CSC2231: Quality of Internet Paths

http://www.cs.toronto.edu/~stefan/courses/csc2231/05au

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Administrivia

- **You've made it so far!**
  - Congratulations!
- **P2P stuff from next lecture on**
- **"mock" PC really soon now**

Motivation

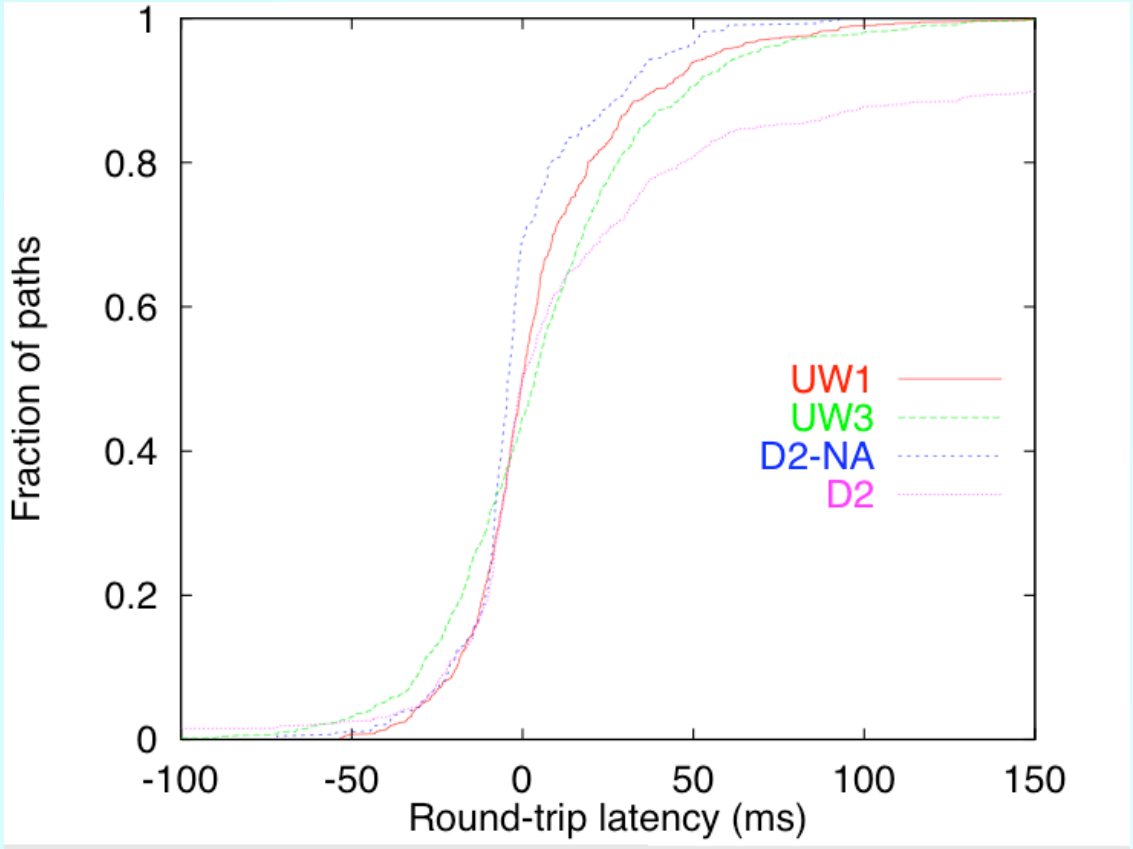
- **Routing is a black box**
  - Label packet with destination
  - Put it on the wire
  - Here it goes….
- **Routing path choice subject to:**
  - Traffic engineering
  - ISP peering policies
  - Network topology
  - Poor routing algorithms
- **Question:**
  - How does path selection affect end-to-end performance?

