

# **97-0616: UBR Buffer Requirements for TCP/IP over Satellite Networks**

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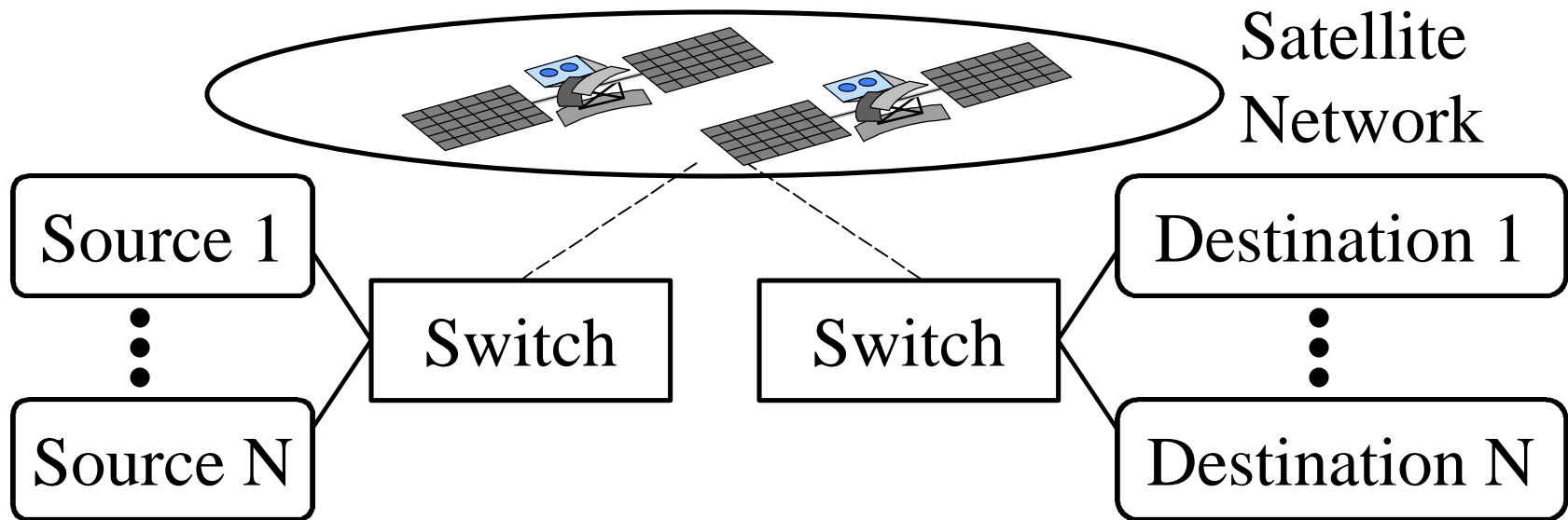


- ❑ Goals
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# Goals

- ❑ Assess buffer requirements for TCP over UBR for satellite latencies
- ❑ How does TCP throughput increase with increasing network buffers?
- ❑ How well can we do with less than 1 RTT buffers?

