Direct Broadcast Satellite: Architecture and Evaluation

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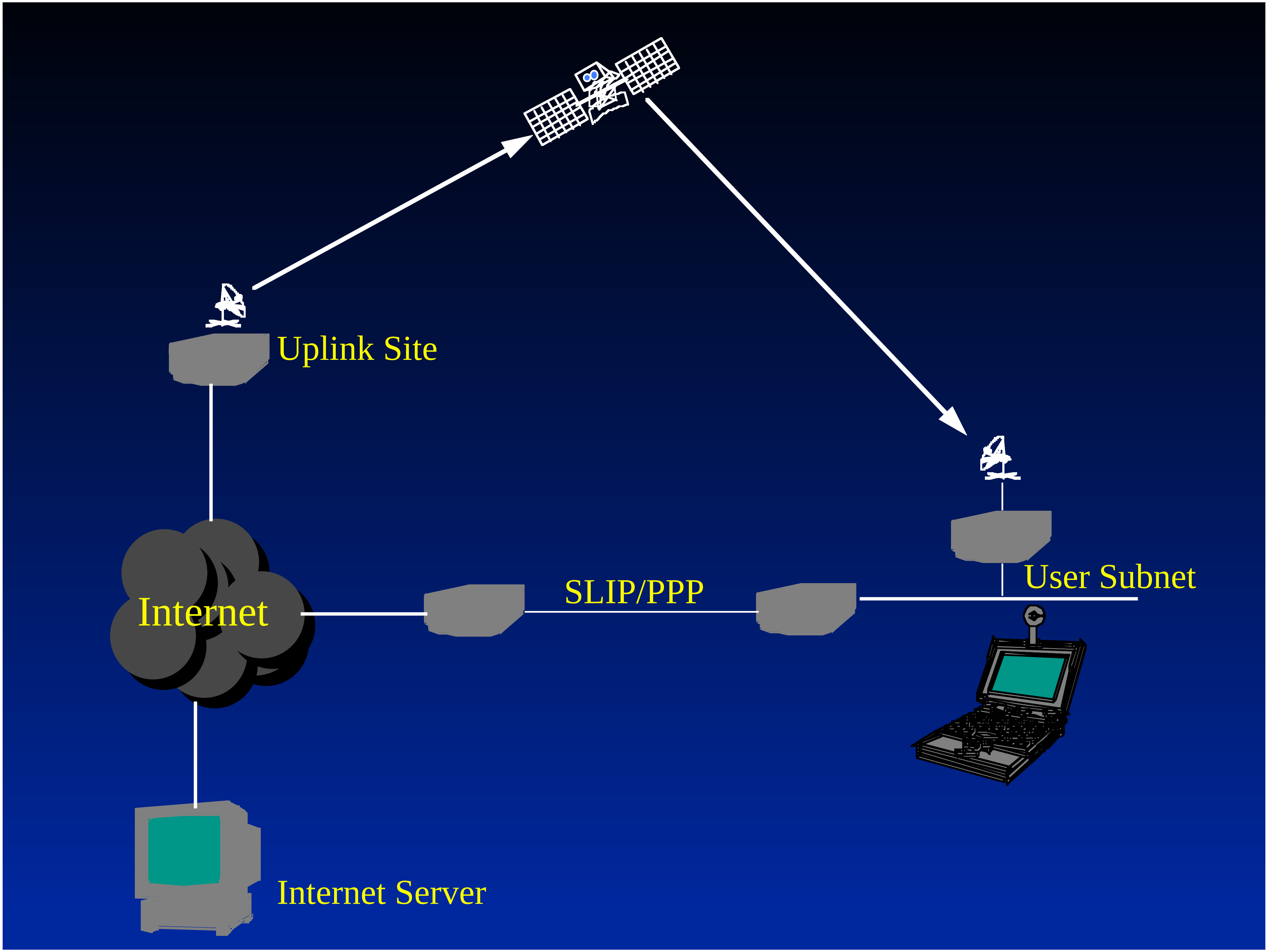
Overview

- Geostationary satellite broadcasts directly to user premises
  - 24 inch dish antenna, ISA adaptor card
- Asymmetric Internet access
  - users typically receive more data than they send
  - 12 Mbps satellite downlink; target rate of 400 Kbps per user
  - slow uplink: SLIP/PPP over a modem line
- Easy to deploy at short notice even in remote locations


