Multicast Multimedia Traffic and the Design of Real-Time Protocols

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Outline

Introduction and motivation

Environment and methodology

Measurements

Analysis and other observations

Conclusions and implications for protocol design

Introduction

IP Multicast

- MBONE (Multicast Backbone): Virtual network for supporting Internet-wide multicasts
- Multicast "sessions" and session directory

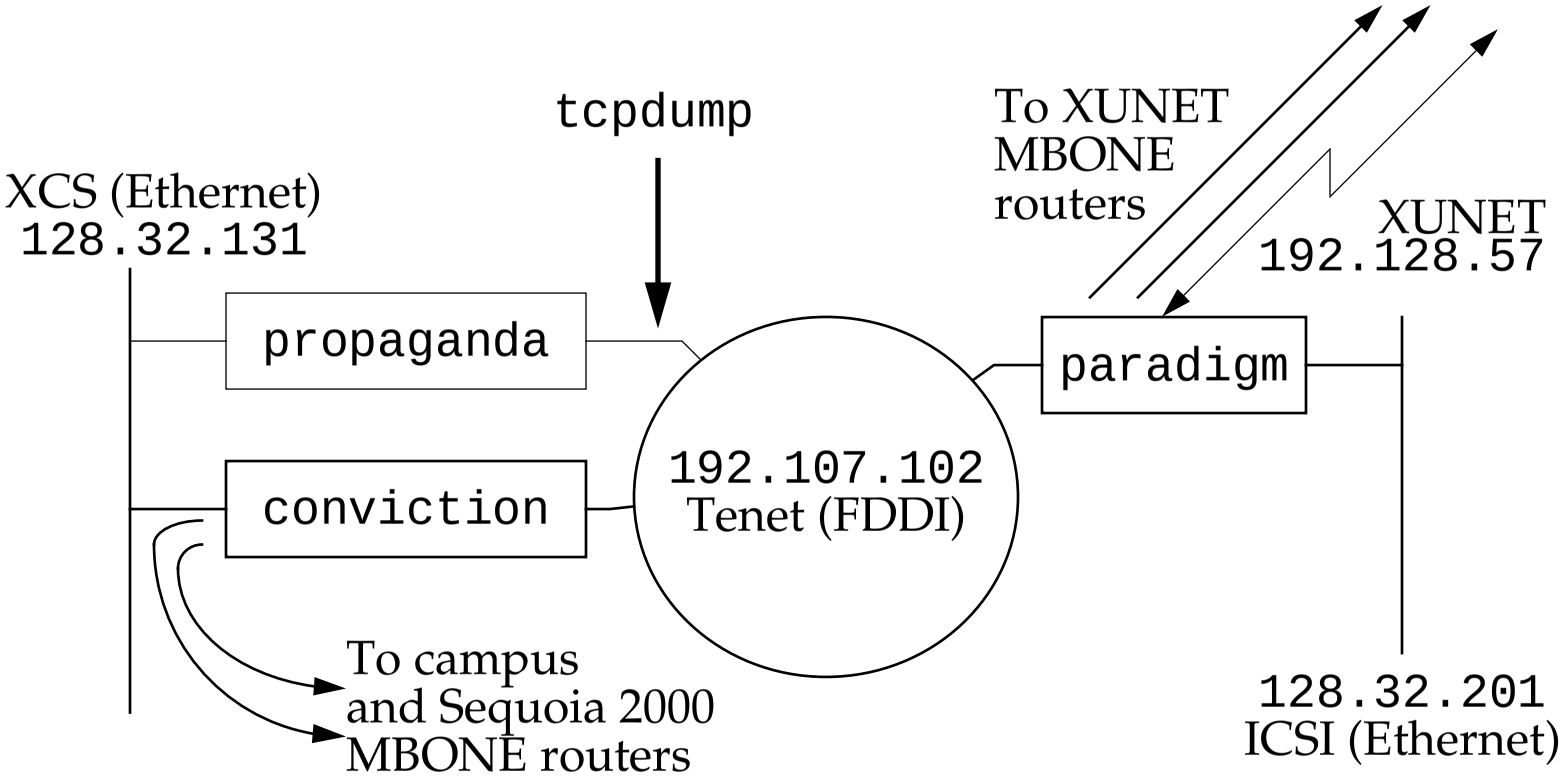
Multimedia tools

- Video conferencing (`nv, vic, ivs`)
- Audio conferencing (`vat, nevot`)
- Shared whiteboard (`wb`)
- Still image distribution (`imm`)

Questions

- What can we learn about network traffic generated by *production use* multimedia applications?
- How can real-time network protocols best support these applications?

