# Towards a Bay Area Research Wireless Access Network (BARWAN)

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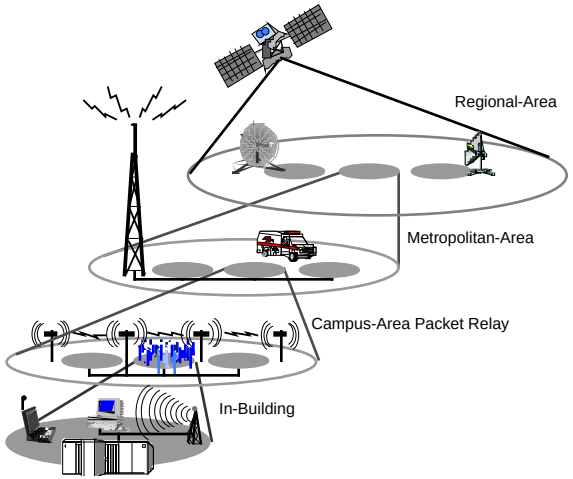
# Wide-Area Wireless Testbed

**Multiple Overlayed Wireless Networks**


**Seamless Mobility Across Overlays**

**Integration with wide-area high performance networks (BAGNet)**
**Bandwidth/latency aware APIs; Wide-area untethered applications**

# Wireless Overlay Concept




**Remote Clinics**

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**Emergency Dispatch**

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**Hospital Campus**

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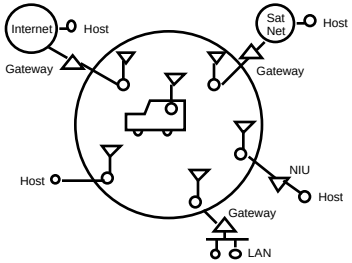
**Hospital**
**Operating Room**
**Emergency Room**



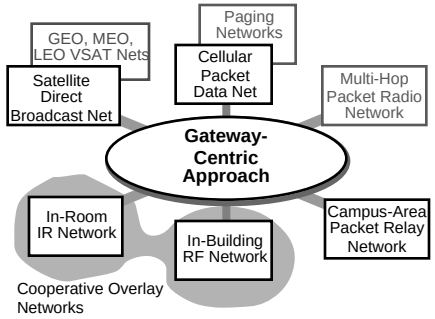
# Application: Emergency Response

# Overlay Internetworking




**Network Centered**

- **Within homogeneous net**
- **No roam between nets**




**Gateway Centered**

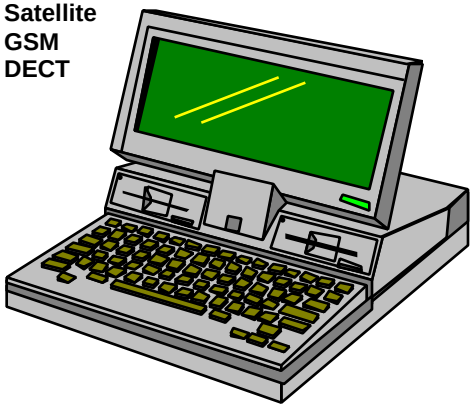
- **Heterogeneous nets**
- **Roam between them**



# Multimode “Radios”

**ITU “Future Public Land Mobile Telecommunications System” (FPLMTS)**

- **Satellite**
- **GSM**
- **DECT**



**PCMCIA #1: IR modem**
**PCMCIA #2: RF modem**
**AT Slot: Hughes DirectPC**
**Floppy Slot: CDPD modem**
**Serial Port: Metricom modem**

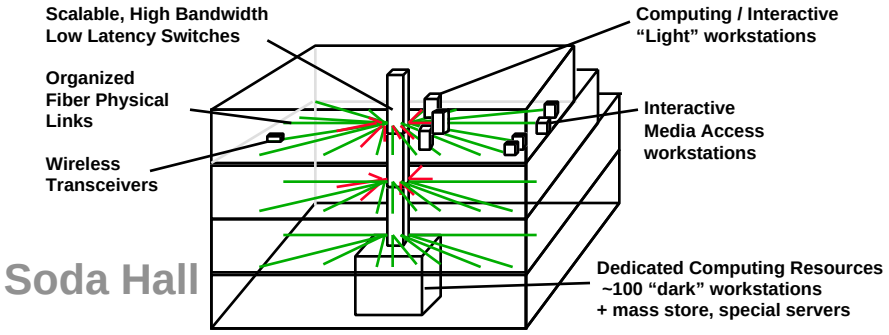
# Characteristics of Alternative Overlay Technologies

