

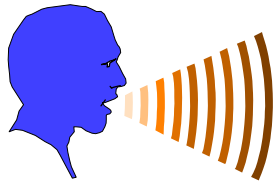


EEL 6935

Special Topics in Multimedia Communications and Networking

Scalable Video Transport over Wireless IP Networks

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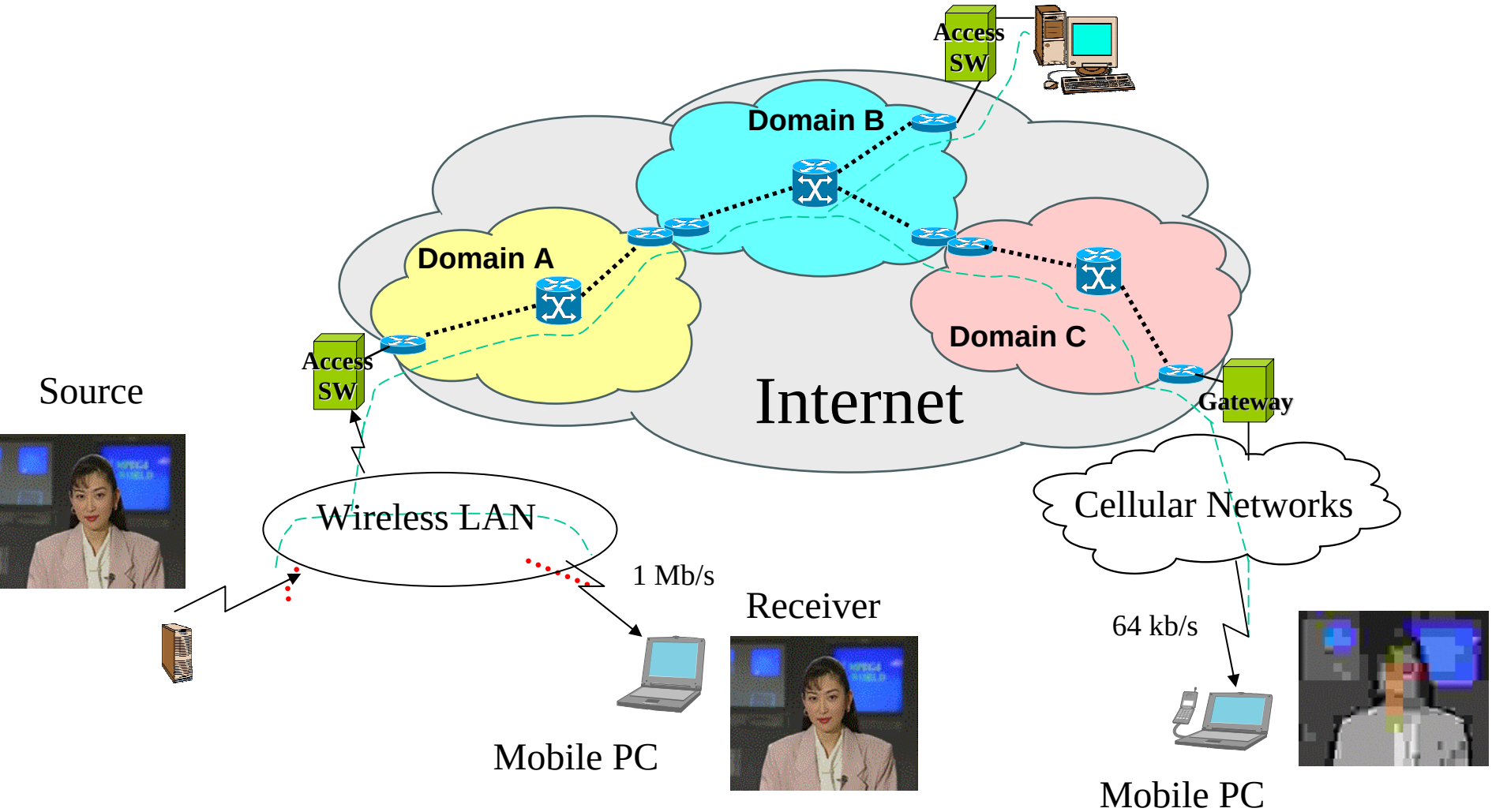
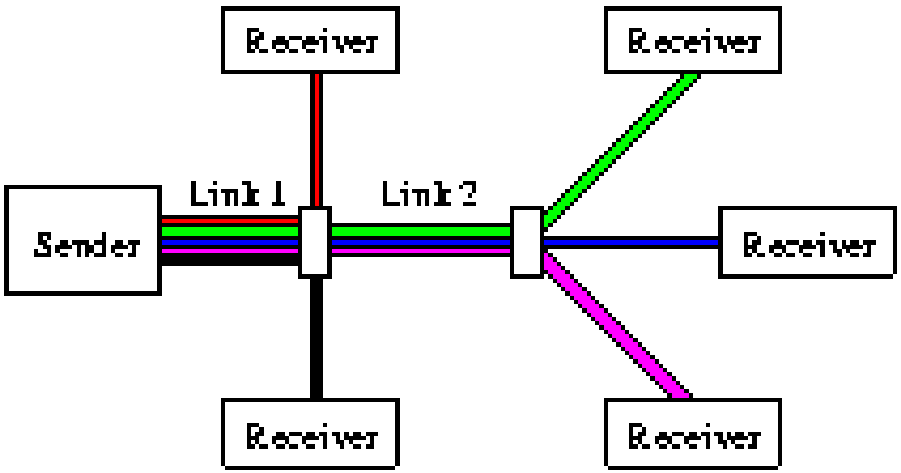
Bandwidth Fluctuations



