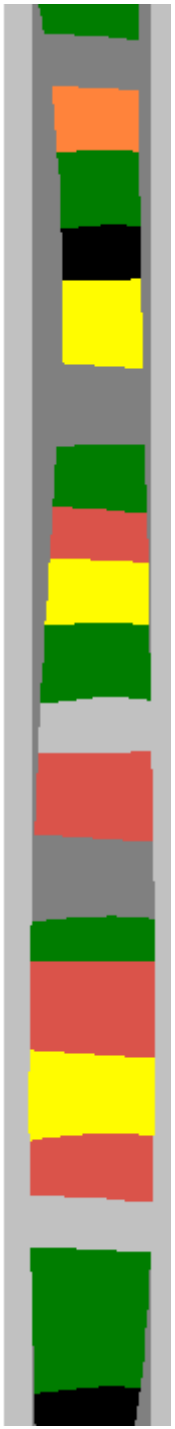

Treatment-Based Traffic Signatures

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WPI

Diversity of Internet Applications in the Home

P2P File Sharing

Email

Web Browsing

Loss Sensitive

Loss Insensitive

Sensors

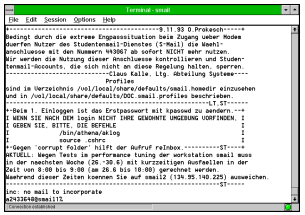
Jitter Insensitive

Jitter Sensitive

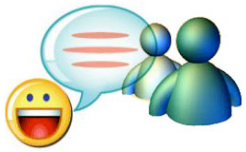
Video Streaming

Delay Insensitive

Delay Sensitive



Remote Login

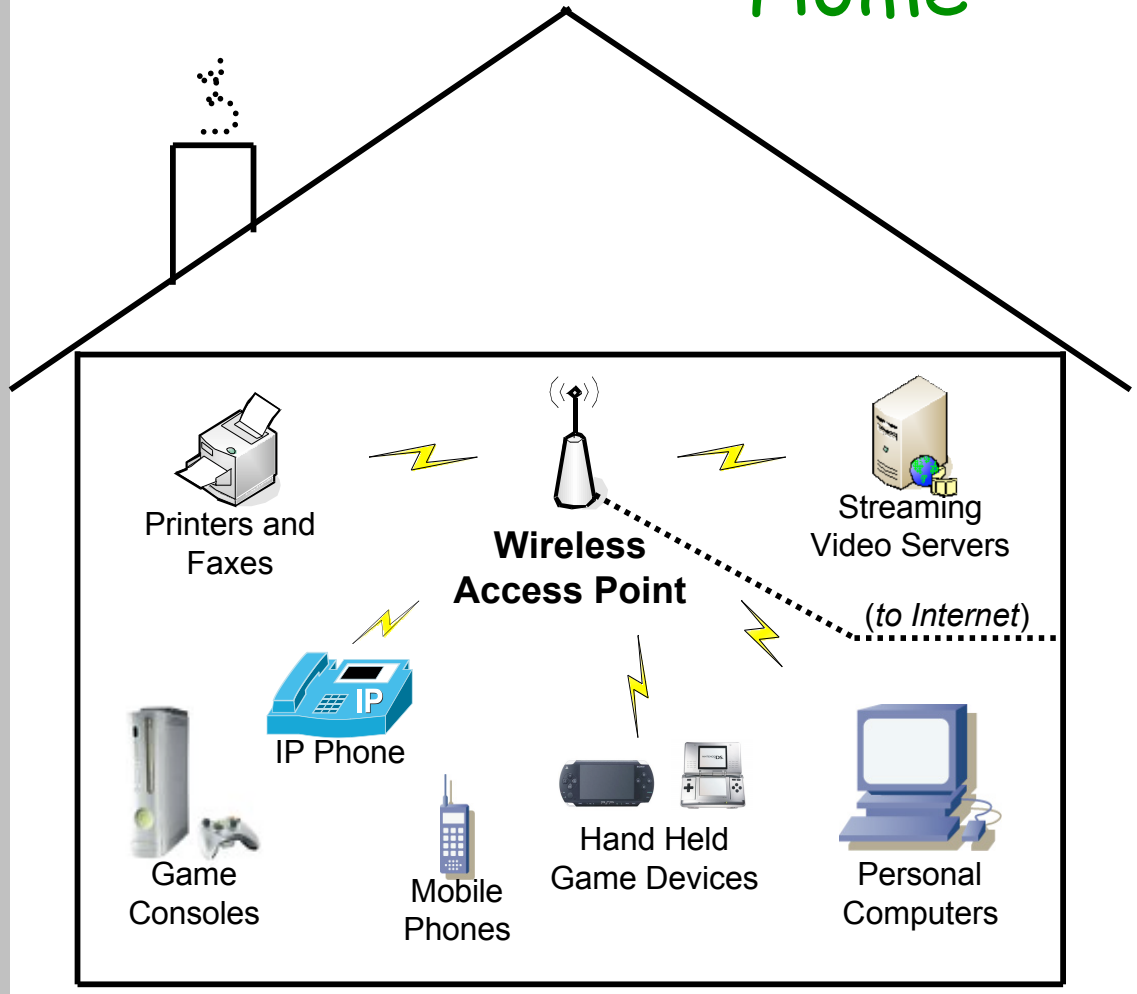


Instant Messaging

Network Games

Voice over IP

Proliferation of Network Devices in the Home



Opportunity…

◊ "Smart" AP

- Automatically improves performance
- Interoperable, easy-to-use

But first…

◊ Need to classify applications

- Then can apply treatment to improve QoS

Goals

- Classification for purpose of QoS treatments (versus DoS prevention or payments or measurement or …)
  - Want match between signatures and potential treatments
- Not classifying applications ◊ instead concentrate on *nature of traffic* due to specific applications and devices
  - Different applications with same QoS requirements should get equal network treatments
    - E.g. VoIP and Network Game
  - Not all instances of a particular application yield the same signature, nor is that needed
    - E.g. Web for browsing, Web for download