Anectodal Evidence

Methodology

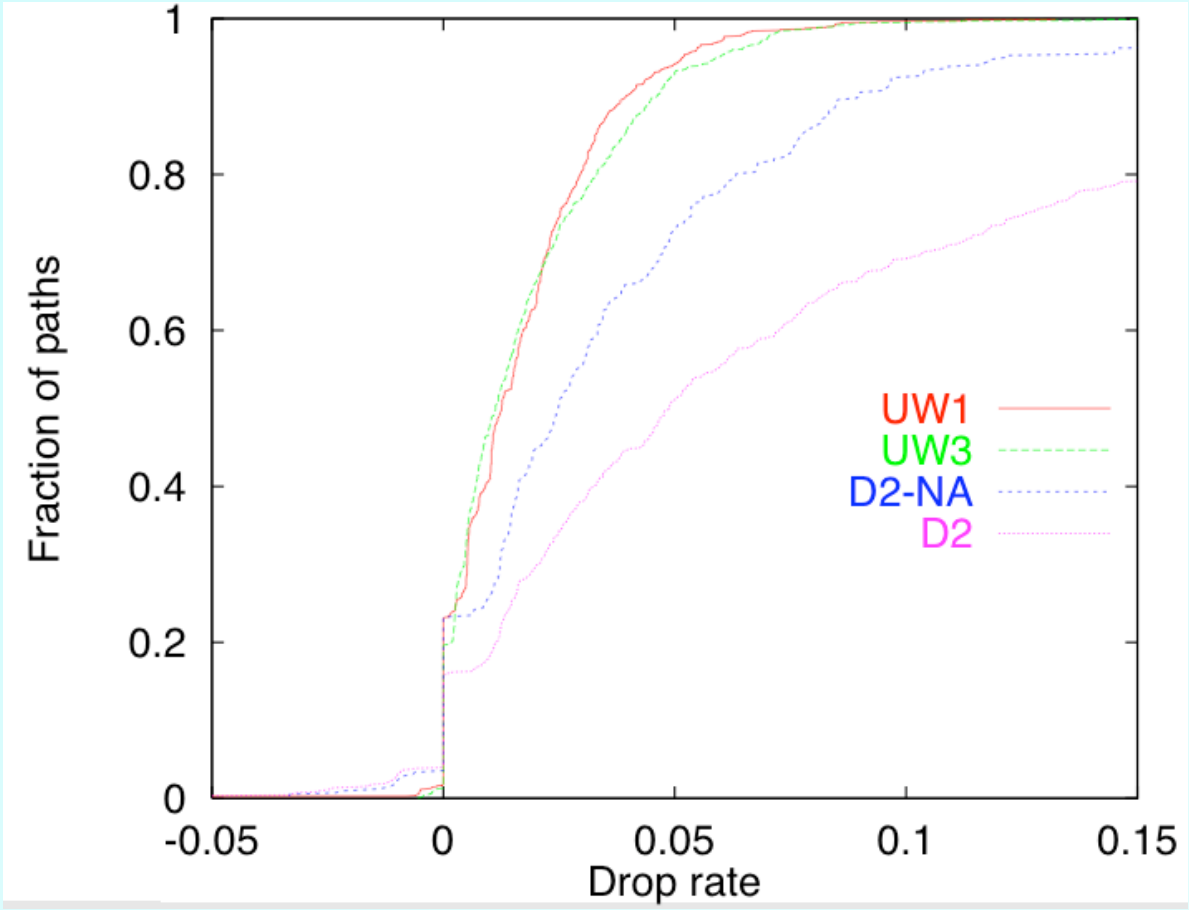
- **Basic metric:**
  - Let X = performance of default path
  - Let Y = performance of best path
  - Y-X = cost of using default path
- **How to find the best path:**
  - Measure paths between N nodes
  - Generate synthetic full mesh topology (N^2)
  - Find best path on this graph
- **Their best path underestimates "true" best path**
- **Not many dialup, DSL, cable users in their traces**