# Simulation Model



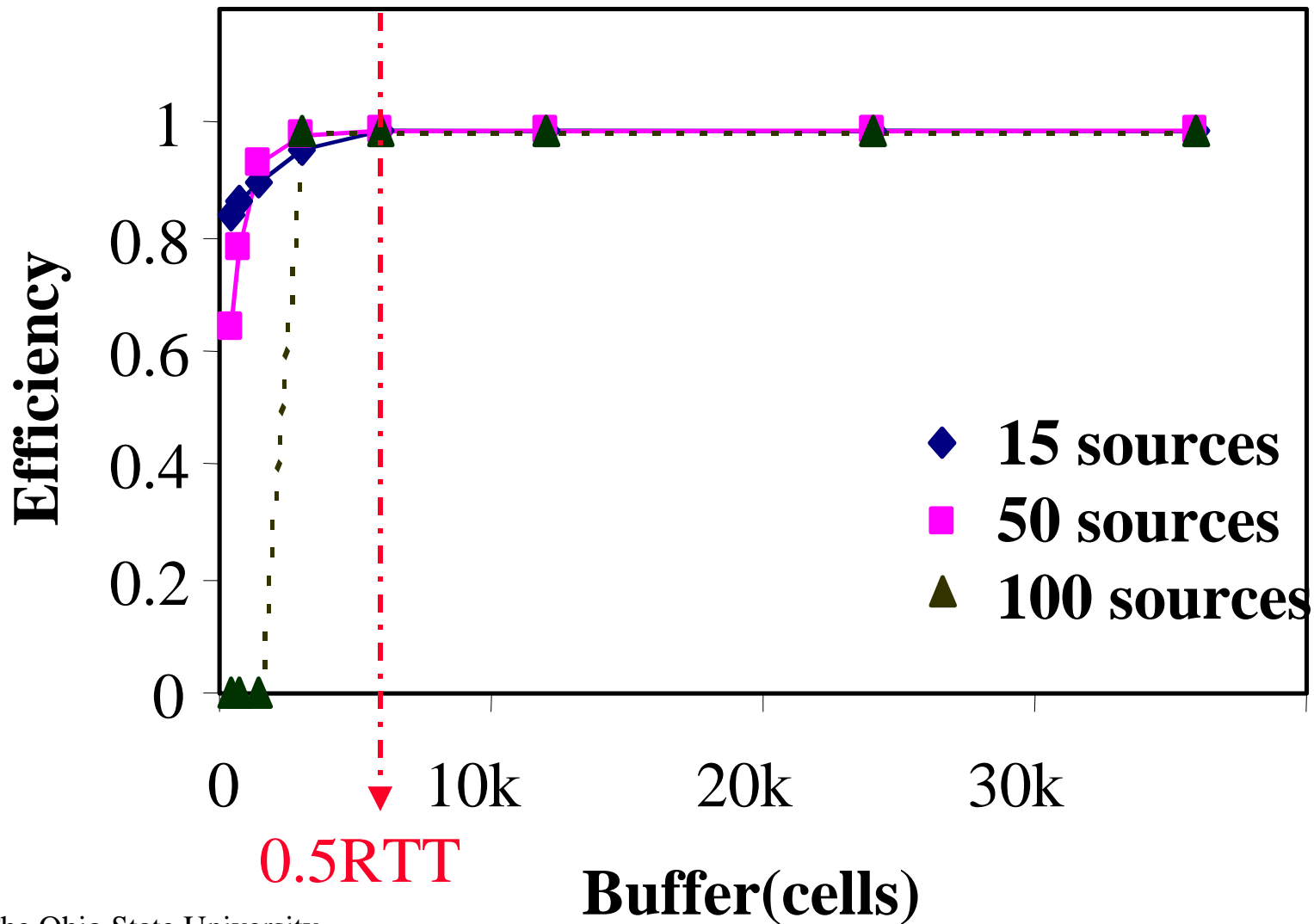
← 5 ms → | ← 5, 100, 275 ms → | ← 5 ms →

- ❑ N identical infinite TCP sources, SACK TCP
- ❑ Link Capacity = PCR = 155.52 Mbps
- ❑ Per-VC buffer management in switches (sel. drop)
- ❑ Simulation time = 100 s