| Type of Network | Bandwidth | Latency | Mobility | Typ Video Performance | Typ Audio Performance |
|---|---|---|---|---|---|
| In-Building | >> 1 Mbps<br>Comm'l RF: 2 Mbps<br>Research IR: 50 Mbps | < 10 ms | Pedestrian | 2-Way 'ractive Full Frame Rate (Comp) | High Quality 16-bit Samples 22 Khz Rate |
| Campus-Area Packet Relay Network | ≈ 64 Kbps | ≈ 100 ms | Pedestrian | Med. Quality Slow Scan | Med. Quality Reduced Rate |
| Wide-Area | 19.2 Kbps | > 100 ms | Vehicular | Freeze Frame | Asynchronous "Voice Mail" |
| Regional-Area (LEO/DBS/VSAT) | 4.8 kbps–10+ Mbps (asymmetric) | > 100 ms | Vehicular Stationary | Seconds/Frame Freeze Frame | Asynchronous "Voice Mail" |

**Wide diversity of network performance parameters**
**Mutually distrusting infrastructure providers**
**Pedestrian vs. vehicular mobility**
**APIs that are network-aware**



# State-of-the-Art In-building Networking Infrastructure




**Cooperative In-building Wireless Overlays:**
- **IR for offices, meeting spaces, classrooms**
- **RF overlay for "between" spaces, connectivity load sharing**

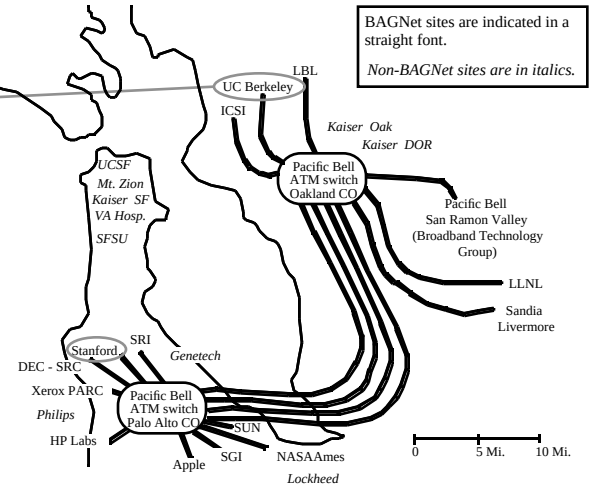
**Integration with building-scale computing resources**

# Wide-Area Wireline Infrastructure

**Wireless-to-wireline gateways in Berkeley**

**Possible exploration of wide-area medical dispatch applications**

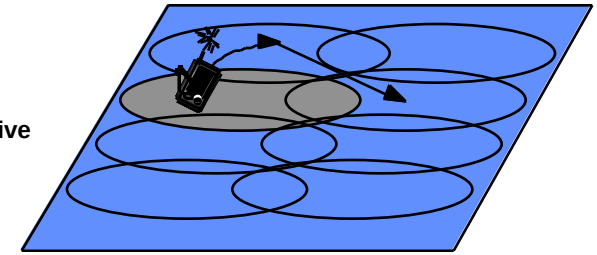
**Integration with wide-area computing resources**






# Mobility Challenges: Horizontal Roaming

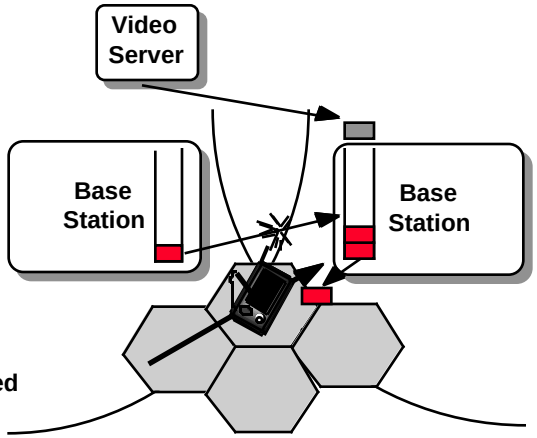
**Single Administrative Domain**



**Roaming within an administrative domain**

- **-- Mobile IP provides initial solution for the routing problem**
- **-- Single authentication with home domain**

# Mobile Handoff: Packet Forwarding

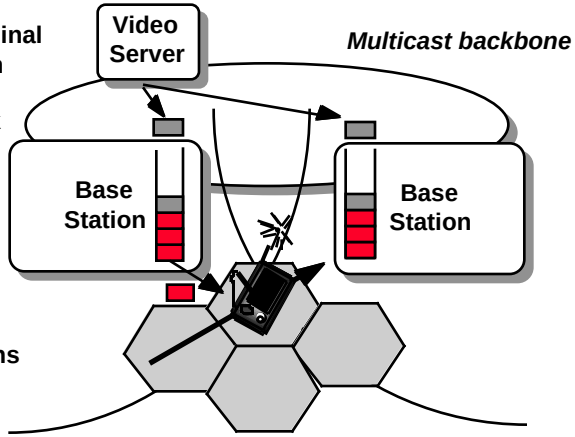



Forward buffered packets at old base station to new base station while rerouted connection is made