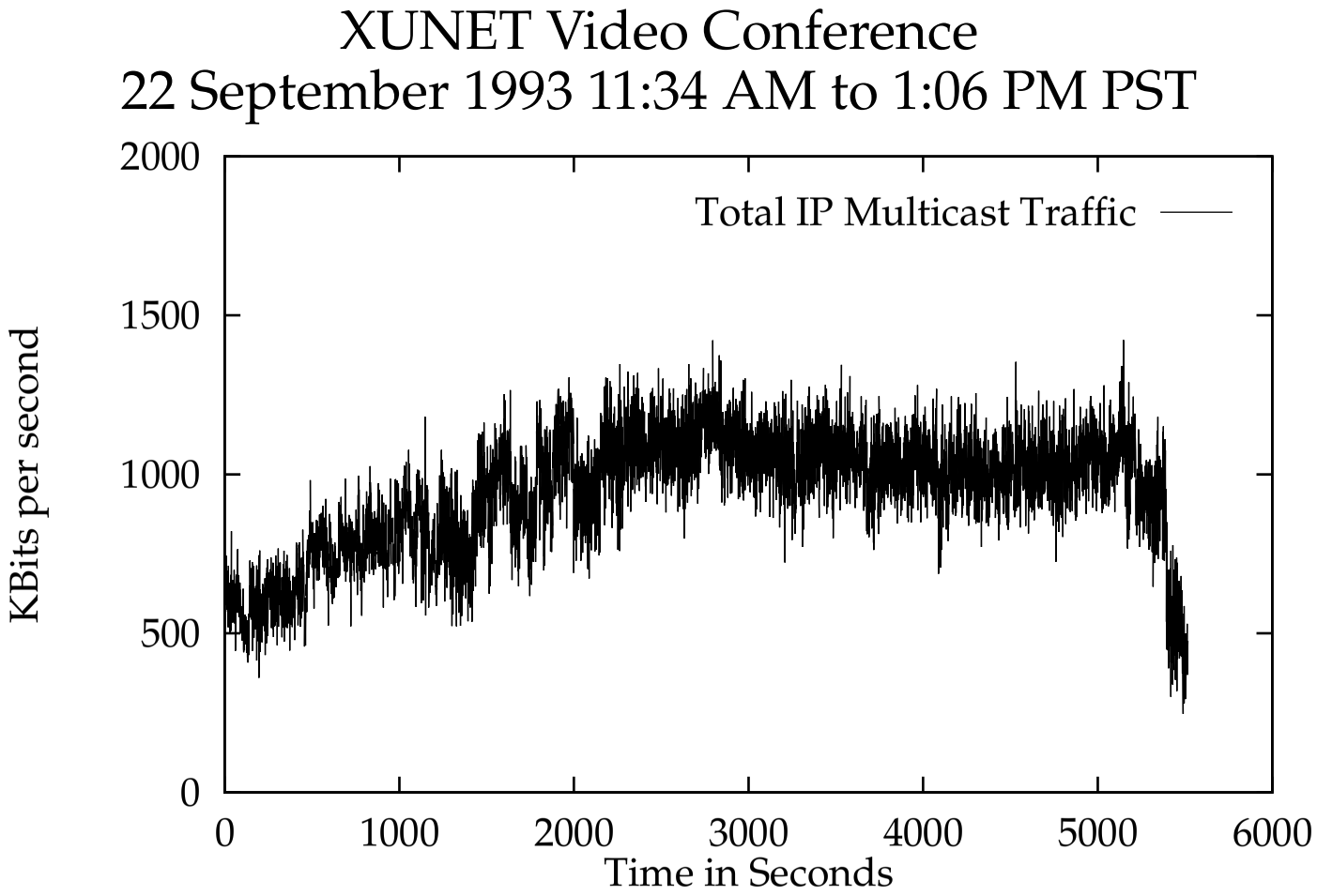
Environment and Methodology



Capture packet headers for off-line processing

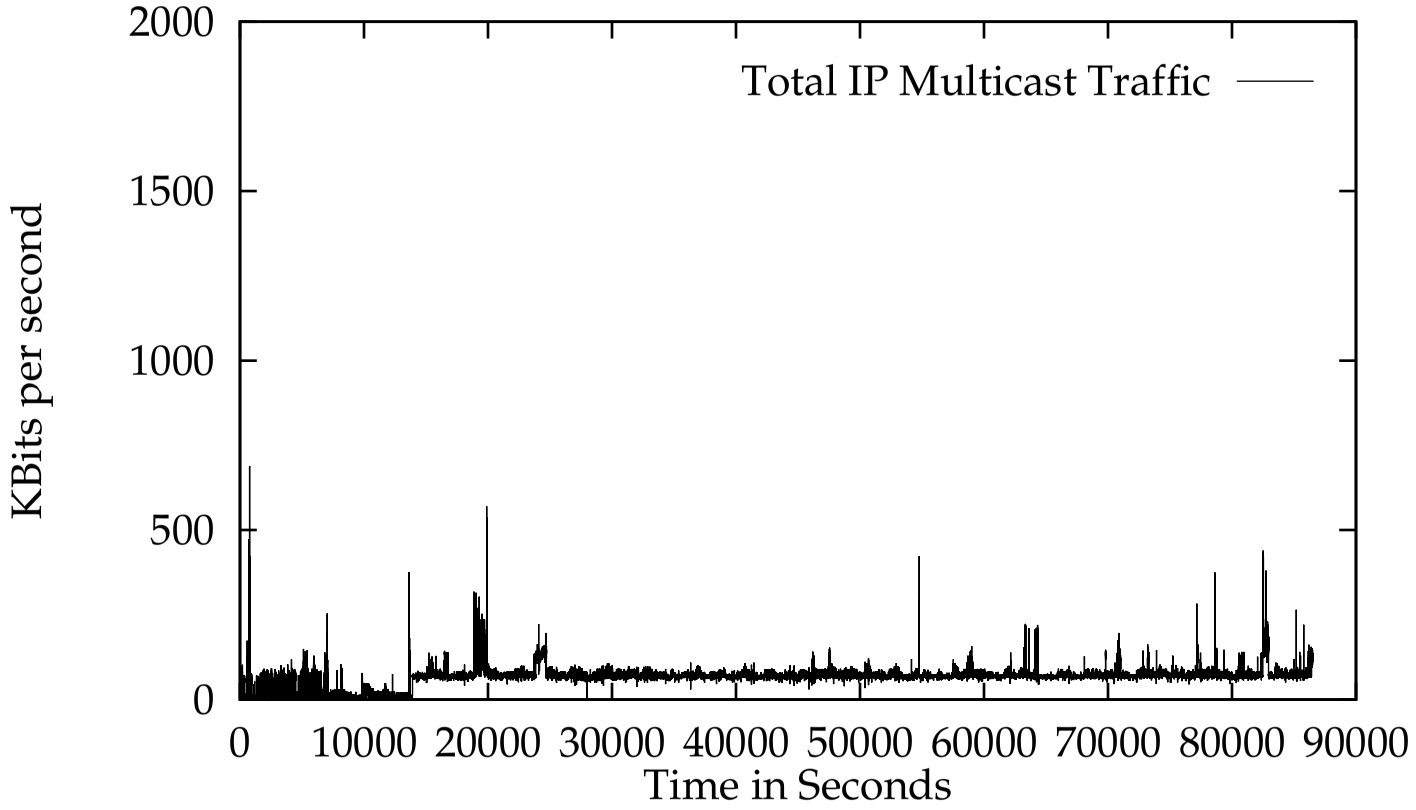
