

Web-Based Nomadic Computing

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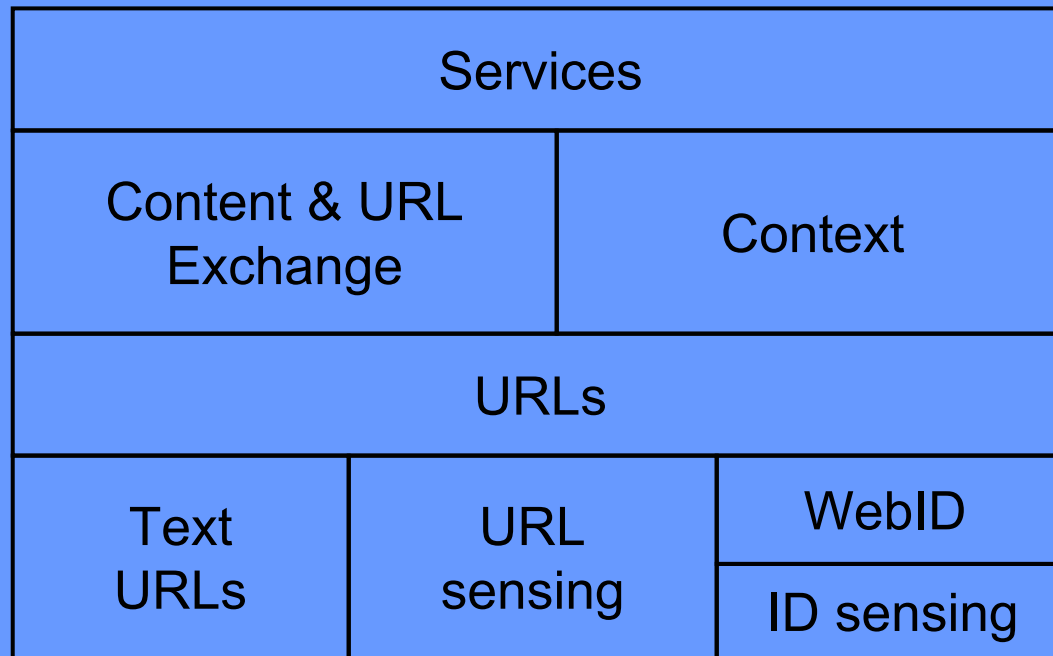
Palo Alto, CA

"By hyperlinking the physical world and extending web technologies to exploit those links, we support nomadic users of ubiquitous computing devices."

Nomadic Computing

- Ubiquitous Computing (Kindberg & Fox):
 - Spontaneous interaction
 - Physical-virtual connection
- Nomadic Computing is Ubicomp where
 - Mobile, autonomous systems require spontaneity
 - Physical/virtual connections support mobility.
- Beyond Mobile Computing
 - But somewhat short of Star Trek.

Web-Based System for **Nomadic** Computing



Places



<http://cooltown.hp.com>

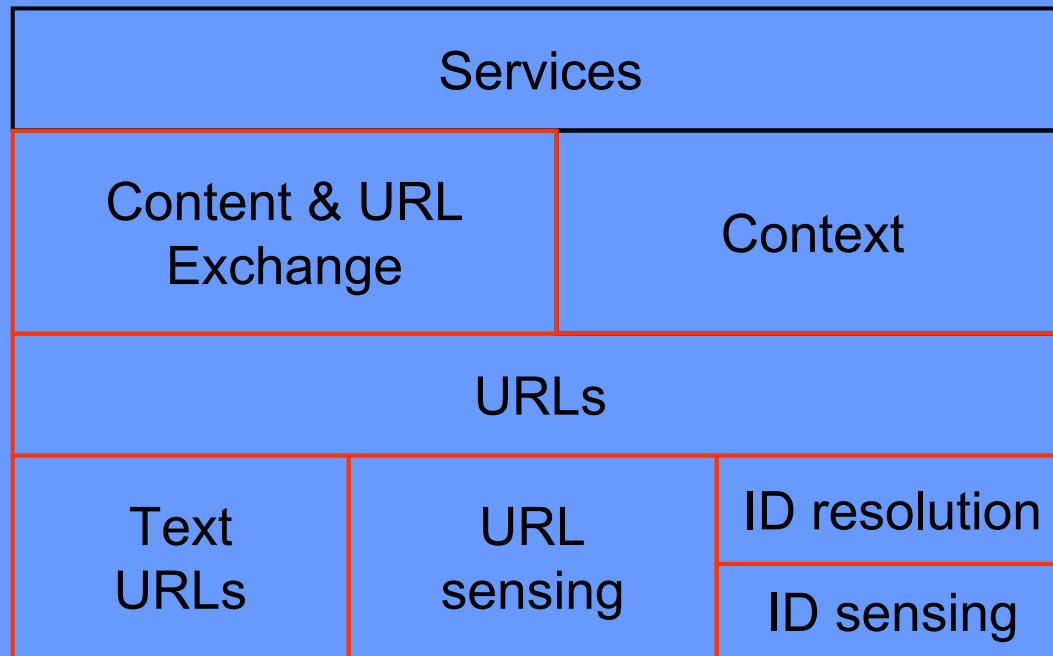


beacon



■ tag

Web-Based System for Nomadic Computing



Places



<http://cooltown.hp.com>



beacon



■ tag

Physical URL Sources

- Infrared Beacon
- URL “Localcast”



Opaque ID

- WebId: ID->URL



barcodes



Radio freq. tag

(but beacons can give ids and rfid can give full urls)

Web ID, Physical Hyperlinks

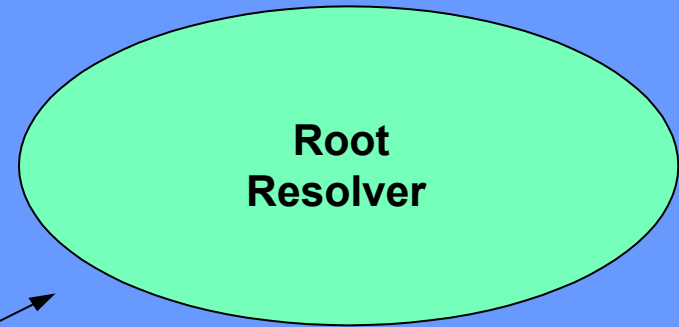


Scan
Barcode
(or RFID or...)