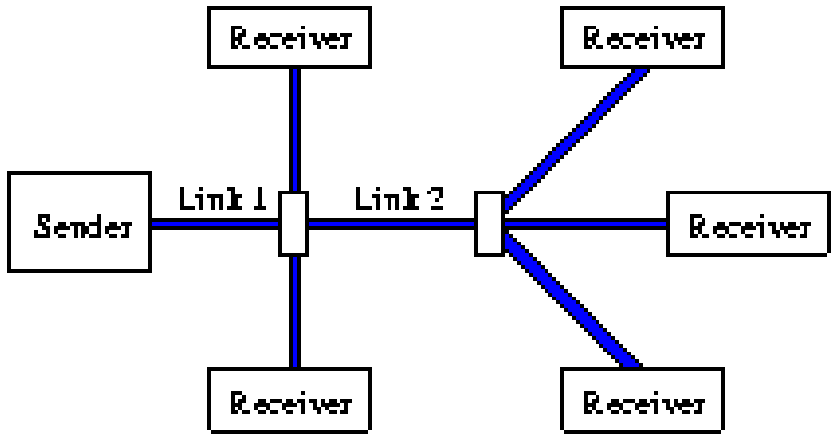
Challenges

- Unreliability
  - Fading
  - Noise
- Bandwidth fluctuations
  - Moving between different networks (LAN to WAN)
  - Hand-off
  - …
- Heterogeneity for multicast

