

Location Services and WhereAml

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Location Services

Location Applications



Location Services



Location Determination

Location Applications

- Emergency Services - FCC mandates for accuracy
 - e.g. 100 meters accuracy 67%, 300 meters 90%
- Law enforcement
- Alert Services
- Home Zone Billing
- Fleet Mgmt, Asset Mgmt
- Person tracking, pet tracking
- Vehicle traffic congestion reporting
- Roadside assistance, Navigation
- Localized Advertising, Mobile Yellow Pages
- Network planning and provisioning by carrier
- And many, many, many others

Tornado Warnings

AirGraffiti

Where can I park?

Where's the bus?



Determination Technologies

- GPS - becoming more common in devices but indoors remains a huge problem
- Cellular and WiFi
 - Techniques are very similar
 - Differs in scale and who is in control
- Network-based vs Client-based
 - network service tracks devices or clients determine locations themselves
 - Association Lists - which base station is the client “connected to” - network or client
 - Signal Strength Triangulation - could be network or client
 - Fingerprint Database - What Base Stations do I see? - client based with fingerprint server
- Other beacons
 - Bluetooth, audio, video markers



Indoor is still a challenge!



Sample “indoor” location trace using GPS

Location Services

- What does the service provide in terms of “location”?
 - Geo coordinates (lat, lon), Altitude, Velocity, Contextual (e.g. address, room, political)
- To whom?
 - Third party lookups?
 - Security and privacy constraints
 - End users vs. applications
- How?
 - Data format - evolving standards such as GEOPRIV
 - Frequency, Accuracy, Event triggered

Standards Efforts

- 3GPP
 - TS 22.071 - Location Services (LCS) Service description (see link on class website)
- IETF
 - RFC 4119 - A Presence-based GEOPRIV Location Object Format
 - Extensions to PIDF for location

Example with GML Location

```
<?xml version="1.0" encoding="UTF-8"?>
<presence xmlns="urn:ietf:params:xml:ns:pdf"
  xmlns:gp="urn:ietf:params:xml:ns:pdf:geopriv10"
  xmlns:gml="urn:opengis:specification:gml:schema-xsd:feature:v3.0"
  entity="pres:geotarget@example.com">
  <tuple id="sg89ae">
    <status>
      <gp:geopriv>
        <gp:location-info>
          <gml:location>
            <gml:Point gml:id="point1" srsName="epsg:4326">
              <gml:coordinates>37:46:30N 122:25:10W</gml:coordinates>
            </gml:Point>
          </gml:location>
        </gp:location-info>
        <gp:usage-rules>
          <gp:retransmission-allowed>no</gp:retransmission-allowed>
          <gp:retention-expiry>2003-06-23T04:57:29Z</gp:retention-expiry>
        </gp:usage-rules>
      </gp:geopriv>
    </status>
    <timestamp>2003-06-22T20:57:29Z</timestamp>
  </tuple>
</presence>
```


Example with GML Location

```
<?xml version="1.0" encoding="UTF-8"?>
<presence xmlns="urn:ietf:params:xml:ns:pidf"
  xmlns:gp="urn:ietf:params:xml:ns:pidf:geopriv10"
  xmlns:cl="urn:ietf:params:xml:ns:pidf:geopriv10:civicLoc"
  entity="pres:geotarget@example.com">
<tuple id="sg89ae">
<status>
<gp:geopriv>
<gp:location-info>
<cl:civicAddress>
<cl:country>US</cl:country>
<cl:A1>New York</cl:A1>
<cl:A3>New York</cl:A3>
<cl:A6>Broadway</cl:A6>
<cl:HNO>123</cl:HNO>
<cl:LOC>Suite 75</cl:LOC>
<cl:PC>10027-0401</cl:PC>
</cl:civicAddress>
</gp:location-info>
<gp:usage-rules>
<gp:retransmission-allowed>yes</gp:retransmission-allowed>
<gp:retention-expiry>2003-06-23T04:57:29Z</gp:retention-expiry>
</gp:usage-rules>
</gp:geopriv>
</status>
<timestamp>2003-06-22T20:57:29Z</timestamp>
</tuple>
</presence>
```