RTT



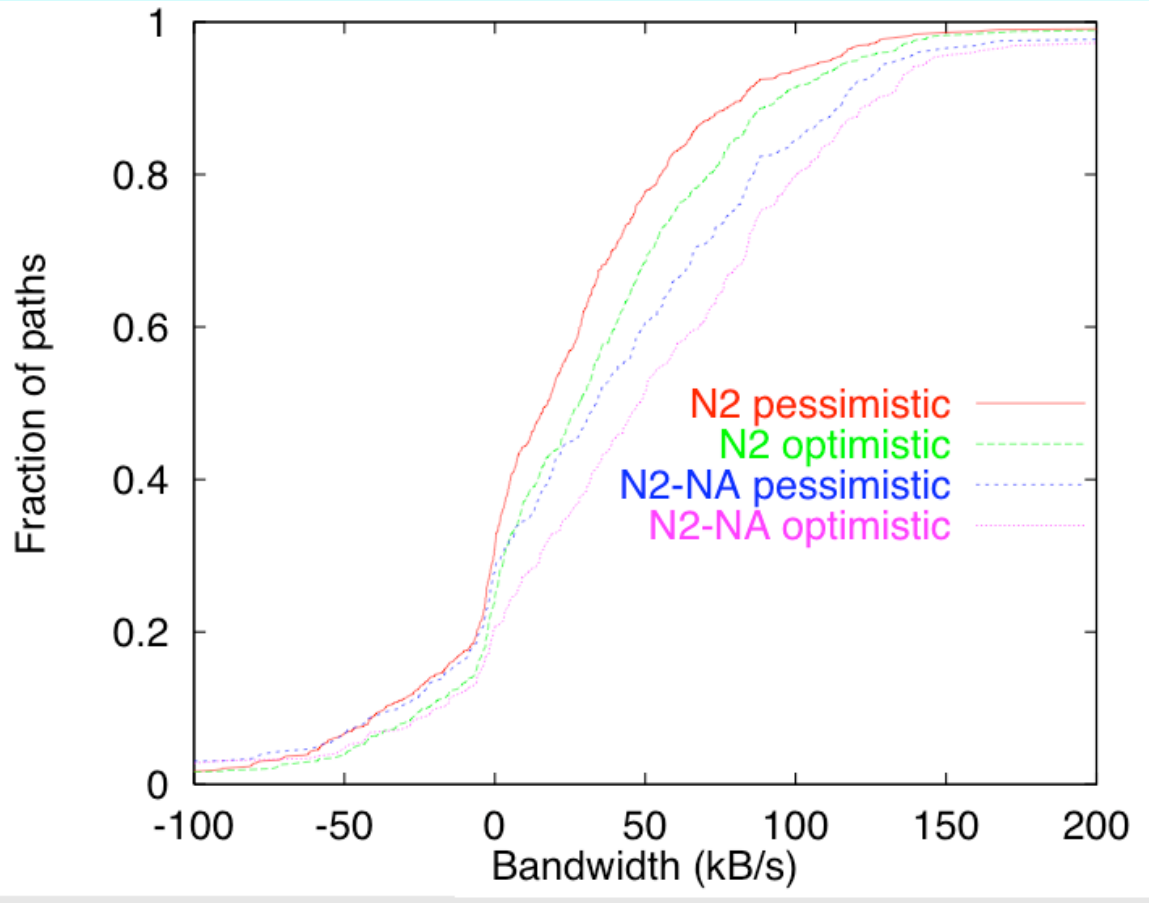
30-55% of default paths have longer RTTs

