring

Display Watch

Keys

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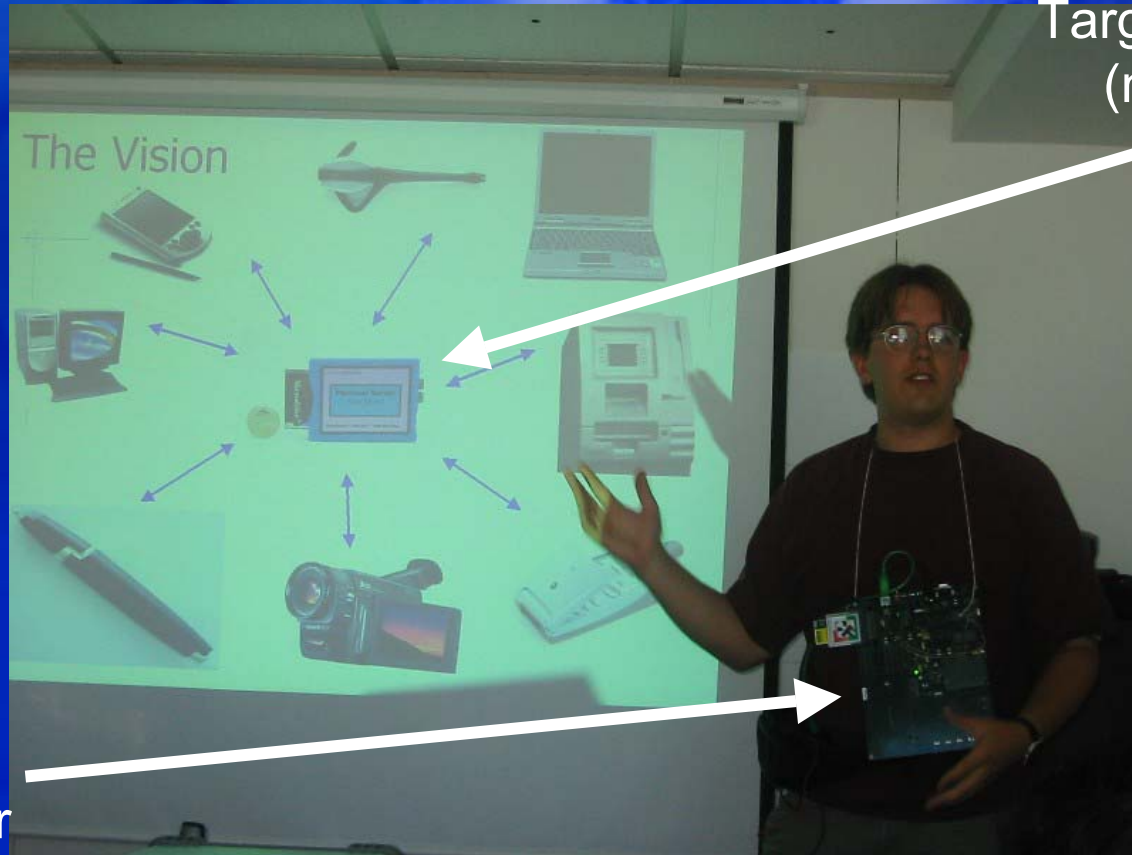# Current Progress with the Project

Consus V1.1 Debug Hardware

Personal Server FDM Housing

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Presentation made using our Personal Server

Target Form factor
(not to scale)

Experimental
Personal Server
Hardware

Steven Swanson giving his Summer 2001, Intern Presentation

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Looking to the Future

- **We will be building an experimental system**
  - System Replication
  - Integration with work practice
  - Working with some universities

- **Fully explore security models**

- **Building a demonstration environment**
  - Demonstrate a representative suite of applications using common infrastructure
  - Explore new ways of designing applications to make best use of the personal server approach

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Acknowledgements

Trevor Pering, Jim Kardach, Graham Kirby Gunner Danniels, Peter Adamson, Muthu Kumar, Jim Rosa, Sandeep Chivkula, Neil Yang, Steven Swanson, Rebecca McKinney, Paul Wright

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