An interactive location service for
software agents and intelligent systems

wherehoo.media.mit.edu

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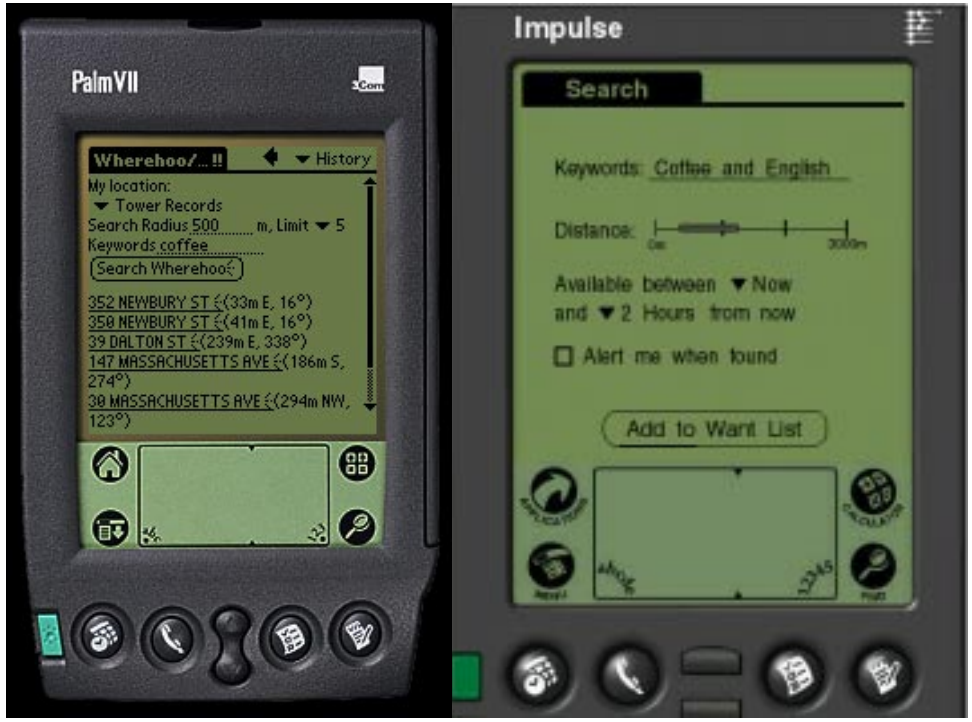
Giving a person “on the street” the benefits of the Internet

- Really “on the street”
- Low search cost
- Coordination
- Discovery of situated resources and people



- Target clients:

HARDWARE	Palm devices / PDAs Embedded systems Wearables
SOFTWARE	Multiagent systems
PEOPLE	Explorers

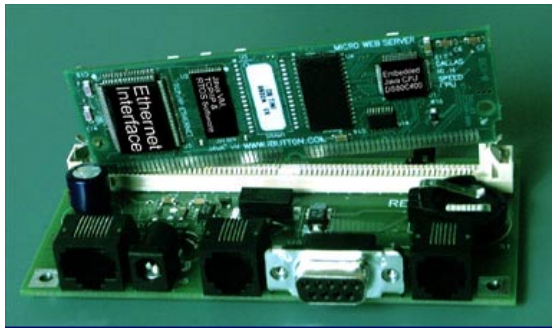
Wherehoo
the Stuff Around You

A place and time for everything

- Temporal
  and
  geographic coordinates
  - Where are you
  - When are you?
  - What's happening - there - now
  - What happened - here - at 0900?
- Scope
  - Long- and short-lived entities
    (~6 seconds to ∞)
  - Modest storage capacity for data
    belonging to small agents
    (1 to 64K bytes)

Queries and Inserts

- Devices with limited communications/processing *and* more powerful systems will use the server
- Some queries will be answered fully by the Wherehoo server. Others require additional lookups by the client
- Some data will be stored in the Wherehoo server. Other data will be stored elsewhere



