Metrics, Measurements and Network Model

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Performance Attributes

- **Four main components**

  Mean Delay

  Distance-dependent (slide 4)

  Packet Loss

  Delay Variation

  Measured as Percentiles less Mean Delay

  Unavailability (slide 5)

- **All specified one-way**

- **…with timescales**

Measurement Standardization

- **It's critical that customers can correlate and concatenate measurements across different providers**

    e.g. Can't have one provider measure jitter over a month and another measure it over 15 minutes

    Also important that the same start time is used for measurement intervals to allow correlation of information from different providers

- **These factors plus need for one-way delay measurement drive need for accurately synchronized clocks at measurement points**

Mean Delay (Site-to-Site)
Note: Strawman Values Only!

Mean Delay is a function of Distance

Categories:	Definitions	Distance baseline	Min delay	Guideline Transit Delay
		(km)	(ms)	(ms)
Metro	Within 100 km	100	0.50	5.00
Regional	Within 1000 km	1000	5.00	15.00
Continental	Within 5000 km	5000	25.00	45.00
International	Anywhere	20000	100.00	140.00

- **Guideline >> Min to allow for non-optimal fiber routes**

Unavailability Measurement - Site to Site
Note: Strawman Values Only!

- **Unavailability is significant when a human observer detects a business impacting application failure due to network loss.**

- **Indicated by excessive packet loss in close time proximity**

    Network instability, transmission failures, severe congestion

- **Unavailable period starts**

    First probe loss where 3 probes out of 10 lost

- **Unavailability period ends**

    First successful probe where 10 consecutive probes are not lost.

- **During unavailability periods, other metrics are not included in statistics (avoids double hit)**

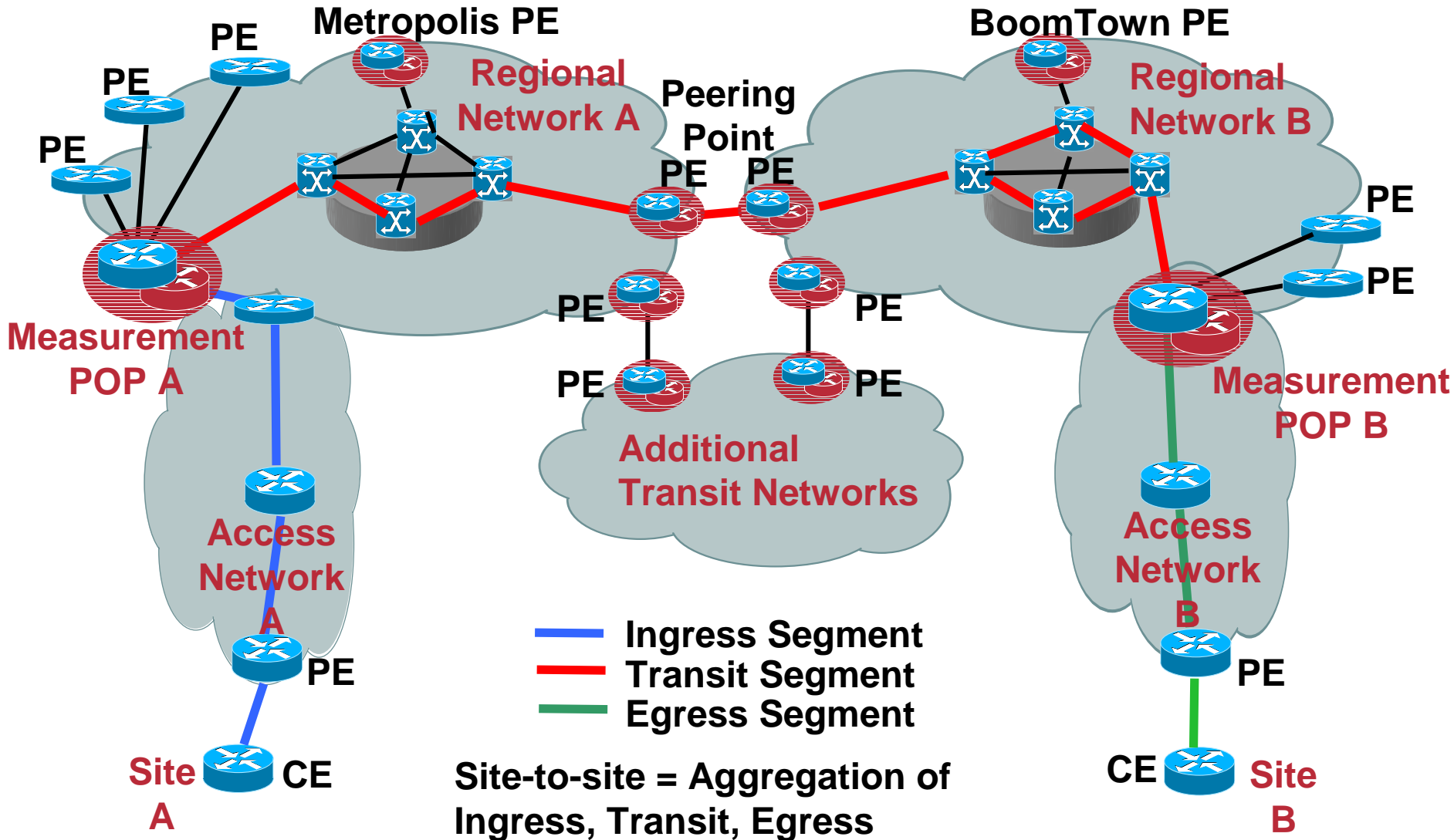# Service Performance Targets – Site to Site Note: Strawman Values Only!