Uplink Site
Internet
SLIP/PPP
User Subnet
Internet Server

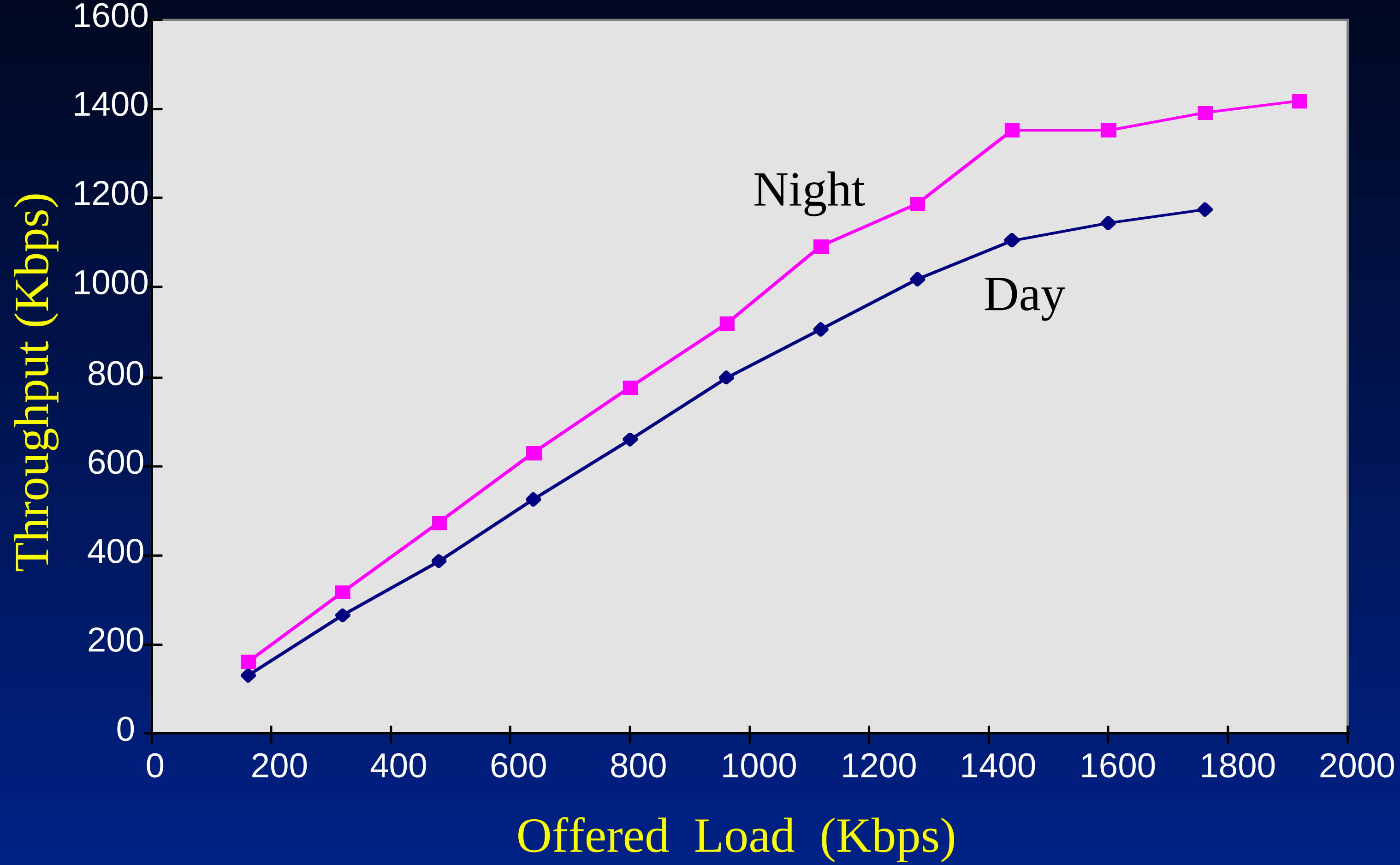
Asymmetric Routing

- Outgoing traffic over the SLIP/PPP line; Incoming traffic over the satellite hop
- Option 1: Encapsulation
  - outgoing packets use DBS source address
  - packets sent encapsulated over the SLIP line
  - works for a single host but not for a subnet
- Option 2: Home agent-based routing
  - outgoing packets use home source address
  - home agent tunnels incoming packets over DBS
  - a more general solution