Unicast vs. Multicast



Unicast

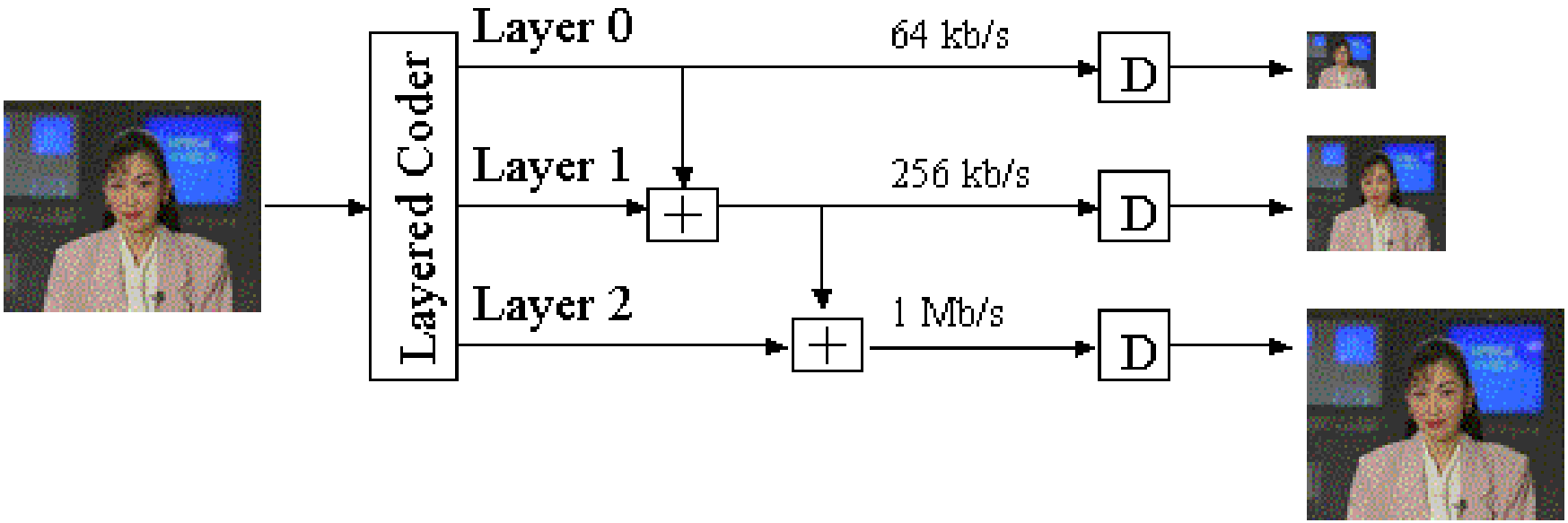


Multicast

Three Independent Techniques

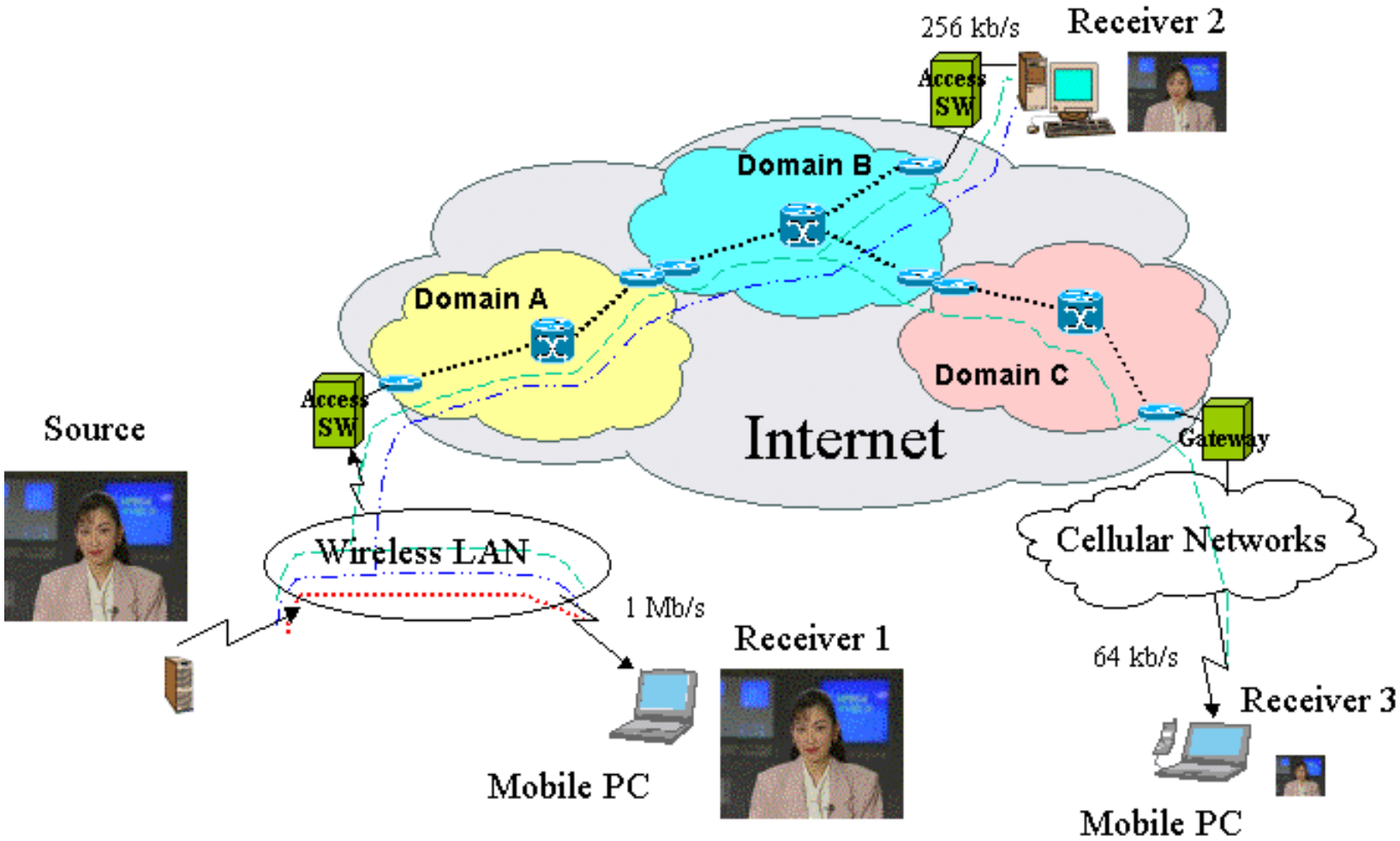
- **Scalable video coding**
- **Network-aware adaptation of end systems**
  - **Network awareness**
  - **Adaptation**
- **Adaptive QoS support from networks: *adaptive services***

Scalable Video Representations



Layered video encoding/decoding. D denotes the decoder.

