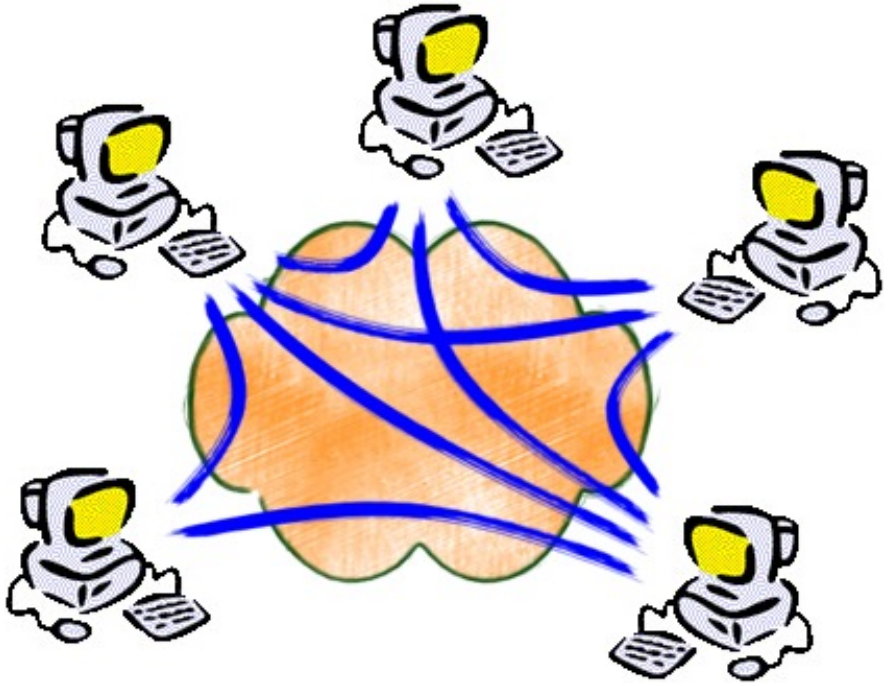
HyperCast

Brief overview

Jorg Liebeherr

University of Virginia

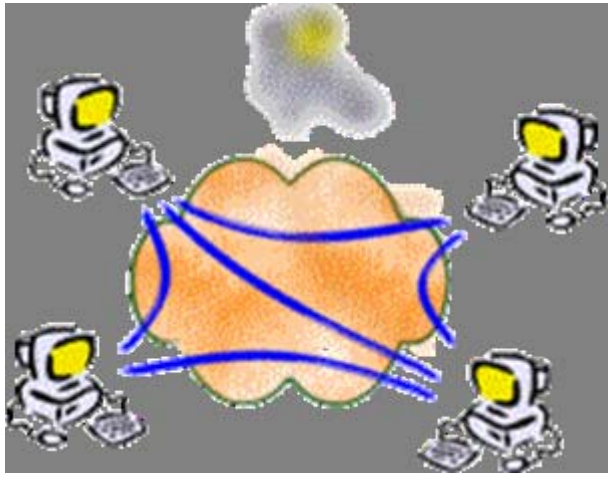


HyperCast Project

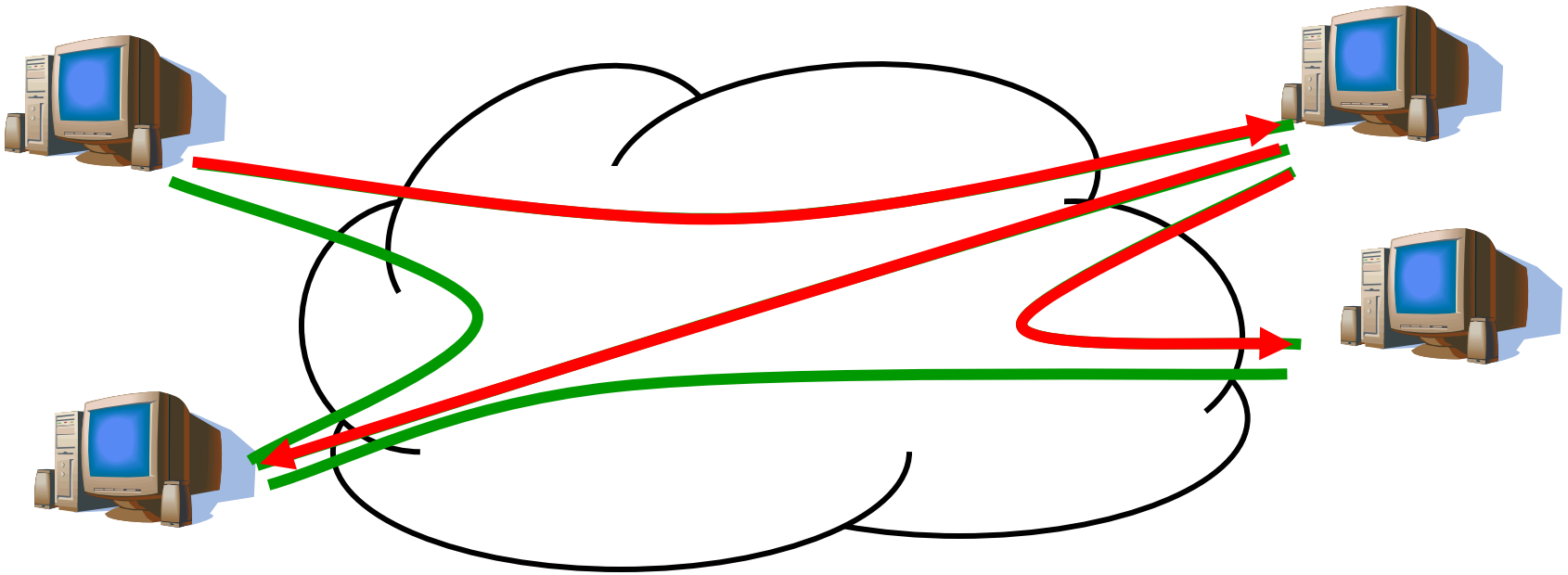
- **HyperCast** is a set of protocols for large-scale overlay networks (P2P networks)

Research Questions:

- How to maintain a very large overlay network that supports
  - … large number of peers
  - … that spuriously join and leave
  - … in a network that is dynamically changing ?
- How to build applications in such a network?