Transport Issues

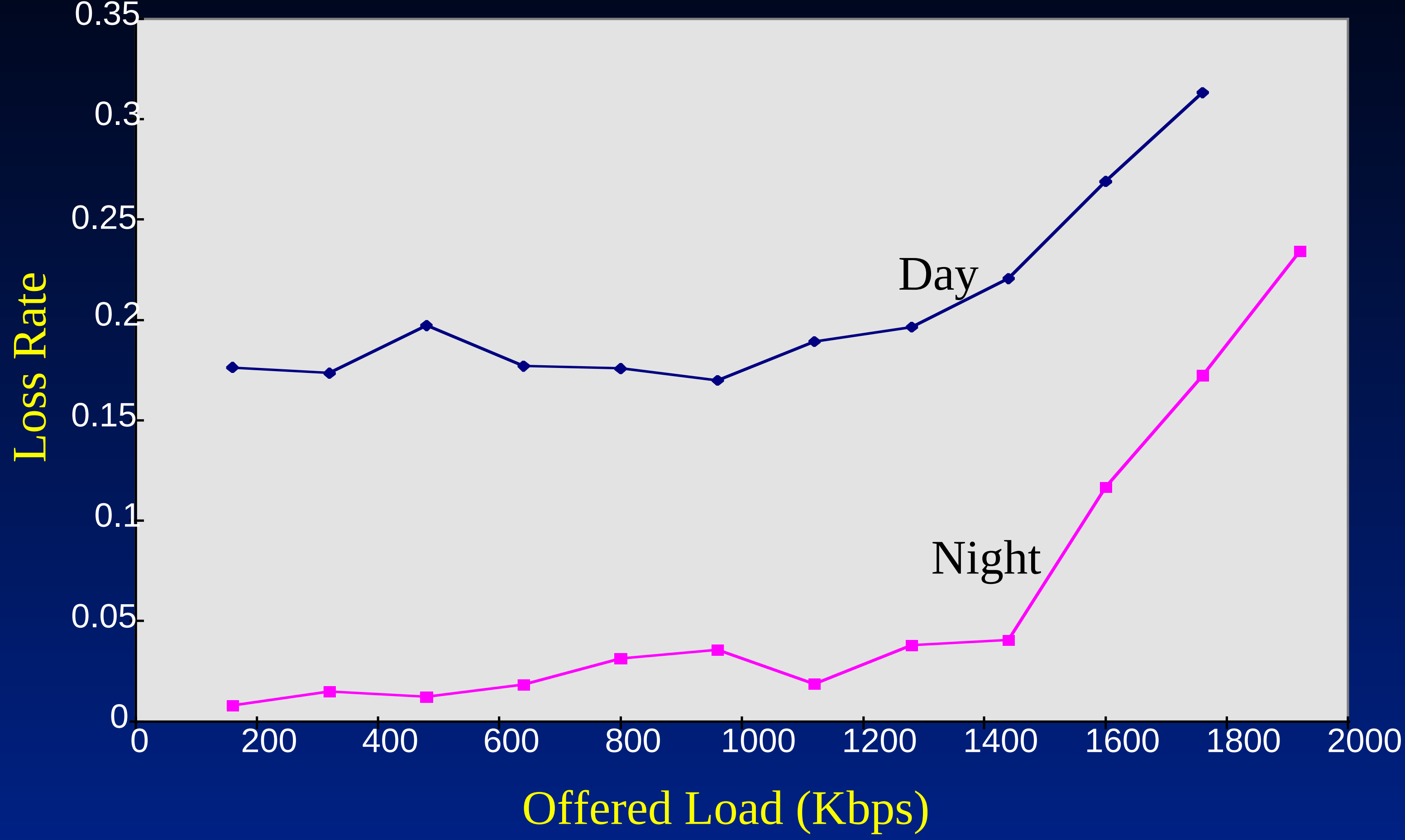
- Large bandwidth-delay product
  - TCP sender and receiver need to maintain large windows to keep the “data pipe” full
  - 500-1000 Kbps times 1 second = 50-100 KB
- Asymmetric bandwidth
  - Uplink has much smaller bandwidth than the downlink
  - TCP acknowledgements stream might throttle the flow of data packets