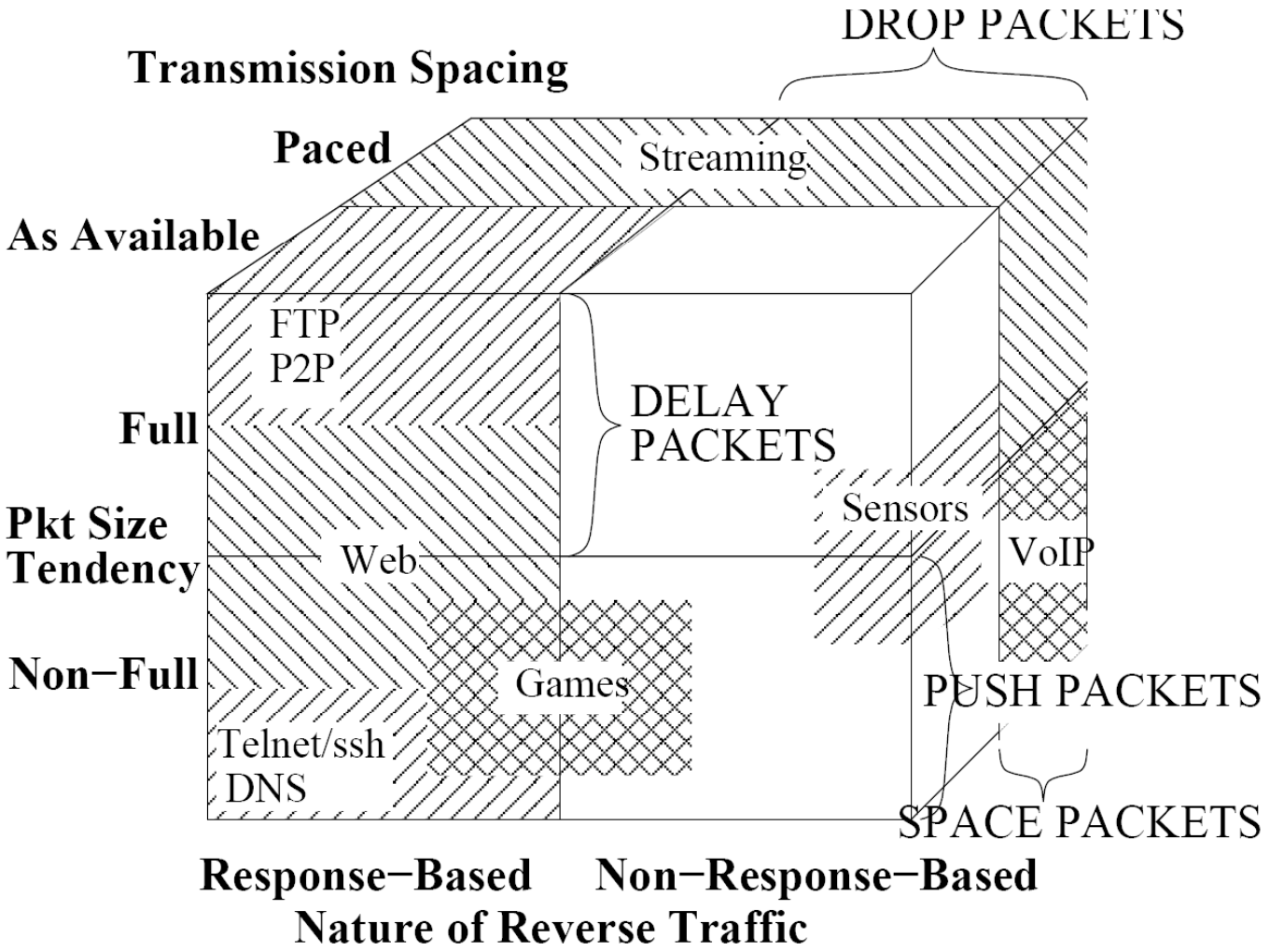
Related Approaches

- Port classification alone does not work
  - Applications can share
    - Non Web apps use port 80 around firewalls
    - `scp` and `ssh` both over port 22
  - Users run non-standard
    - Web server on different port since 80 restricted
  - Some applications not officially defined
    - `Kazaa` not in IANA registry
- Payload examination alone does not work
  - Increased encryption at application layer
  - Can be computationally expensive
  - New applications cannot be identified this way
- Machine learning alone does not work
  - Take too long in real-time
  - Needs external validation so does not work with "new" apps