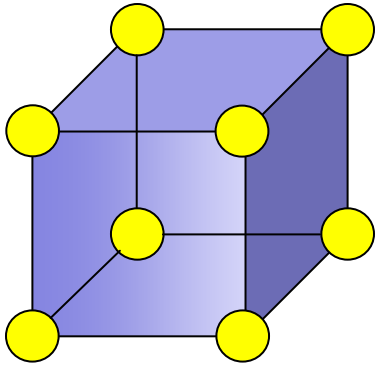
Overlay Network



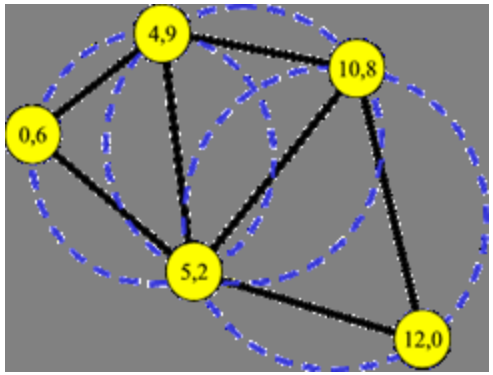
- An **overlay network** is a logical network on top of a substrate network (Internet, ad-hoc wireless network, etc.)
- Data is transmitted between neighbors in the overlay
- Overlay network can support services not available in the substrate network

HyperCast Overlay Topologies

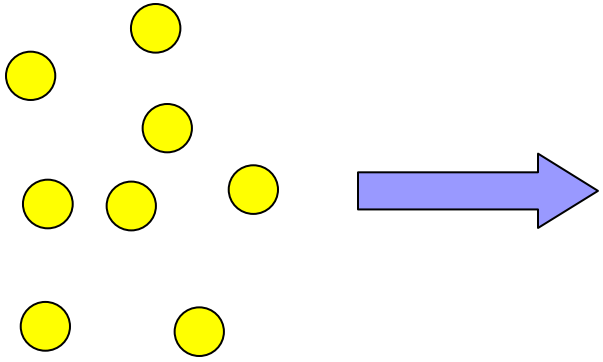
- HyperCast builds application-layer overlay networks
- Applications self-organize to form a given overlay topology
- Data is forwarded along the edges of the overlay topology

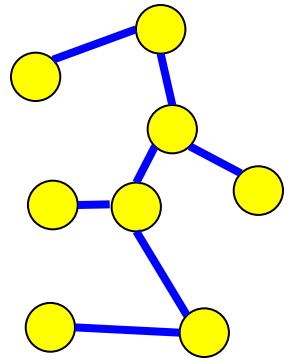


Hypercube



Delaunay triangulation

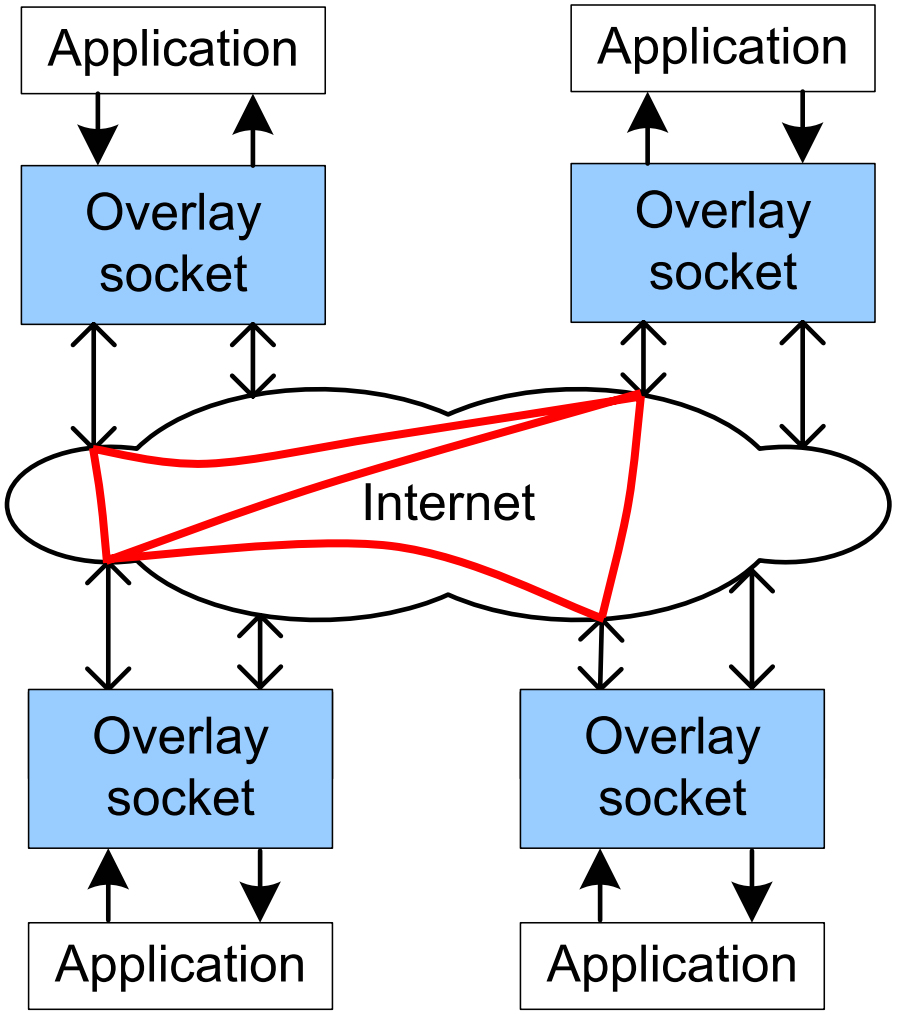




Spanning tree
(for mobile ad hoc)