`sdsnoop`: Session Directory Snoop

Aggregate IP Multicast Traffic

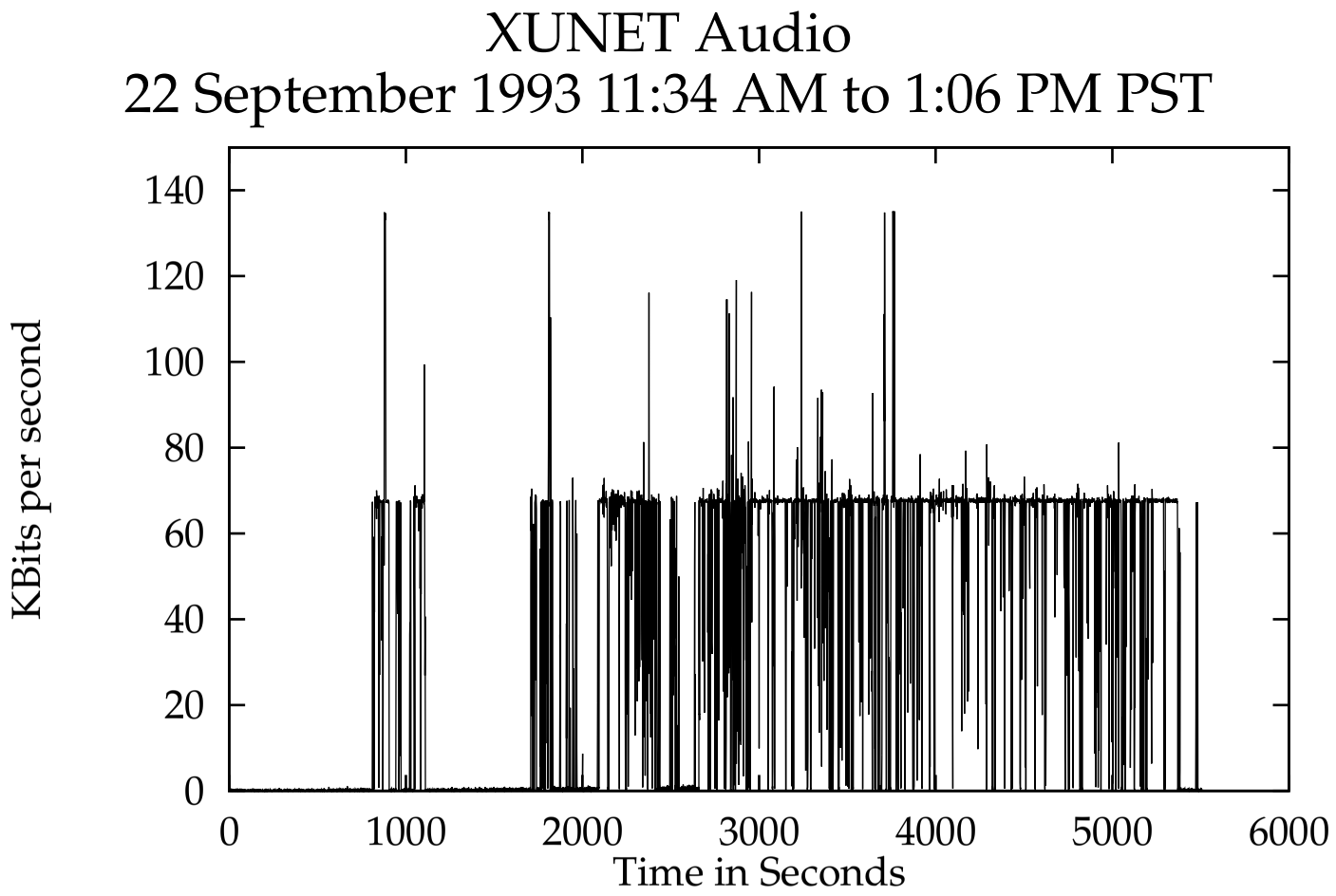


Aggregate IP Multicast Traffic