Bindings to Web
Resources

Lookup Bindings for
Local Resolvers



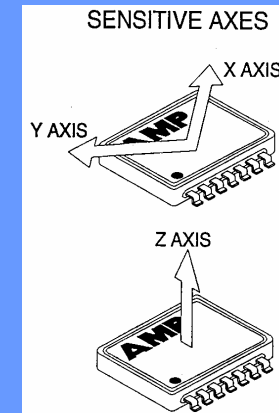
Redirect to Local
Resolver

Bill Gates's
Home

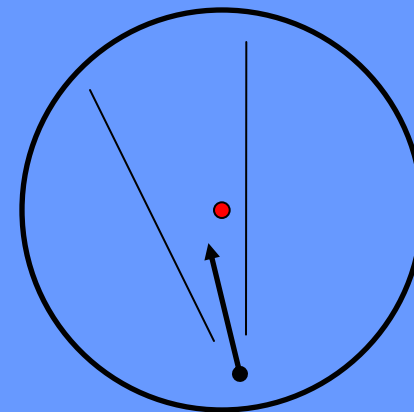
Carly Fiorina's
Home

Local Resolvers

Locations as URL Sources

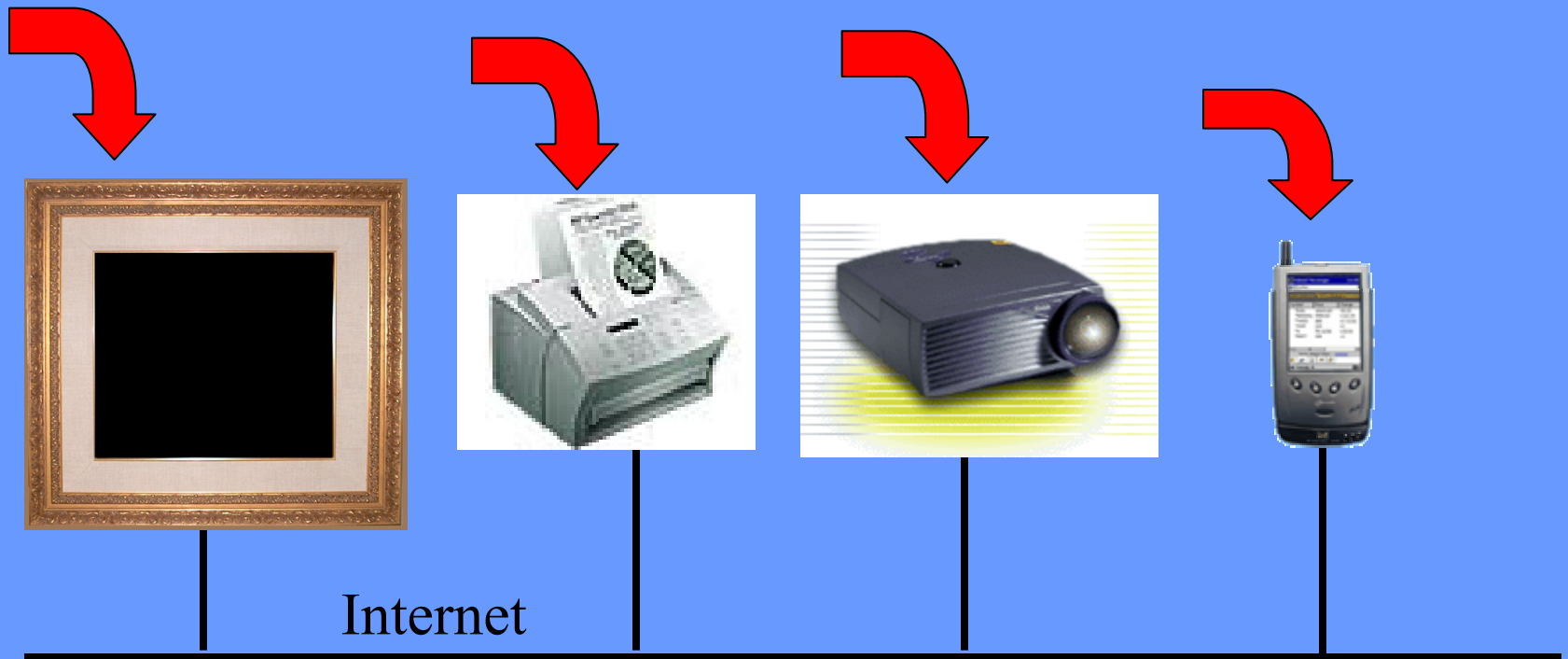


GPS +
Electro-magnetic Compass



{ (position, radius) => URL }

Physical Sinks for URLs

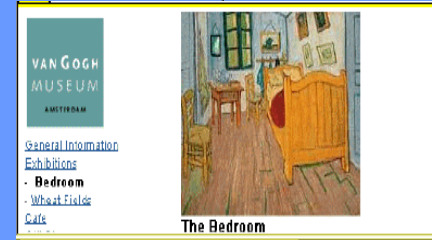
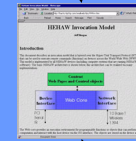
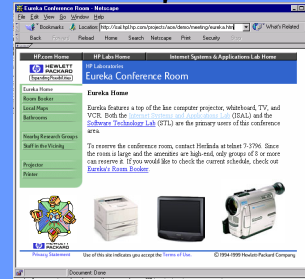


Handheld clipboards for URLs



What Physical URLs Mean: Web Presence

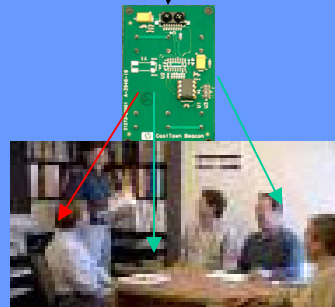
Web



Physical



Jeff



`<a:thing xlink:href=.../>`

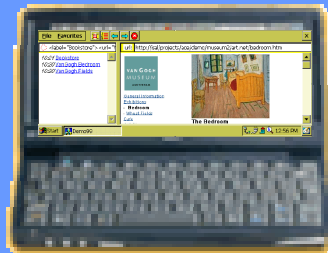
`<a:place xlink:href=.../>`

`<a:person xlink:href=.../>`

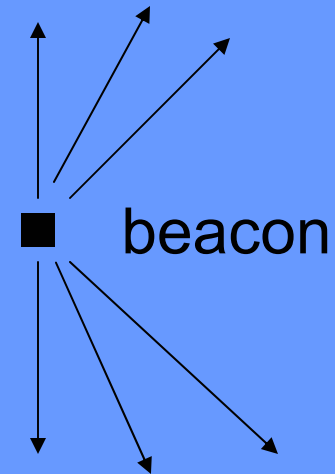
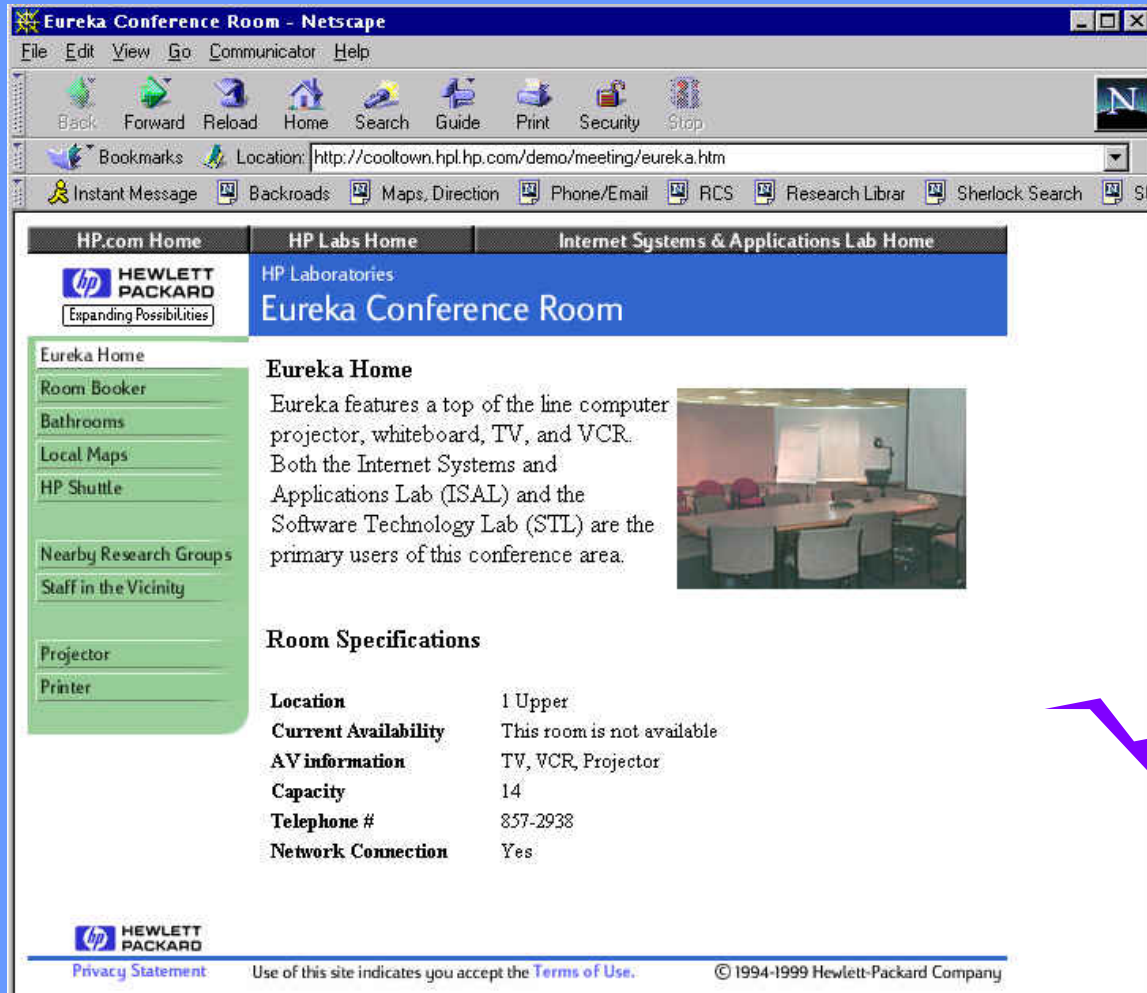
Things with Web Presence