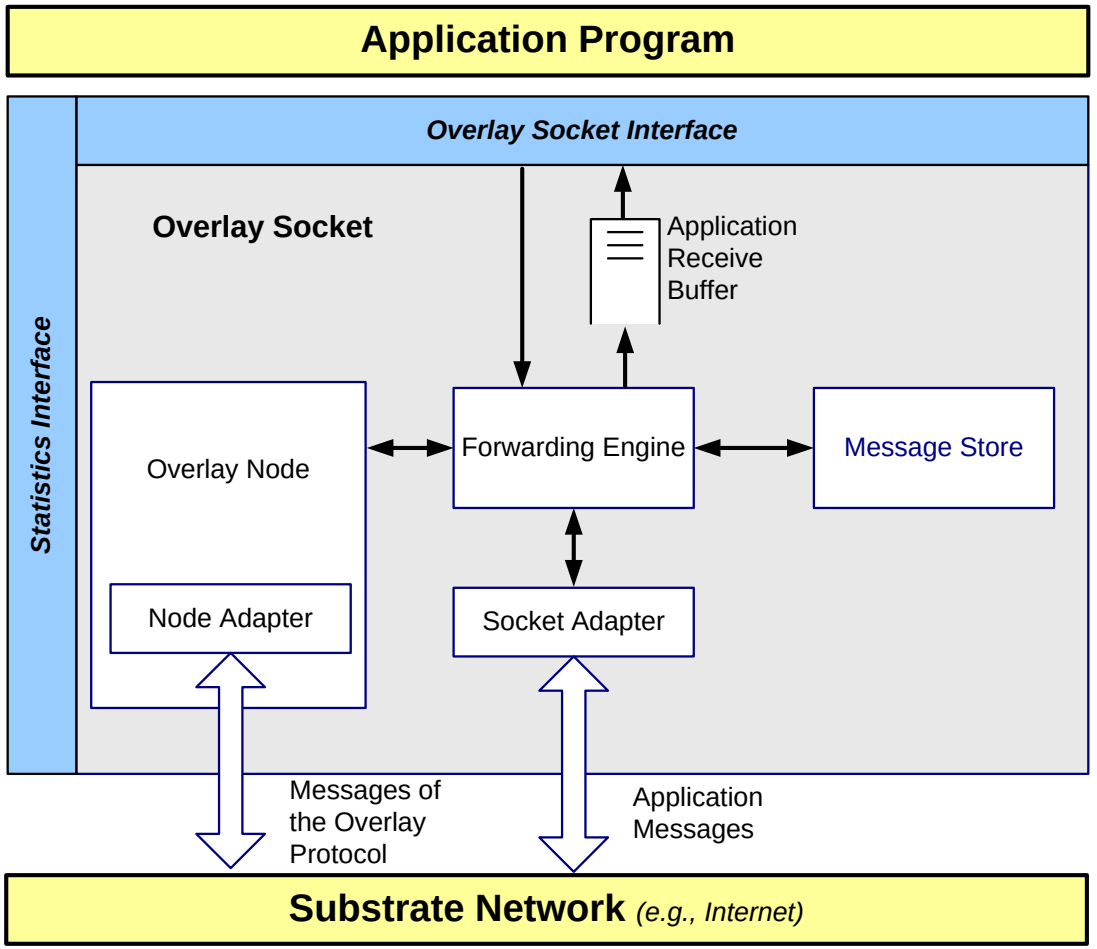
Network of overlay sockets

- An **overlay network** is a collection of overlay sockets



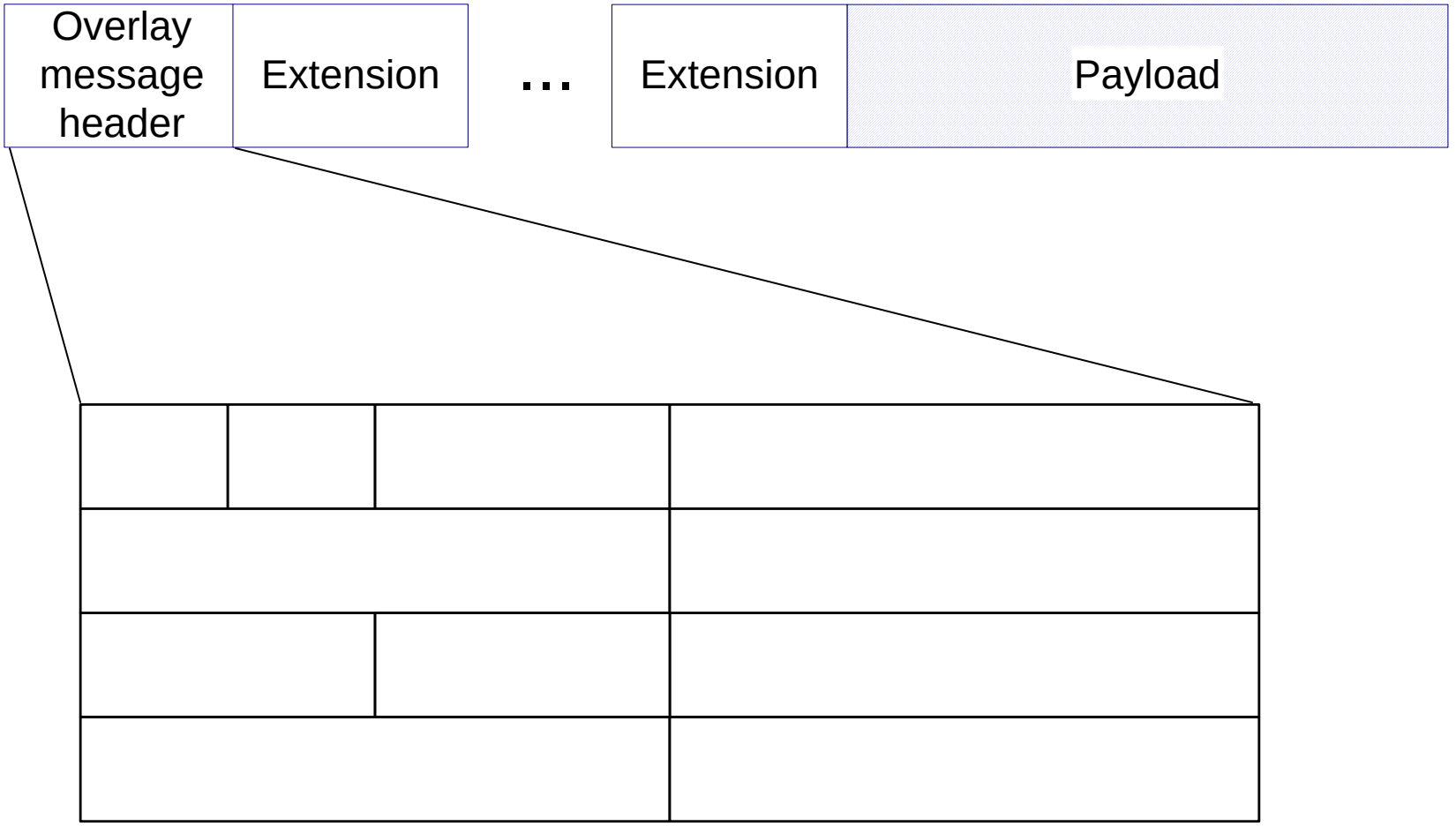
Overlay Socket

- Socket-based API
- Supports different semantics for transport of data
- Supports different overlay topologies
- Supports different protocols in substrate network (UDP unicast, UDP multicast, TCP, or SSH tunnels)
- Implementation in Java



Message Formats

Loosely modeled after IPv6 → minimal header with extensions



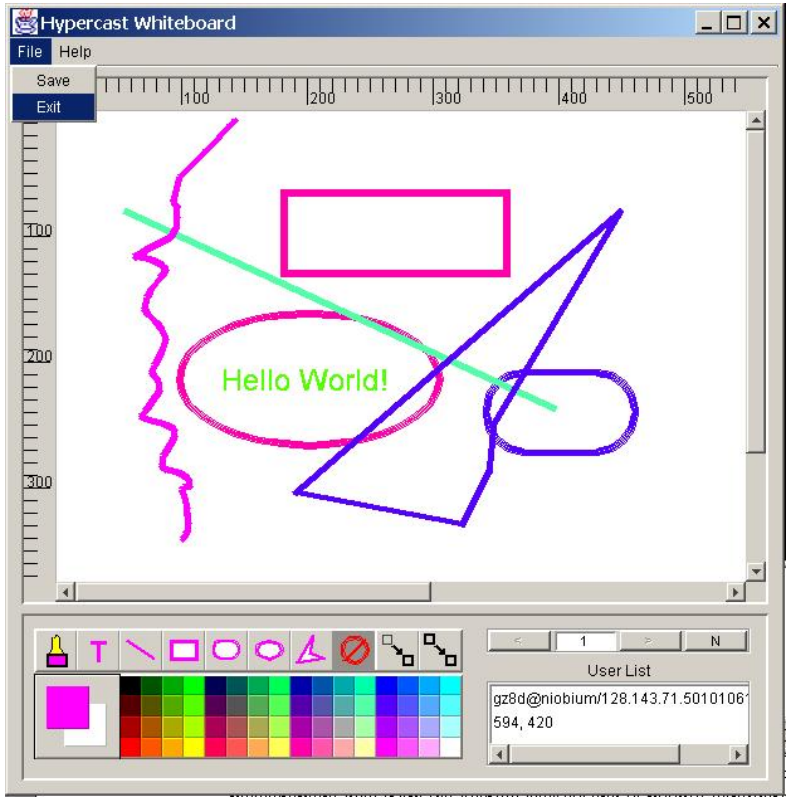
Socket Based API

- Tries to stay close to Socket API for UDP Multicast
