Week 4: Bandwidth

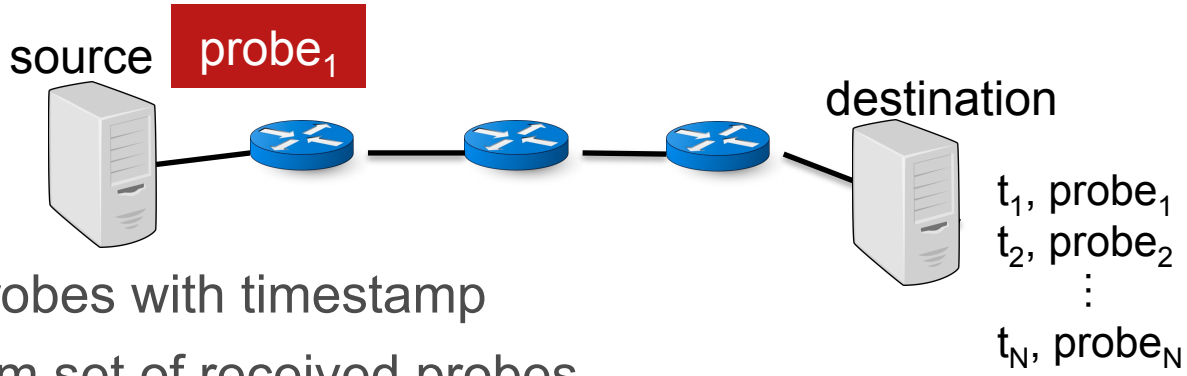
1. Introduction
2. Definitions of bandwidth metrics
3. **End-to-end measurement approaches**
4. Flooding
5. Advanced probing
6. Conclusion

Our focus this week: active methods

- Active methods measure properties of e2e paths
  - Metrics: capacity, available bandwidth, bulk transfer capacity
  - Measure any path with access to source and/or destination
- Passive methods require access to network equipment
  - Metrics: configured capacity, utilization
  - Measure single links or small number of links

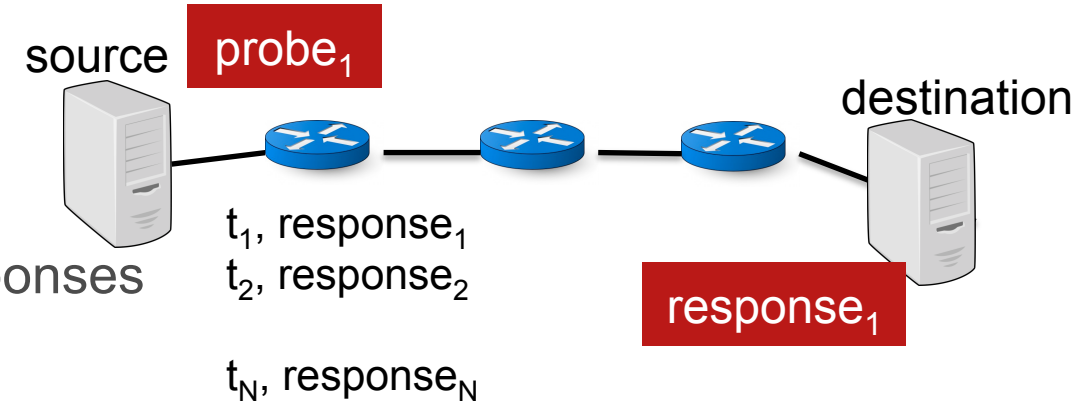
Active measurement with control of source and destination of paths

- Source host
  - Issues probes
- Destination host
  - Records received probes with timestamp
  - Estimate metrics from set of received probes



Active measurement with control of source of paths only

- Source host
  - Issues probes
  - Estimate metrics from responses
- Limitation
  - Hard to distinguish properties of forward and reverse paths



Probing method

Flooding

- Issue large number of probes to “fill” path
- Pro
  - Measure what users can get
- Con
  - Large overhead affect network and users

Advanced methods

- A number of methods in literature
  - Packet pair, size-delay, self-induced congestion
- Pro
  - Less overhead than flooding
- Con
  - Rely on assumptions that don’t always hold in practice

Picture credits

- Slides 3 & 4 :
  - **Server Linux box clip art** by OCAL, www.clker.com (public domain)
  - **Router clip art** by OCAL, www.clker.com (public domain)