Domain

- Provide in wireless Access Point (AP), the same point that provides QoS
- Home environment
  - Both directions of a flow travel through AP
  - Users are not trying to avoid classification
  - Can be customized and flexible per-flow treatments
    - Home APs carry few flows compared to core router
- Needs to be real-time
  - Quick, so as to apply treatment to improve QoS

Treatments-Based Classification



Preliminary Results

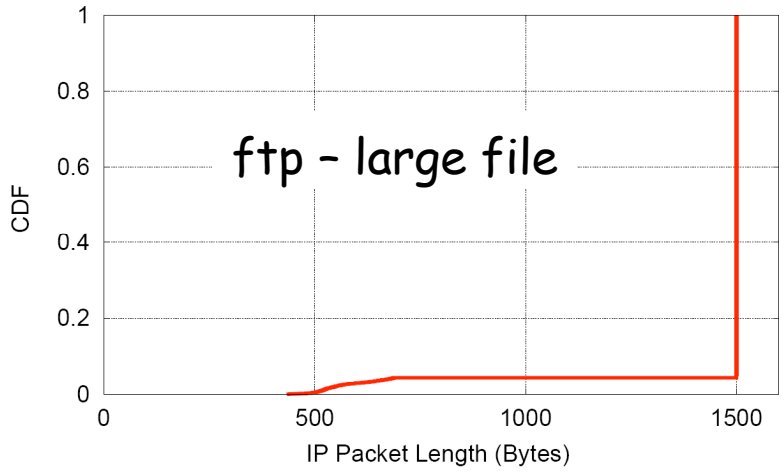
- Nature of reverse traffic
  - *Response based* or *Non-response based*
  - TCP makes it response based
- Packet size tendency
  - *Full* or *Non-full*
- Transmission spacing
  - *Paced* or *On-demand*