ID Tag

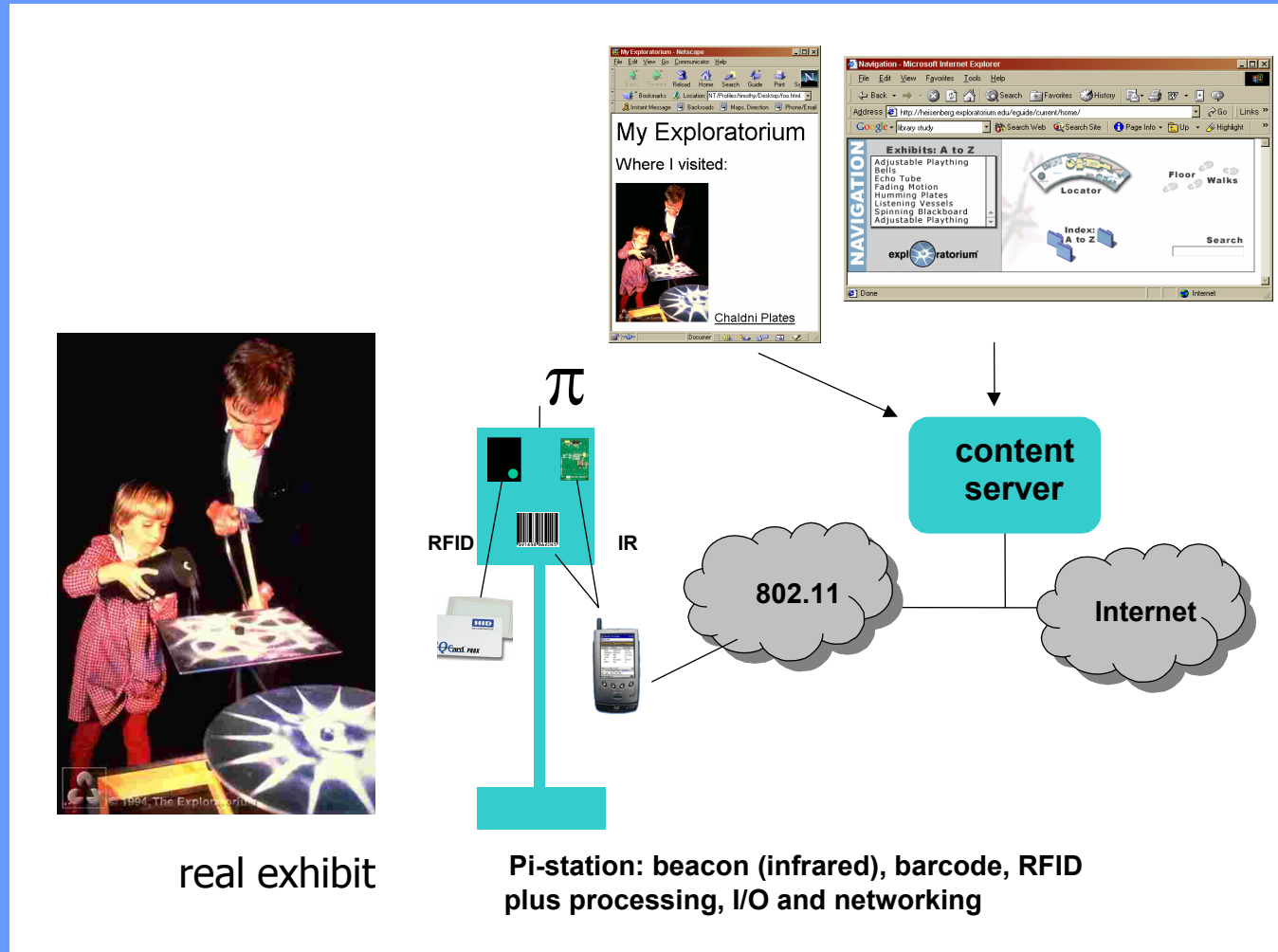


Places with Web Presence



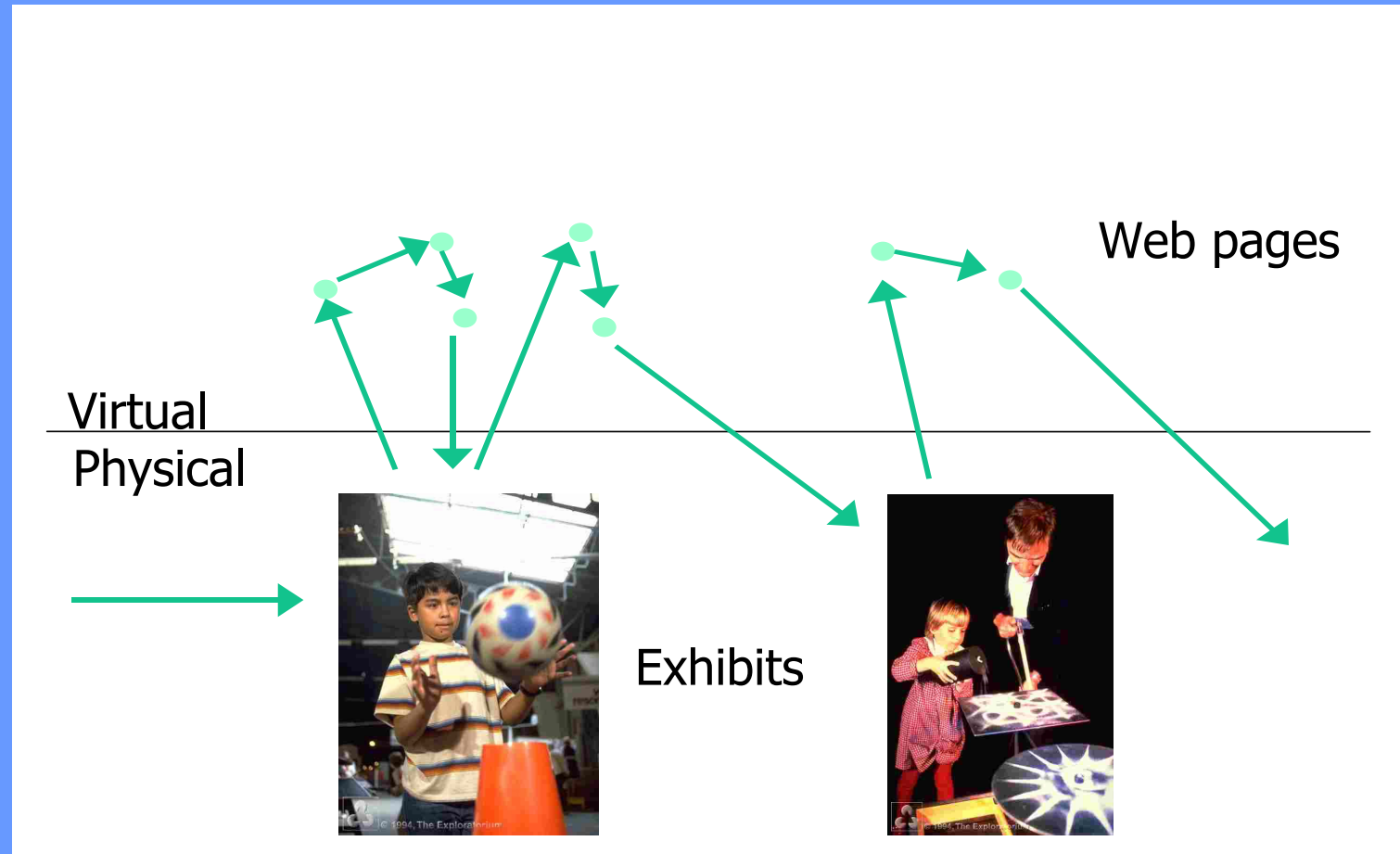
Wireless network

Can Users Use This Stuff?

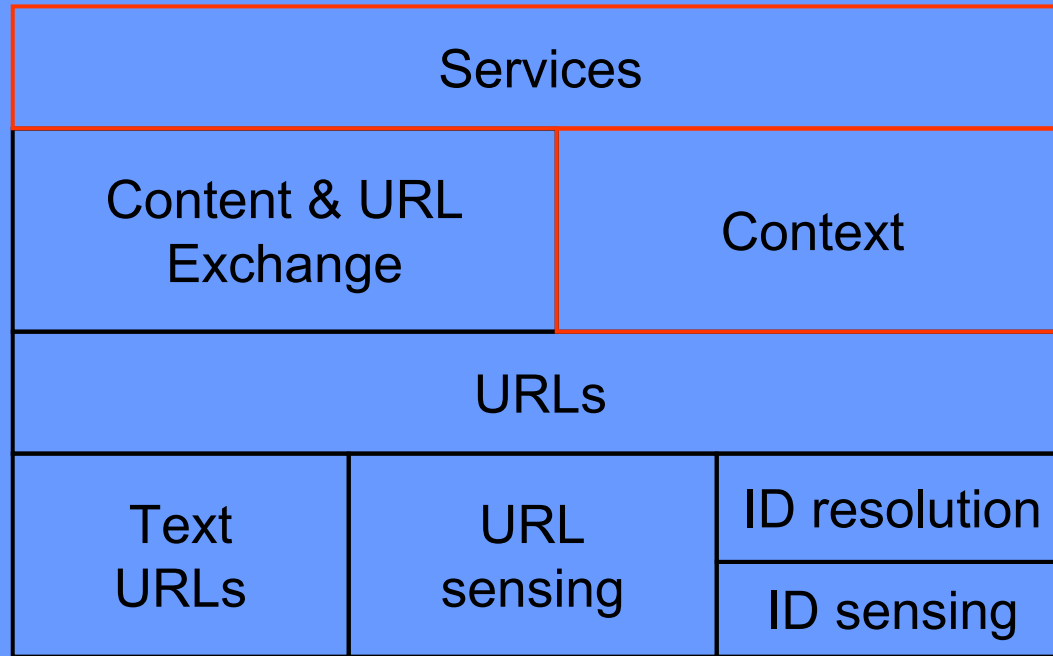


User study at the Exploratorium Science Museum, SF

Physical vs. Virtual navigation



Web-Based System for Nomadic Computing