	Mean Delay	Max Delay (DETL)	DV90	DV99	DV99.9	Availability	Loss
Telephony	Distance-dependent	200ms	30ms	40ms	50ms	99.9%	0.1%
Low Latency Data	"	500ms	100ms	200ms	U	99.9%	0.5%
Multimedia Streaming	"	750ms	50ms	U	U	99.8%	0.25%
Standard	U	U	250ms	U	U	99.5%	1%

U = unspecified

Network Model

- **Driven by need to leverage active probes**

    Imagine a full mesh of CE-CE probes – not scalable

    Re-use of single probe for many purposes - scalable

- **General Approach**

    Divide site-to-site performance characteristics into three segments

    Ingress

    Transit

    Egress

    "Measurement POP" = Demarcation point between Ingress, Transit and Egress

Network Model – 3 Segments

Metropolis PE

PE

PE

PE

Regional Network A

BoomTown PE

Regional Network B

Peering Point

PE PE

PE

PE

Measurement POP A

PE

PE

PE

PE

Measurement POP B

Additional Transit Networks

Access Network A

Access Network B

PE

PE

——— Ingress Segment
——— Transit Segment
——— Egress Segment

Site A CE

CE **Site B**

Site-to-site = Aggregation of Ingress, Transit, Egress

Measurement POPs

- **Dedicated Measurement Platform & accurate clock source**

- **Each SP chooses their own Measurement POPs**

    Majority of the customer site's traffic passes through this POP - typically in the same City/Region as customer site

    Each peering POP must also be Measurement POP

    Global POPS may provide estimates for nearby prospective service

Measurement Purposes

- **Operating - made on an ongoing basis between MPs, PEs and CEs to monitor normal operation of the three segments along customers' data paths**

    E.g.. Ingress, Transit and Egress segments

- **Supporting - may be taken continuously are used to provide information for SPs. These measurements occur in addition to Operating measurements and can be between MPs and other internal or alternate SP MPs as well as to specific devices in the local network.**

    E.g.. Each SPs' contribution to the Transit segment

- **Testing - made on an exception basis following the detection of abnormal operating measurements for troubleshooting or to test a new path. In addition to Operating or Supporting measurements and are between MPs, PEs and CEs which do not have Operating or Supporting measurements being taken.**

    E.g.. A particular CE to CE path for a prospective customer

Enhanced UDP Echo

- **Single probe allows one SP to measure performance to another SP in both directions**

- **Enhanced UDP Echo allows one-way delay and loss measurement in both directions**

