WiMAX
Application Performance
Testing Guidelines

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These slides are available at

http://www.cse.wustl.edu/~jain/wimax/testing.htm

Overview

❑ Why Performance Testing?

❑ Testing Guidelines: Scope

❑ Goals and Non-Goals

Why Performance Testing Guidelines?

❑ Service providers/users need to be able to compare different vendors equipment/services.

❑ For WiMAX to succeed, it is important that performance of user application on WiMAX be better than that on competing technologies.

    ❑ Confusion caused by differing terminology and differing benchmarks will eventually lead to customer dis-satisfaction

❑ Imagine the confusion if the definitions of throughput, response time, fairness, etc. are different by different vendors.

❑ Other organizations have standardized performance testing definitions and procedures, e.g., 3GPP, IETF, ATM Forum..

❑ Better customer information will contribute to more customer satisfaction and more sales and hence success of WiMAX.

Dictionary Definition

❑ **Benchmark** *v. trans*. To subject (a system) to a series of tests in order to obtain prearranged results not available on competitive systems.

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From: The Devil's DP Dictionary

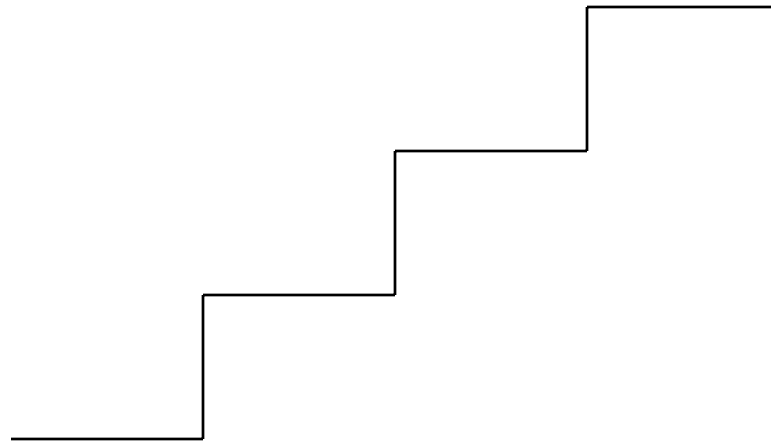S. Kelly-Bootle
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Performance: Different Vendors

❑ Vendor A: Throughput = 55 Mbps

❑ Vender B: Capacity = 100 Voice users

❑ Vendor C: Goodput = 200 packets per second 512 B packets

❑ Observation:

  ❑ no standard set of metrics,

  ❑ no standard definition of metrics

  ❑ no standard procedure to measure these metrics

Testing Guidelines: Scope

❑ Define metrics that help the service providers and users compare various WiMAX equipment and devices.

❑ The metrics should be independent of device architectures. They should apply to all architectures.

❑ Develop precise methodologies for measuring these metrics. Methodology = Procedure + Configuration + Traffic Pattern ⇒ Anyone (user or vendor) can conduct it and come up with the same result.

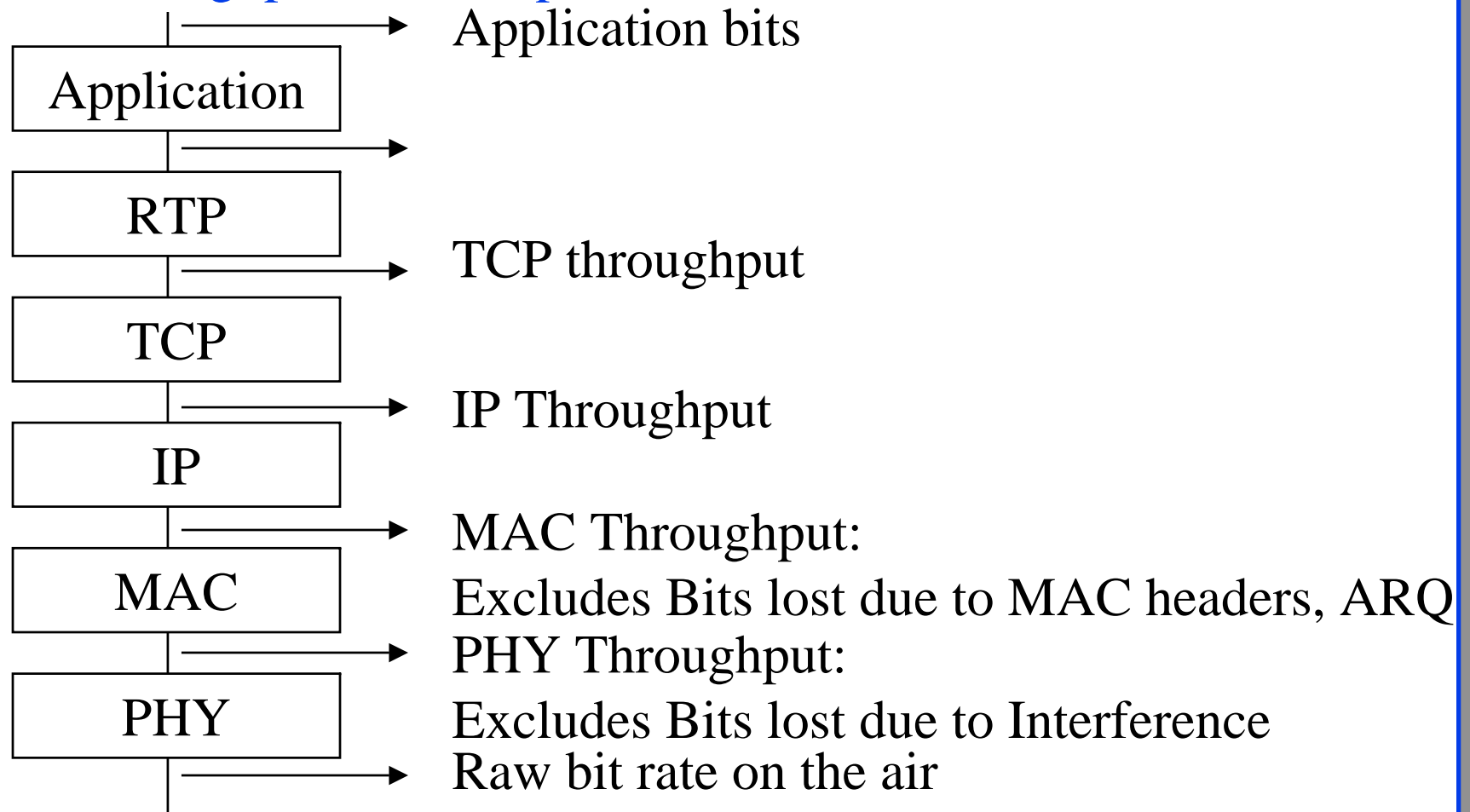❑ Any extensions of the above that enhance the marketablity of WiMAX can be added to the scope

