The Future of High-Volume, High-Reliability Data Networks

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Allied Partners LLC

NASPI Workgroup Meeting
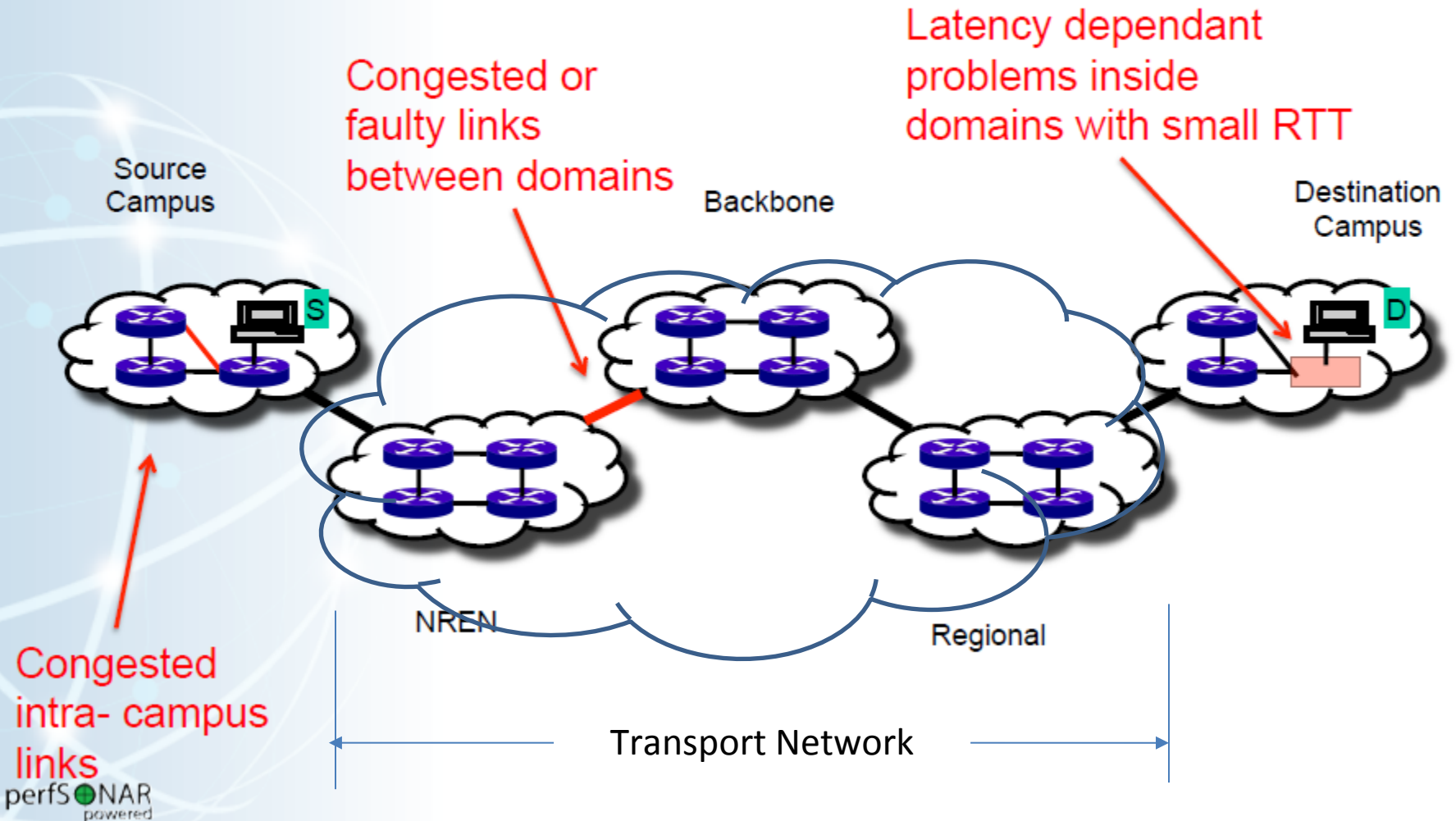
October 23, 2014 - Houston, Texas

The Future is Here!

Our issues have already been solved by others

Where Are The Problems?

