

A Hierarchy of Network Measurements for Grid Applications and Services

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NMWG GGF5 Monday Session

Agenda for Meeting

Discuss "Hierarchy" Document

- Purpose
- Terminology
- Hierarchy organization
- Characteristics

Upcoming Documents

Tools Mappings

Revise Milestones

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Getting Involved

Network Measurements Working Group (NMWG) is part
of the newly merged Performance and Information
Systems area.

Mailing list is perf-wg@gridforum.org

Webpage is <http://www.didc.lbl.gov/NMWG>

Join mailing list and participate
Volunteer to work on documents

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Document Purpose

Ultimate Goal: Portability of Measurements

- Many APIs
- Many tools

Natural Grid Development Process

- More measurement systems
- More measurement tools
- More cooperation
- More shared deployed infrastructure

Middleware must be able to determine what network
performance information is measuring.

How do we share measurement information without
discouraging development of new APIs and tools?

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How the Hierarchy Helps

Need to classify measurements

- ❑ **What** does it measure? Sometimes more important than **how**.

Not necessarily a new schema

- ❑ Should be a good schema for network measurements
- ❑ Not all systems are/should be organized this way

Can be used as annotation in any schema.

Goal is an agreed-upon standard of the types of measurements in use, to allow both current and future measurement methodologies to classify their observations to maximize their portability.

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Terminology

Network Characteristics

- ❑ Intrinsic properties of a portion of the network that are related to its performance and reliability

Measurement Methodologies

- ❑ Means and methods of measuring those characteristics

Observation

- ❑ An instance of information obtained by applying a measurement methodology.

Note on IETF IPPM RFC2330

- ❑ Compatible where possible, but metrics means many things.

Guiding principle, clear meanings, follow standards where defined.

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Network Characteristics

“Intrinsic Property”

Property itself, not an observation

Unrelated to how measurement is made

- You don't typically care how the alcohol content of your scotch is measured

Not a particular number

Packet Loss

- ❑ Fraction of traffic
- ❑ Loss patterns
- ❑ Traffic profile

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Measurement Methodology

Technique for recording or estimating a characteristic

Two approaches:

- ❑ Raw: measuring actual characteristic
- ❑ Derived: aggregate or estimate from other characteristics

Round trip delay

- ❑ ping
- ❑ TCP transmit/ACK pair
- ❑ two one-way delay measurements
- ❑ link propagation and queue length data

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Observations

Singleton

- ❑ Atomic observation

Sample

- ❑ Several singletons together

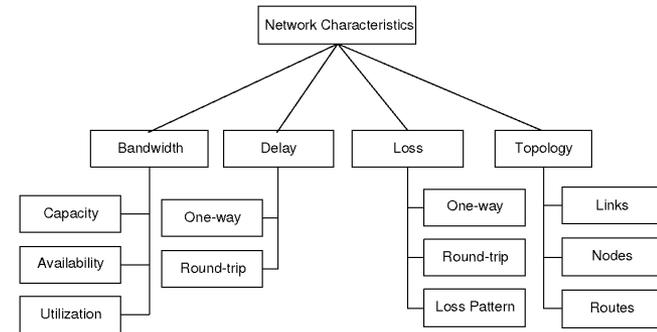
Statistical

- ❑ Derived from a sample by calculating a statistic

Timestamps, and ranges, are issues with each observation

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Characteristics Overview



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Bandwidth

Capacity

- ❑ Theoretical maximum link-layer throughput available on a link or path when there is no competing traffic

Utilization

- ❑ Aggregate capacity being consumed on a link or path
- ❑ Note timing issues. Singleton observations uninteresting.
- ❑ Good example of different sub-characteristics

Available

- ❑ Most interesting, and hardest to measure
- ❑ Maximum IP-layer throughput a link or path can provide
- ❑ Bulk Transfer Capacity—what can I get?
- ❑ Strength of hierarchical description of characteristics

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Available Bandwidth

Many issues with measurement

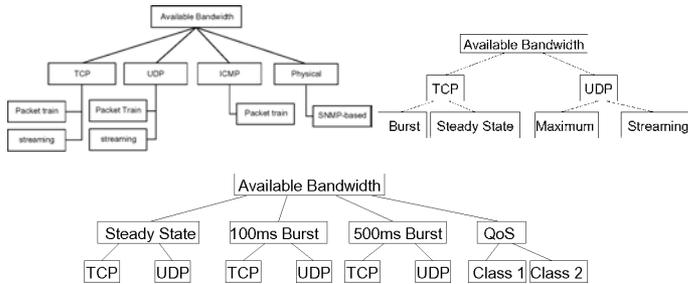
- ❑ TCP implementation
- ❑ TCP buffer tuning
- ❑ Host issues
- ❑ Slow-start
- ❑ Intrusiveness
- ❑ Application bursts

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Available Bandwidth Hierarchy

How to classify different measurements?

Where is the line between measurement methodology and characteristic?



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Delay

One-way Delay

Roundtrip Delay

Jitter

- ❑ Frequently a separate metric (IPPM)
- ❑ Variance in many characteristics interesting
- ❑ We regard as a statistical property of delay

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Loss

One-way loss

Roundtrip loss

Loss Patterns

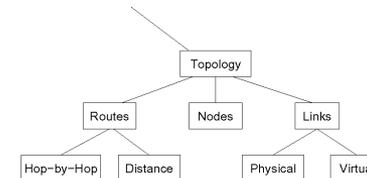
- ❑ Possibly even more interesting
- ❑ Statistical, but somewhat more complex
- ❑ Can require different measurements than loss percentage
- ❑ Loss Burstiness
- ❑ Loss-free seconds
- ❑ Conditional loss probability

Measurement technique can affect results

- ❑ ICMP, TCP, UDP

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Topology



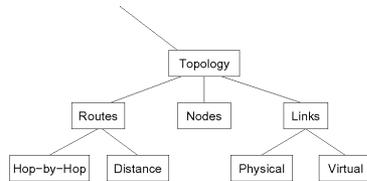
Two different types of topology

- ❑ Physical: Actual links and nodes
- ❑ Functional: Derived closeness

Links

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Nodes and Routes



Nodes

- Queue information associated with routers
- Information needed for analytical modeling of networks

Routes

- Hop-by hop follows physical or virtual links across graph
- Distance indicate derived characteristics

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Upcoming Documents

Original documents:

- Metrics
- Conversions

New document documents hierarchy, but doesn't attempt to map tools or systems to spots in the hierarchy.

We propose that mapping tools and techniques to the characteristics they represent is an important task and should be its own document.

- Characteristics Hierarchy
- Characterization of Tools and Techniques
- Relationship Between Measurements

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Characterization of Tools

Goal of hierarchy is to make measurements portable.

First step is to agree on what characteristic tools measure.

Some tools measure multiple characteristics, depending on parameters.

Ratilal Haria working on website for participation

Many lists of tools, our goal is to annotate these lists and produce hierarchy with multiple views.

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Relationship Between Measurements

Can we develop systems that use whatever information is available?

- iperf
- pathload
- QoS support

Need to be able to request measurement of particular characteristic, without regard to what sub-characteristic or tool is used to return the result.

Convert loss pattern to loss rate.

Traffic profile to utilization fraction.

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Revised Milestones

July 2002	Begin work on tools classification
Oct 2002	Submit hierarchy document to GFSG
Oct 2002	Finalize classification format and writeup
Oct 2002	Begin work on relationship document
Mar 2003	Submit tools classification to GFSG
Mar 2003	Solid draft of relationship document
Mar 2003	Begin working with implementors
July 2003	Submit relationship document to GFSG