- Program is independent of overlay topology

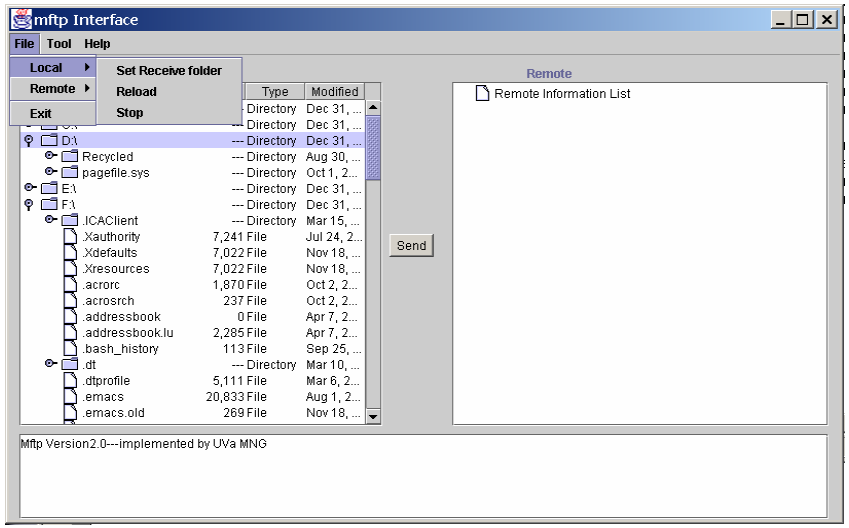
```
//Generate the configuration object
OverlaySocketConfig ConfObj =
          OverlaySocketConfig.createOLConfig("hypercast.xml");

//Create an overlay socket
 I_OverlaySocket socket=ConfObj.createOverlaySocket(null);

//Join an overlay
socket.joinOverlay();

//Create a message
OL_Message msg = socket.createMessage(byte[] data);

//Send the message to all members in overlay network
socket.sendToAll(msg);

//Receive a message from the socket
OL_Message msg = socket.receive();

//Extract the payload
byte[] data = msg.getPayload();
```