Congested or
faulty links
between domains

Latency dependant
problems inside
domains with small RTT

Source
Campus

Backbone

Destination
Campus

S

D

NREN

Regional

Transport Network

Congested
intra- campus
links

perfSONAR
powered

3 Major Factors That Effect Network Performance

- Packet Loss
- Latency (round trip time, or RTT)
- Buffer/Window Size
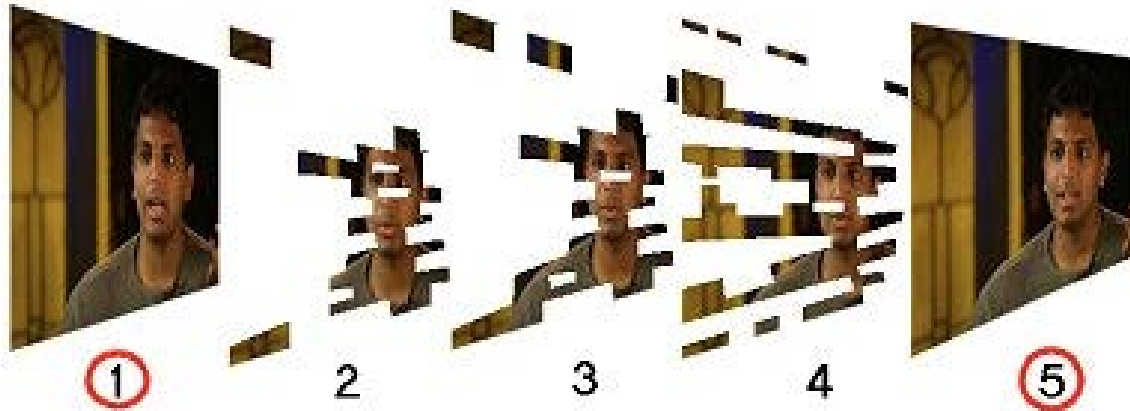- there are others, but these are the big three.

All three are interrelated.

Even a very small packet loss has a huge impact on data integrity and network reliability and performance.
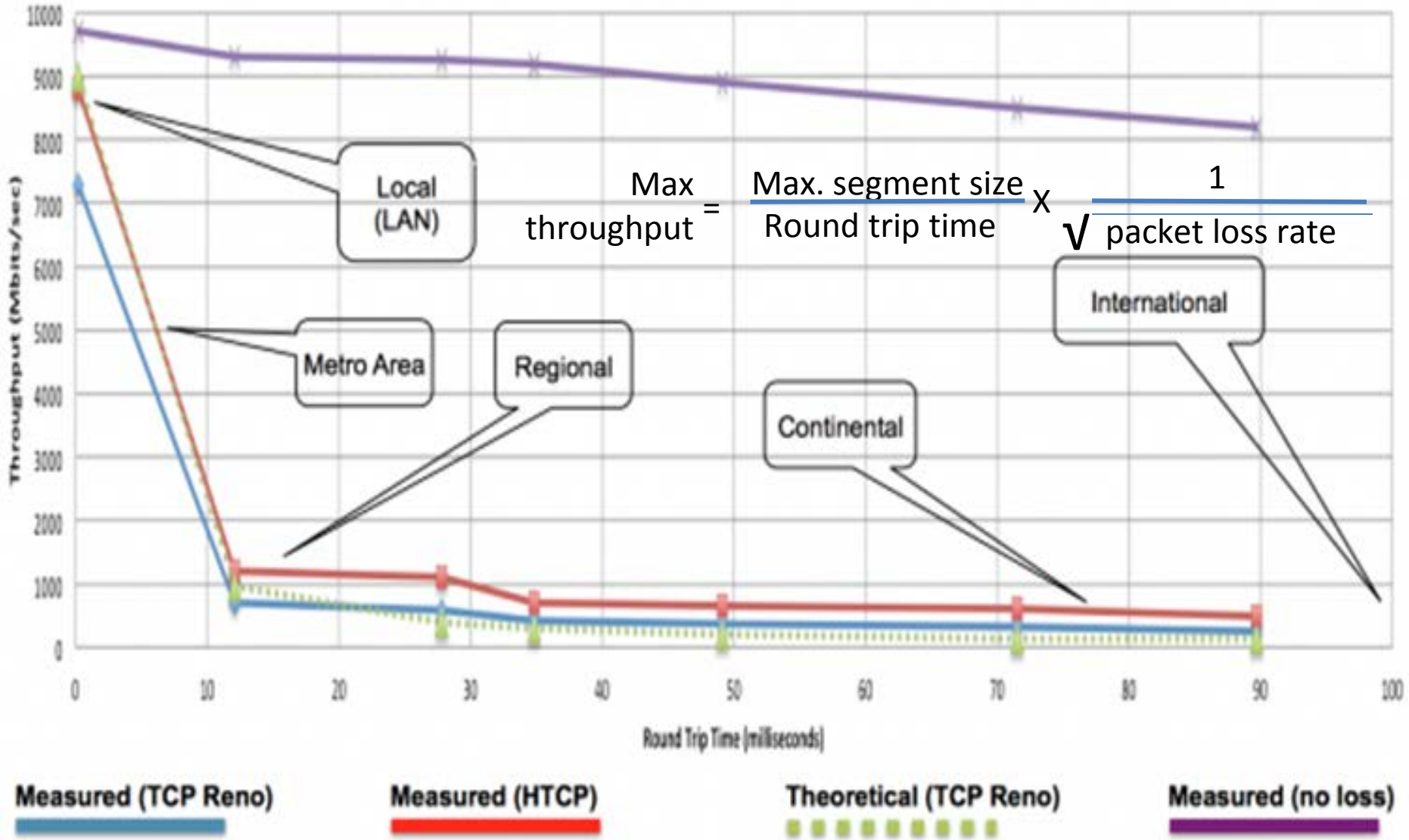
MPEG Video Example

Uncompressed AVI


Compressed MPEG

What is the effect of packet loss?