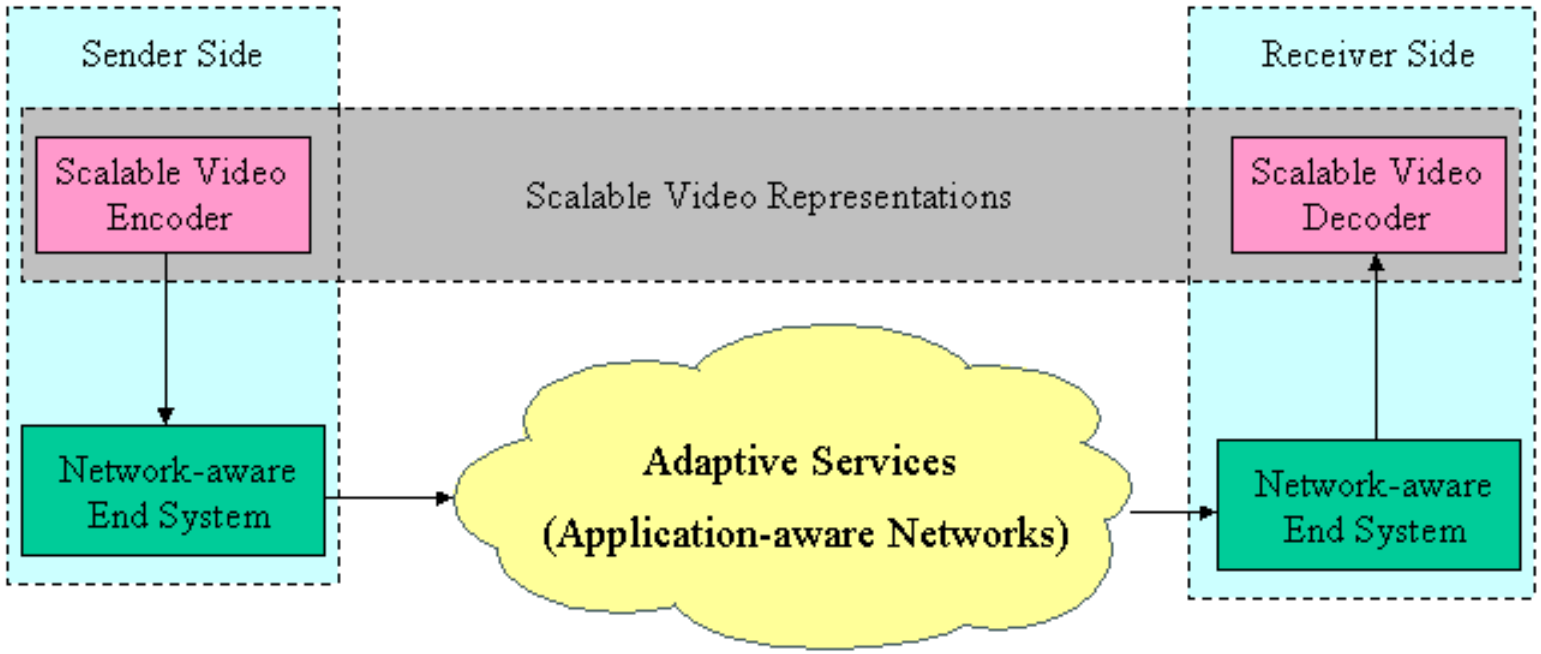
An Application: IP Multicast



Our Approach

- **Unify the three techniques:**

  an adaptive framework



Outline

- Challenges for video over wireless IP networks
- An adaptive framework for video over wireless IP networks
  - Scalable video representations
  - Network-aware end systems
  - Adaptive services
- Summary

