Location Management

Overview of the Talk

- Introduction
- Active Badges
- User Location Standards
- Location Information Replication

Location Management - Issues

- Tracking Mobile Users
  - Maintaining update intensive location information
  - Replication to reduce location query latency
  - Consistency between location information replicas

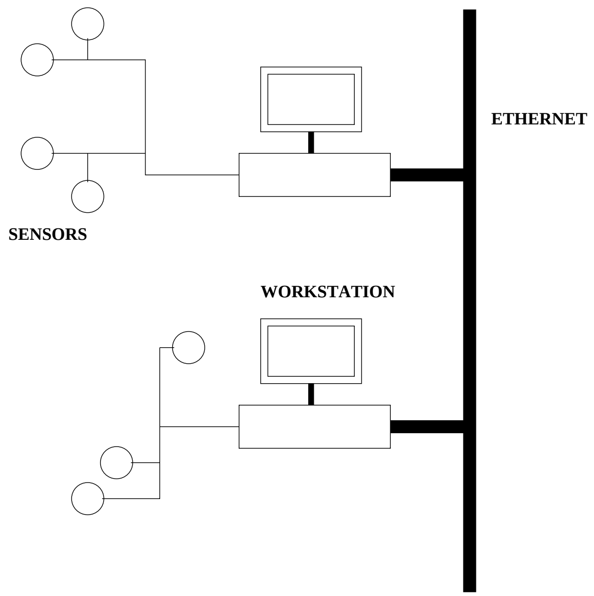
Active Badges

- Work done at Olivetti Research, England
- Each person wears a badge
- Applications :
  - Tracking employees
  - Routing telephone calls

Active Badge Design

- Unique code emitted every 15 seconds
- Duration of code is 0.1 seconds
  - Reduces the probability of signal collision
- Badge turns off in the dark
  - Conserves battery power

Badge Sensors



- Sensors placed in offices and corridors
- Use an existing network
- Sensors have buffering capabilities

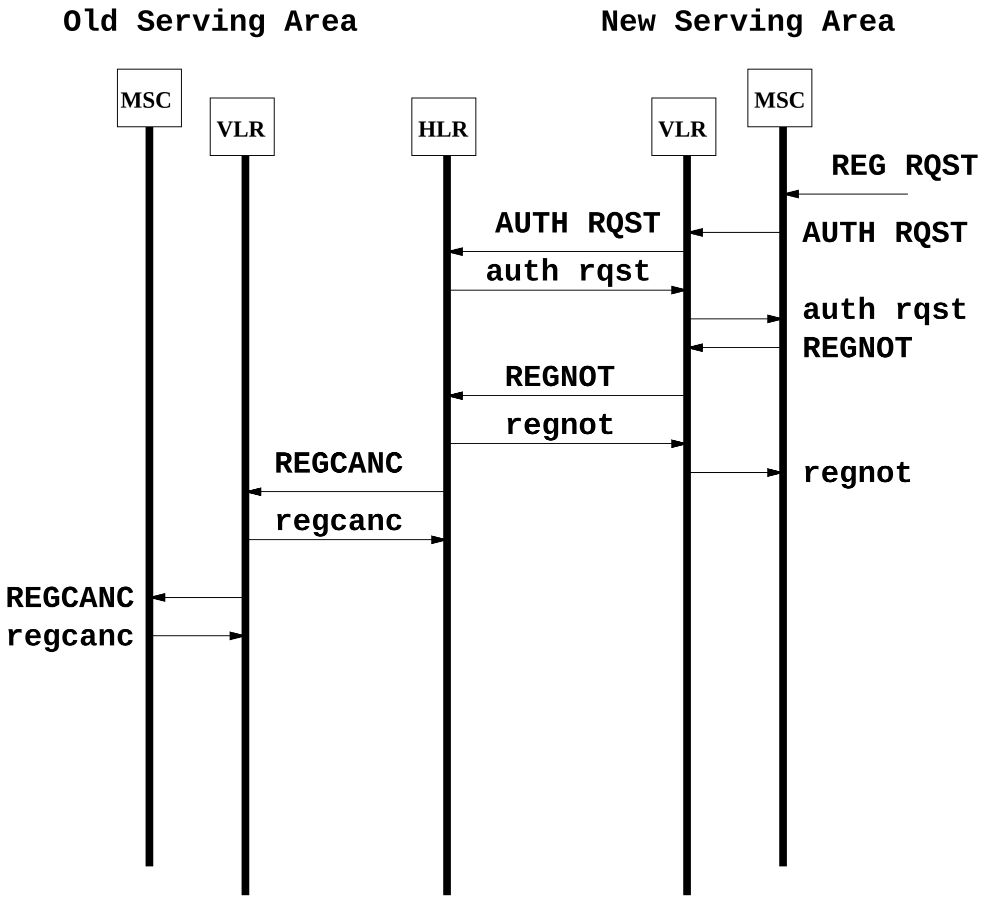
Location Server

- Network Controller polls all sensors on the network
- History of movements maintained at location server
- Applications query the location server
- Location and Name based queries are allowed