Scope (Cont)

❑ Cover as many device types as possible.
   Begin with most devices: Base station, user terminals.

❑ Should include performance of traffic management, network management, connection setup, along with data transfer.

Performance at Different Layers

❑ Throughput = 55 Mbps. What does this mean?

Application bits

Application

RTP

TCP throughput

TCP

IP Throughput

IP

MAC Throughput:

MAC

Excludes Bits lost due to MAC headers, ARQ

PHY Throughput:

PHY

Excludes Bits lost due to Interference

Raw bit rate on the air

Goals

❑ Emphasize end-user/service provider view point where-ever possible.

❑ At some levels, the performance should be independent of lower level mechanisms:

   ❑ Voice over ertPS, rtPS, nrtPS, BE

Non-Goals

- WiMAX Forum will not do any measurements.
- Independent labs may use the WiMAX forum specified methodology to perform these measurements, e.g.,
  - Harvard Network Device Test Lab
  - University of New Hampshire Interoperability Lab
- Labs generally work with the vendor to prevent premature disclosure of information
- WiMAX Forum will not set any performance thresholds
  - Setting thresholds can kill the performance-cost tradeoffs
  - Example 1: Frame loss rate should be no more than 1%
  - Example 2: BS delay should be less than 1 ms.

Performance Metrics

❏ General Metrics

❏ Traffic management metrics

❏ Protocol specific metrics

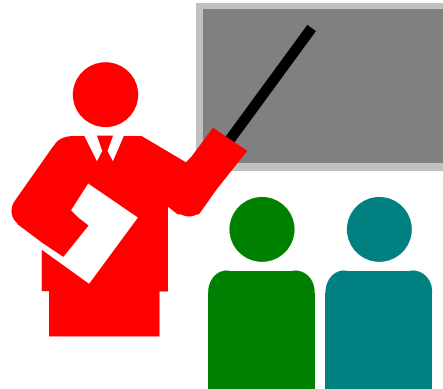❏ Network management metrics

Reference Configuration
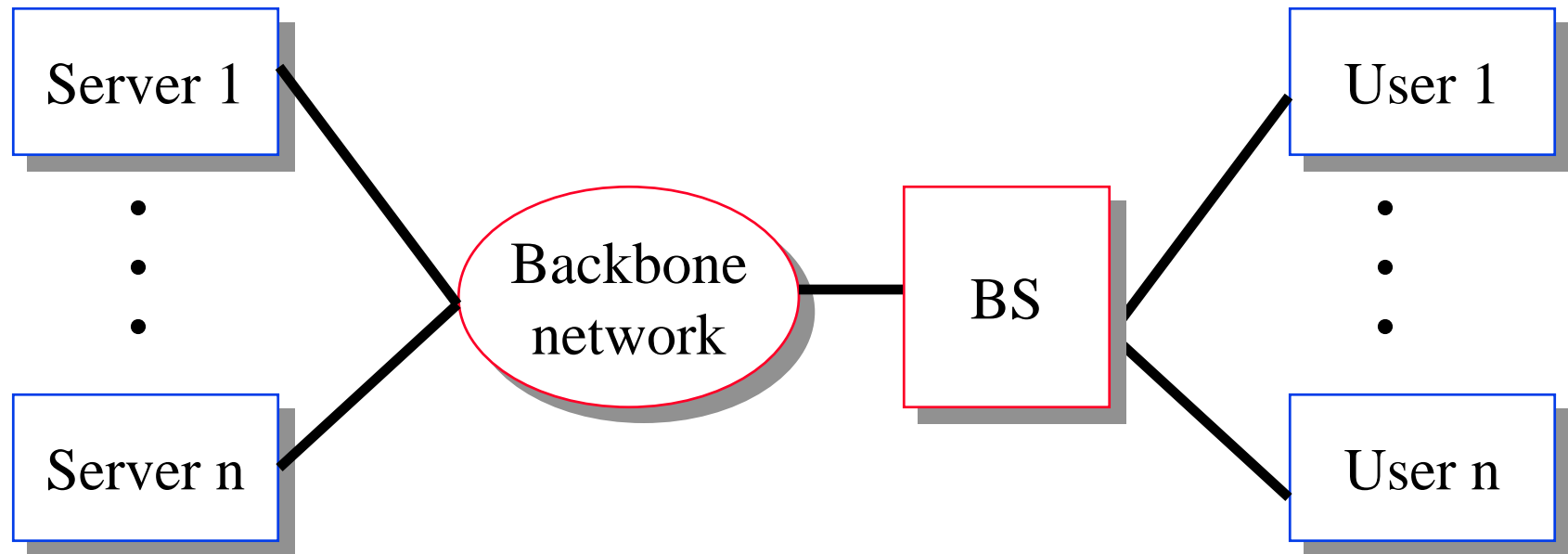
❏ Exact scope and configuration to be discussed

Example Performance Metrics

❑ Throughput

❑ Frame loss rate

❑ Back-to-back burst size

❑ Latency

❑ Call establishment time

Summary

- Performance testing guidelines will help service providers use the same terminology and procedures for performance

- Service providers and users will be able to compare results from different vendors/sources

- Other telecom technologies including 3GPP, IETF, have similar documents

IP Performance Metrics: RFCs

- RFC 2330 "Framework for IP Performance Metrics," May 1998.

- RFC 2501 "Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation Considerations," January 1999.

- RFC 2647 "Benchmarking Terminology for Firewall Performance," August 1999.