Loss Rate



75-85% of default paths have higher loss rates

Bandwidth



70-80% of default paths have lower bandwidths

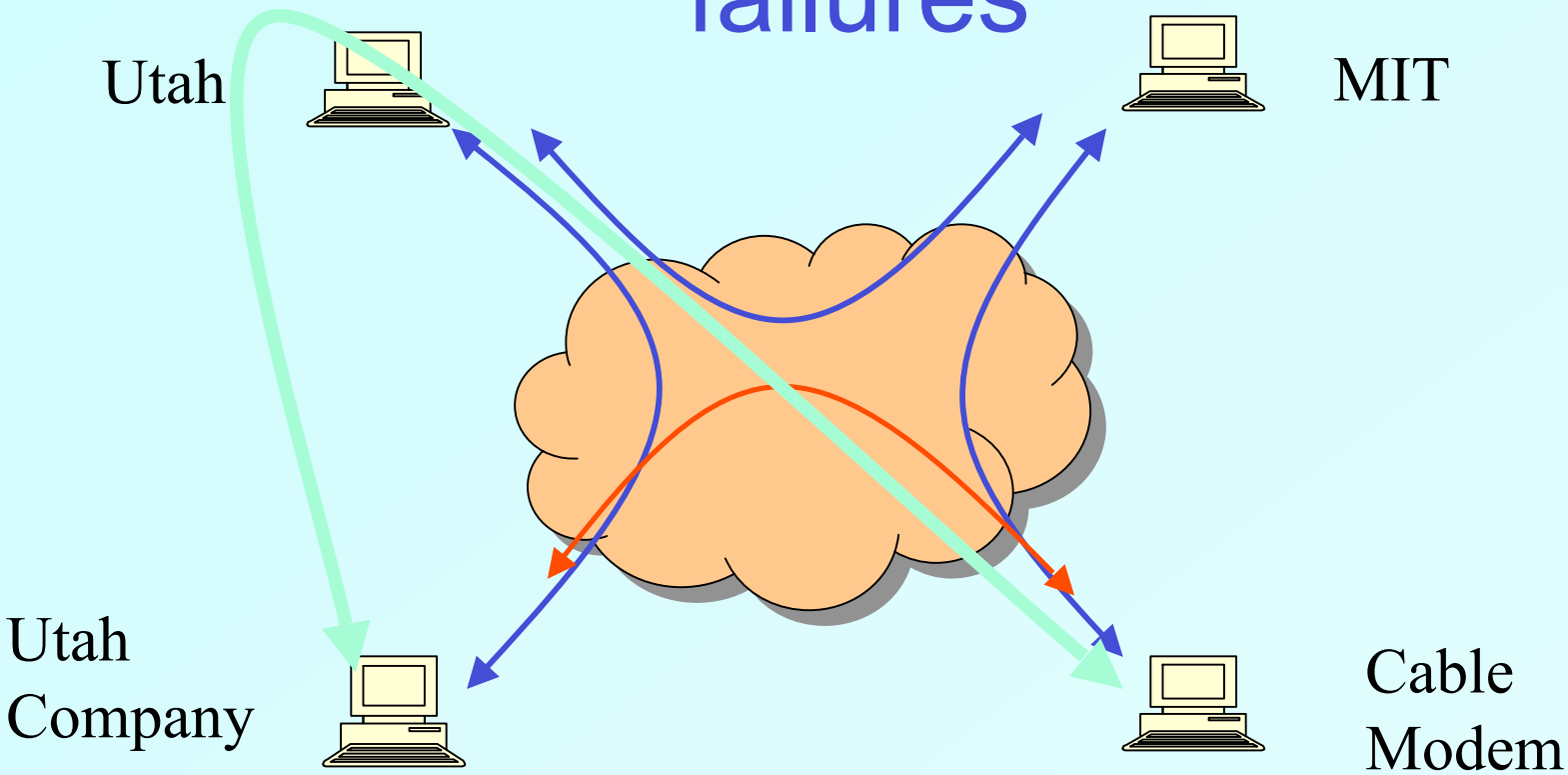
Adding it all up

- **Plenty of opportunity to improve on quality of routing paths:**
  - Why hasn't this been done before?
  - Can we do this?