Places



<http://cooltown.hp.com>

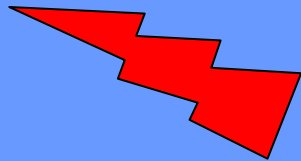
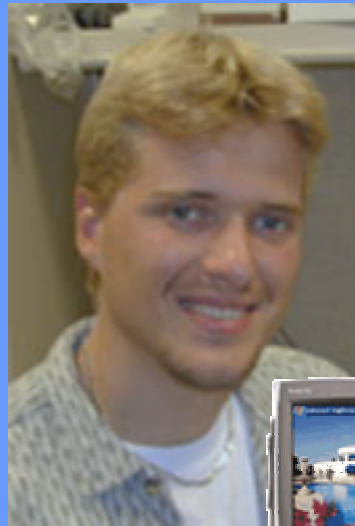


beacon

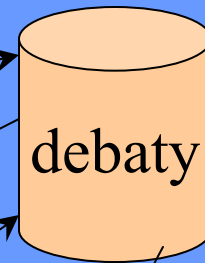
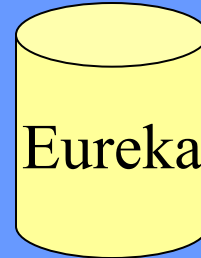


■ tag

Context Dependence With Web Presence Manager



Eureka URL



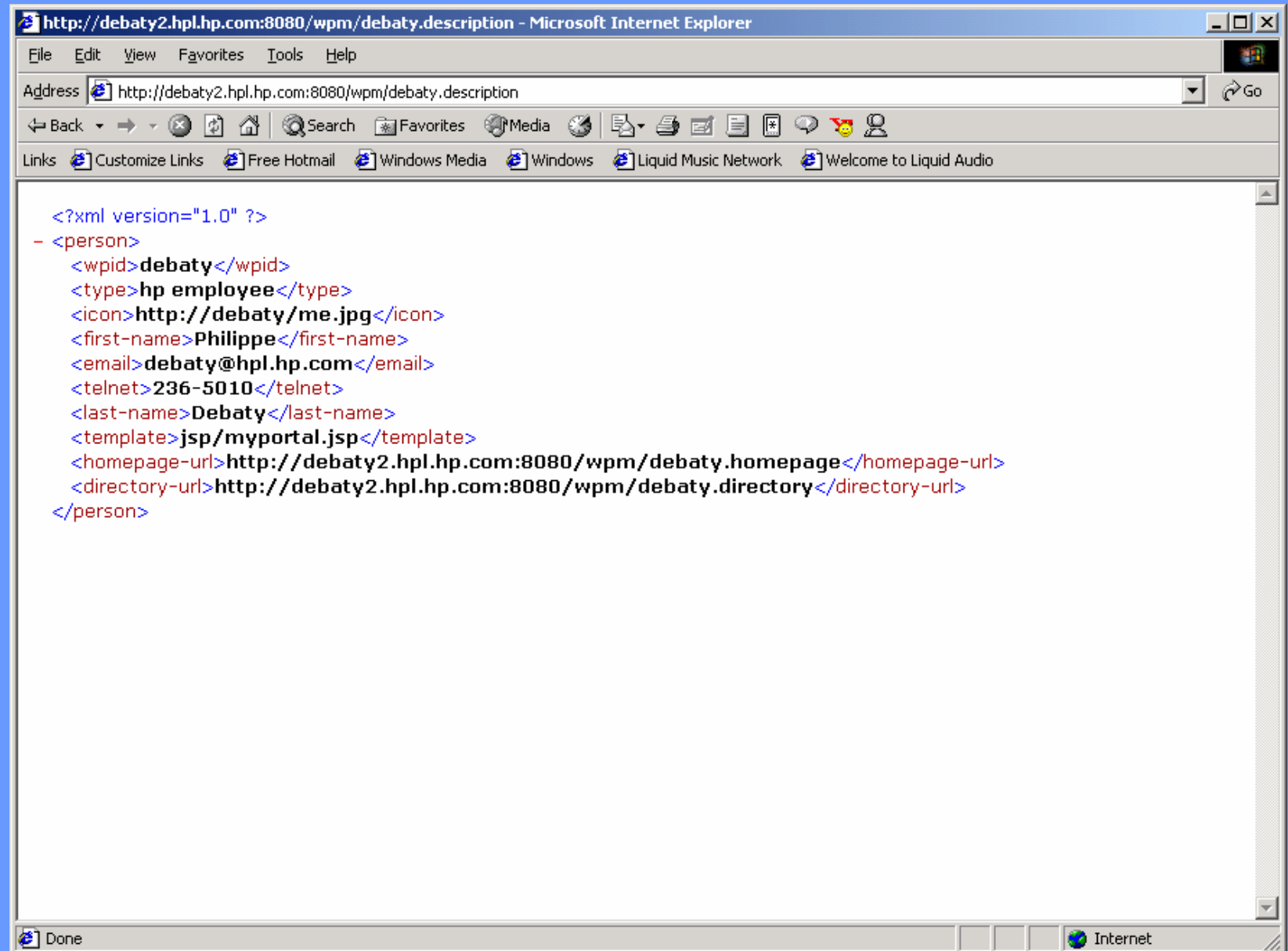
debaty.register(Eureka)

