Engineering Research Center for
Collaborative Adaptive Sensing of the Atmosphere

An Application-Aware Overlay Networks Architecture & API

Tarun Banka, Panho Lee, H. M. N. Dilum Bandara, and Anura P. Jayasumana

Department of Electrical and Computer Engineering,
Colorado State University, Fort Collins, CO 80523.

Dilum Bandara
dilumb@engr.colostate.edu


University of Massachusetts Amherst


University of Oklahoma

Colorado State University


University of Puerto Rico Mayaguez

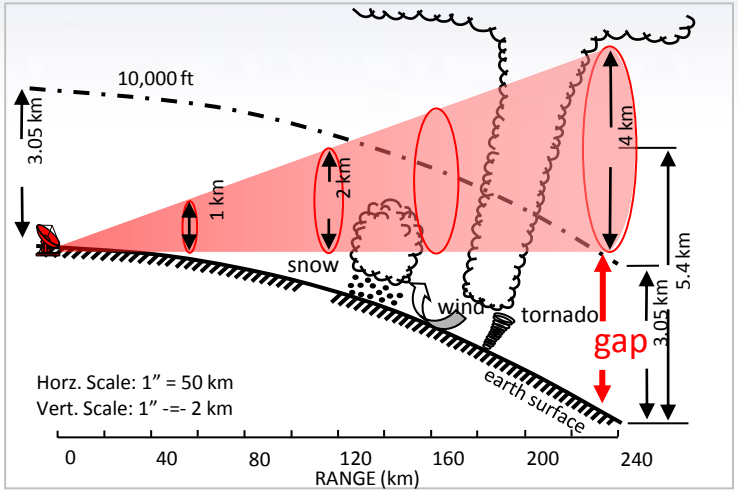
CASA is primarily supported by the Engineering Research Centers Program of the National Science Foundation under NSF award number 0313747.

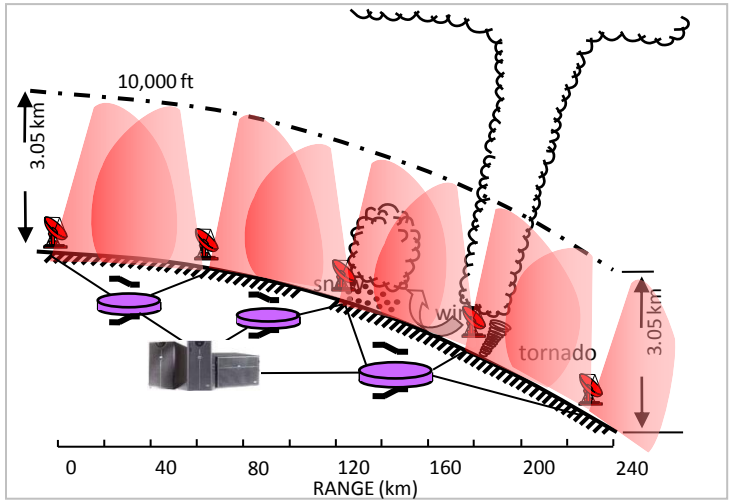
Outline

- CASA
- Application aware networks
- Overlay networks
- AWON architecture & API
- What's ahead