Hypercast Software: Demo Applications

Distributed Whiteboard

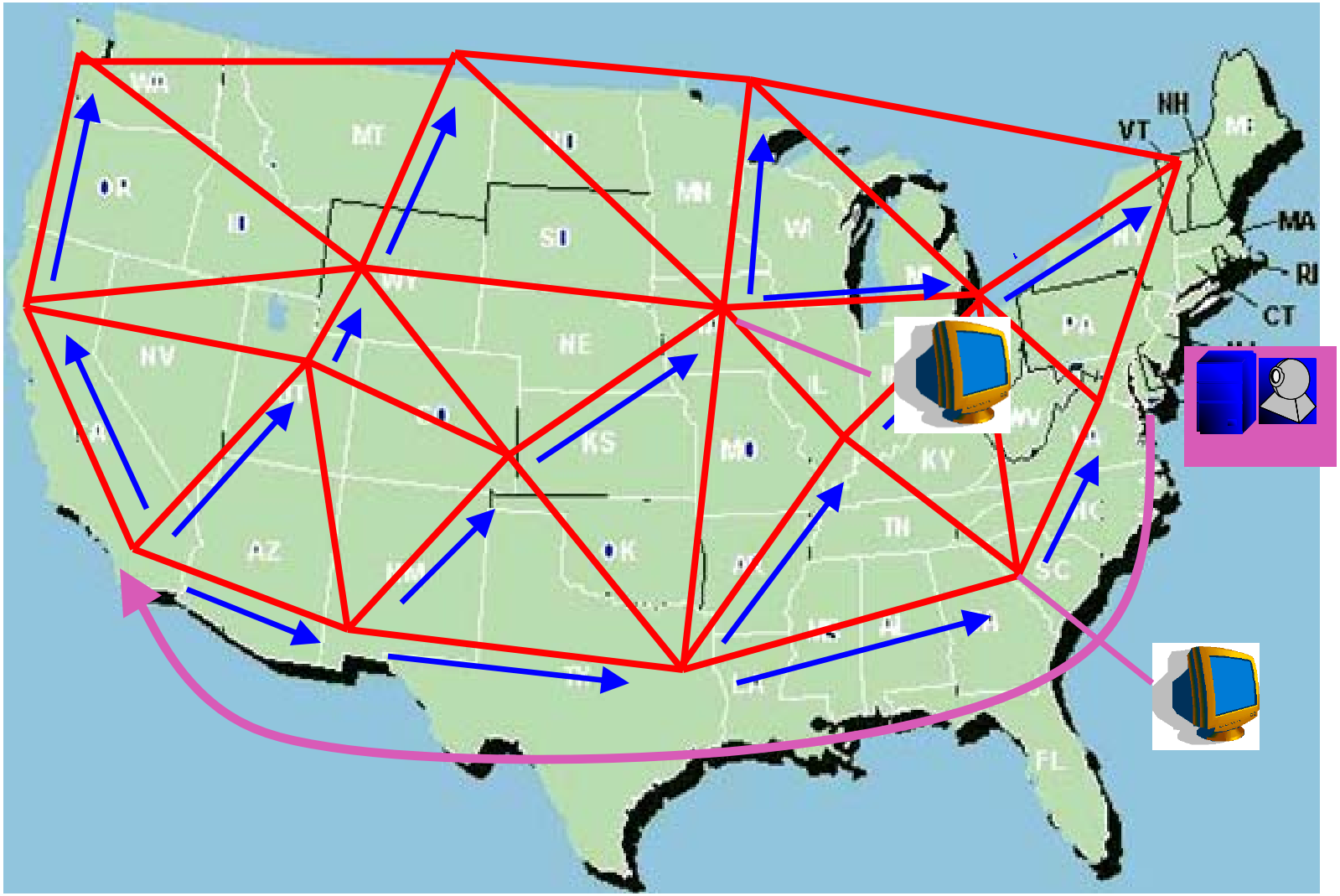


Multicast file transfer

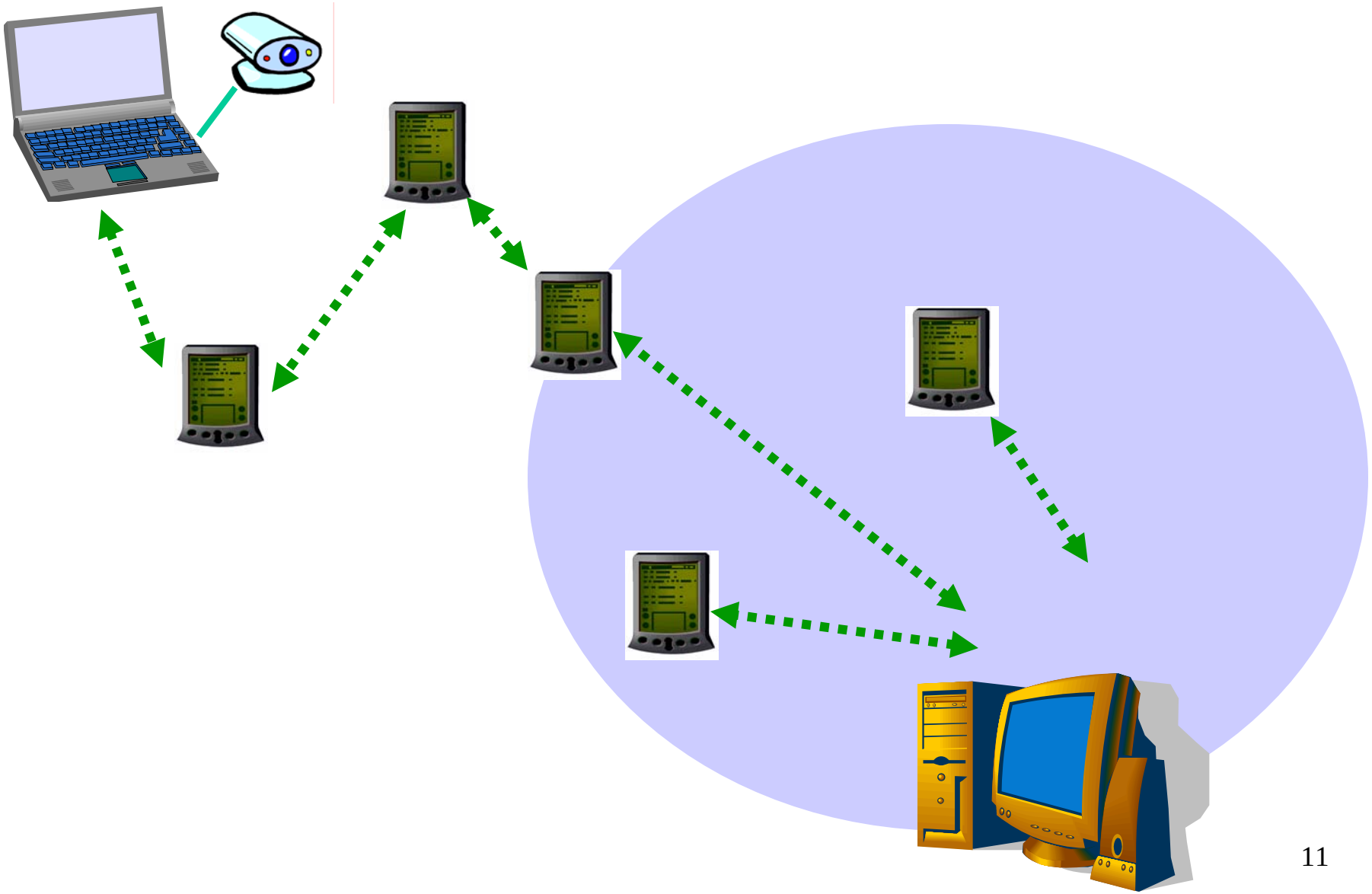


Data aggregation in P2P Net: → *CS757 Homework*