RON

Slides © David Andersen

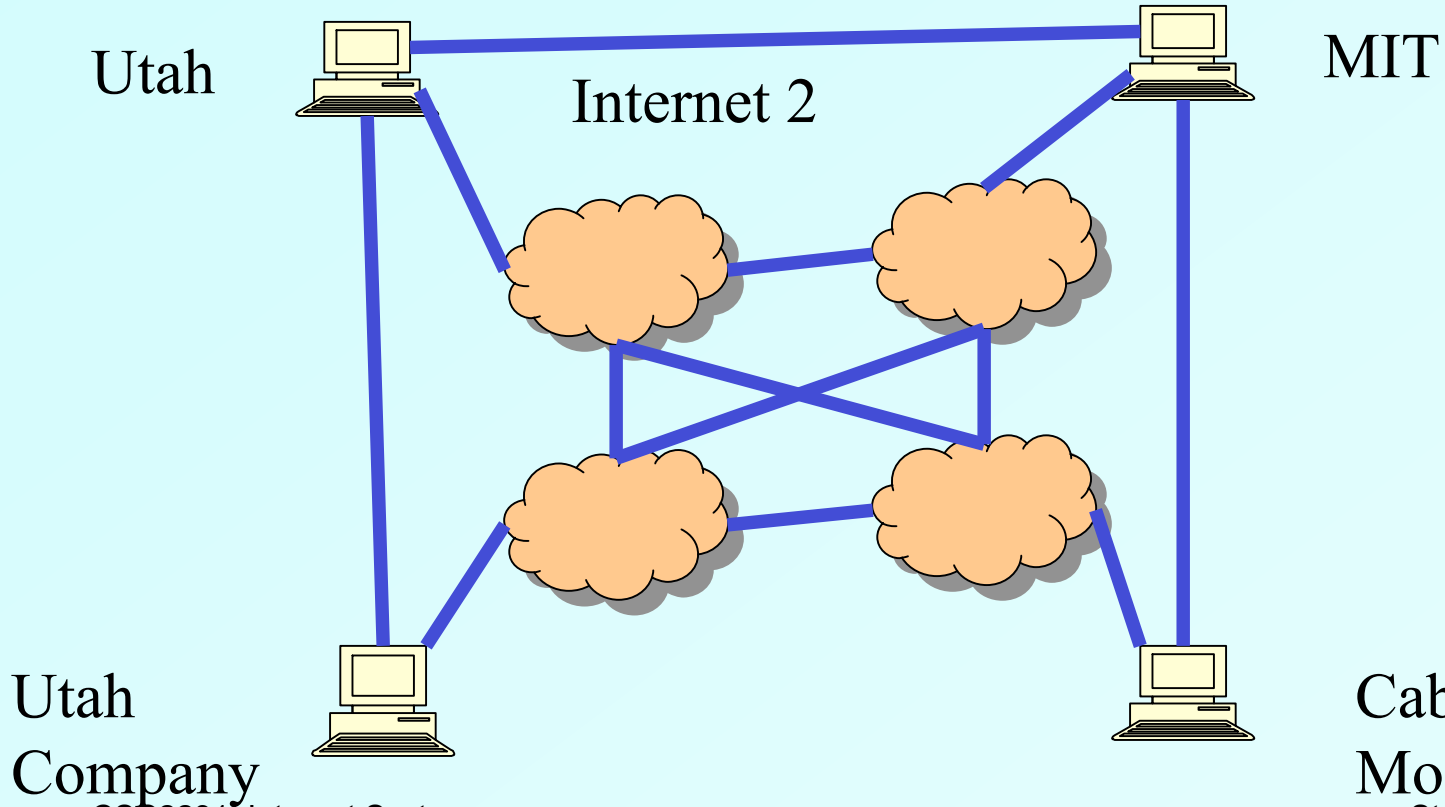
Overlay routes around Internet failures



- Failures:
  - –Outages: Configuration/operational errors, backhoes, etc.
  - –Performance failures: Severe congestion, denial-of-service attacks, etc.