  Service Class aware (DSCP, packet size)
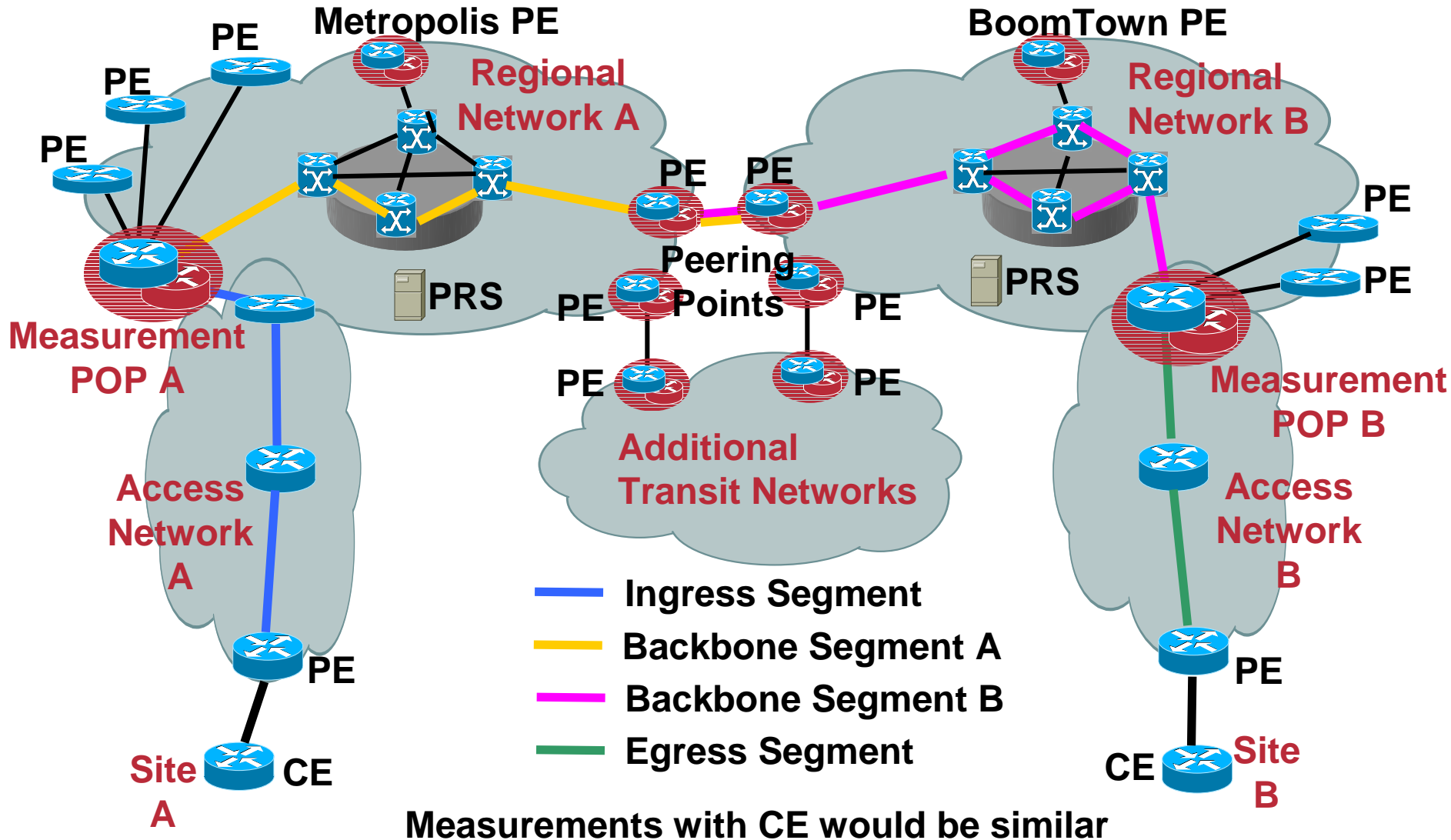
  Multiple timestamps, each end, ingress and egress