"Just an ordinary day"
20 January 1994 09:45 AM to 21 January 1994 09:47 AM PST

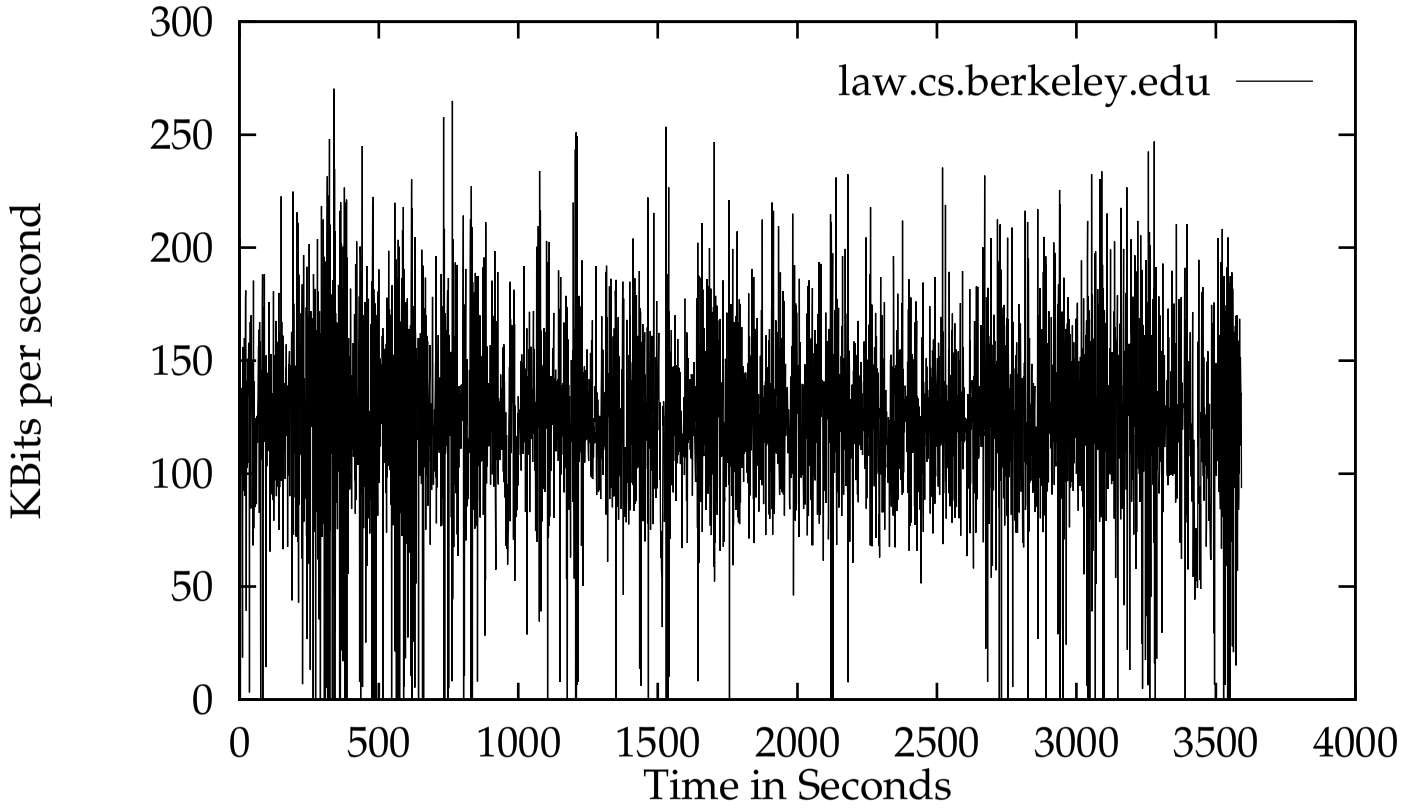


Audio Bitrate (`vat`)