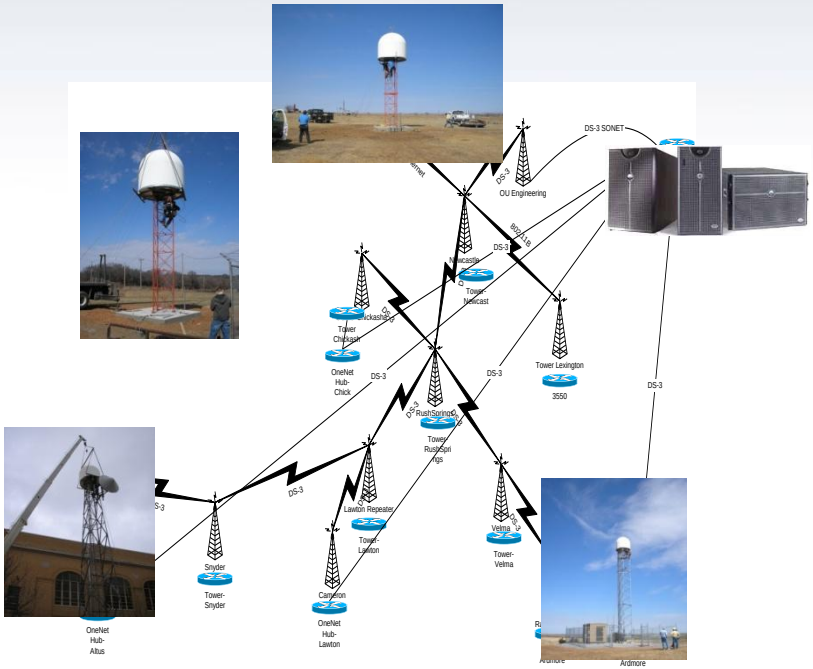
Collaborative Adaptive Sensing of the Atmosphere (CASA)

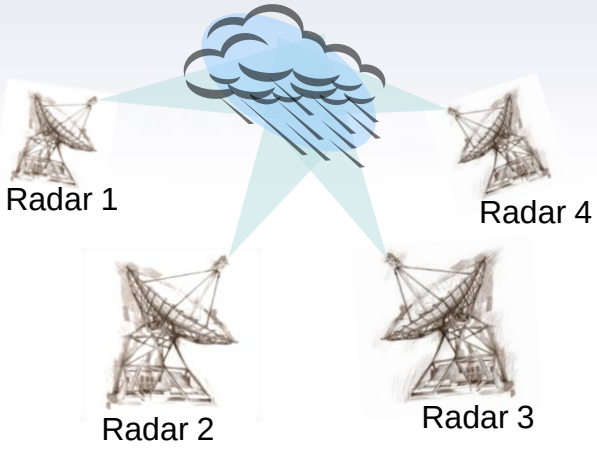
- Concept
  - A set of networked small radars instead of a large radar
  - Sense lower 3 km of atmosphere
  - Collaborating radars:
    - Improved sensing, detection, & prediction
- Goal
  - Improve warning time & forecast accuracy for hazardous weather

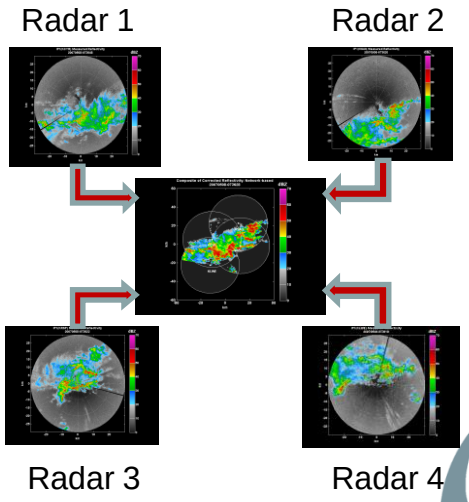




CASA Oklahoma Test-bed



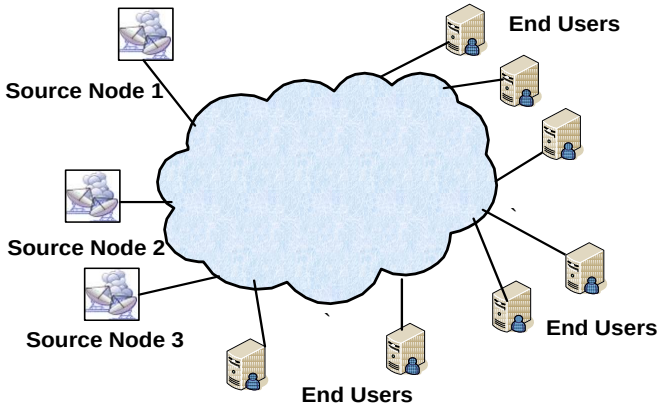




- Multiple high bandwidth streams
- Real-time communication
- Heterogeneous infrastructure & end users
- Simultaneous observations by multiple radars
- Multi-sensor data fusion
- Hostile weather conditions