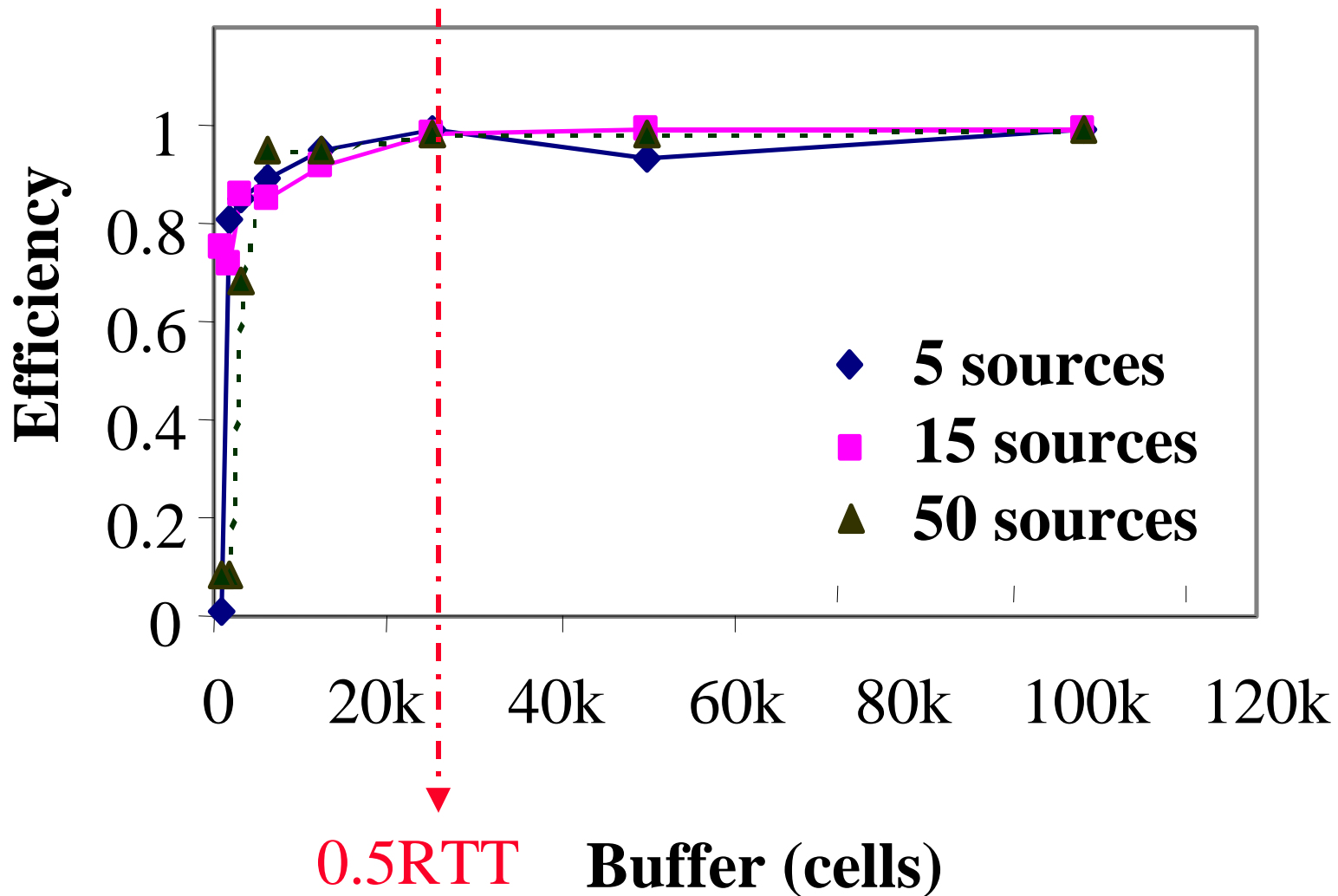
# Parameters

- ❑ Latency between earth stations via satellite (1 way)
  - ❑ Single hop LEO: 5ms
  - ❑ Multiple hop LEO: 50 ms
  - ❑ Single hop GEO: 275 ms
- ❑ Number of Sources
  - ❑ Single hop LEO: 15, 50, 100
  - ❑ Multiple hop LEO, single hop GEO: 5, 15, 50
- ❑ Buffer Size
  - ❑  $RTT \times 2^{-k}$ ,  $k = -1, 0, 1 \dots 6$

