Metrics

- One Way
  - latency
  - packet loss
  - Jitter – delay variation
- Two way
  - extensions of one-way metrics
- Availability
- Other metrics (R, BW, ..?)

Jitter – Delay variation

- **Jitter – RFC 3393 (Y1541), RFC 1889**
  - Inter packet delay variation calculated from the delay variance at the receiver with reference to the inter packet delay at the source
  - Measures the changes in the inter packet delays with reference to the source encoding schema
  - Reflecting the packet treatment, isolated from network changes (?)
    - route changes
    - Would you use this definition in Metro?
  - Depends on the ‘selector’ function
  - Does not need TOD synchronization at the source and destination
  - Not additive
  - Used in SLAs across US providers
  - Similar metric defined for MEF
  - Consistent with RTP measurement and reporting

Jitter – Delay variation

•Delay variation –ITU- Y1541

- •Measures the change in the packet latency with the reference to some base line latency – minimum sample latency, mean sample latency, expected path latency
- •Additive (?)
- •Needs TOD synchronization at the ends
- •Sensitive to base line reference
  - •The actual DV depends on the selected reference measurement
- •Sensitive to network changes (path changes)
- •Reflecting sample by sample variations
- •How this metric would translate into multicast measure (?)
- •Supports rt calculations of jitter (RTP)

Jitter – Delay variation

- Jitter (IETF) is not measuring the same network property as delay variation (ITU)- under some conditions maybe equivalent
- Delay variation is sensitive to time synchronization of ends, while Jitter is isolated from synchronization inaccuracies
- Jitter and delay variation do not give the same results but react similarly to network events
- Use both ?!
- Need consistency among Standard bodies and services in definitions

Sprint is offering three levels of SLAs to IP, frame relay and ATM customers.

SLA	Network availability	Latency	Packet loss	Jitter
Standard SLA Dedicated IP	100%* or 99.9%	Less than 55 millisec	Less than .3%	Less than 2 millisec
Standard SLA for frame relay	99.9%	Less than 100 millisec	Less than .1%**	n/a
Standard SLA for ATM	99.9%	Less than 100 millisec	Less than .01% up to 1%***	n/a

AT&T

•The performance objective for the MIS Jitter SLA is a MIS Jitter of no more than 1 millisecond in a given calendar month.

•“MIS Jitter” is a monthly measure of the US AT&T IP network-wide IP packet delay variation, which is the average difference in the interval of time it takes during the applicable calendar month for selected pairs of test packets of data in data streams to travel between pairs of AT&T US IP Backbone Nodes. Specifically, the difference in time it takes a selected pair of test packets in a data stream to travel from one AT&T US IP Backbone Node in a pair to another is measured for all pairs of AT&T US IP Backbone Nodes over the month. One of the test packets in the selected pair will always be a packet in the data stream that takes the least time to travel from one AT&T US IP Backbone Node in a pair to another. MIS Jitter for the month is the average of all of these measurements

Availability

•Connectivity (ICMP –like)

- ***layer 2, layer 3, layer 4+***

•Availability of the service, of network , of transport – what we are talking here about?

•Packet loss (MEF)

•Connectivity is an instance- availability is a periodic event

•Some workable definitions of (un) availability

- ***Packet loss in a sample > 20%- measured with packet loss (layer 2/3) (MEF)***
- ***No response from the destination in n sequential tests***
- ***100 % of packet loss in a probe sequence***

•Need consistency across Standard bodies

•Some issues:

- ***in SLAs do we penalize for packet loss and availability ? And/Or***
- ***How do we measure it ? Incidental measurements or separate measurements ?***

Thoughts on availability (Un)

•How do we translate availability as 9s into availability from measurements?

	Unavailability interval allowed	
Availability Objective	**Seconds per month**	**Minutes per month**
99.000%	25,920	432
99.900%	2,592	43
99.990%	259	4.3
99.999%	26	0.43
99.9999%	2.6	0.04

Thoughts on availability (Un)

- Performance independent model:
  - Service performance guarantees that performance objectives would be met only for the ‘available’ time –
- Performance dependent model:
  - Based on performance results, availability is calculated, e.g., if any of the three service performance attribute objectives are ‘missed’ for time ‘T’, then service is deemed ‘unavailable’ for ‘T’
- Connectivity should be separated from availability ?
  - Connectivity should be defined for transport, availability for CoS class ?
- Availability should exclude scheduled downtimes
- Availability defines time intervals when other metrics (SLAs) are observed.
- MTTR is no availability

Thoughts on availability (Un)

- Network Availability refers to the percentage of time over a measured calendar month that the service is available for use by Customer.
- Service availability is this the same ?

Backup

RFC 1889 (RTP)

•An estimate of the statistical variance of the RTP data packet interarrival time, measured in timestamp units and expressed as an unsigned integer. The interarrival jitter J is defined to be the mean deviation (smoothed absolute value) of the difference D in packet spacing at the receiver compared to the sender for a pair of packets. As shown in the equation below, this is equivalent to the difference in the "relative transit time" for the two packets; the relative transit time is the difference between a packet's RTP timestamp and the receiver's clock at the time of arrival, measured in the same units.

• If Si is the RTP timestamp from packet i, and Ri is the time of arrival in RTP timestamp units for packet i, then for two packets i and j, D may be expressed as

$$D(i,j)=(Rj-Ri)-(Sj-Si)=(Rj-Sj)-(Ri-Si)$$