CENS **Center for Embedded Networked Sensing**

Metropolitan Wi-Fi Research Network

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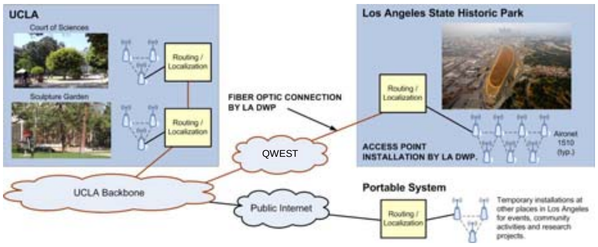
Urban Sensing | CENS - http://urban.cens.ucla.edu & REMAP - http://remap.ucla.edu

Introduction: We have deployed a metropolitan scale Wi-Fi mesh network for research that focuses on the design and development of an architecture for a data-centric network-fabric to support urban participatory sensing.

Expanding UCLA's urban sensing network into the community

- By deploying a metropolitan scale Wi-Fi mesh Network around the new Los Angeles State Historic Park (LA SHP), a 32-acre site directly adjacent to LA's downtown.
- The network connects two campus centers and the Los Angeles State Historic Park, in an agreement the California State Department of Parks and Recreation.
- A portable unit can be deployable in other locations.


UCLA
Court of Sciences
Routing / Localization
Sculpture Garden
Routing / Localization
UCLA Backbone
FIBER OPTIC CONNECTION BY LA DWP
QWEST
Public Internet
Los Angeles State Historic Park
Routing / Localization
ACCESS POINT INSTALLATION BY LA DWP.
Aironet 1510 (typ.)
Portable System
Routing / Localization
Temporary installations at other places in Los Angeles for events, community activities and research projects.

Framework for research in Urban & Participatory Sensing

The network enables increasing credibility of sensor data by embedding network–attested location and time in sensor readings.

Provides a framework for developing policy-based privacy, and related security mechanisms for participatory sensing.

In addition, the network at the LA SHP enables two area of exploration:

- Long–term technology research on how networks can support individuals and communities around the LA SHP in documenting their own environments as part of creating healthy and livable cities;
- Collaborative work with local communities that investigates how emerging technologies can be employed to express their own identities and histories in today's mediatized society.

Network Architecture

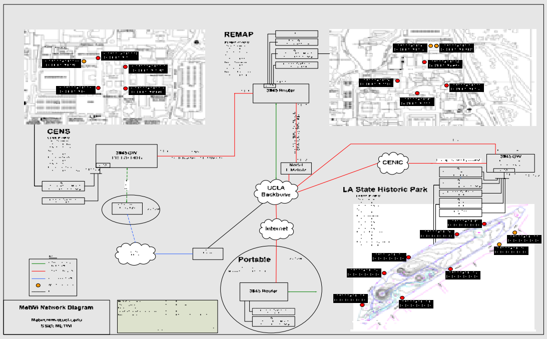
A site-to-site VPN is used to connect two UCLA research centers, the network at the LA SHP and the portable system.

We are using four class C subnets to allow each client device on the network to act as a directly-accessible server.

The network comprises of Cisco products and general purpose hardware.

The network allows participant to increase the credibility of their location data by providing an location attestation service.

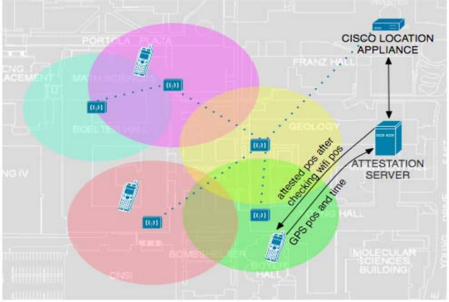
Thus, will be used as a framework to build Mediator services for time/location attestation and data scrubbing, as well as services for auditing data.

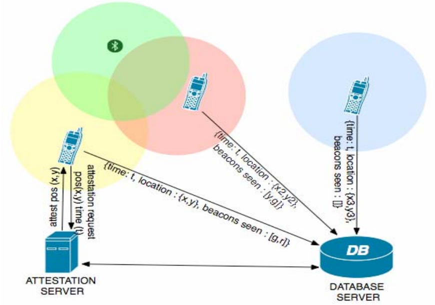


Applications: Service for network attested location and time in sensor readings.

Infrastructure Based Attestation

- Client devices connected to the network may obtain additional geographic location information from a paired GPS device or using cell tower id.
- This location will be attested using the location that the network infrastructure associates with the device.
- A device may request the network to attest its location by providing its GPS/Celltower location to a local trusted attestation service on the network running on a trusted server close to the APs.
- The server will compare the reported location to the network-observed location and send back the attested location.
- In the future we might have this attestation service be implemented in the APs or as smart devices connected to the APs.




attest pos (x,y)
attestation request pos(x,y) time (t)
{time: t, location : {x,y}, beacons seen : [g,r]}
{time: t, location : {x2,y2}, beacons seen : [y,g]}
{time: t, location : {x3,y3}, beacons seen : []}
DB
ATTESTATION SERVER
DATABASE SERVER

Beaconing Based Attestation

- Devices scan and upload the identifiers of visible wi-fi and bluetooth beacons along with their GPS/Celltower location.
- A trusted service on the network will have access to the resulting database.
- A device can then ask the proximity attestation service to verify its location and the service will look at the database and check if it has any other devices that have seen the requesting-device beacons and check if the location reported by those devices is near the one reported by the requesting device.

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