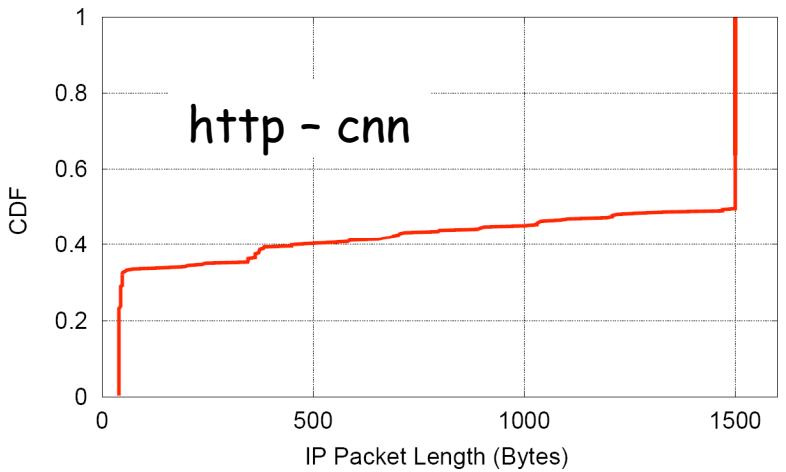
Nature of Reverse Traffic

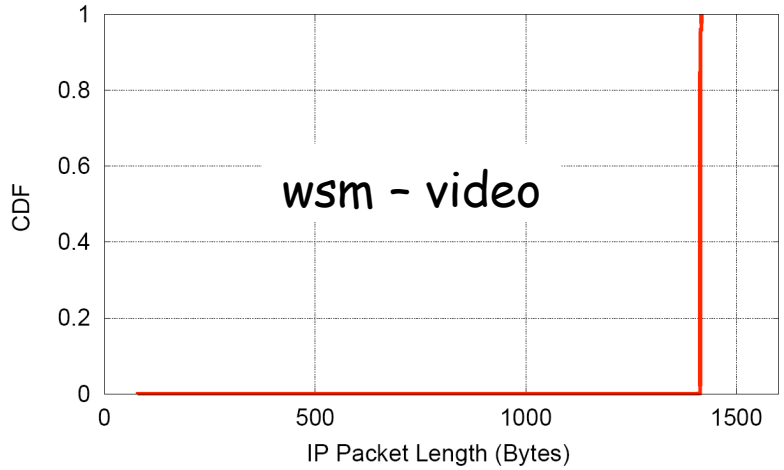
- TCP makes it response-based
- UDP is trickier - is a downstream packet sent in response to one up (or vice versa)?
- Try simple up/down count, first:

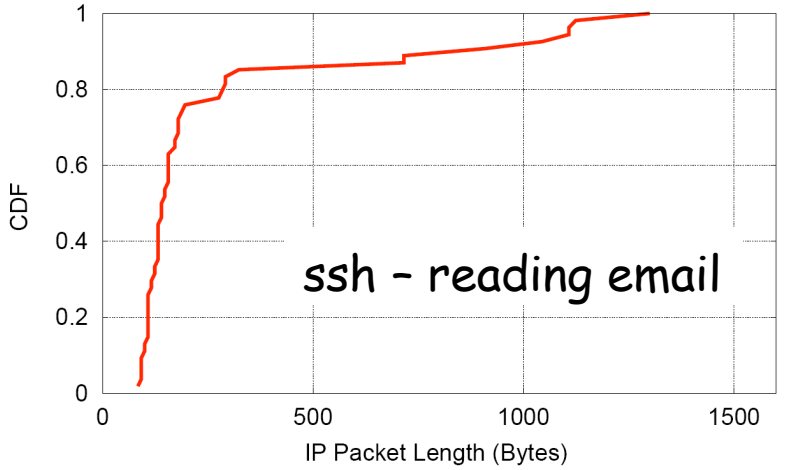
Count	Application
11725	Streaming video (down)
21	Streaming video (up)
393	Network game (down)
1231	Network game (up)
934	VoIP (down)
935	VoIP (up)

