Mobility and Media
How mobile computing is evolving at HP

Mark Smith (msmith@hpl.hp.com)
Mobile and Media Systems Lab
Hewlett Packard Laboratories
Technologies that support mobility and targeted application spaces

• Content delivery
  - Dealing with mobile infrastructure (the infrastructure and the clients are mobile).
  - Connectivity heterogeneity
  - Exploiting new messaging methods and standards

• Real support for sensing in applications
  - Manageable/zero-configuration location measurement
  - Low user impact ID management

• Virtual spaces and aggregation management
  - Using work from persistent social spaces/web presence
  - Network technologies to support aggregation of devices
Mobile Streaming Media Project

- **Goal**
  - Design a mobile streaming media infrastructure that delivers compelling next-generation media services to mobile clients

- **Research Topics**
  - Streaming media: *Making media friendly to networks*
  - Networking: *Making networks friendly to media*
  - Client/Server architecture: *Optimizations for media & networks*

- **Testbed Prototype**
  - Mobile streaming media CDN system design
  - Edge server prototype with streaming and caching functionality

- **API & System Design**
  - Define an open standard for a Mobile Streaming Media CDN
MSM-CDN: Content distribution

1. Content Distribution
2. Content Redistribution
MSM-CDN: Streaming and handoffs

1. Network-adaptive streaming
2. Handoffs triggered by client movement
Network Overlay Architecture

OpenView

Monitors
- Passive
- Collect info
- Coarse timescale
- For NW admins

Virtual Overlay Subsystems
- Application services
- Value-added services

Managerial NW Services
- Coordination

Elementary NW Services
- Dynamic
- Decision making
- Fine timescale

Base Network
- IP, Best-effort
- QoS

Increasing Control

Network Monitor
Server Monitor
Content Monitor
Service Monitor

CDN X
Streaming Media CDN
VoIP

CDN Y
Service Network

Content Location Agent
Home Location Registry
Authentication Agent
Billing Agent
Policy Agent

Communication Session Manager
Service Manager

Base Network, WAN, LAN, Wired or Wireless
Secure Delivery and Transcoding of Compressed Video Streams

**HP Secure Streaming System**

*Secure media streaming and transcoding over packet networks.*
Sentient Environments Project

- **Goal**
  - End-to-end technologies for transforming conventional spaces into more efficient, self-managed sentient environments, with a degree of autonomous protection and regulation

- **Research Topics**
  - GeoVisualization: Management through sensor data visualization
  - Asset Management: Using location and object ID
  - Infrastructure Mobility support: Zero configuration deployment

- **Testbed Prototype**
  - Websigns
  - Smart Locus

- **API & System Design**
  - Define an open API for sensing, management and visualization
Websign
Hyperlinks from a physical location to the web

Infrastructure
- PDA expansion pack implementations
- Contains circuitry for:
  - Location (GPS)
  - Orientation (compass)
  - Tagged object reads (barcode and RFID)
- Power management for optimum client battery life. Expansion pack matches the PDA’s power state

“what is available at this location”

Websign II: A mobile client for location based services
Geoff Lyon, Mehrban Jam, Cyril Brignone, Salil Pradhan
Ubicomp 2002, Sweden, September 29 - October 1, 2002

Websign: Hyperlinks from a physical location to the web
Salil Pradhan, Cyril Brignone, Jun-Hong Cui, Alan McReynolds, and Mark Smith
IEEE Computer special issue on location-based computing, August, 2001

Websign: A looking glass for e-services
Cyril Brignone, Salil Pradhan, John Grundback, Alan McReynolds, Mark Smith, and Jun-Hong Cui
3rd IEEE Wetice Workshop on Knowledge Media Networking, MIT, June 2001
Smart Locus
Self-assembling wireless network of nodes capable of distributed autonomous localization

Prototype v.1 (November 2002)
- basic localization algorithms implemented
- accuracy of 1cm over 12m achieved!

Next steps
- improve scalability and robustness against localization grid drift
- ranging using ultra wide band
- paper (in process)

Step 1. determining the range between two nodes
\[ \text{rf}_{\text{speed}} = 908\ 000 \times \text{ultrasound}_{\text{speed}} \]
Time difference of arrival between the 2 signals → distance

Step 2. evolve local positioning grid
After the few master nodes are initialized, a basic coordinate system is created

Step 3. basic coordinate system is percolated thought the wireless network via multi-hop routing
Sub-PDA Appliance Systems

- Devices intended to transact events on your behalf.
- Wireless vertical appliances that use sensors and media.
- New connectivity model that maps services with events.
- Used to form federations with other devices allowing them to exploit sensors and data:
  - Current Focus areas:
    - ID management
    - Personalization
    - Privacy management
Web interactive Watch
Security / ID management token

Biometric enabled wearable token.
Applications with information portals, access and security infrastructure.
Federated Appliances
PAN-LAN-WAN

when connected
- redirect I/O
- smart sync

when disconnected
- compensate

Interlayer technologies
Support device aggregation
Communication Architecture

PSTN

SCOM

SIP signals

backhaul
Session Management using SIP

- **Application Session Management**
- SIP is an IETF proposed standard for session management in arbitrary topologies
- **For anything that can use the net**
- Although often associated with voice over IP telephony, SIP is well suited for establishing multimedia sessions among multiple rich media clients, not just voice terminals
- **Orthogonal session interface**
- SIP was invented to make the initiation of multimedia sessions simple, light-weight, giving end-points the responsibility to negotiate the session parameters
- **Wide support, including Microsoft**
- SIP can be used with other IETF protocols to build a complete multimedia architecture (e.g. RTP, RTSP, SDP)
Persistent Virtual Spaces: Web Presence Manager

- A platform for deployment/management of web presences.
- Discovery and retention of people, places, and things and the resolution to their associated web presence.
- Allows continued interaction with those people, places and things even after they are physically gone.
- Used with Swatch to create persistent social spaces.
- How about persistent classroom / study group spaces?
Extended Access Technology

Mobile Hotspot Server

Communication and session management
- WAN (2.5G, 3G)
- WLAN (802.11)
- PAN (Bluetooth)

Information, entertainment and communication passenger devices.
Internal and external telematic and maintenance devices.

Builds on the Mobile Streaming Media and all the other projects.
Project goals

• Connection Diversity. Users need interoperability support that spans WAN, LAN and PAN.

• Storage Services. Small personal devices like watches and smart phones have next to no storage of their own. Provide plenty of storage for personal media that moves with their owner.

• Media, communication and messaging services. The most wanted features. Can provide security, media processing (ie transcoding), game support and other applications the small personal devices can’t do.

• Manageable. these devices can be supported remotely.
Personal server

WAN, LAN and PAN wireless is built in

Would a tablet PC be a reasonable platform for this?
Other aspects of this project:

- These devices can find and synchronize each other. A user can have more than one, and they are all kept current. Remember, these things are very wireless.

- As they become deployed in cars, they can form large, ad hoc computing fabrics. A mobile UDC.

- Platform for future, HP managed services and applications. Emerging interactive gaming or bidirectional media processing are good examples.
A few other mobility application spaces of particular interest

- Mobility support for WLAN
  - Example: Inter-Access Point Protocol (IAPP) for mobility across WLAN microcells

- Aggregation management
  - Ontologies, extensible knowledge sharing
  - Emerging personal device ideas like the business suits
  - Virtual spaces

- Teleconferencing that focuses on artifact sharing.
  - Objects, documents, watching things work, systems…

- Applications that support instant messaging models
  - Using WLAN infrastructure
  - SIP, P2P, others
  - Using advanced media