<debaty<Eureka>>

<Eureka>

Eureka.register(debaty)

XML for my description



My Homepage with my content merged with local appliances

The screenshot shows a Microsoft Internet Explorer browser window with the title "wpm description view for debaty - Microsoft Internet Explorer". The address bar displays "http://debaty2.hpl.hp.com:8080/wpm/jsp/myportal.jsp?wpid=debaty". The browser's menu bar includes File, Edit, View, Favorites, Tools, and Help. The toolbar contains buttons for Back, Forward, Stop, Home, Search, Favorites, Media, and a Go button. Below the toolbar, there are links for Customize Links, Free Hotmail, Windows Media, Windows, Liquid Music Network, and Welcome to Liquid Audio. The main content area features a navigation bar with links to hp home, products & services, support, solutions, and how to buy. The HP logo is displayed on the left. The page title is "my personal web presence". A welcome message reads "Welcome Philippe Debaty." Below this is a table listing files with their names, actions, and delete options. A sidebar on the left contains a "cooltown wpm" section with links to home page, directory view, directory query, directory xml, description view, description xml, autobiographer, observer, wp manager, and help. At the bottom of the sidebar is a "jump to" search box with a "go" button. The footer includes links for privacy statement and legal notices, and a copyright notice for 1994-2001 Hewlett-Packard Company.



















hp UNITED STATES

hp home products & services support solutions how to buy

hp
invent

my personal web presence

Welcome Philippe Debaty.

file	actions	delete
 IMG_1536.JPG	 	
 mcrdev_overview.ppt	 	
 InfrastructureIEEE2.doc	 	
 HUC2000architecture.pdf	 	
 Goldman - A nos actes manques.mp3		

cooltown wpm

- home page
- directory view
- directory query
- directory xml
- description view
- description xml
- autobiographer
- observer
- wp manager
- help

jump to go

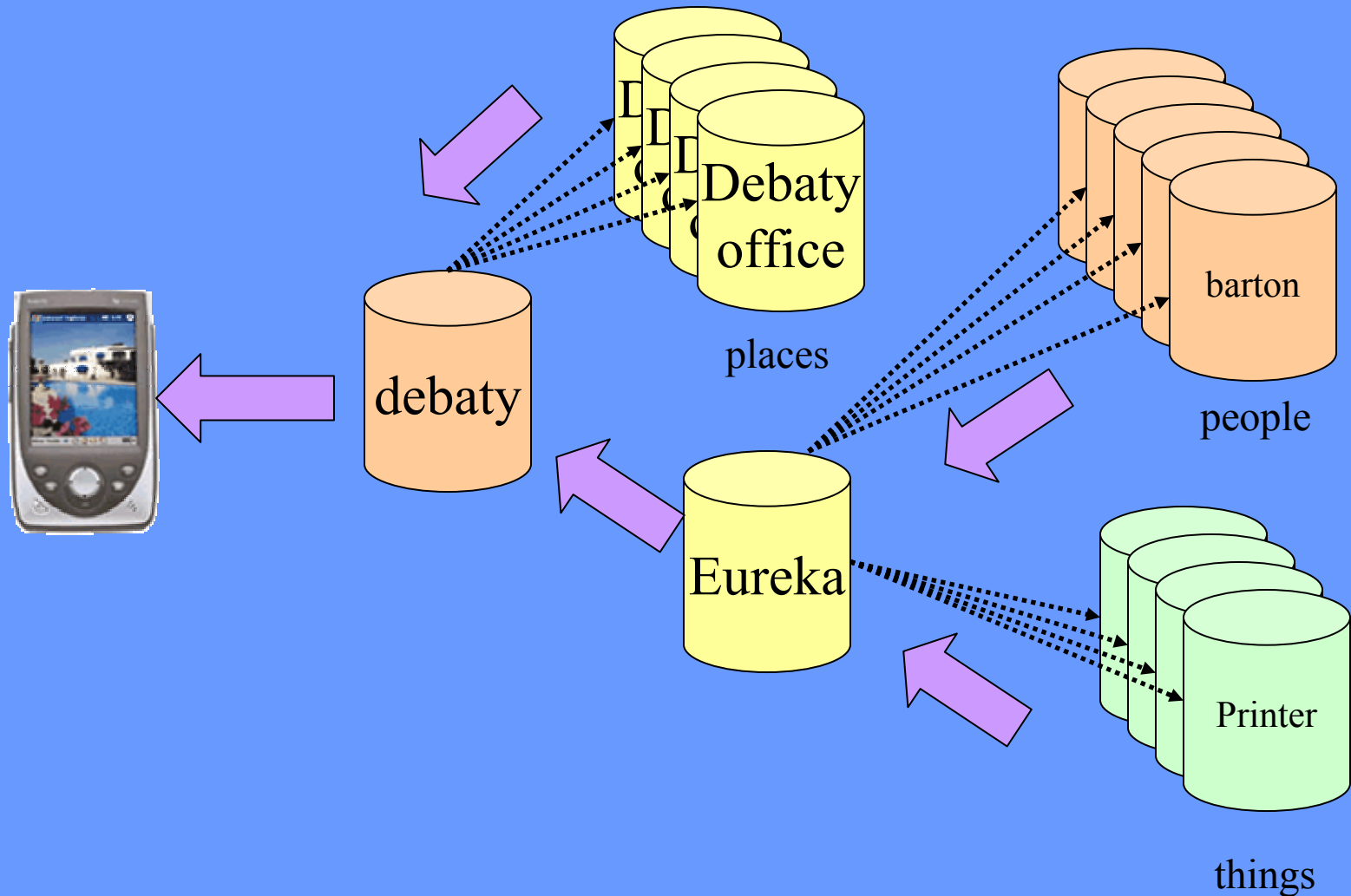
privacy statement legal notices © 1994-2001 hewlett-packard company