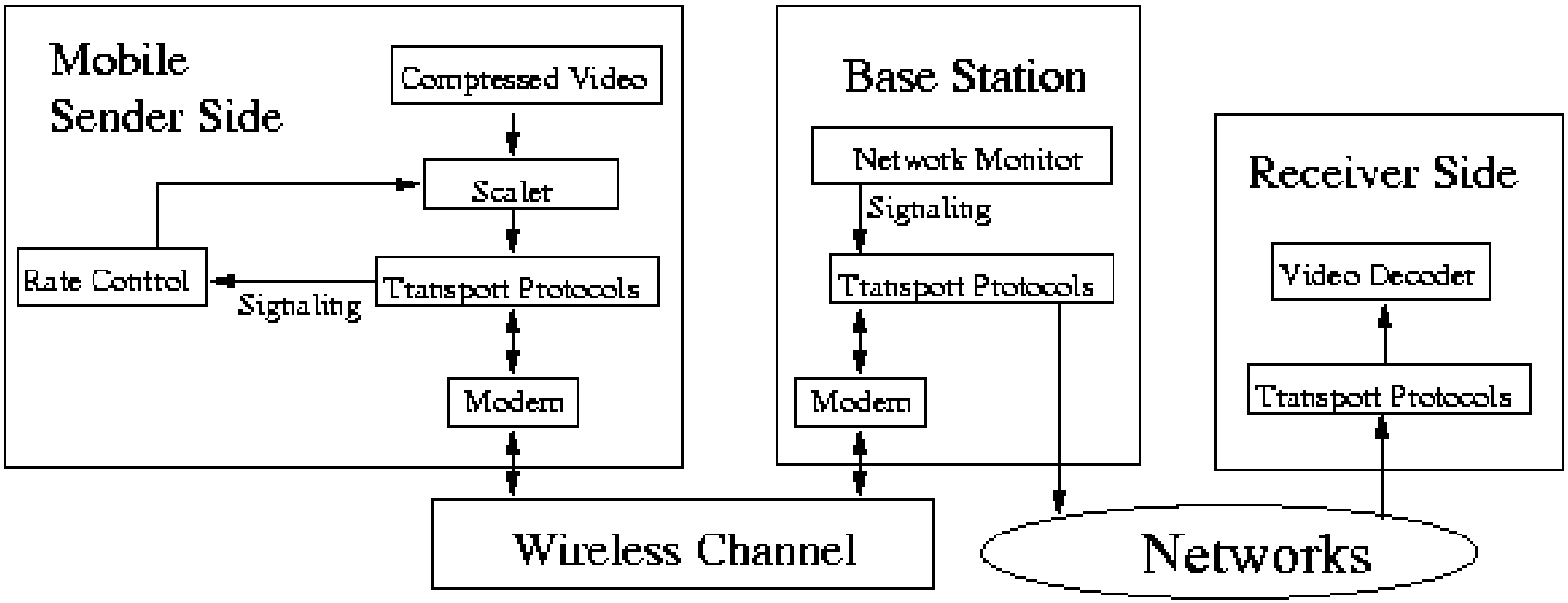
Network-aware End Systems

- Why using network-aware end systems?
  - All layers may get corrupted with equal probability without awareness of channel status
- How?
  - Discard enhancement layers at the sender based on network status
- Network-aware adaptation:
  - Network monitoring: collect information
  - Adaptation: adapt video representations based on network status

Taxonomy of Network Monitoring

Criteria	Type of monitoring	
Method of monitoring	*Active*	*Passive*
Monitoring frequency	*On demand*	*Continuous*
Replication of information	*Centralized*	*Distributed*

Adaptation/Scaling



An architecture for transporting scalable video from a mobile terminal to a wired terminal.

Scaling

- The operations of a scaler
  - Drop the enhancement layers
  - Do not scale the video
- Scaling based on network status
  - Available bandwidth
  - Channel quality (BER)

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Adaptive Services

- Objective:
  - achieve smooth change of perceptual quality in presence of bandwidth fluctuations.
- Functions:
  - Reserve a minimum bandwidth for the base layer
  - Adapt enhancement layers based on available bandwidth and the fairness policy

Adaptive Services (cont'd)

- Provisioning
  - End-to-end deployment (our focus)
  - Local deployment
- Components:
  - Service contract
  - Call admission control and resource reservation
  - Substream scaling
  - Substream scheduling
  - Link-layer error control

Service Contract

- A service contract consists of multiple subcontracts
  - Bandwidth reservation for the base layer
  - No QoS guarantee for enhancement layers
- Enforcement
  - Shaping
  - Priority

Call Admission Control (CAC)

- Objective:
  - Provide a QoS guarantee while efficiently utilizing network resources
- The operation of CAC: check
  - whether QoS for existing connections is violated
  - whether the incoming connection's QoS can be met

Resource Reservation

- Different from the counterpart in wired networks:
  - The reserved bandwidth may not be rigidly guaranteed in wireless networks
- Two parts of resource reservation
  - Reserve resources along the current path
  - Reserve resource on the paths from the current base station to neighboring base stations