UDP Throughput



– Throughput tapers off beyond an offered load of about 1.4 Mbps

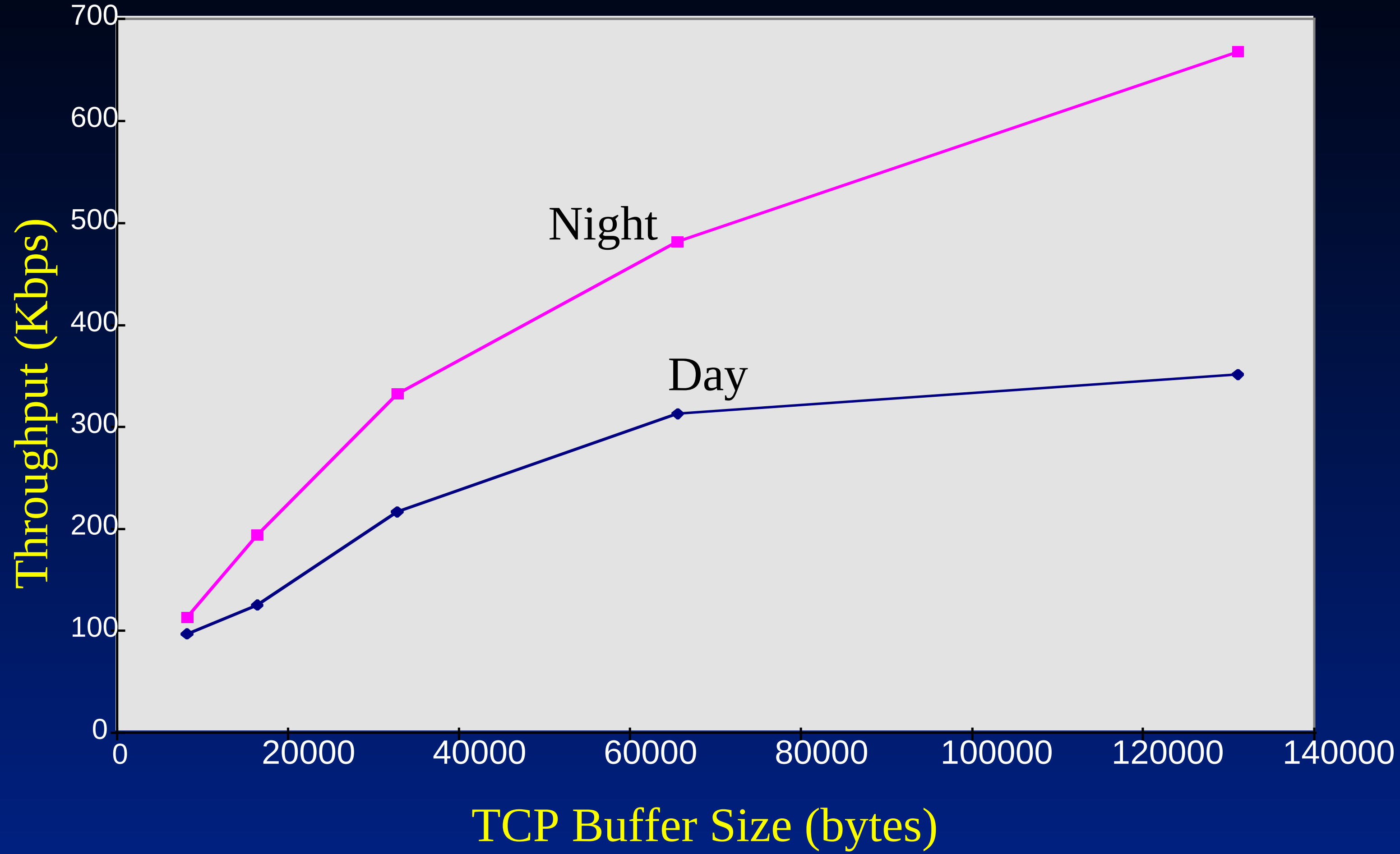
UDP Loss Rate



– High loss rate due to Internet during the day

– Sharp upswing for offered load beyond 1.4 Mbps

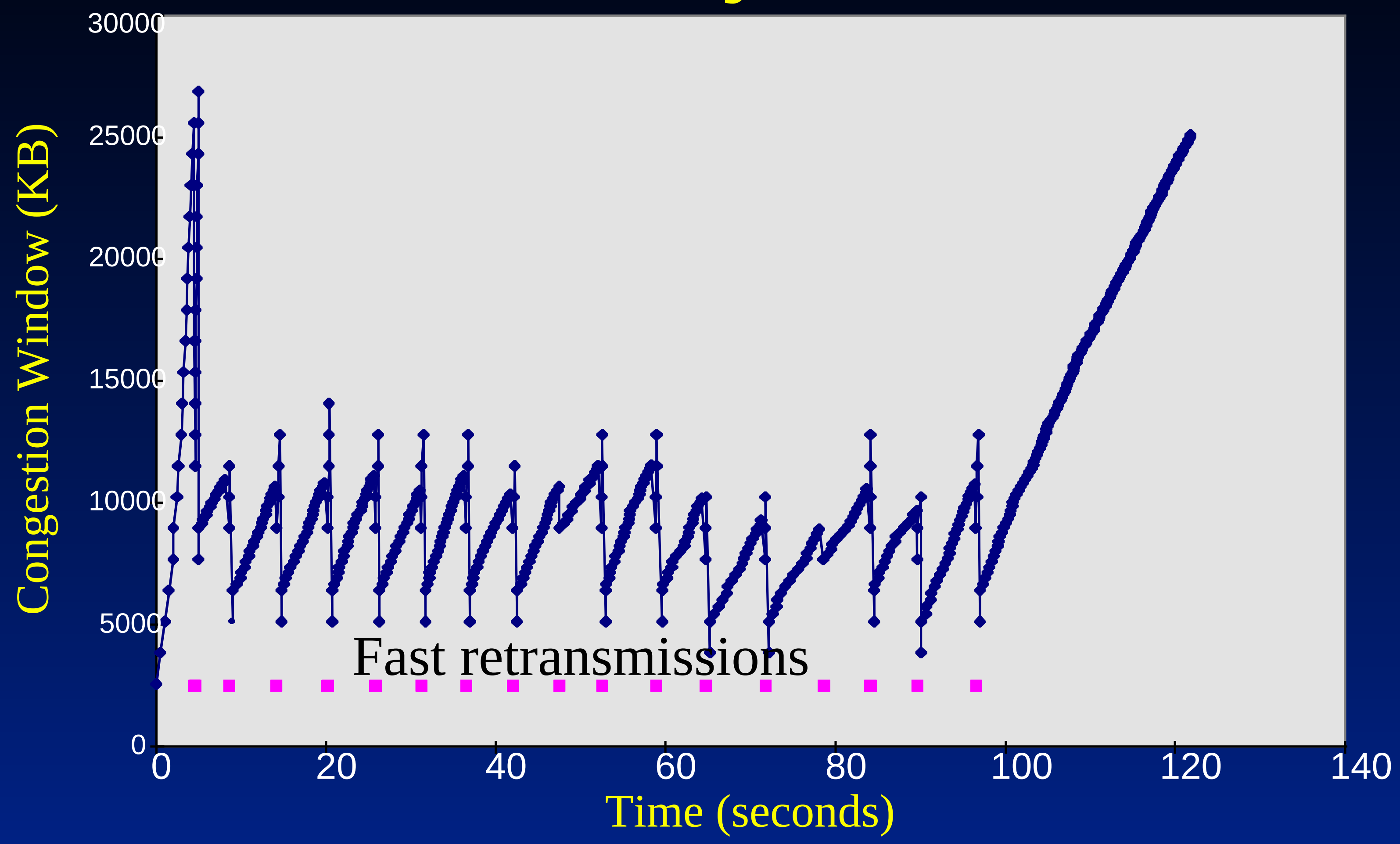
TCP Throughput



– Poor throughput for the 8-32 KB buffers used by most Internet servers

– Comparable to UDP when loss rate is low

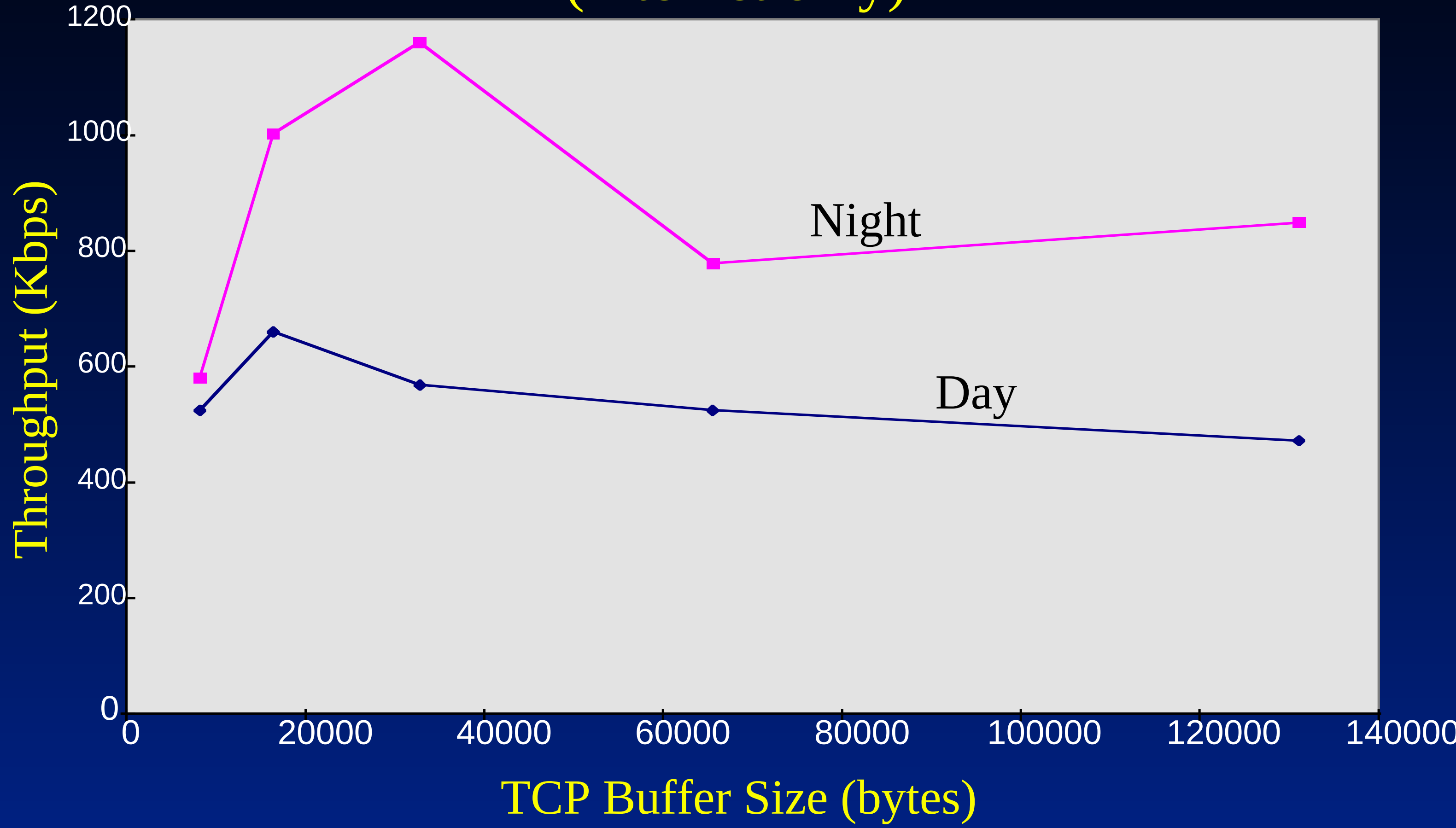
TCP Dynamics



– 2 MB transfer with 130 KB buffers
– Poor throughput due to fluctuation in congestion window size though not timeouts at source

TCP Throughput

(Internet only)



– Best throughput for 16-32 KB buffers

– Deterioration for large buffers presumably due to increased burstiness of the source

Conclusions

- Performance of DBS system is often limited by the Internet
- Large TCP windows needed to keep data pipe full
  - buffer sizes typically used by servers on the Internet are too small
  - but large buffer sizes could increase source burstiness and lead to Internet losses.

Future Work

- Improve performance of data transport
  - install host close to uplink to evaluate the satellite hop in isolation
  - split-connection approach (for instance, in conjunction with a Web proxy cache)
  - reduce burstiness of TCP source
- Evaluate application-specific solutions
  - plentiful downlink bandwidth, large latency
  - suitable for predictive prefetching of Web data [PM96]

Status of the UCB Testbed

- One DirecPC host fully functional
  - BSD/OS driver for the ISA adaptor card (Keith Sklower)
- Home agent-based routing
- Web browsing and video dissemination demonstrated