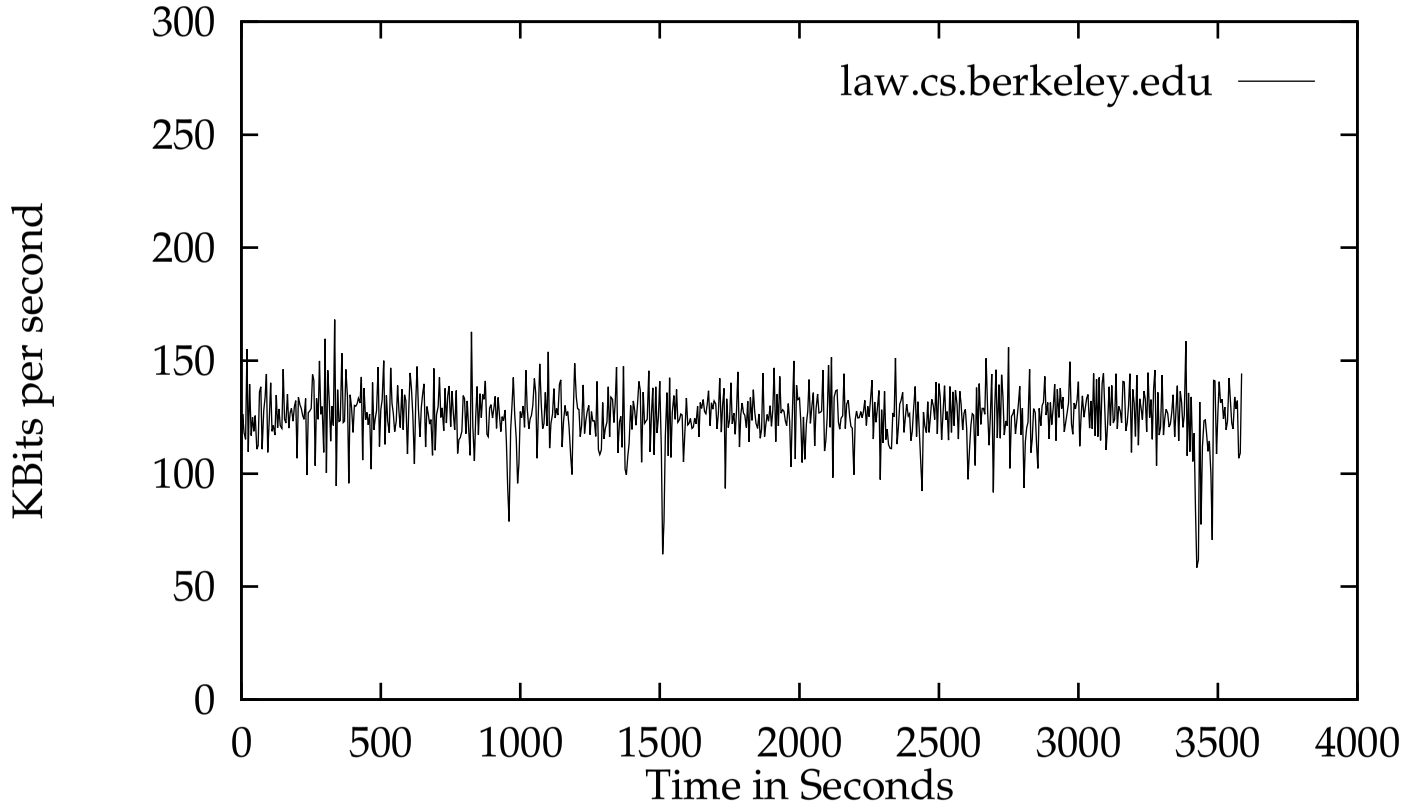
Video Bitrate (nv 128Kbps)

law.CS.Berkeley.EDU to XUNET Video (one-second samples)
22 September 1993 11:34 AM to 1:06 PM PST