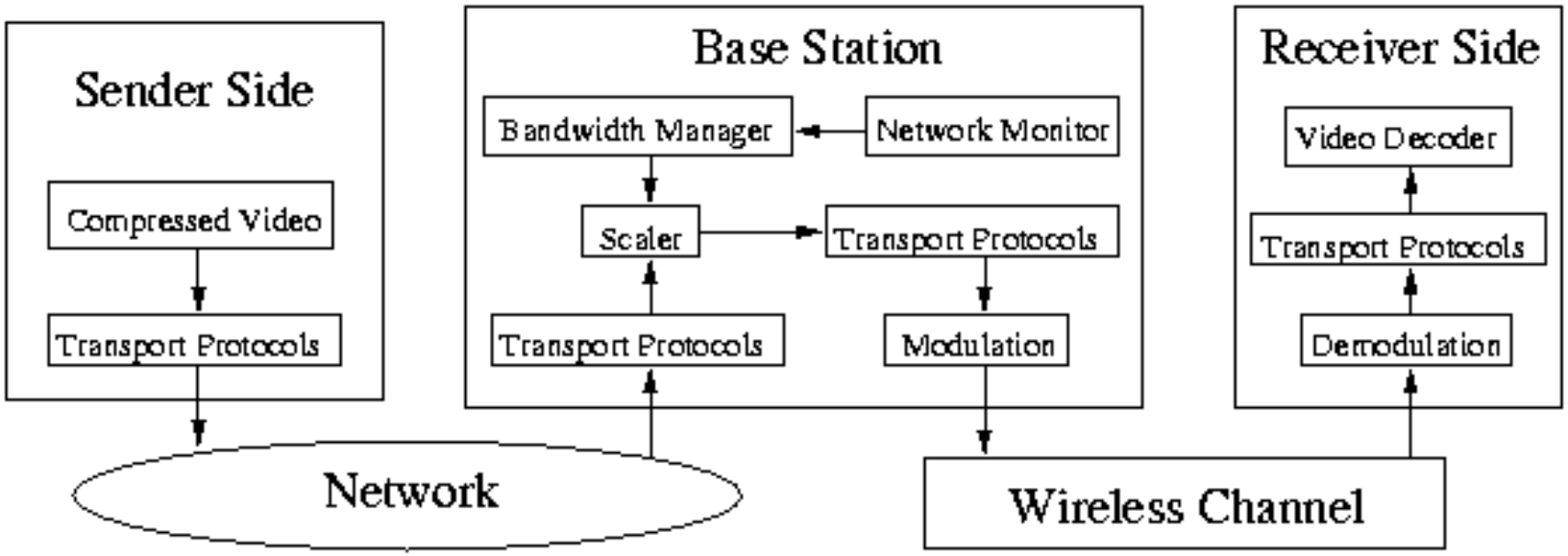
Mobile multicast mechanism

- Objective:
  - Provide seamless QoS during a handoff
- Multicast mechanism:
  - Multicast the base layer to the neighboring base stations

Substream Scaling

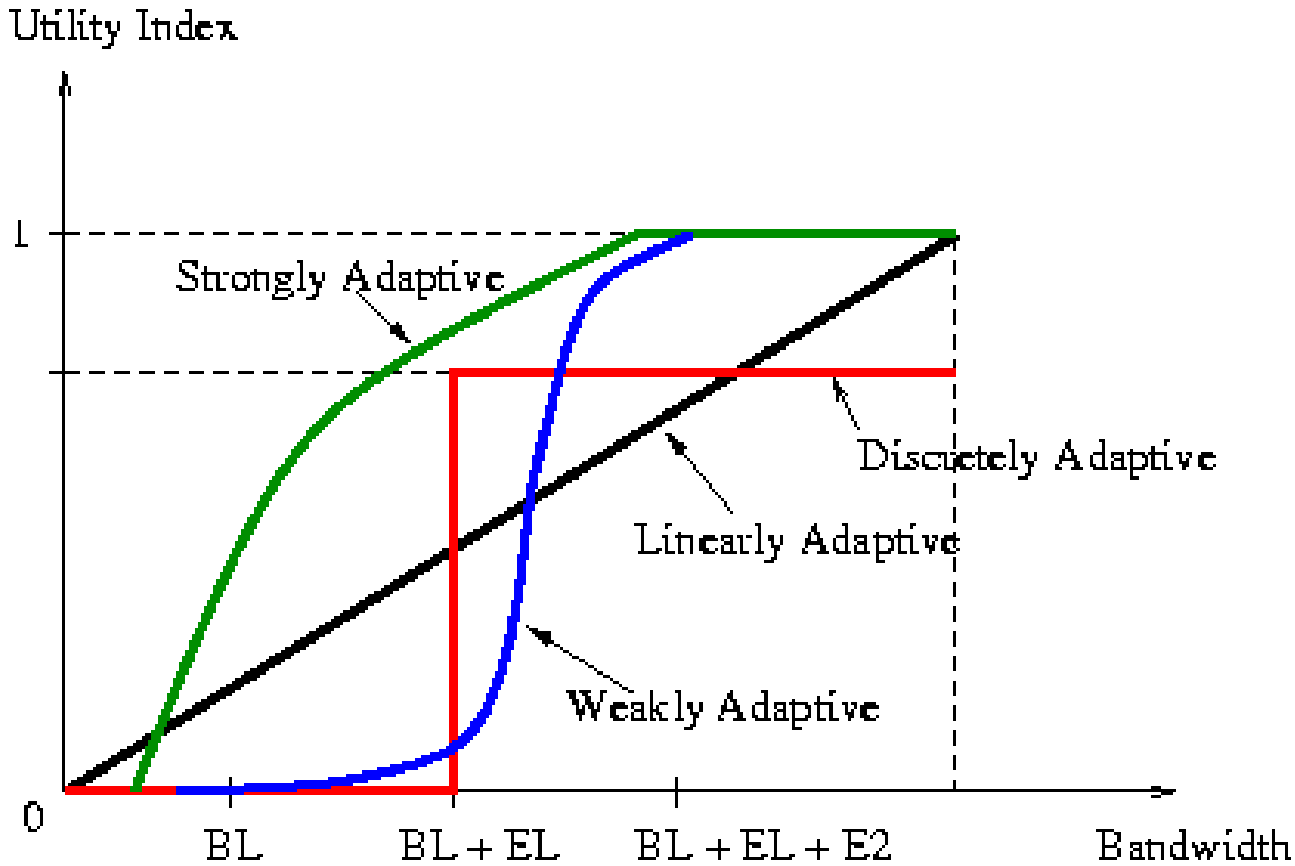
- Objective:
  - Adapt video streams during bandwidth fluctuations and/or under poor channel conditions
- Scaling decision based on utility fairness or max-min fairness
  - Utility fairness is based on utility functions
  - Max-min fairness is based on revenue