Internet

Again, but now on that tiny screen



Dynamic, Physical hyperlinks + transforming proxies = Context Dependence



Beyond Context-Dependent Information

- Context-Dependent Information

- Portable Web Browsers
- Physical Hyperlinks
- Meta-services for discovery



*Like Anind's
Display Category*

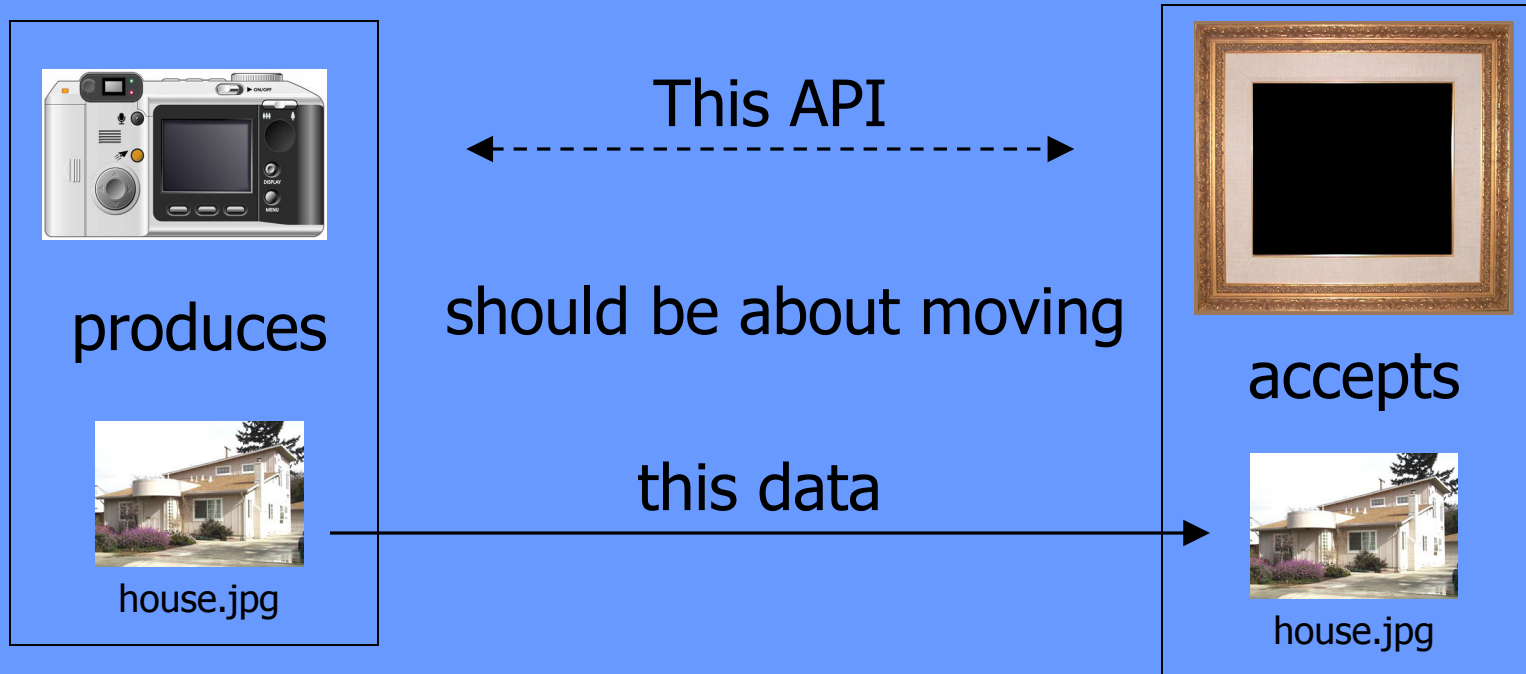
- Context-Dependent Media Creation

- Portable Sensors
- Context aggregation
- Meta-services for registration

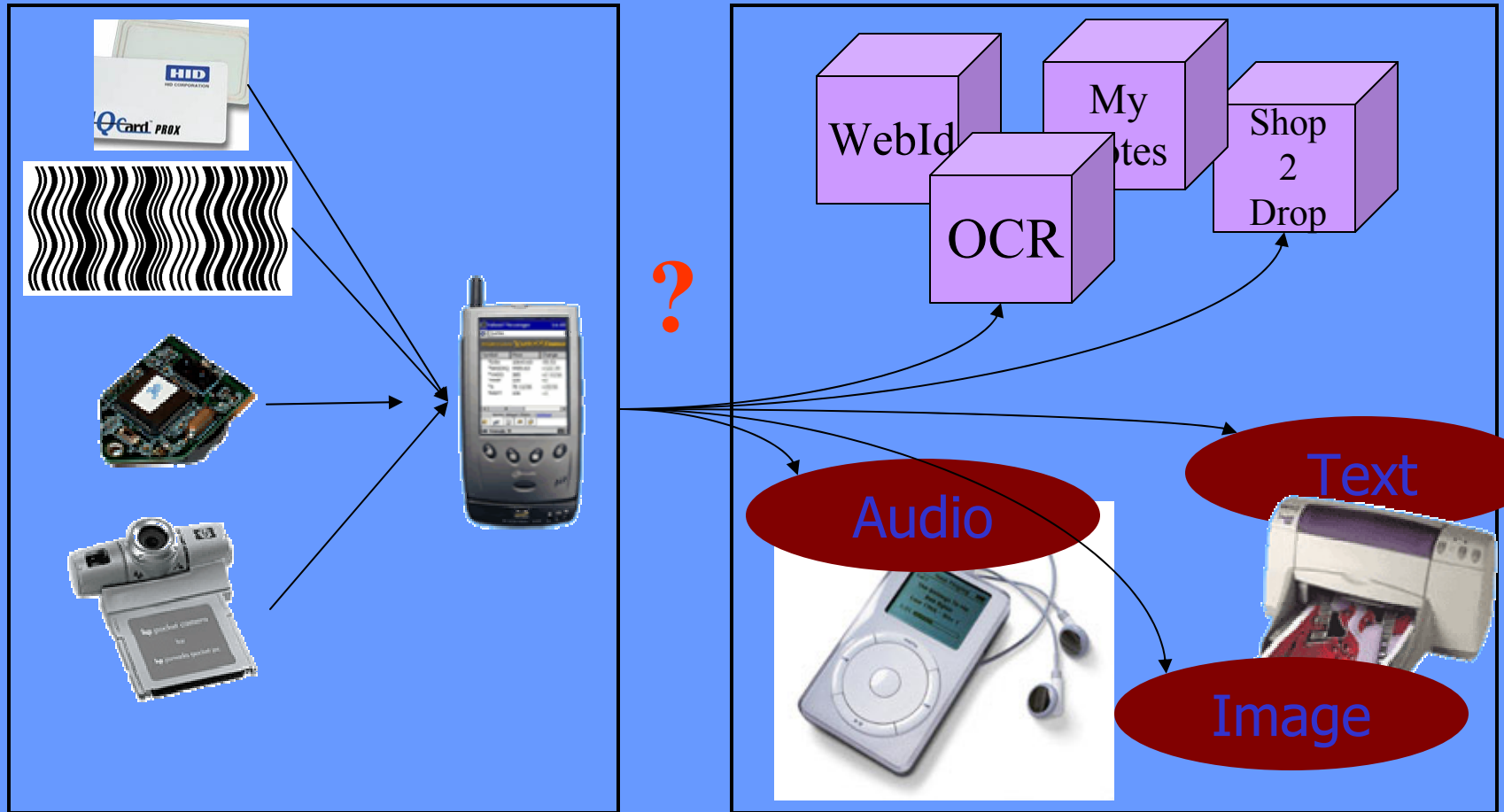


*Like Anind's
Tagged-data Category*

The Basics Of Upload



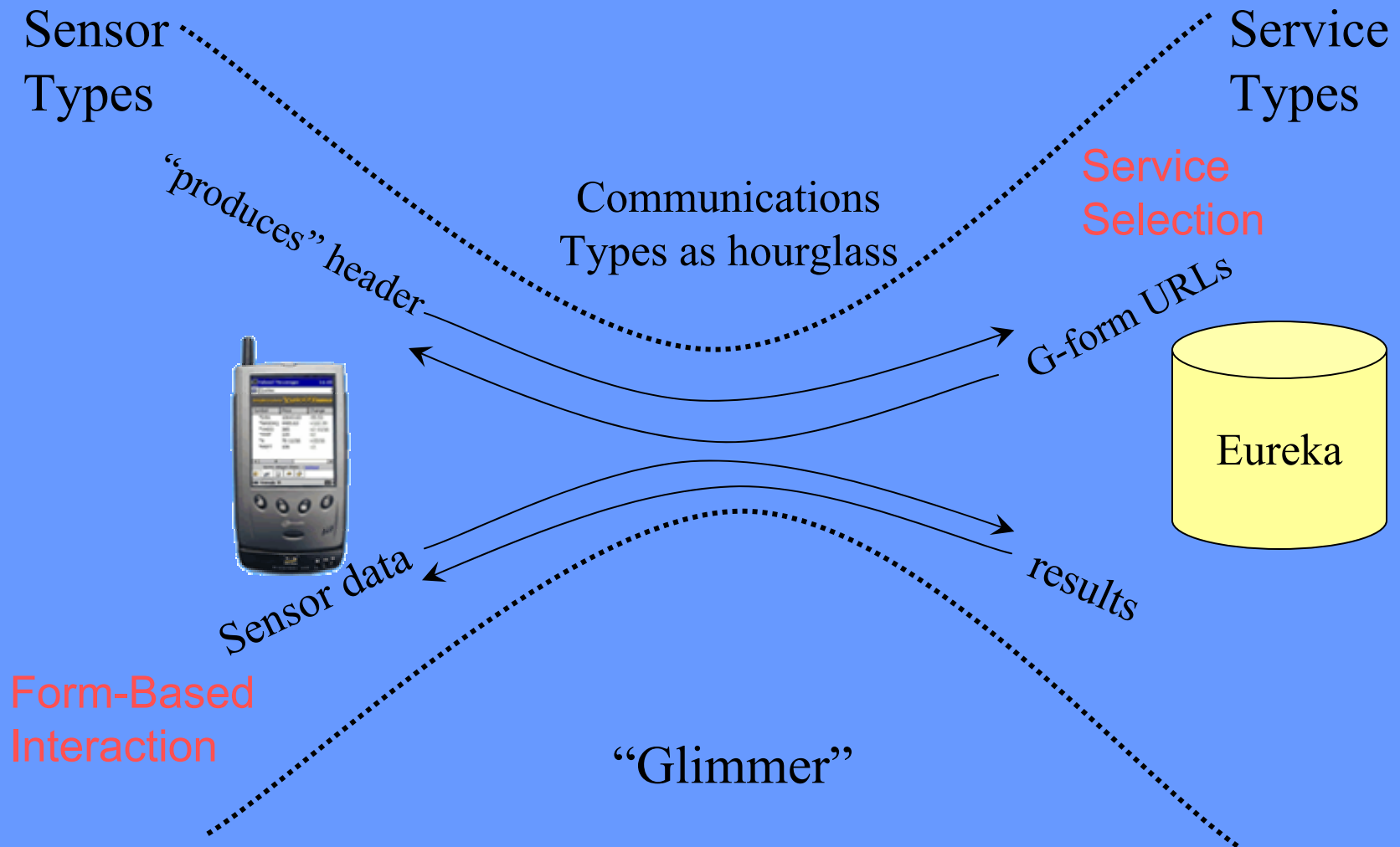
Glimmer: Sensor Enhanced Web Clients with Spontaneous Service Discovery



Data Sources

Data Services

Type-dependent Discovery; Sensor-fill in of Forms



Service Selection for Sensors



camera



pda

accepts
media

produces
Service List

produce/accept