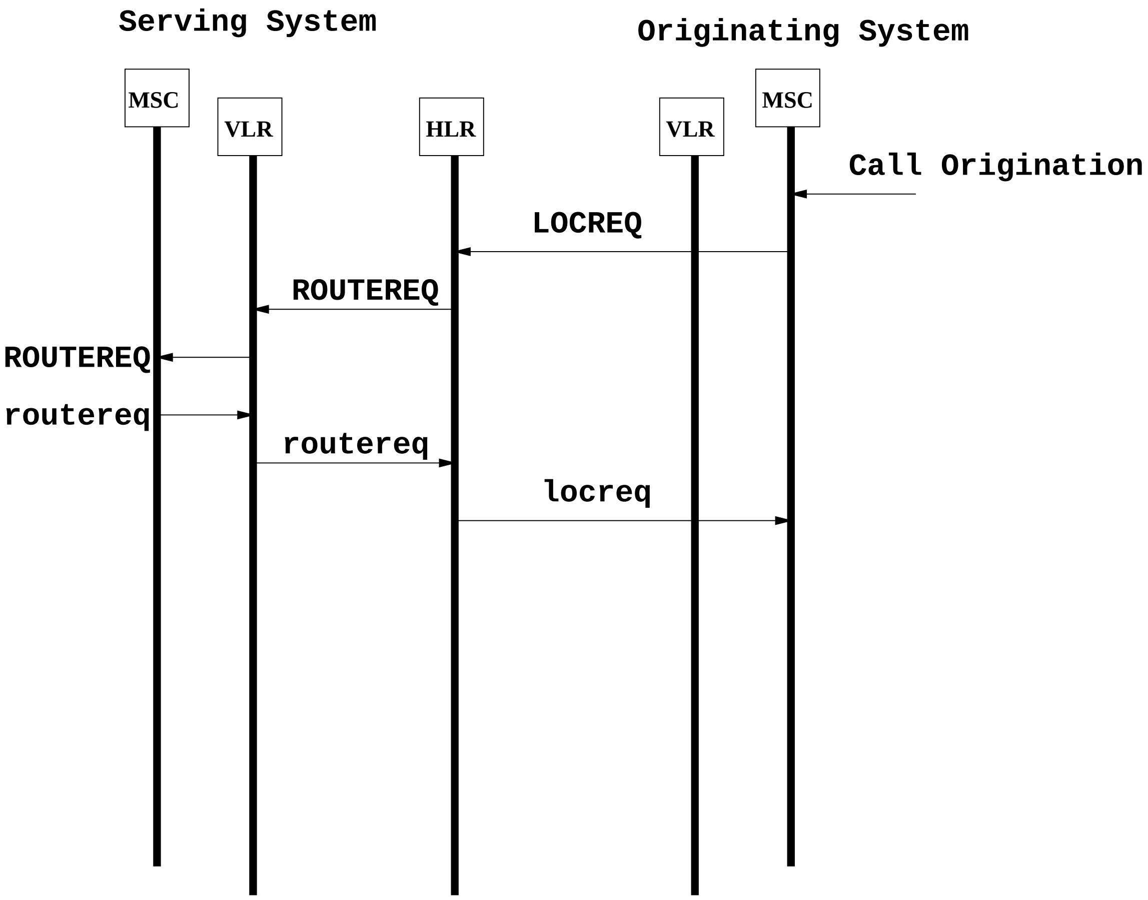
IS-41 : User Location Standard

- Each area is serviced by a Mobile Switching Center (MSC)
- Each service area has a Visitor Location Register (VLR)
- Each mobile client has a fixed Home Location Register (HLR)