# Mobile Handoff: Multicast

Use hints about terminal trajectory to assist in hand-offs to support continuous playback with real-time constraints

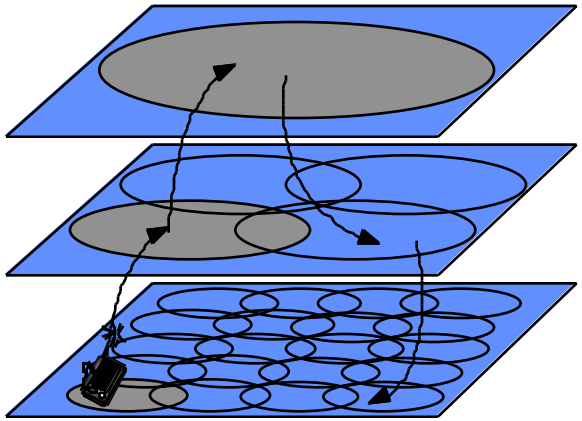



Multicast packets to adjacent base stations to smooth hand-offs

# Mobility Challenges: Vertical Roaming

**Multiple Administrative Domains**

-- Handoff
-- Authentication
-- Routing
– Billing



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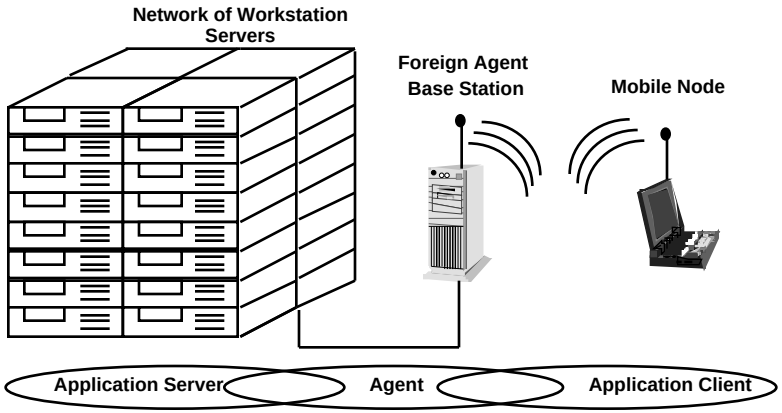
# Application Support

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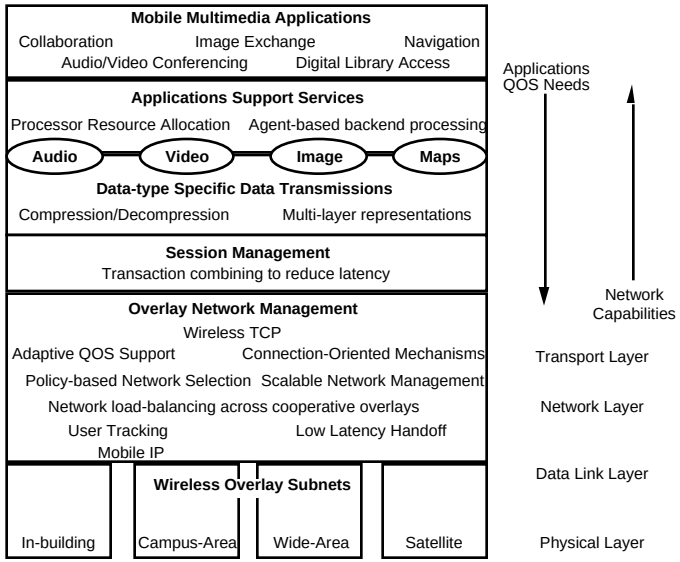
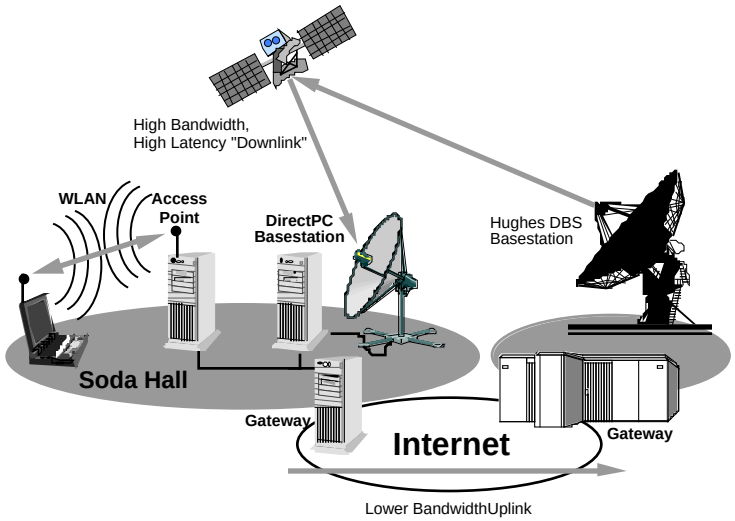
# Layered Architecture