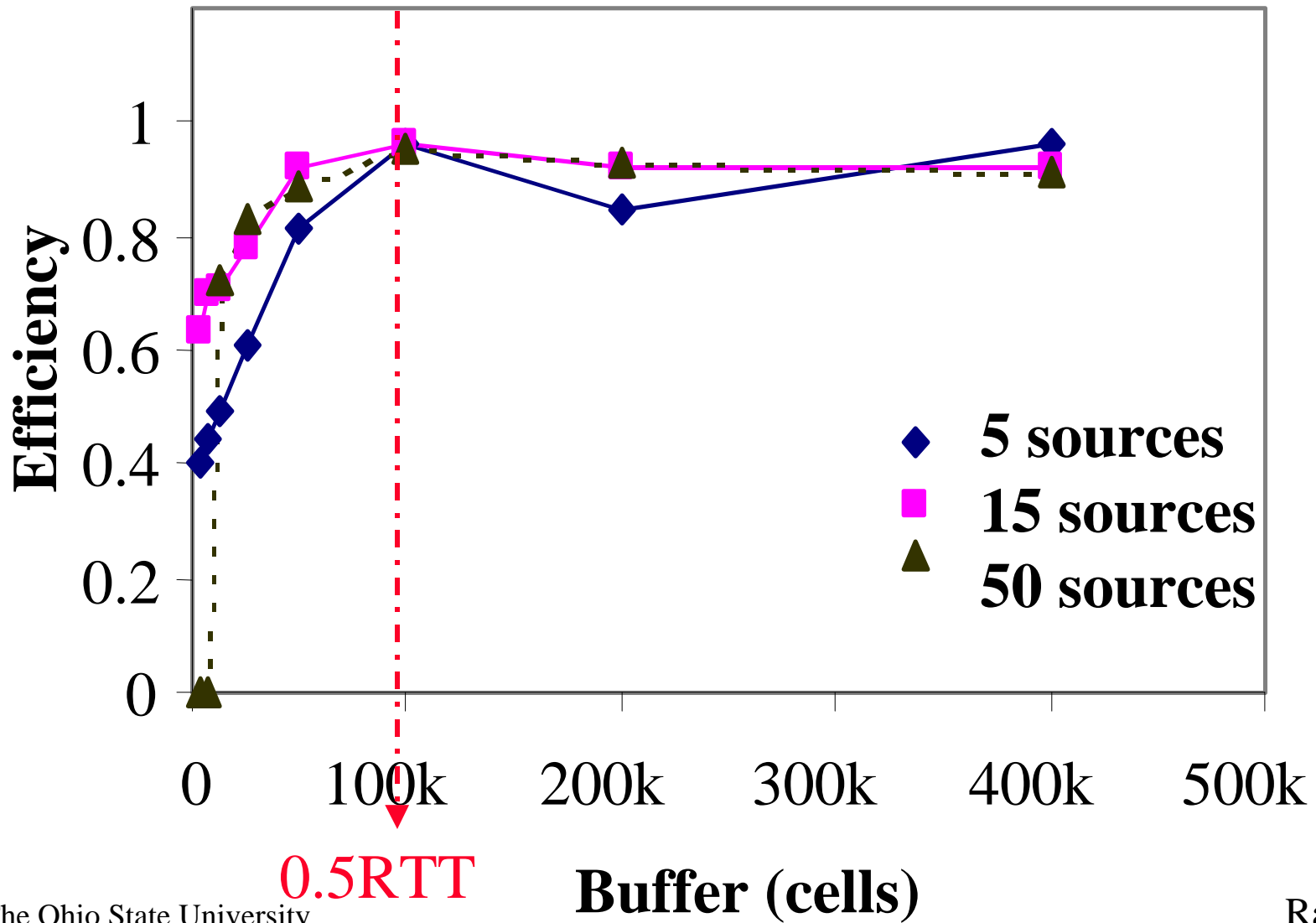
# Single hop LEO



# Multiple hop LEO



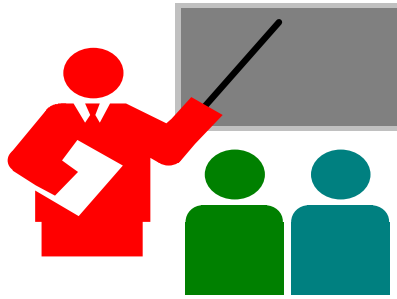
# Single hop GEO



# Results

- ❑ Very small buffer sizes result in low efficiency
- ❑ Moderate buffer sizes (less than 1 RTT)
  - ❑ Efficiency increases with increase in buffer size
  - ❑ Efficiency asymptotically approaches 100%
- ❑ Buffer size =  $0.5 * RTT$  results in very high efficiency (98% or higher) even for a large number of sources
- ❑ Fairness is high because of per-VC buffer management

# Summary



- ❑ Assessed buffer requirements for SACK TCP over UBR with per-VC buffer management for satellite latencies
- ❑ Latencies included single hop LEO, multiple hop LEO, and GEO
- ❑  $0.5 * RTT$  buffers provide sufficiently high efficiency for TCP over UBR even for a large number of TCP sources