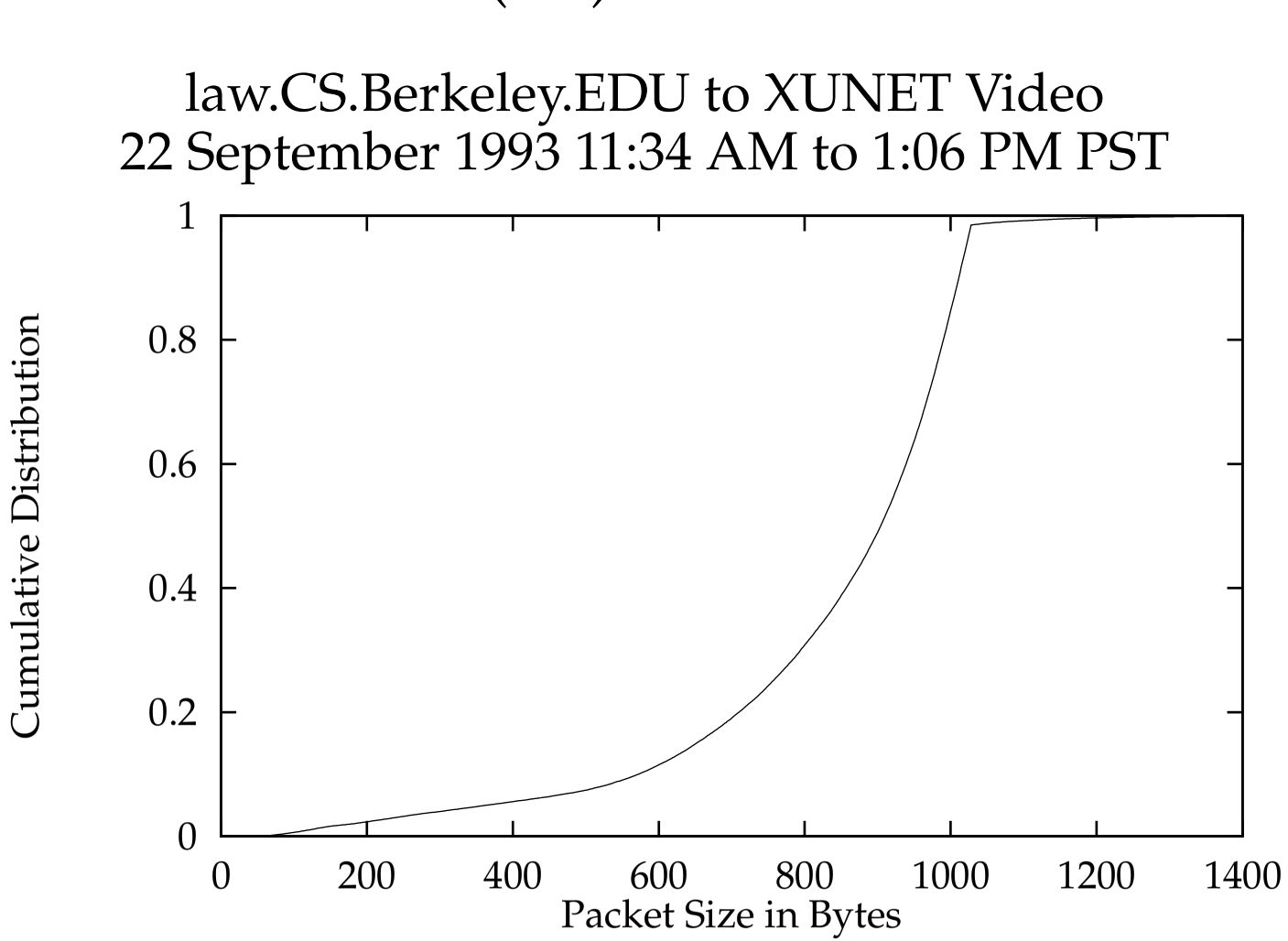


Video (nv) Bitrate

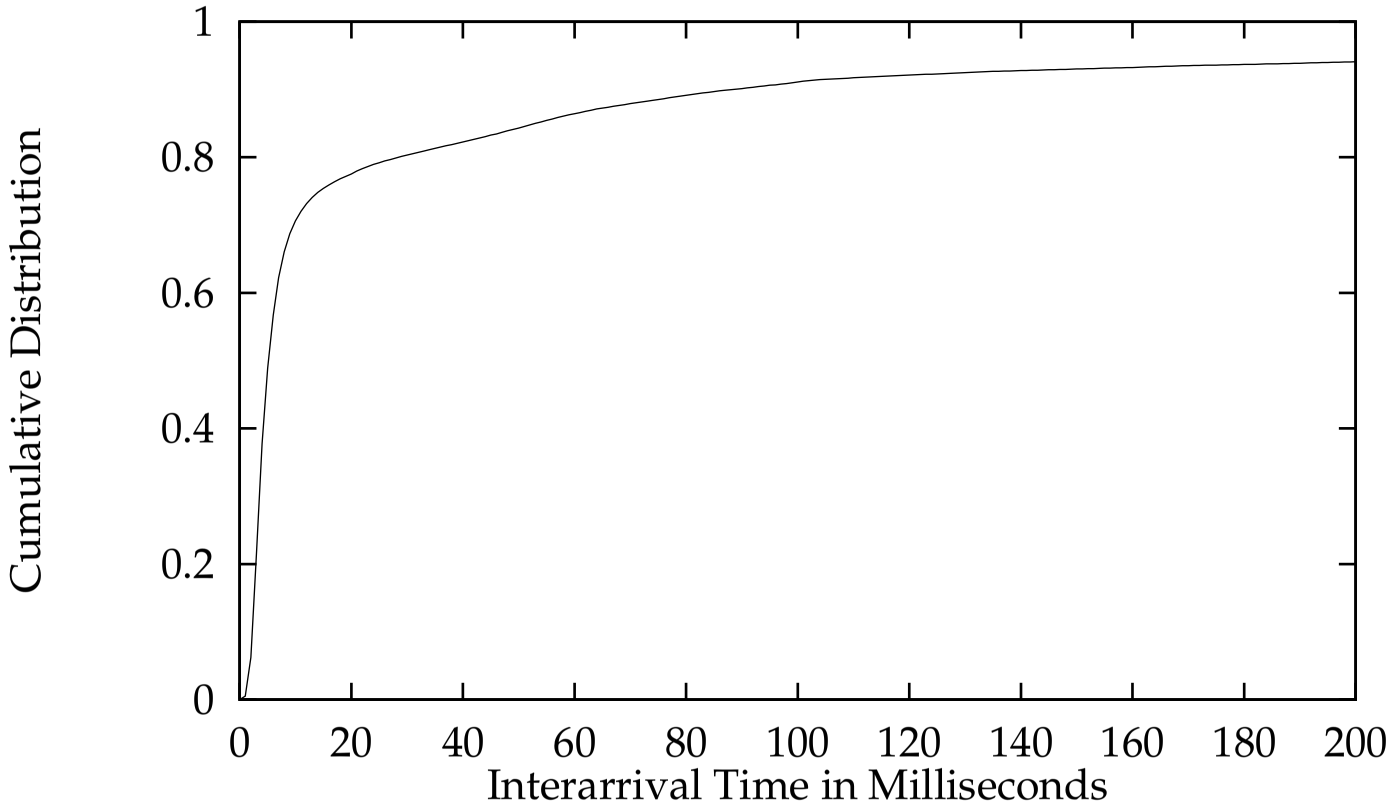
law.CS.Berkeley.EDU to XUNET Video (five second samples)
22 September 1993 11:34 AM to 1:06 PM PST