Challenges

- Distributed Collaborative Adaptive Sensing (DCAS)
  - Sensing, processing, & storage elements are interconnected via the Internet
  - High bandwidth data streams
  - Real-time communication
  - End users rely on different subsets of data



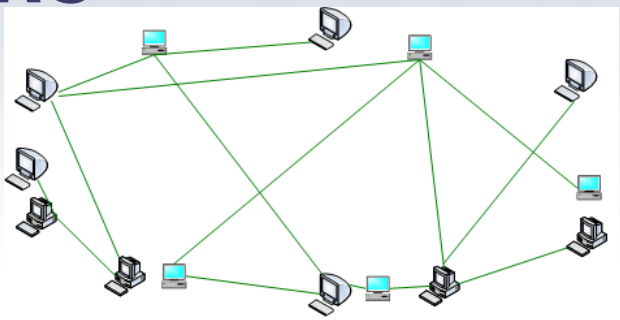
- Adapting to varying network conditions
- QoS perceived by end users depends on
  - Timeliness & usefulness of received data
  - Jitter, excessive delay, & random packet losses
- End-host based correction/adaption is not effective

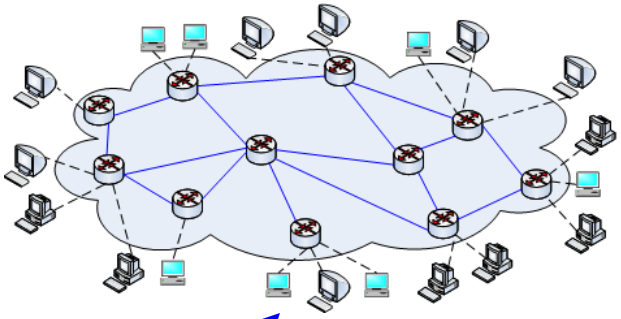
Application Aware Networks (AANs)

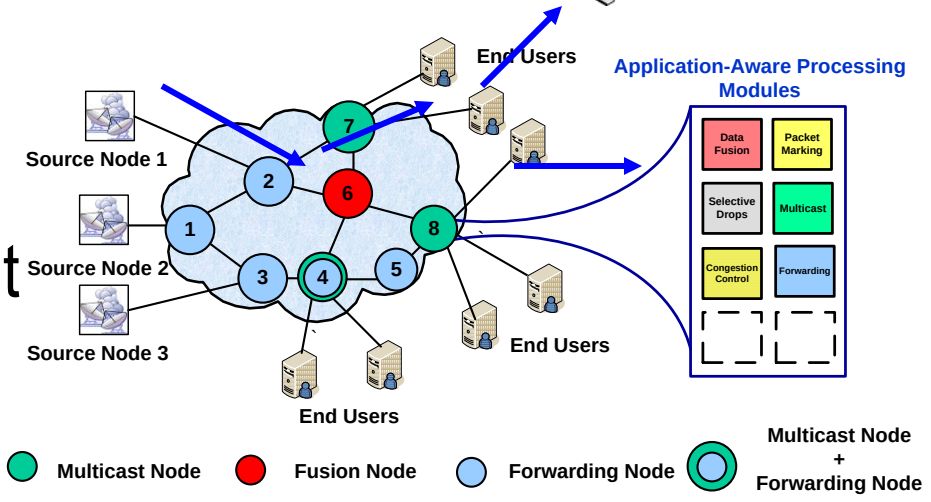
- Networks that implicitly or explicitly learn about the application characteristics & adapt their forwarding strategy to meet the application requirements in the best possible way
- Possibilities
  - Application aware packet forwarding
  - In-network application aware processing & storage
  - Enhance the adaptability of applications
  - Enhanced QoS provided to end users
- Current networks are not application aware
  - Lack of hardware & architectural support
- Overlay networks are a viable solution

Overlay Networks

- A computer network built on top of another network
  - e.g., dial-up Internet, P2P
- Application layer solution
- Virtual links between overlay nodes
- Overlay routing
  - Control path/link selection
  - QoS enhancement
- Application-aware processing at intermediate nodes

