An Active Router Architecture for Multicast Video Distribution

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(Presented by: Hemant Kumar)
Video vs Data

- Timely delivery is critical
- Not all bits are created equal
Problem

- Network doesn’t care (content blind)
- All packets get same treatment
- Problem for many apps : voice, video, music...real time content
How it (doesn’t) work right now

• Buffering at receiver to counter jitter and packet loss

  *Doesn’t work with interactive media*

• Sender adapts rate according to receiver’s feedback

  *Not suited for point to multipoint*

• Resource reservation

  *Not widely available*
Requirements

• Smart Router

• Codec with fine grained scaling

• Efficient scaling algorithm
Approach

• Use scalable wavelet based codec
  ✓ provides fine grained scalability
  ✓ enables a simple algorithm to make decisions about the packet

• Plugin at router tells it how to deal with video packets
  ✓ different video formats can have different plugins
Wavevideo Encoding

Adapted from Dr. Keller’s presentation at Infocom 2000
Scaling with sub bands

Decoded Image

Adapted from Dr. Keller’s presentation at Infocom 2000
Scaling with sub bands

Adapted from Dr. Keller’s presentation at Infocom 2000

33011 bytes (33)  25239 bytes (30)  17179 bytes (27)  9265 bytes (24)
7042 bytes (21)  4819 bytes (18)  2617 bytes (15)  2006 bytes (12)
1393 bytes (9)  793 bytes (6)  447 bytes (3)  227 bytes (1)
Classification of packets

1 2 3 2 8

Unused

Color channel

Transformation level

Sub band

Sequence no.

LUT

128 quality levels
Active network node

User space
- Plugin Management
  - Plugin Requester
  - Plugin DB controller
  - Policy controller
  - Security Gateway
  - Active Plugin Loader

Kernel
- Active Function Dispatcher
- Plugin Control Unit
  - Class X plugin
  - Class Y plugin
- Packet Classifier
- Packet Scheduler

IP
- RSVPd/routed
- IPv4/v6 forwarding

Network Device Drivers
## WaveVideo datagram

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32 bits
Packet processing

Adapted from Dr. Keller’s presentation at Infocom 2000
How it works

Adapted from Dr. Keller’s presentation at Infocom 2000
Quality Measurements

PSNR (dB)

Active queuing

Lossless

Passive queuing

PSNR (dB)
With bursty traffic

Reaction to bursts

Adapted from Dr. Keller’s presentation at Infocom 2000

plain queueing

active dropping

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Distribution of received sub bands

Drop across all sub bands

Drop occurs in high frequency sub bands
Conclusions

• Good Scalability (with a general purpose CPU, time taken is 22 µs)

• Quick Response to congestion (at most 50 ms)

• Can be implemented on any active networks environment.
Notes (- / +)

- Would be more convincing if applied to commercially available wavelet based codecs (VDONet etc.)

- Doesn’t show how effective this approach is when intermediate routers are passive

- WaveVideo will not be able to achieve compression of MPEG (because MPEG eliminates temporal redundancy also) – this is where we pay the price!

- Easily deployable solution.

- Shows efficacy of active networks approach. Even small amount of processing capability can deliver solid gains.