Client

Query (lat,lon,radius)

1

Data *or* pointer

Wherehoo Server

Get

2

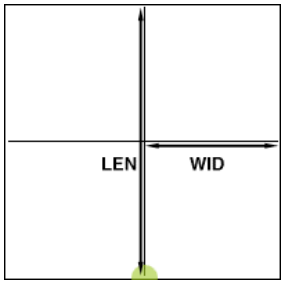
Data

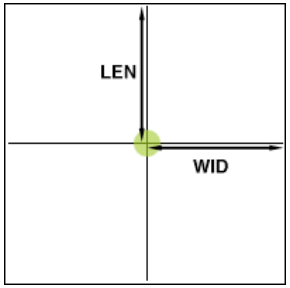
Other server

Queries and Inserts

- SMTP-like interaction

IDT jim
wherehoo_server 0.56 30 20 1024 65535
ACT QUERY
LLH 42.023 -071.33 0
LEN 250
WID 250
LIM 10
.
OK
96 N 1443 99999999 33212 WHEREHOO IMAGE/JPG META
DATA
(33212 bytes of data)
138 NW 230 99999999 74 HTTP TEXT/HTML NONE
SKIP
.
BYE





Queries and Inserts

- SMTP-like interaction

IDT jim
wherehoo_server 0.56 30 20 1024 65535
ACT INSERT
LLH 72.019 288.908 0
MIM TEXT/PLAIN
PRO WHEREHOO
DAT 18
(18 bytes of data)
ACK
MET This is some metadata describing the content of the DATA field
.
OK
c08b9ac6d59dba9be0106096626809b2e4098f0a
.
BYE

Design philosophy

- **Powerful clients** will do their own sorting/filtering and exploration
- **Don't interpret data**, just faithfully store and retrieve it
- All **times are deltas** from local time
- **No content filtering in searches.** Clients will select along many axes we cannot predict
- **Filter literal data** when both client and server benefit (MIME type, protocol, data size, time)
- **Small clients** may require an intermediary to do the hard work
- **Socket interface** yields platform and language independence
- **Minimal embellishment** - add time,distance,heading vector to discovered records - Client cannot do this well; server is authoritative
- **Precise geode model** for accurate distance measures*
- **Read/write facile** - as many clients may be writing records as querying them, for example, subway trains and buses will insert many short-lived records

* Derived from http://www.census.gov/cgi-bin/geo/gisfaq
and Perl examples by Darrell Kindred <dkindred@cmu.edu> (1998)