Video Streaming over Internet

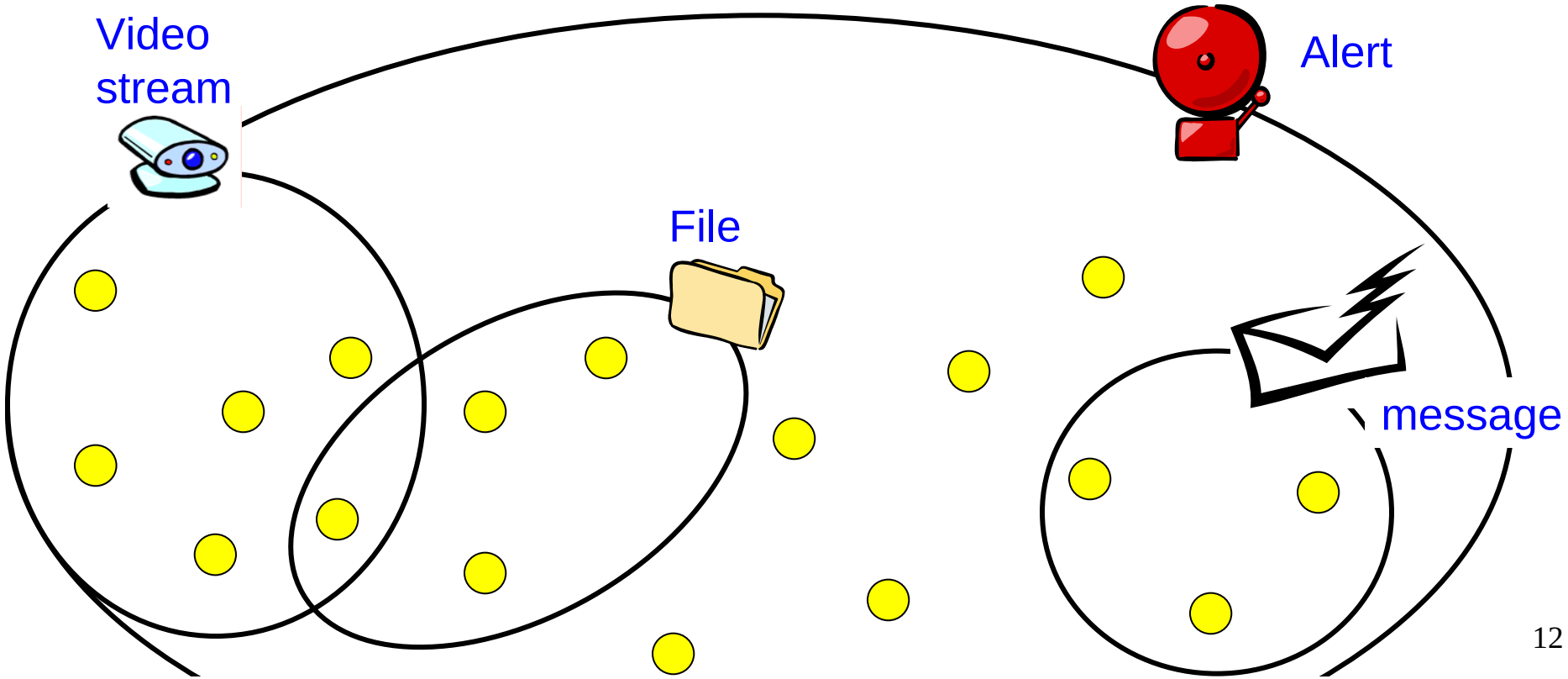


Video-streaming in ad-hoc network

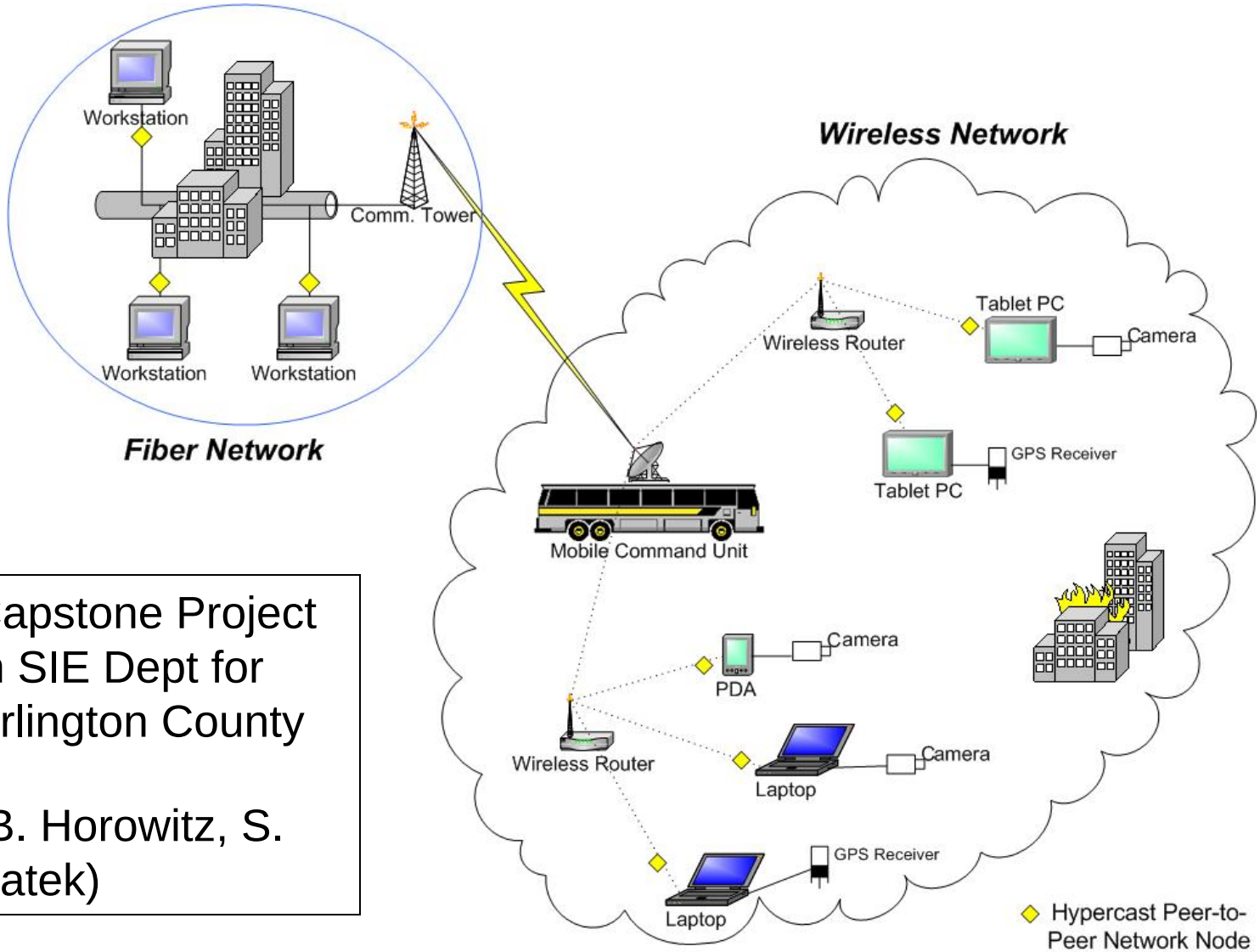


Overlay networks and Information Management

- An application can be a member of many overlay networks
- Access to information is provided through dynamically created overlay networks



Application: Emergency Response Network



Capstone Project in SIE Dept for Arlington County

(B. Horowitz, S. Patek)