Some Defined Parameters

- Immediate Requests
 - no delay
 - low delay - timeliness $>$ accuracy
 - delay tolerant - timeliness $<$ accuracy
- Deferred Requests
 - scheduled, perhaps periodic updates
 - event based - e.g. enter campus, calendar update
- QoS
 - Accuracy and Response Time
 - Assured vs Best Effort

Privacy Definitions

- Codeword - password limited access
- Privacy Exception List - e.g. buddy list
- Service Type Privacy - vary access for different clients and client types
- Privacy Override - lawful intercept, emergency services

Privacy Options

1. Location allowed
2. Location allowed with notification
3. Location allowed with notification and verification, allow if no response
4. Location allowed with notification and verification, deny if no response
5. Location not allowed

WhereAml

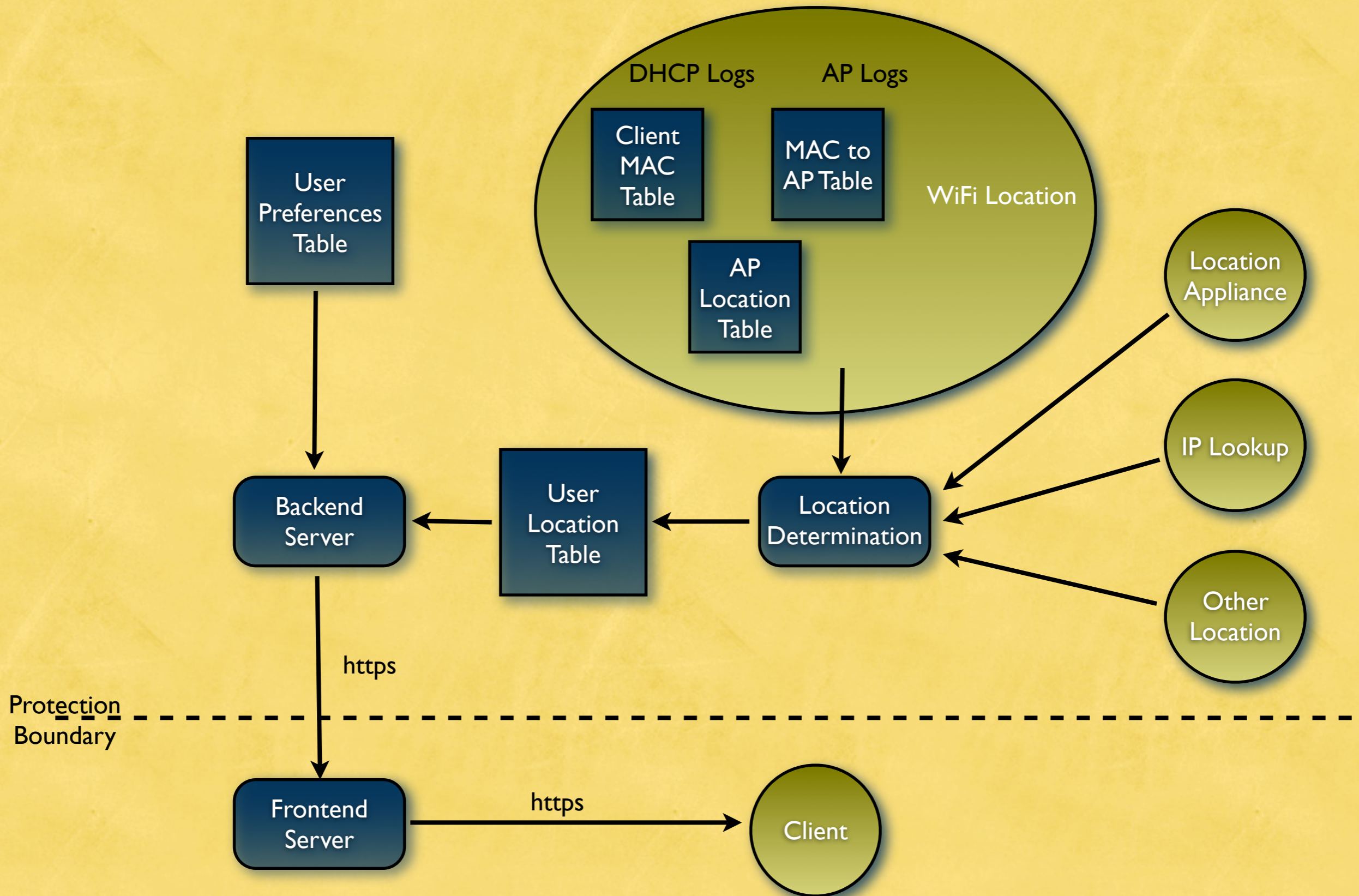
A location service for the Georgia Tech community.

