Towards Tunable Measurement Techniques for Available Bandwidth

Ningning Hu, Peter Steenkiste
Carnegie Mellon University

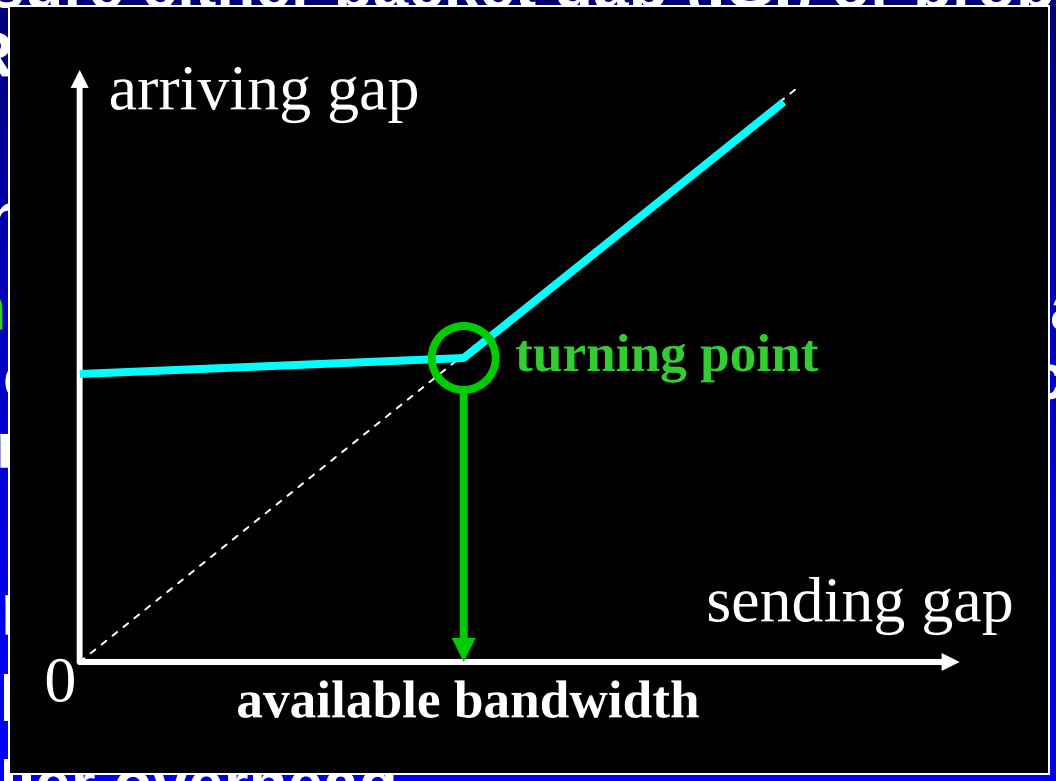
BEst 03
12 / 09 / 2003

Outline

- Our experience
  - IGI & PTR
  - PaSt
- A taxonomy of current techniques
- Challenge – tunability

IGI & PTR

- **Uniform packet train probing techniques**
  - **Measure either packet gap (IGI) or probing rate (PTR**
- **Search**
  - **Turn** **ap**
    (larg **creased**
    (decr
- **Perfor**
  - **Simil**
  - **Smaller overhead**



Paced Start (PaSt)

- Application of PTR
  - Use PTR to improve TCP startup performance
  - Similar in flavor to TCP NewReno
- PaSt uses multiple windows of data packet train to search for the turning point (available bandwidth)
- Performance [ICNP 03]
  - Less packet loss
  - Smaller startup time

What We Learned from PaSt

- Application's considerations are very important for the measurement technique design
- Accuracy
  - IGI/PTR sometimes have 30% error, good enough?
  - TCP startup: 50% error can be easily accommodated
- **Think MORE about applications!**
  - TCP startup: overhead is critical
  - IGI/PTR took all effort to reduce the overhead
- Two-end control
  - Hard to deploy
  - TCP: an two end protocol

Outline

- Our experience
  - IGI & PTR
  - PaSt
- A taxonomy of current techniques
- Challenge – tunability

Taxonomy of Current Techniques

Manish Jain, Constantios Dovrolis

- **Pathload**
- **IGI/PTR**
- **TOPP**
- **pathChirp**
- **Spruce**

Ningning Hu, Peter Steenkiste

Bob Melander, Mats Bjorkman, Per Gunningberg

Vinay J. Ribeiro, Rudolf H. Riedi, Richard G. Baraniuk, Jiri Navratil, Les Cottrell

Jacob Strauss, Dina Katabi, Frans Kaashoek

Taxonomy of Current Techniques

		How to measure			
		Uniform probing	Non-uniform probing	Diff.	common
What to measure	A_bw (rate)	Pathload, PTR, TOPP	pathChirp	Not need B	Timer problem Two-end control
	C_bw (gap)	IGI	Spruce	Need B	
	Diff.	Small interval	Long interval		

The list of techniques here is not a complete list.

Outline

- Our experience
  - IGI & PTR
  - PaSt
- A taxonomy of current techniques
- Challenge – tunability

The Challenges

- Two-end control
- Accuracy vs. overhead
- Extreme environment

Deployment and Application – Tunability

Two-End Control

- Single-end control needs echo packets
- Accurate timestamp for the echo packet is hard to get

1. **Tunability #1: Single-end probing**
   - *K.G. Anagnostakis, et.al*. cing: Measuring network-internal delays using only existing infrastruture. Infocom 03.
2. Return path queueing

Accuracy vs. Overhead

- Accuracy is often a tradeoff with probing overhead

Tunability #2:
Enable application to configure the tradeoff between accuracy and probing overhead

Extreme Environment

- The environment where the bandwidth measurement assumptions don't hold
  - Time measurement assumption
  - Available bandwidth determining factors

- **Tunability #3:**
  Deal with the environment of the future

- Wireless network
  - Available bandwidth determining factor could be different

Conclusion

- Our experience from IGI/PTR & PaSt
  - Active probing design must consider both accuracy and overhead
  - The tradeoff is closely related with the application requirement
- Tunability is the key challenge for the deployment of current techniques for available bandwidth measurement
  - Achieve single-end control
  - Understand the tradeoff between accuracy and overhead
  - Solve real system issues