Ubiquity and the Personal Server Concept

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In collaboration with MPG and HPG
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.
Forecasts for shipments of MPU and embedded CPU components

Forecast for MPUs Shipped

<table>
<thead>
<tr>
<th>Year</th>
<th>Units (millions)</th>
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<tbody>
<tr>
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<td>2003</td>
<td>300</td>
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Forecast for Embedded CPUs Shipped

<table>
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<th>Year</th>
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IDC – Gartner group 2001

Computer infrastructure will become even more ubiquitous
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
One Solution: The Personal Server Concept

A Personal Computer

but actually only one of many computers being used
THE PERSONAL SERVER PROVIDING UBIQUITOUS ACCESS THROUGH A UBIQUITOUS INFRASTRUCTURE

Personal Server

Office

Home

Visiting Customers
THE PERSONAL SERVER PROVIDING UBIQUITOUS ACCESS IN A MOBILE WORLD

Public Spaces

- City
- Airport
- Trade-show

Personal Server

Person-Person

Traveling
Some Technology Trends

Disk storage density

- Storage density is doubling each year
- 10Gbits per sq.in is available now

Scientific American, May 2000
Some Technology Trends
Processor Power/Function

- 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

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*Bluetooth: Sullivan & Frost 2001
IEEE802.11: Gartner Group*
The Personal Server

- High Density Storage
- High Performance Processor
- Low power
- Short Range Radio

- No real display or keyboard
- The interface is only accessible via the wireless link
Software Infrastructure – first approach

- Adaptation layer enables use of legacy systems

- Application
- Web server
- Embedded OS
- Bluetooth Stack

- Browser & GUI
- Adaptation Layer
- Windows OS
- Bluetooth Stack
Software Infrastructure – first approach

Standard (IP) Pan layer interface enables use of legacy systems
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
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
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
Not your average wearable computer
Personal Server: Supporting a Personal Computing Environment

- Choice of PDAs
- Pen (Anoto)
- Display Watch
- Headphones
- Hearing aid
- Fixed Infrastructure
- Health Monitor
- Authentication Ring
- Keys
Current Progress with the Project

Consus V1.1 Debug Hardware

Personal Server FDM Housing
Presentation made using our Personal Server

Target Form factor (not to scale)

Experimental Personal Server Hardware

Steven Swanson giving his Summer 2001, Intern Presentation
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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