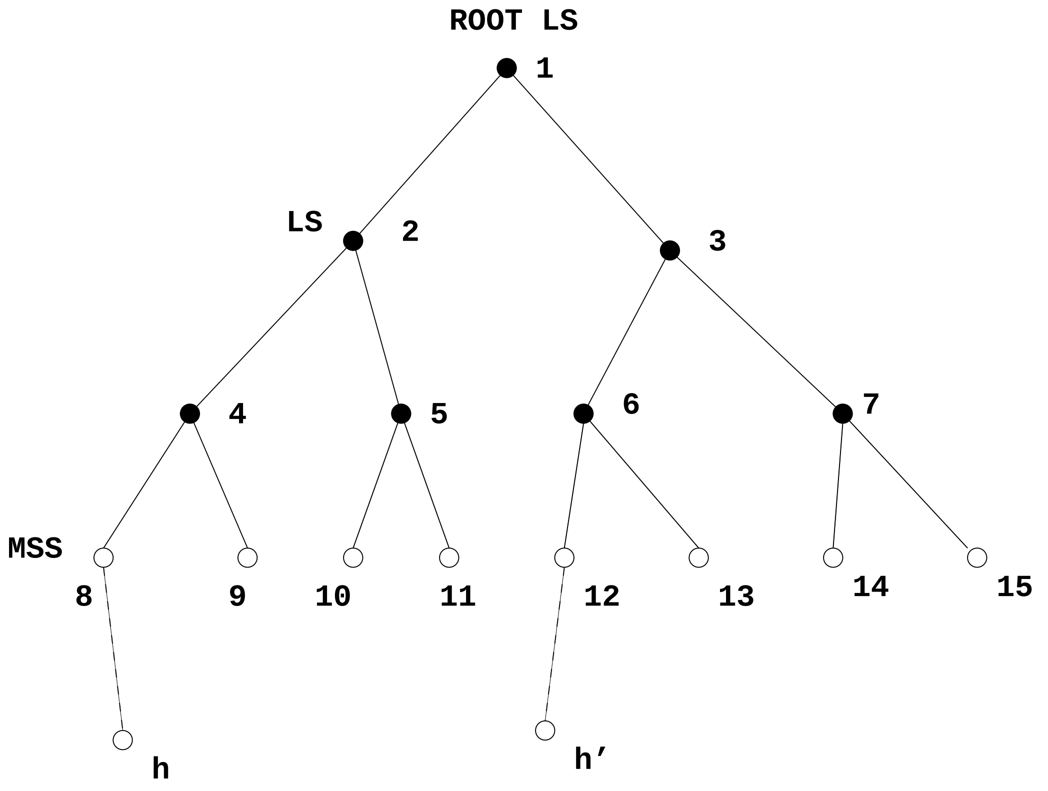
Example : Client Registration



Example : Call Setup



Location Information Replication



- No Home Location Register
- Hierarchy of Location Servers
- Each server maintains information about its subtree
- Root Server maintains information about all mobile clients

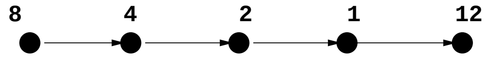
Update Protocols

- Location updates are stored as forwarding pointers
  - They are stored as triples, $< host, dest, time >$
- Lazy Updates : Updates occur only at source and destination MSS's
- Full Updates : Updates occur at all LS's on the paths from source or destination to the root
- Limited Updates : Updates occur at LS's upto a certain height

Search Protocol

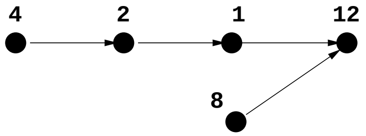
- **Step 1 : If** MSS of cell has entry for h
  - **If** dest = cell, search complete
  - **Else** cell = dest. Repeat Step 1
- **Else** forward query to LS at next level
- **Step 2 : If** LS has entry for h
  - cell = dest. Repeat step 1
- **Else If** LS is root
  - Root broadcasts query to locate host and receives an entry
  - cell = dest. Go to Step 1
- **Else** Forward query to LS at next level. Repeat step 2

Search-Update Protocols

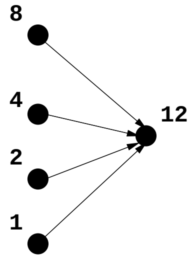


- No Updates

- Jump Updates



- Path Compression Updates



Dynamic Algorithm

- Mobility Measure
- Call Frequency Measure

Thresholds used to determine whether a host is highly mobile or frequently searched.

- Jump Updates used when host is frequently searched and has low mobility or when host has high mobility and low frequency of search
- Path Compression Updates are used otherwise

Other Interesting Work

- Location Strategies for Personal Communication Networks
  - Mobile Computing Group at Rutgers
- Pleiades Project
  - Stanford Database Group
- Location Systems for the Active Office
  - Ollivetti Research and University of Cambridge