- A research and education enabling service
- Aggregates input from multiple location determination methods
 - Cisco Location Appliance
 - Access Point Association Events
 - IP address mapping
- Location information returned in multiple formats
- Allows user feed back through map interface

WhereAml - Privacy

- Privacy observant
 - Location is only calculated for service users - no need to “opt in/out”
 - Only first-person look-ups, client can only look-up its own location
- Experimental support for third-person look-ups only with verification and white list

WhereAmI - Architecture



WhereAmI - Web Interface

- Uses best available location determination method
- Uses Google Maps interface to represent client's location
- www.rnoc.gatech.edu/whereami



[whereami Home](#) Using the [Association Event](#) location determination method:
You are currently at 33.7772570005, -84.3901139999 with an accuracy of 50 meters at 2008-01-28 13:27:36.

[Raw Location Data](#)

[Projects](#)

[Documentation](#)

[Programming](#)

[People](#)



Imagery ©2008 DigitalGlobe, GeoEye, Earthstar (RealVista), Swire, Telig Atlas - Terms of Use

If you believe the given location information to be inaccurate please let us know [where you think you should be](#).

If you have any comments or questions, please email us at location@lists.gatech.edu

WhereAmI - XML API

- Allows any third party developer to use location
- No special device programming or local data storage required
- www.rnoc.gatech.edu/whereami

```
<LocationResponse>
  <requestInformation>
    <IpAddress>128.61.2.134</IpAddress>
    <determinationMethod>Association Event</determinationMethod>
  </requestInformation>
  <locationInformation>
    <bldgNum>153</bldgNum>
    <bldgName>Klaus Computing Bldg</bldgName>
    <apName>153-1134</apName>
    <coord>
      <latitude>33.7770600000</latitude>
      <longitude>-84.3962400000</longitude>
      <altitude>280</altitude>
    </coord>
    <accuracyRadius>50</accuracyRadius>
    <arriveTime valid="true">2013-03-10 00:00:00</arriveTime>
    <leaveTime valid="false">UNKNOWN</leaveTime>
  </locationInformation>
</LocationResponse>
```

WhereAmI - Third Party

- Allows users to look-up the location of others
- Users can register multiple devices to be associated with their location
- Users can set the level of information another user is able to see about them.
 - Precise – All location information disclosed
 - Building – Shows which building a user is in, but not room information
 - Campus – Tells whether the user is on campus or not
- Users identified by anonymous screen name that is not attached to other campus IDs (student #, prism ID)
- Full XML API available for 3rd party look-ups
- Java application built to show case API
- <https://webhost.gatech.edu/rnoc/whereami3p/>
- <http://rnoc.gatech.edu/whereami/whereami3p.jar>

Rich Geo-Referenced Data

- Now that we have a location service, we need the data that goes with all of those applications!
 - Parking Spaces
 - Detailed Building Layouts
 - Color Printers
 - Snack machines
 - Walkpaths
 - Open Lab Seats
 - Etc, Etc, Etc

Working with GT Center for GIS

- Ongoing projects to bring GIS data sources online
- In a form that is available for students to:
- use data in applications
- contribute and update new data
- explore new uses and new ideas