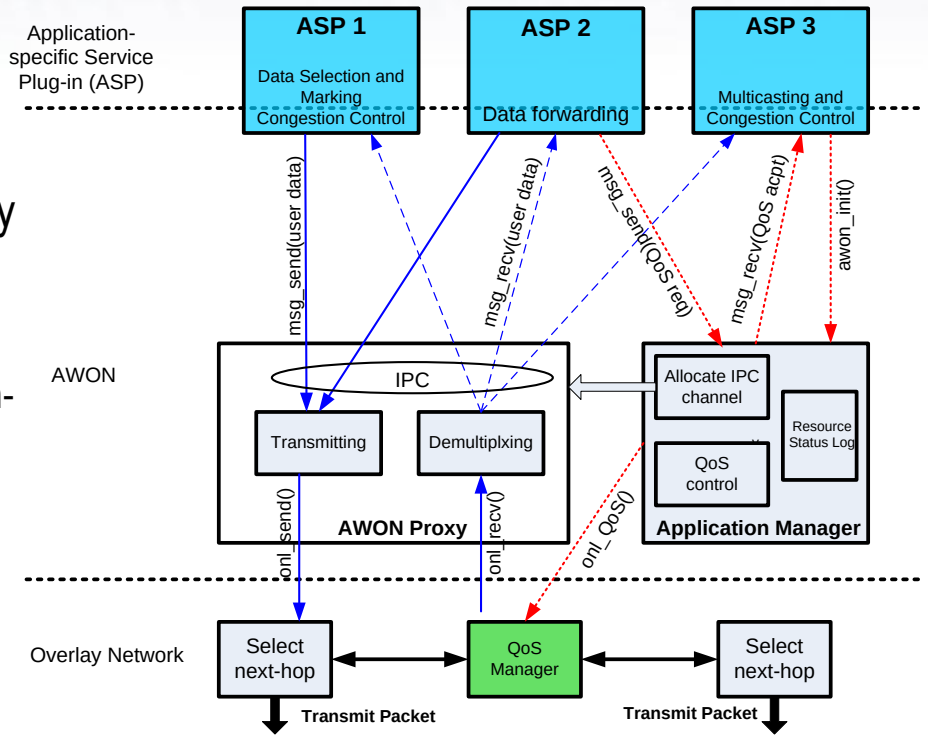




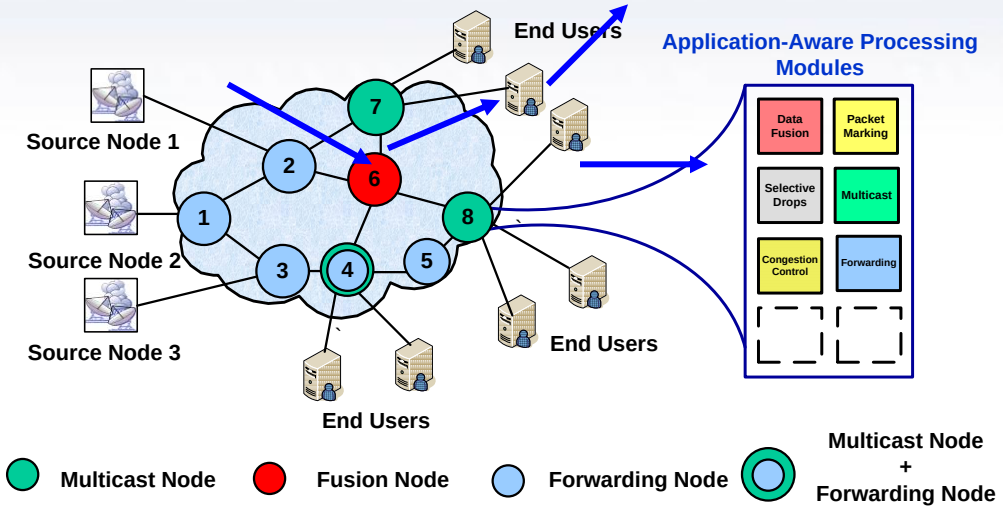


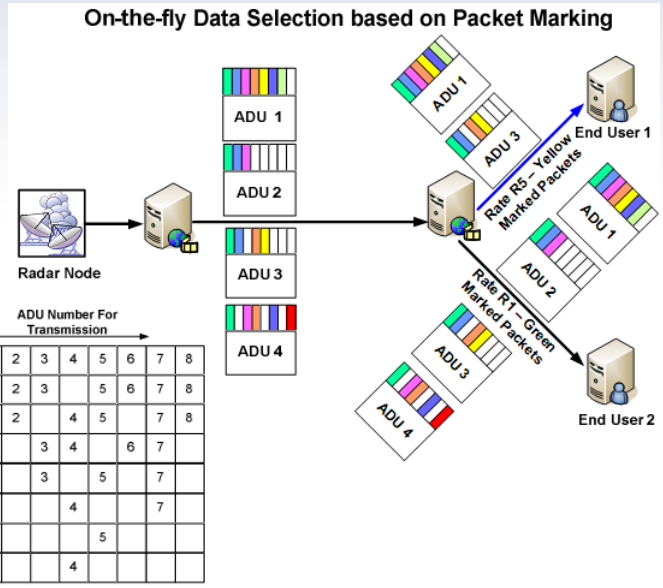
Application-Aware Overlay Networks (AWON) Architecture

- An architectural framework to deploy AAN services
  - ASP - Application-specific Service Plug-in
  - ASPs inject application specific functionality into overlay nodes
  - API for easy deployment of ASPs
    - www.cnrl.colostate.edu/Projects/AWON/awon-api.0.1.tar.gz
- ASPs regulate flow of data through overlay nodes
  - Taking application specific constrains into account
  - Extract, select, fuse, & repack data
- Overlay routing protocol provide desired QoS support

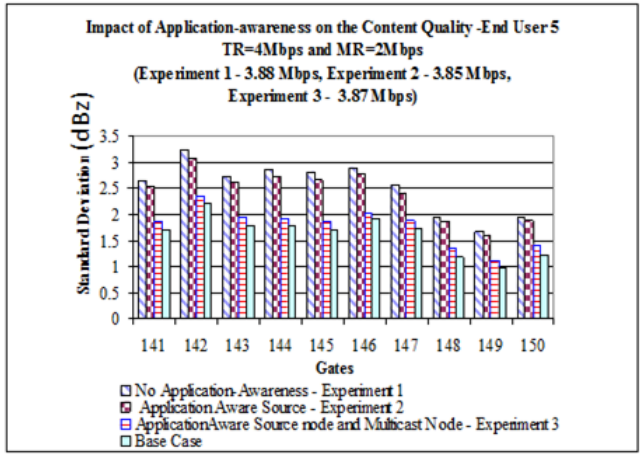


AWON (cont.)





- Different AAN services
- Application specific content delivery under varying network conditions
- Better quality in content delivered to end users