Substream Scaling (cont'd)



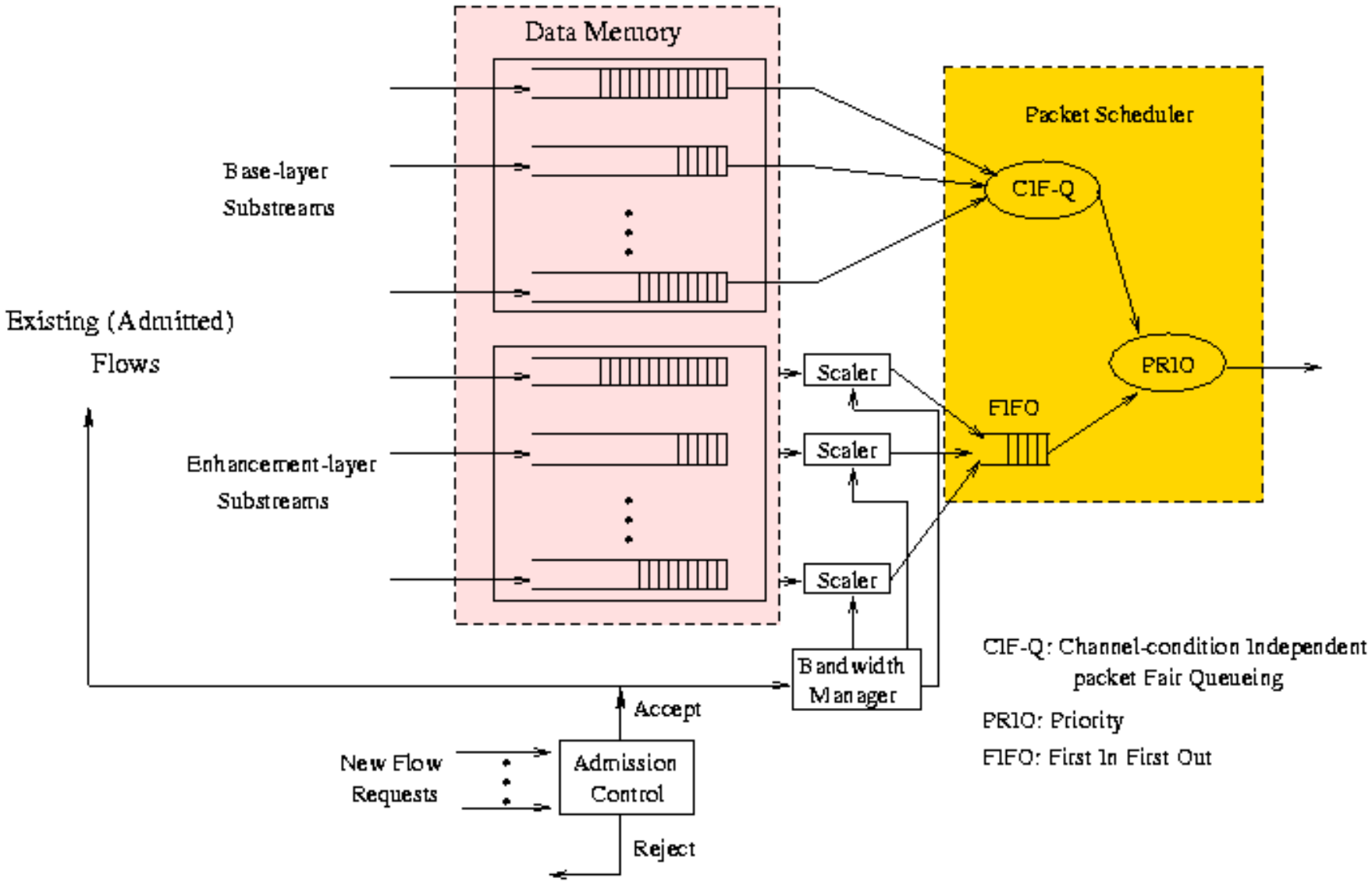
An architecture for transporting scalable video from a wired terminal to a mobile terminal.