Summary

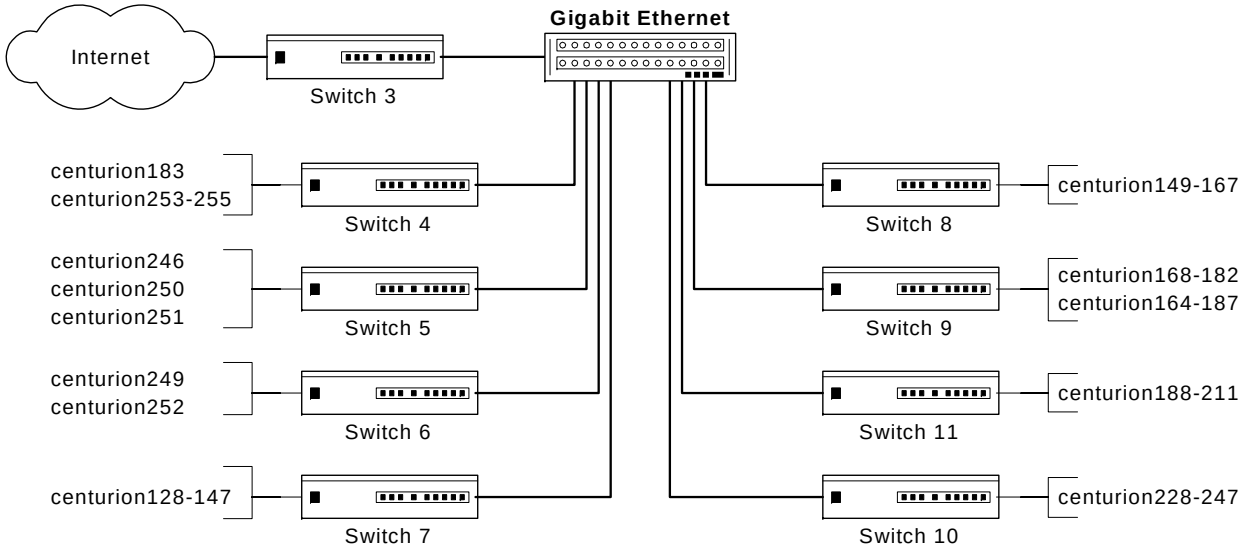
- **HyperCast** is software for application layer overlay networks
- Overlay socket is a programming interface for overlay networks:
  - Independent of type of overlay network
  - Independent of type of substrate network
- Intensive experimental testing in local and wide-area tesbeds
- Several proof-of-concept applications.
- Currently extended to wireless sensor networks (for US Army)

HyperCast web site: **http://hypercast.org**

Design documents, download software, user manual
Release of Java implementation under Library GNU license.

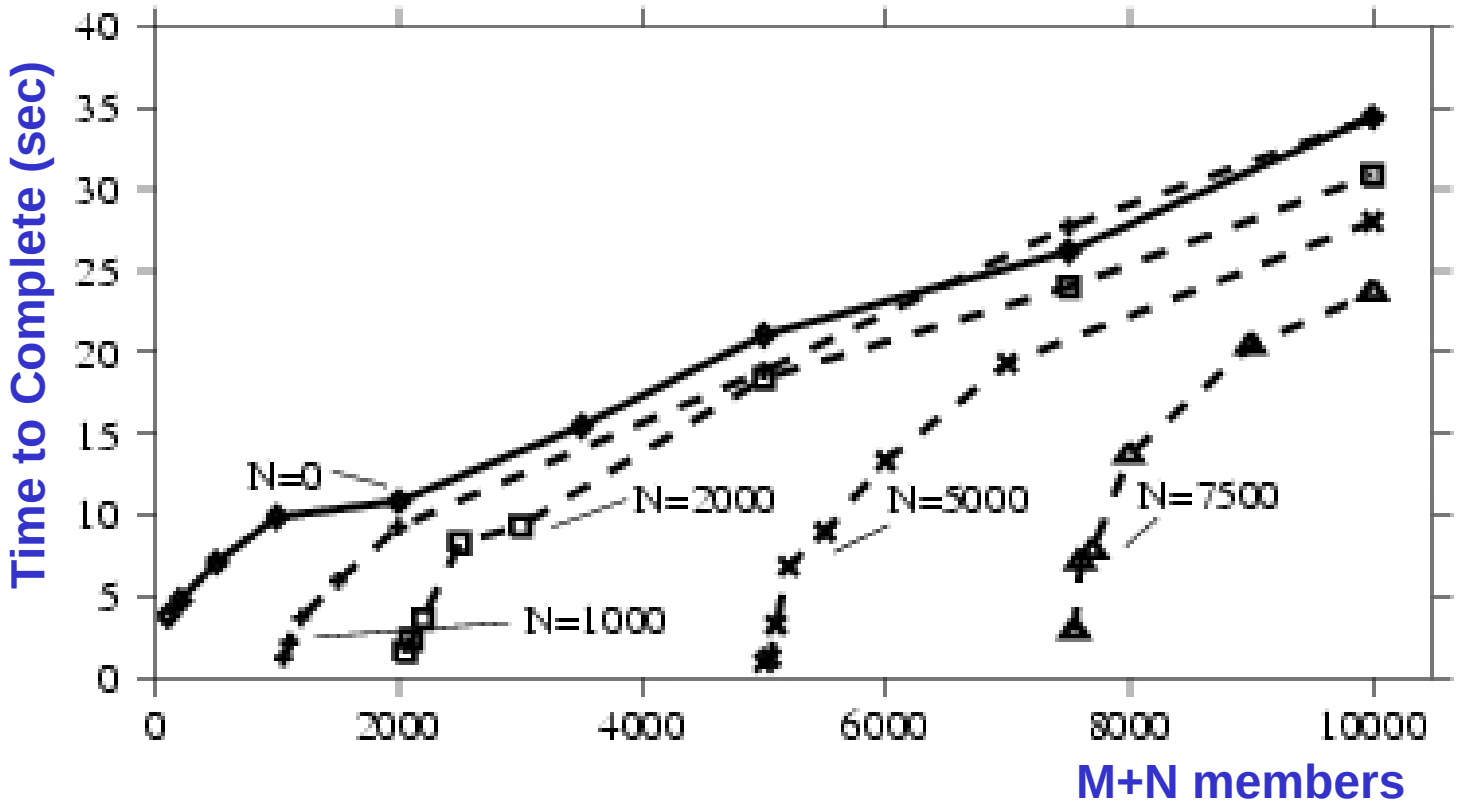
Local Area Experiments

- **Experimental Platform:**
  Centurion cluster at UVA (cluster of 300 Linux PCs)
  - **2 to 100 PCs**
  - **1 to 100 members per PC**
    → 2 to 10,000 overlay members



Experiment: Adding Members

How long does it take to add M members to an overlay network of N members ?



Experiment: Throughput of Multicasting

100 MB bulk transfer for N=2-100 members (1 node per PC)
10 MB bulk transfer for N=20-1000 members (10 nodes per PC)