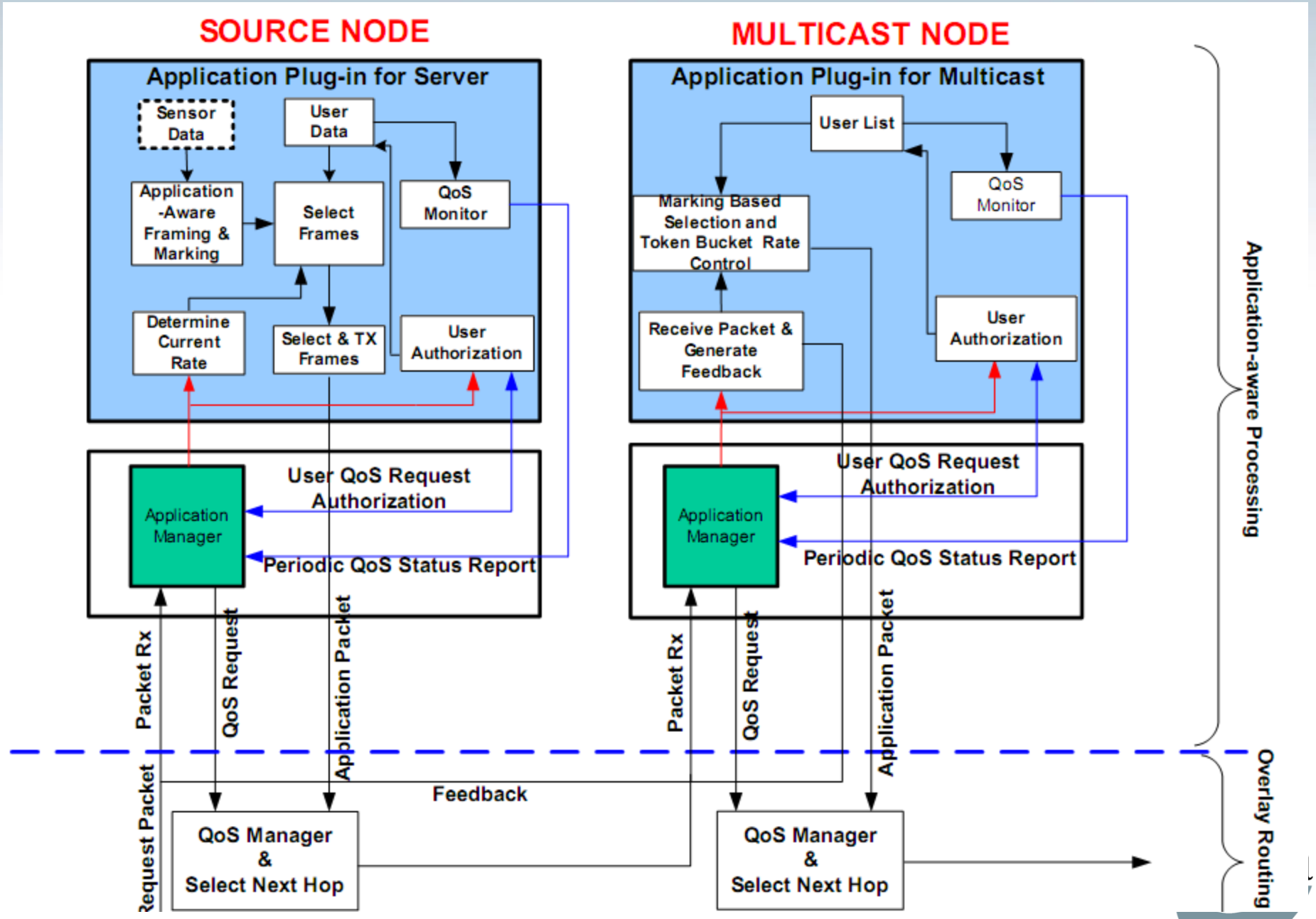
Measurements on PlanetLab

What's Ahead

- Basic functions of overlay networks will eventually be migrated into network elements
- Potential for in-network processing & storage
  - However, resources per application will still be limited
- Renewed interest in AANs
  - Vendors are interested in architectural support
- AWON architecture would be a suitable reference framework in realizing the AAN paradigm
  - Overlay networks, AANs → P2P based in-network fusion
- How to distribute ASPs?
  - Online installation, micro-programs in packets, etc.
  - Need programming & protocol description languages

Questions ?

Thank You…


SOURCE NODE
MULTICAST NODE
Application Plug-in for Server
Sensor Data
User Data
Application -Aware Framing & Marking
Select Frames
QoS Monitor
Determine Current Rate
Select & TX Frames
User Authorization
Application Plug-in for Multicast
User List
QoS Monitor
Marking Based Selection and Token Bucket Rate Control
Receive Packet & Generate Feedback
User Authorization
Application Manager
User QoS Request Authorization
Periodic QoS Status Report
Application Manager
User QoS Request Authorization
Periodic QoS Status Report
Application-aware Processing
Packet Rx
QoS Request
Application Packet
Packet Rx
QoS Request
Application Packet
Request Packet
Feedback
QoS Manager & Select Next Hop
QoS Manager & Select Next Hop
Overlay Routing