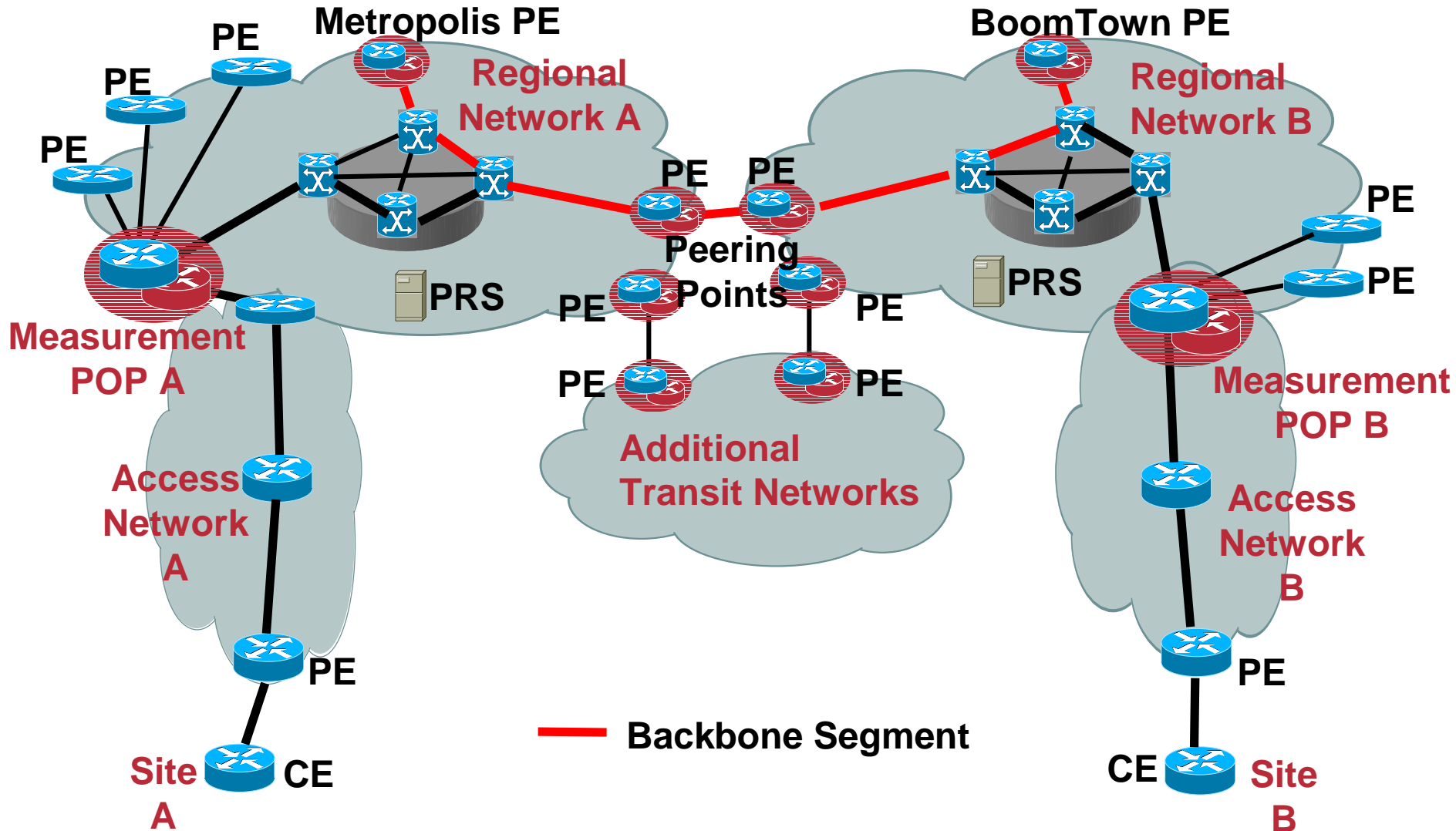 **Counters for determination of loss direction**

  Loss of clock sync indicator

  (ECMP addressing)

  (Pseudo random transmission time)

Supporting Measurements

Metropolis PE

PE
PE
PE
PE

Regional Network A

PRS

Measurement POP A

Access Network A

Site A

CE

PE

BoomTown PE

Regional Network B

PRS

Peering Points

PE **PE**
PE
PE
PE
PE
PE

Additional Transit Networks

PE
PE

Measurement POP B

Access Network B

PE

CE
Site B

— **Ingress Segment**
— **Backbone Segment A**
— **Backbone Segment B**
— **Egress Segment**

Measurements with CE would be similar

Global Measurements

Metropolis PE

PE
PE
PE
PE

Regional Network A

BoomTown PE

Regional Network B

PE
PE
Peering Points

PE

PE

PE

PE

PRS

PRS

PE

PE

Measurement POP A

Measurement POP B

Access Network A

Additional Transit Networks

Access Network B

PE

PE

— Backbone Segment

Site A
CE

CE
Site B

Access Link Provisioning

- **CE-CE SLAs certainly more useful to customer than PE-PE**

- **Important to take account of CE-PE delay when establishing SLA**

  e.g. running telephony at 80% of link speed will probably prevent delay & jitter targets from being met