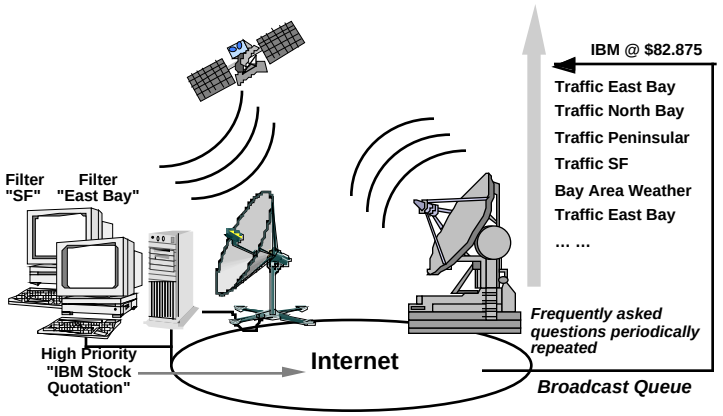





# UCB-Hughes DBS Testbed



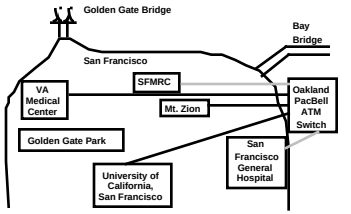
# Satellite Broadcast Application




**Data filtering and query combining**

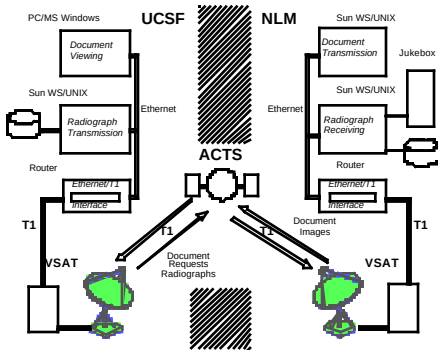


# Collaboration with UCSF

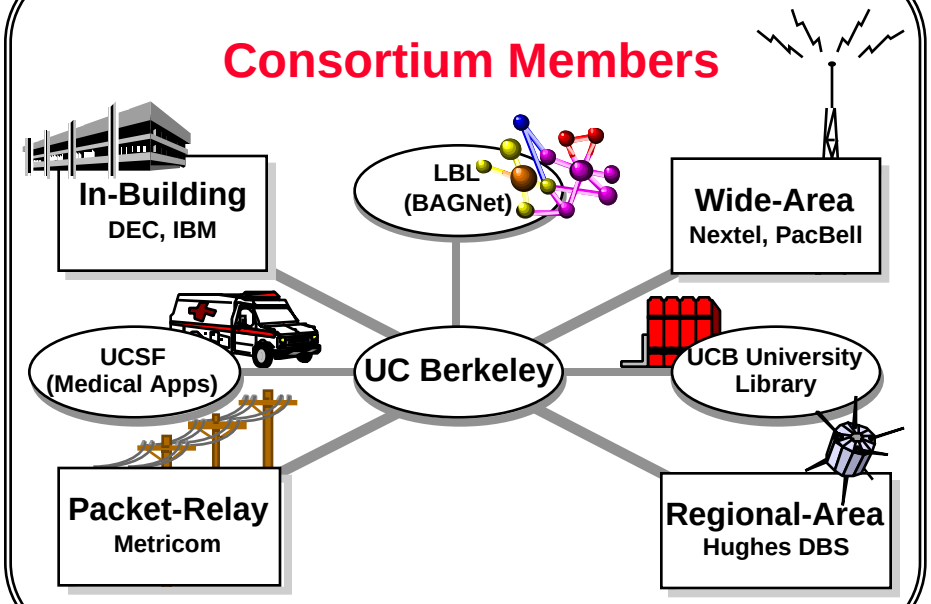



**Picture Archive and Communications System (PACS)**
**linking major hospitals in SF and the National Library of Medicine**

**Laboratory for Radiological Informatics at UCSF**



# Consortium Members






# Research Issues

- **Seamless connectivity over multiple overlays**
  - Implementing low latency handoffs
  - Exploiting movement-tracking and geography
  - Performance characterization of channels
  - Authentication, security, privacy
- **Scalable mobile processing**
  - Hierarchical and distributed network management
  - Load balancing for network mgmt & application support
  - Integration with local- & wide-area networked servers
  - Application support for adaptive connections