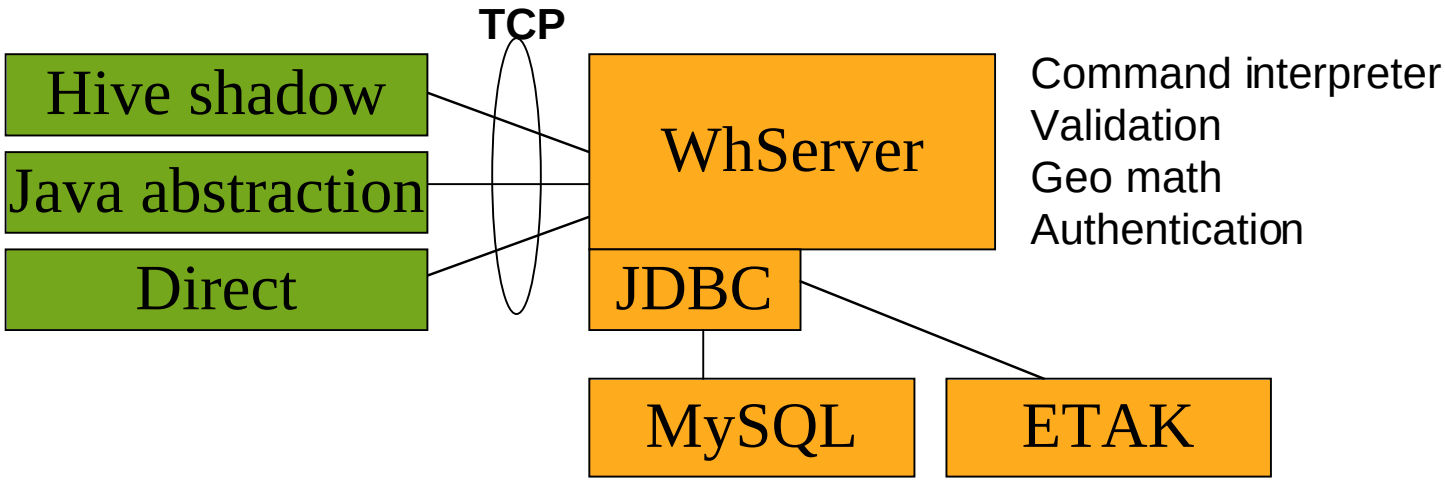
Wherehoo
the Stuff Around You

Security

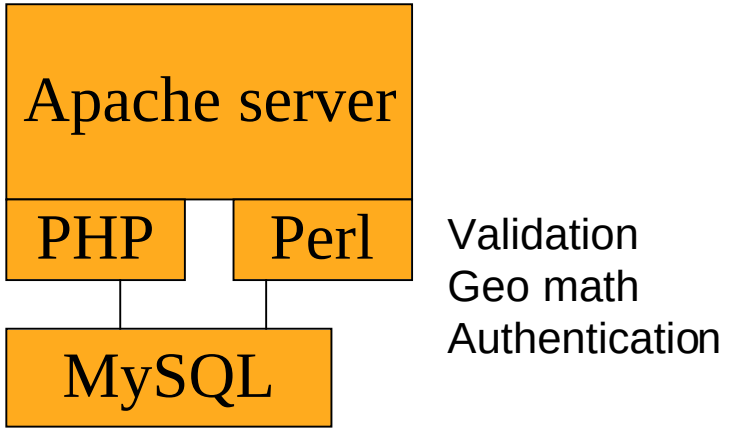
- Protecting your data is up to you!
- Wherehoo is like DNS - its records are all public by design and queries are anonymous
  - (**if the data matters**) Sign data that must not be changed
  - (**and if it's private**) Encrypt data that cannot be shared
  - (**and if revelation of location is dangerous**) Run a private server
- But we try to help:
  - Inserts are authenticated with digital signatures using a shared secret
  - Inserted records return a signed handle that may be used to access the record later

Architecture

- **Server:**
  - Java
  - JDBC
  - MySQL



- **Web interface**
  - PHP
  - Apache
  - MySQL interface
  - Perl



Applications

- **StreetWise**
- **Transponder** to simulate location awareness in devices that don't have it (phones, Palms) with remote online capability (CDPD) and local only (collect,dump later)
- **Tangible browsers** for exploring the world, ”surfing places" instead of "the net"
- **Learning agents** for tracks-based routing. "How did other people get there?"
- **Social applications** - dial by location; friend discovery; "follow me" trails

Problems

- **Data pollution** - no way to detect or delete abandoned records. For example, a building that's torn down should have its record expired.
  - Quality feedback from clients could possibly help here
- **Imprecision of GPS data** and data loss due to tall buildings
  - Clients designed with knowledge that GPS data does not have sub-meter precision should express appropriate expectations and behaviors, using available information to their advantage.
  - Lost signal is a problem for the clients, not the server, e.g. a navigation client must deal with blackout by switching to dead reckoning and compass direction

Future work

- Views that run forward and backward in time
- Improved algorithms for efficient irregular searches.
- Encoding areas rather than just points.
- Layered or container semantics, and/or XML in the server/client interface, Geography Markup Language (GML), OpenGIS: **Probably not**
- Automate account creation
- Client feedback about quality or utility of data
- Many self-managed servers

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