Service List

Services



Form-based Interaction

- Like buying a book from Amazon.com
 - No amazon.exe.
 - But input is sensor data rather than keystrokes.
- “sensor-enhanced” web client.
 - Sensors directly fill appropriate slots in the form
- W3C XForms.
 - Separates form structure from presentation.
 - Provides constructs to describe relationships among different form slots.

Use of XForms Constraints

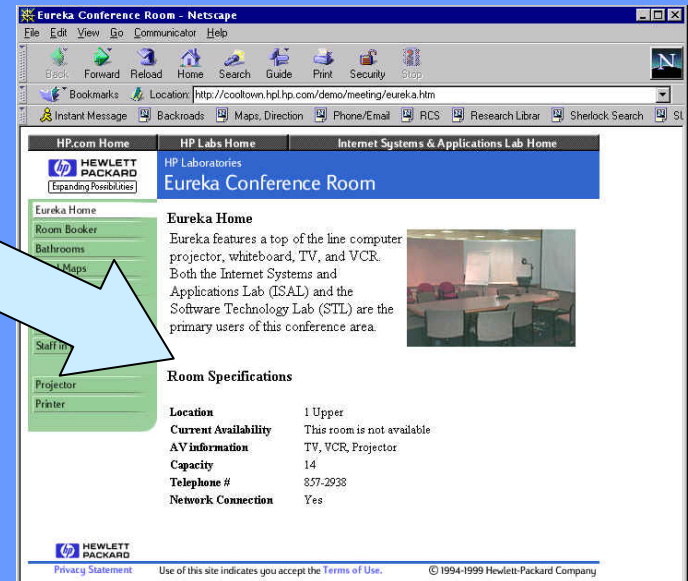
```
<xforms:bind ref="my:world/my:time"  
    relevant="../my:world/my:picture" type="mime/tim  
    required="false"/>  
  
<xforms:bind ref="../my:world/my:barcode"  
    maxOccurs="10" minOccurs="1" type="mime/id"/>
```

- “Relevant” constraint enables proper sequencing of events.
- Some form slots can be specified as optional.
- The cardinality of a sensor value can be specified.

Physical Registration.