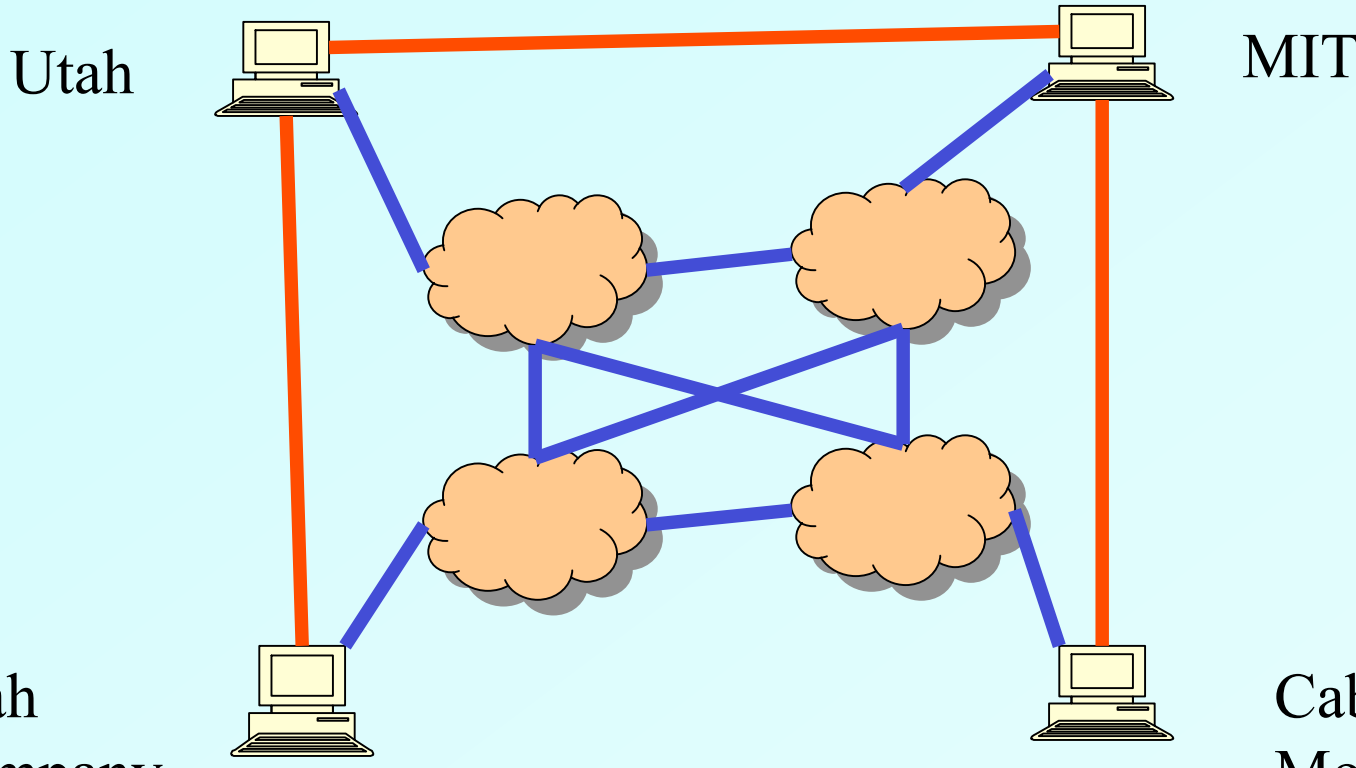
Redundant links

- **Multiple paths between all sites**



Redundant links

- **But many of them are hidden**



Resilient overlay networks

- **Measure all links between nodes**
- **Compute path properties**
- **Determine best route**
- **Forward traffic over that path**

Take home messages

1. **RON reduced outages by a factor 5 to 10, and routed around all major outages**
2. **RON takes 18s (average) to route around a failure, and can do so in the face of flooding attacks**
3. **Single route indirection delivers the majority RON benefits**

Discussion

- **Is Internet path selection algorithm optimal?**
  - Is this the right question to ask?

Discussion

- **RON: route around failures**
- **SOSR: single-hop route around failures**
- **How about other metrics?**
  - Latency:
    - Do we care?
  - Bandwidth
    - Will it make a difference for end-hosts?

M.S. Project Ideas

- **How much does swarming helps file downloads?**
  - And why?
- **Can VoIP benefit from routing around congested links (long latencies?)**
  - What are the differences in jitter between routing and optimal paths?