Packet Size Tendency

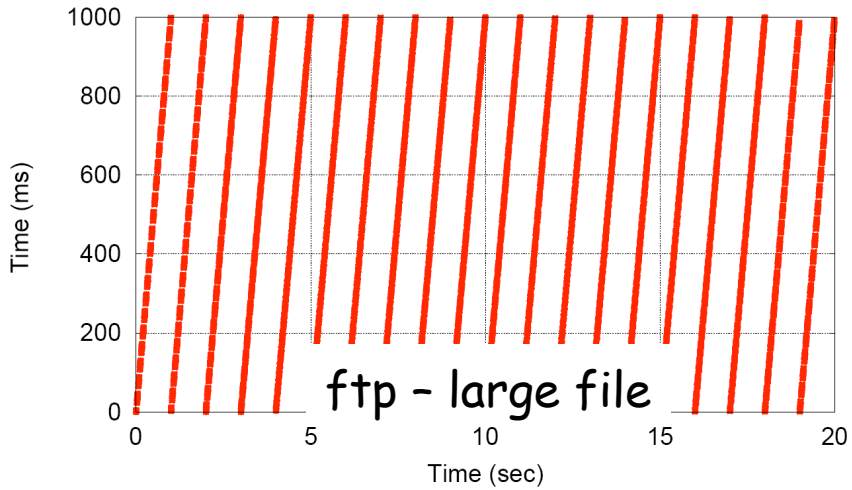


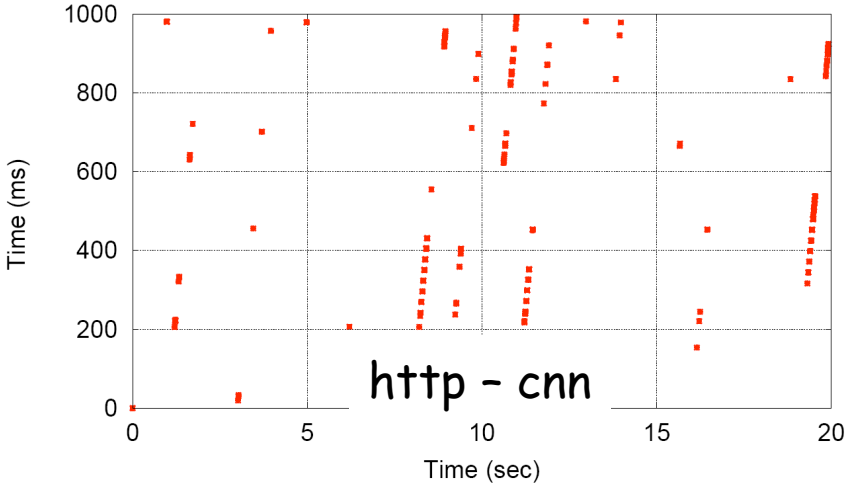


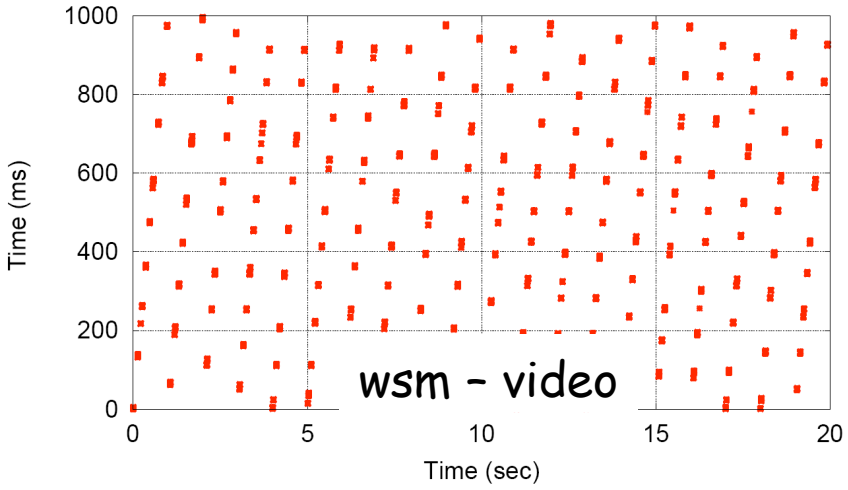


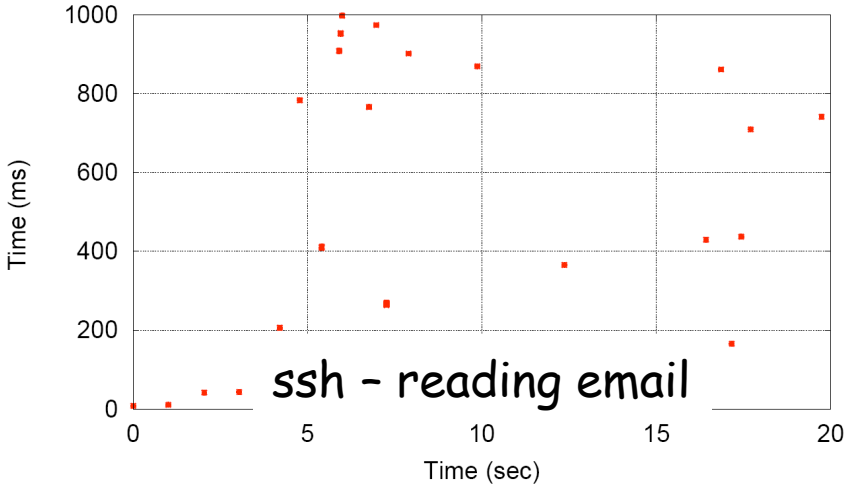


Transmission Spacing

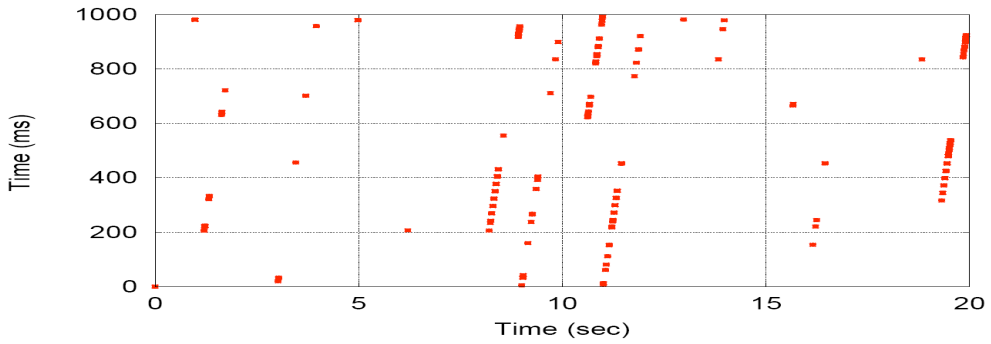




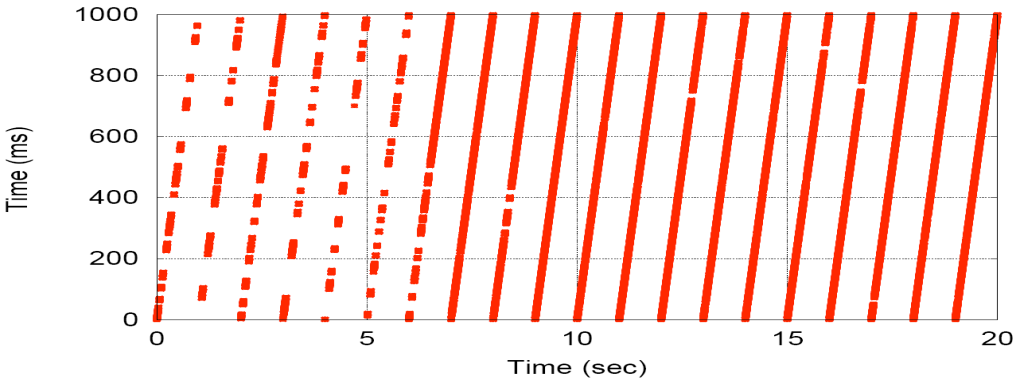