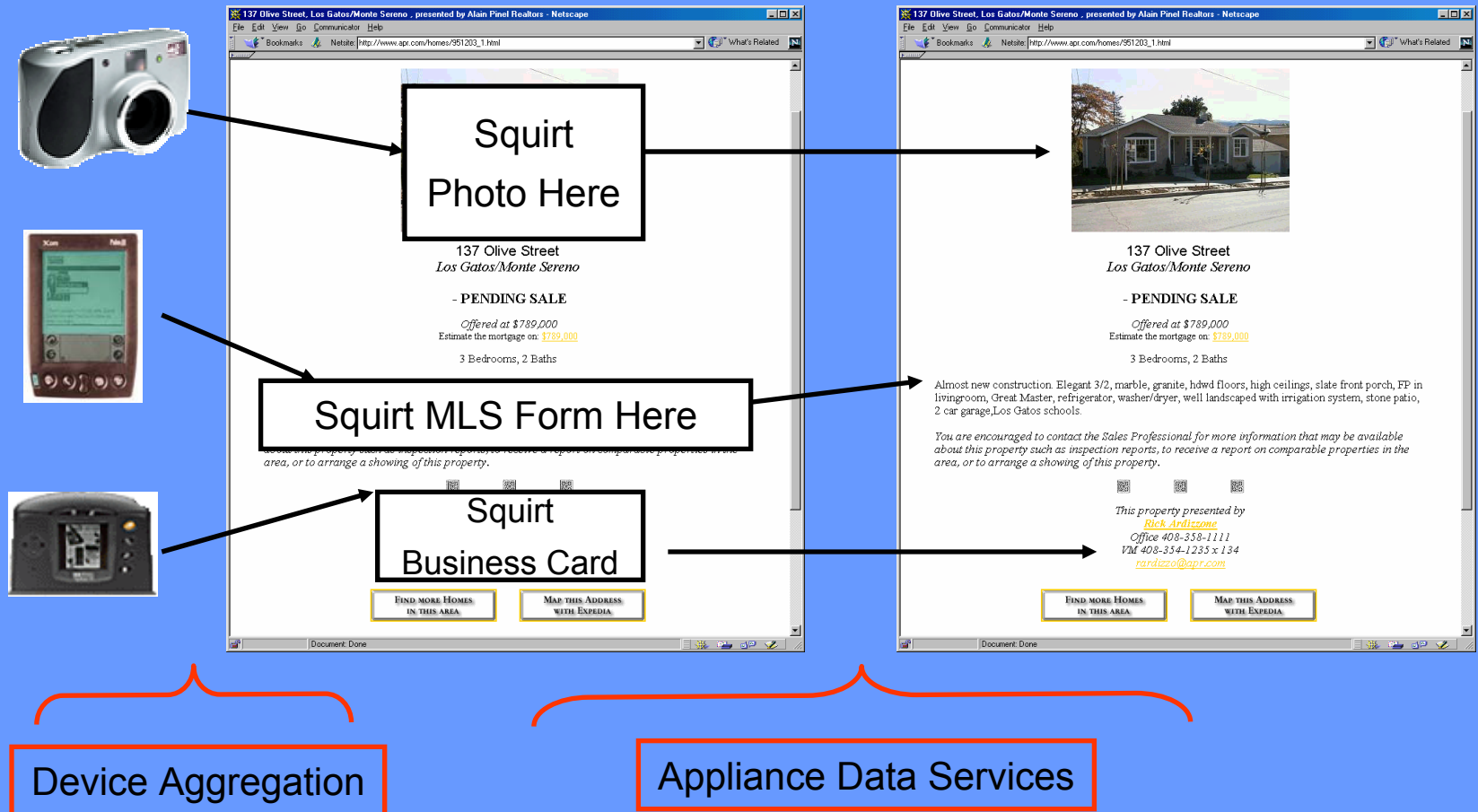


Eureka meeting room
Web page



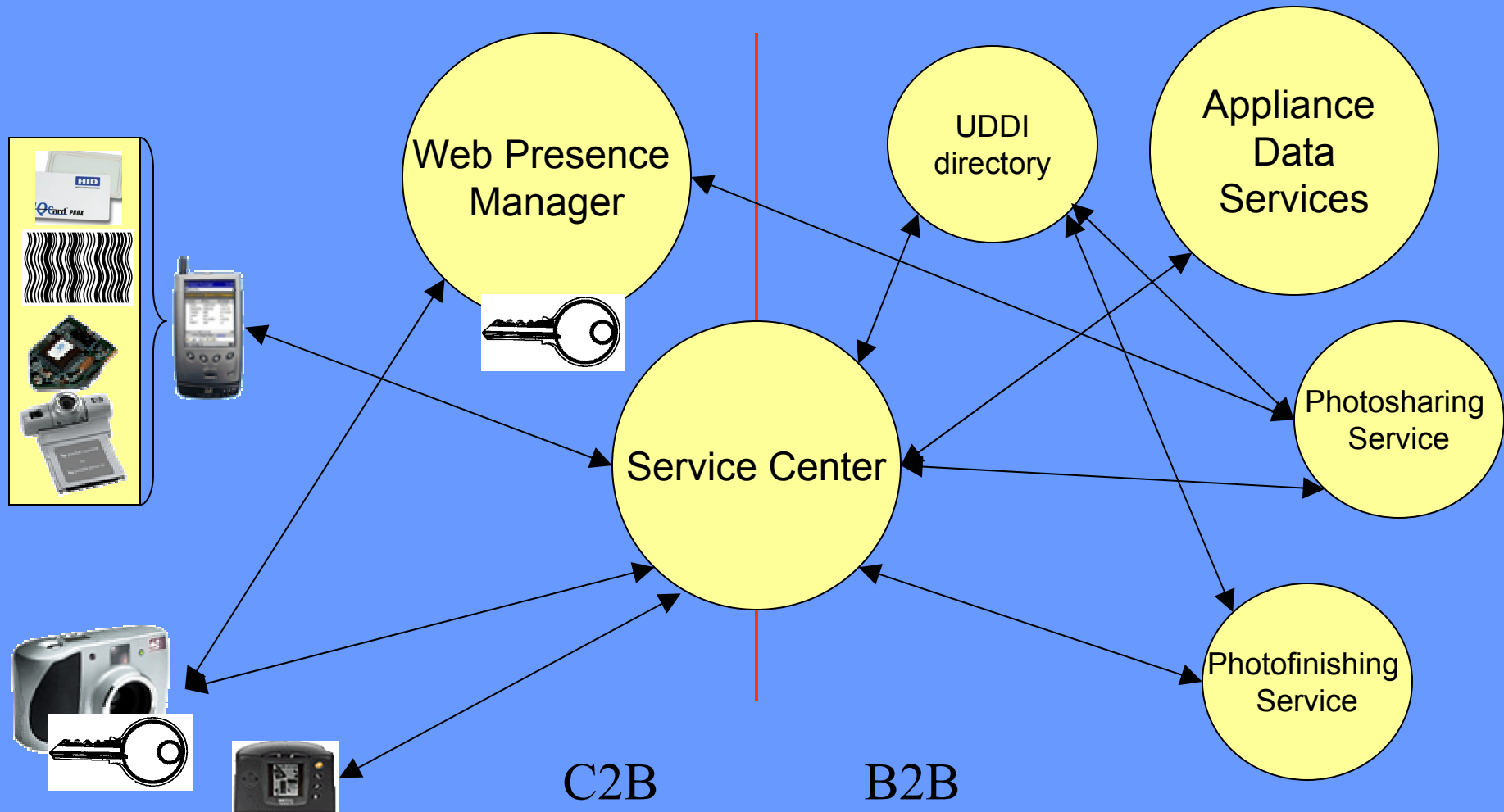
Physical registration

Web Forms+Appliances = Web Pages



Web Services for Handheld Digital Sensors

w/ NCD and Stanford groups



Web-based Nomadic Computing

Physical world	Physical Hyperlinks	Sensorable-Clients
Metaservice	WebID	Service-Selectors
service	WebPresence	Services
Interaction model	Browsing	Glimmer
content structure	Forms	XForms (w/input extensions)
encoding	XML (Parsing)	MIME (packaging, types)
transfer	HTTP	
transport	TCP/IP...	

People

- Web Presence Manager
 - Philippe Debaty, Patrick Goddi, Alex Vorbau, Nic Lyons.
- Exploratorium
 - Mirjana Spasojevic, et al
- Glimmer & Web Services
 - Tim Kindberg, Andy Fitzhugh, Nissanaka Bodhi Priyantha, Hui Dai, and Fahd Al-bin-ali
- Appliance Data Services
 - Armando Fox, Andy Huang, Ben Ling ([Stanford University](#))
- Wireless Information System Emulator
 - Vikram Vijayaraghavan, Mary Baker ([Stanford University](#))
 - Fredrick Espinoza, Markus Bylund, ([Swedish Inst. Comp. Science](#))
- GLAD
 - Margaret Fleck, Marcos Frid
- [Security & Privacy](#)
 - Kan Zhang, Narendar Shankar
- Coolbase
 - Wesley Chan
- www.cooltown.com
 - Megan Taylor
- WebSign
 - Salil Pradhan, et al.
- BadgePad
 - Mark Smith, et al.



<http://www.cooltown.com>

<http://handhelds.org>

<http://www.exploratorium.edu/guidebook>