Utility Functions



BL: Base Layer
EL: first Enhancement Layer
E2: second Enhancement Layer

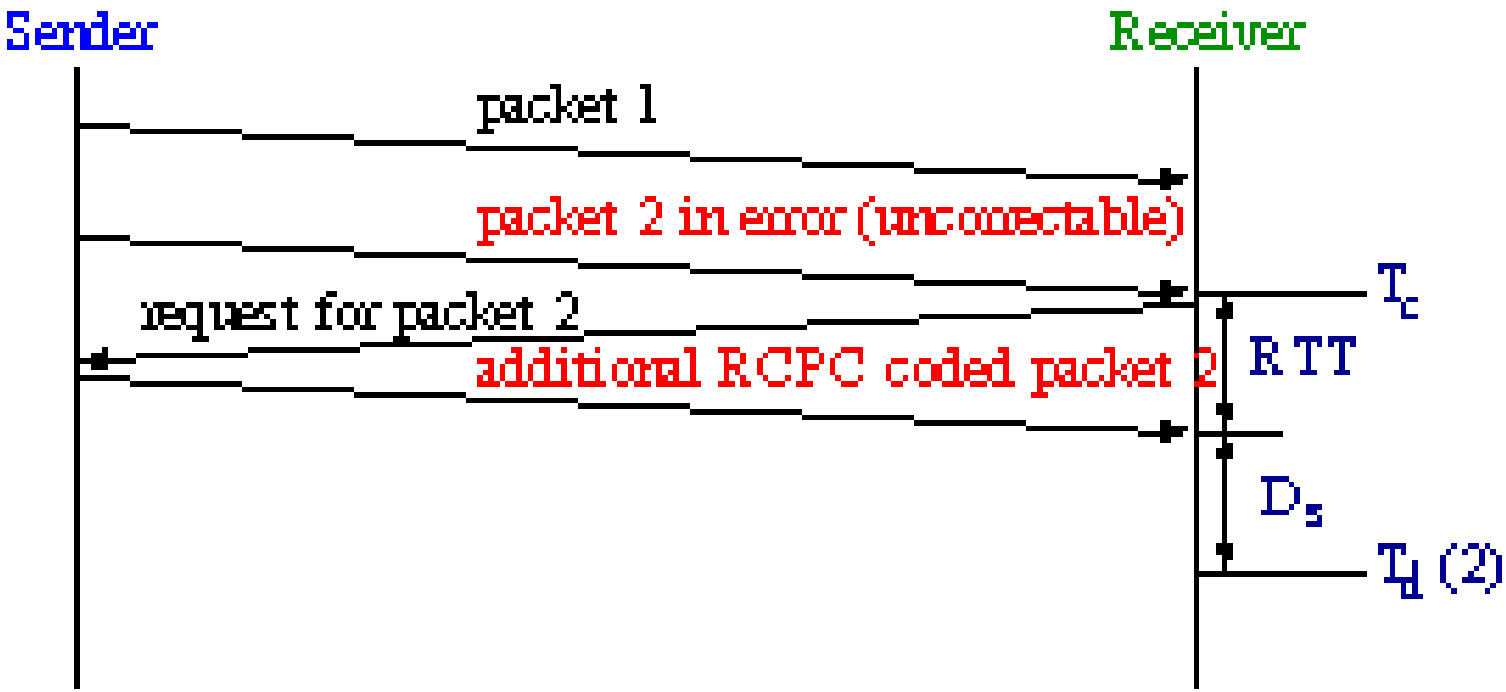
Substream Scheduling



Link-layer Error Control

- Forward error correction (FEC)
- Automatic repeat request (ARQ)
- Truncated type-II hybrid ARQ
- Delay constrained hybrid ARQ
  - A receiver sends request based on delay bound of the packet

Delay-constrained Hybrid ARQ



RCPC: Rate compatible punctured convolution

Summary

- Objective: end-to-end solution to providing QoS for video transport over wireless IP networks
- Our approach: *an adaptive framework*
  - Scalable video representations
  - Network-aware end systems
  - Adaptive services
- Advantages of the adaptive framework
  - Perceptual quality is changed gracefully
  - Resources are shared in a fair manner

Homework

- Reading assignment: Chap. 15