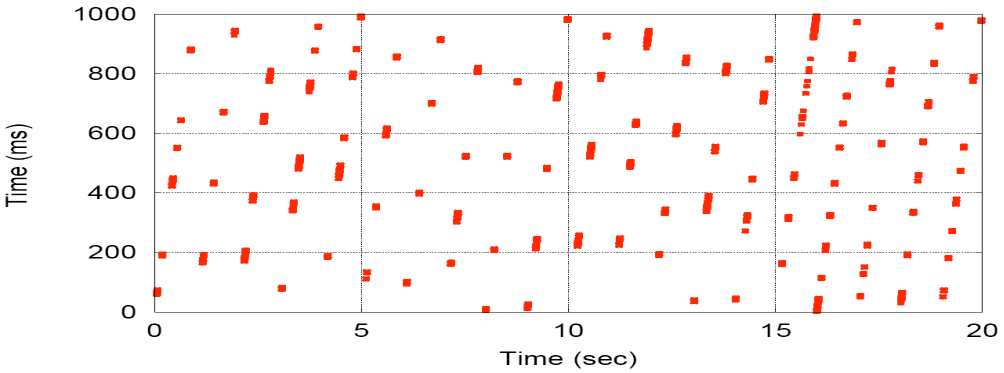
Transmission Spacing



http – browsing

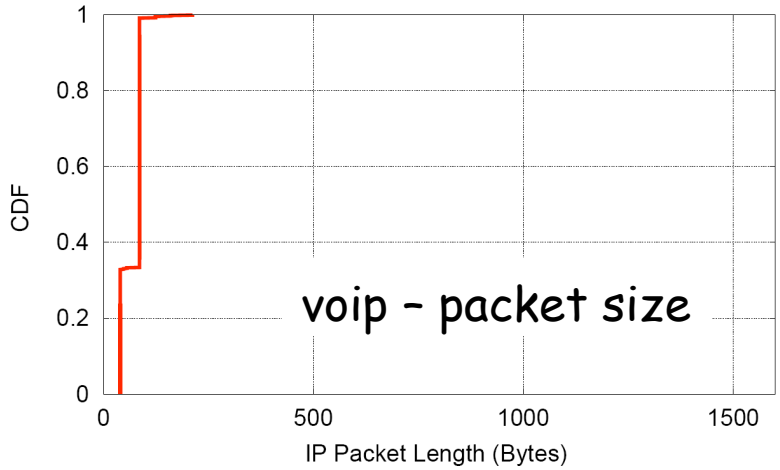


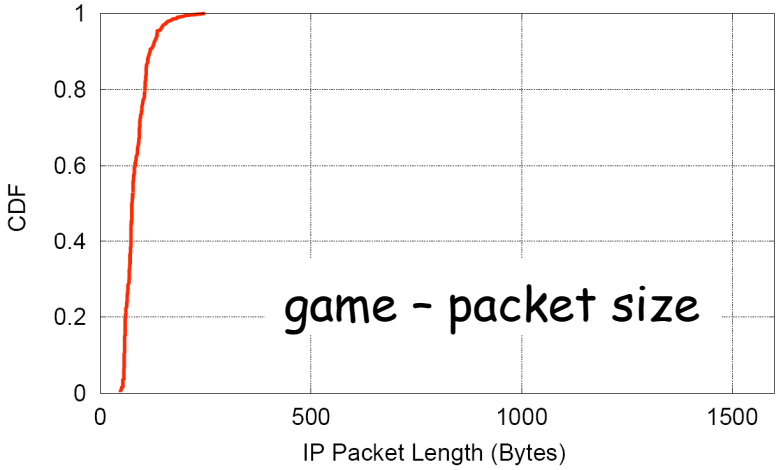
http – download

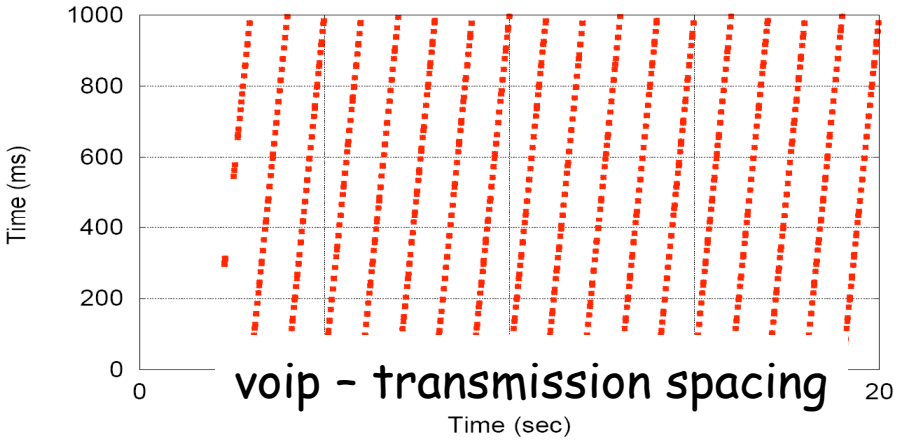


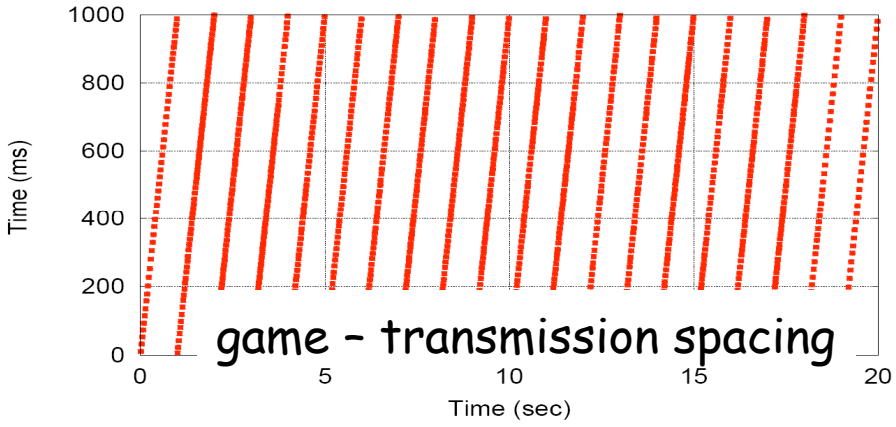