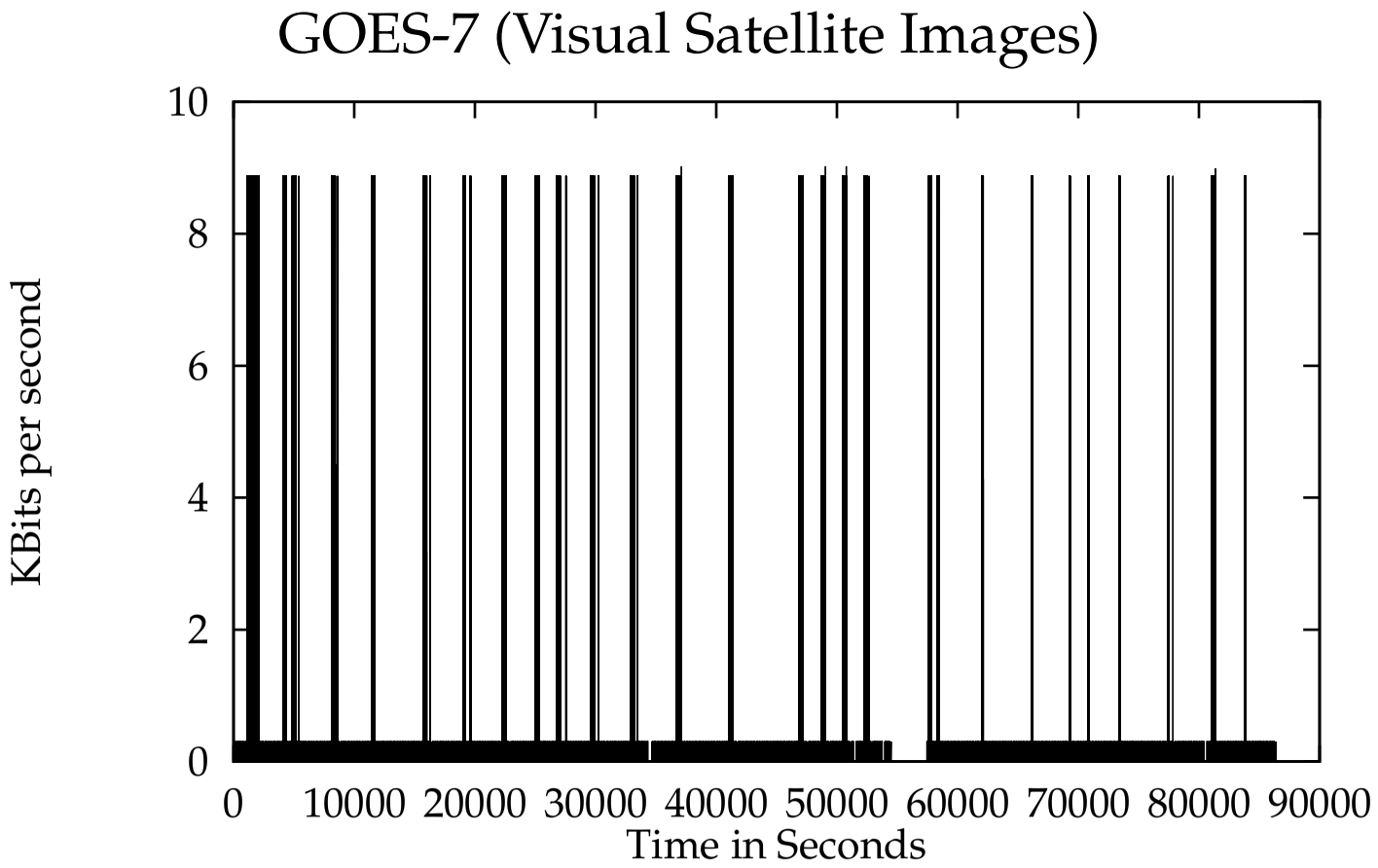
Video (nv) Packet Sizes



Video (nv) Packet Interarrival Time



Still Image Distribution (`imm`)



The solution to “casual Internet usage?”

Some Traffic Analysis

20 January 1994 Trace Gross Characteristics

- 299 traffic sources
- 65 destinations
- 1,005 conversations
- 722,901,051 total bytes
- 2,239,382 total packets

No special events this day...why so many destination addresses?

Traffic Breakdown

723 MB total (all sessions)

- 585 MB (81.0% percent of total) from a locally-advertised "radio session", adjusted totals exclude this session

24 advertised sessions

- 100 MB (72.6% of adjusted total)
- Still Images (`imm`): 46 MB
- Audio (`vat`): 42 MB
- Video (`nv`): 11 MB

7 unadvertised but known sessions

- 8 MB (5.5% of adjusted total)

33 unknown sessions

- 30 MB (21.8% of adjusted total)

Funny User Behavior

What's happening here?

- Traffic patterns suggest `vat` audio conferencing
- Lack of session directory advertisements suggests testing, experimentation
- Improper scope control (most participants in Europe, why should we see their traffic in California?)

Suggestions

- We need real multicast tree pruning!
- Users need education!

Hosts unreachable from NSFNET backbone

Conclusions and Implications

Aggregate traffic

- IP Multicast traffic still highly variable
- Dependent on special events and outside factors
- Difficult to construct a "typical" workload
- Flexibility is important

Audio conferencing traffic

- "Floor control" needed

Video conferencing traffic (nv coded)

- Peak-to-average ratio of about 2:1
- Large packets sent fairly frequently

User behavior

- Better protection in network needed (true multicast tree pruning)
- User education