- RFC 3222 "Terminology for Forwarding Information Base (FIB) based Router Performance," December 2001.

- RFC 3393 "IP Packet Delay Variation Metric for IP Performance Metrics (IPPM)," November 2002.

- RFC 3432 "Network performance measurement with periodic streams," November 2002.

RFCs (Cont)

- RFC 3511 "Benchmarking Methodology for Firewall Performance," April 2003.

- RFC 3729 "Application Performance Measurement MIB," March 2004.

- RFC 4148 "IP Performance Metrics (IPPM) Metrics Registry," August 2005.

- RFC 4149 "Definition of Managed Objects for Synthetic Sources for Performance Monitoring Algorithms," August 2005.

- RFC 4150 "Transport Performance Metrics MIB," August 2005.

IP Benchmarking: RFCs

❑ RFC 1242 "Benchmarking Terminology for Network Interconnection Devices," July 1991.

❑ RFC 2285 "Benchmarking Terminology for LAN Switching Devices," February 1998.

❑ RFC 2432 "Terminology for IP Multicast Benchmarking," October 1998.

❑ RFC 2544 "Benchmarking Methodology for Network Interconnect Devices," March 1999.

❑ RFC 2647 "Benchmarking Terminology for Firewall Performance," August 1999.

❑ RFC 2761 "Terminology for ATM Benchmarking," February 2000.

Benchmarking RFCs (Cont)

❑ RFC 2889 "Benchmarking Methodology for LAN Switching Devices," August 2000.

❑ RFC 3116 "Methodology for ATM Benchmarking," June 2001.

❑ RFC 3133 "Terminology for Frame Relay Benchmarking," June 2001.

❑ RFC 3134 "Terminology for ATM ABR Benchmarking," June 2001.

❑ RFC 3511 "Benchmarking Methodology for Firewall Performance," April 2003.

❑ RFC 3918 "Methodology for IP Multicast Benchmarking," October 2004.

Benchmarking RFCs (Cont)

❑ RFC 4061 "Benchmarking Basic OSPF Single Router Control Plane Convergence," April 2005.

❑ RFC 4062 "OSPF Benchmarking Terminology and Concepts," April 2005.

❑ RFC 4063 "Considerations When Using Basic OSPF Convergence Benchmarks," April 2005.

❑ RFC 4098 "Terminology for Benchmarking BGP Device Convergence in the Control Plane," June 2005.

❑ RFC 4689 "Terminology for Benchmarking Network-layer Traffic Control Mechanisms," October 2006.

❑ RFC 4814 "Hash and Stuffing: Overlooked Factors in Network Device Benchmarking," March 2007.

❑ RFC 4883 "Benchmarking Terminology for Resource Reservation Capable Routers," July 2007.