http – streaming

Data for Some Other Applications



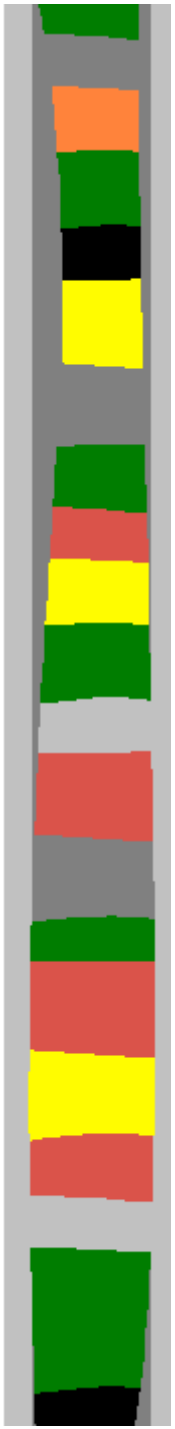






Ongoing Work

- Identification of responsive UDP
  - E.g. DNS or VoIP over DCCP
- Determination of "full" packets
  - E.g. Streaming video packets of 1400 bytes
- Memory of classification
  - E.g. In Second Life, interact on estate then teleport
  - Statistics: continuous, weighted, or windowed
  - Across lifetimes of flow
    - E.g. Game console (Xbox) or VoIP box
- Need for more traces of applications in the home



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