Throughput vs. increasing latency on a 10Gb/s link with *0.0046%* packet loss

$$\text{Max throughput} = \frac{\text{Max. segment size}}{\text{Round trip time}} \times \frac{1}{\sqrt{\text{packet loss rate}}}$$

Throughput (Mbits/sec) vs **Round Trip Time (milliseconds)**

Labels on graph: Local (LAN), Metro Area, Regional, Continental, International

Legend:
- Measured (TCP Reno)
- Measured (HTCP)
- Theoretical (TCP Reno)
- Measured (no loss)

Source: http://fasterdata.es.net/assets/bw-vs-lat.pdf

What Did ESnet Need To Do?

- Reduce or eliminate packet loss that impacts data integrity and produces poor network performance

- Implement appropriate security architectures and controls so that high-performance applications are not hampered by unnecessary constraints.

- Provide an on-ramp for critical resources to access wide area services including virtual circuits, network overlays, and software defined networking.

- Incorporate network testing, network measurement, and performance analysis.
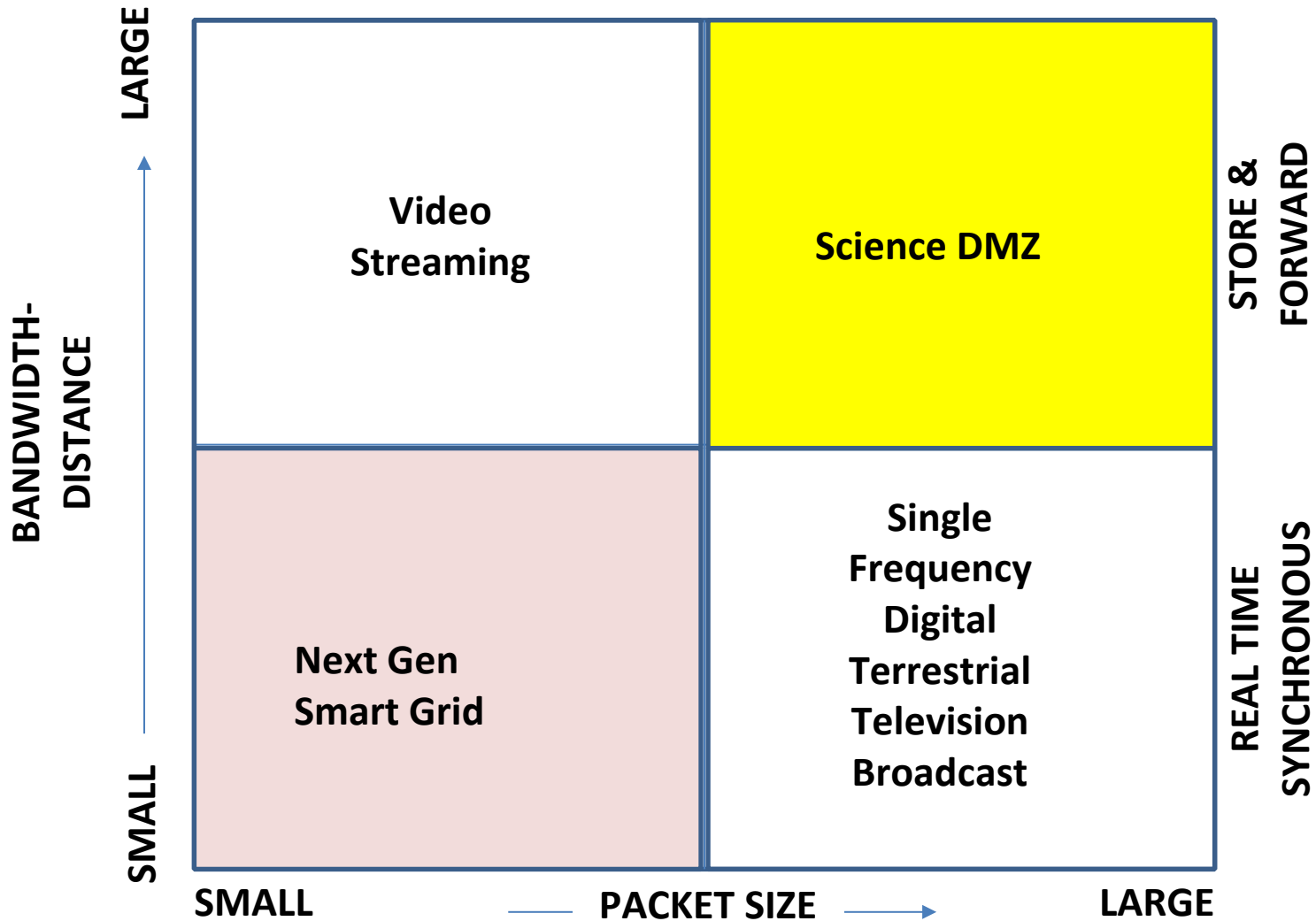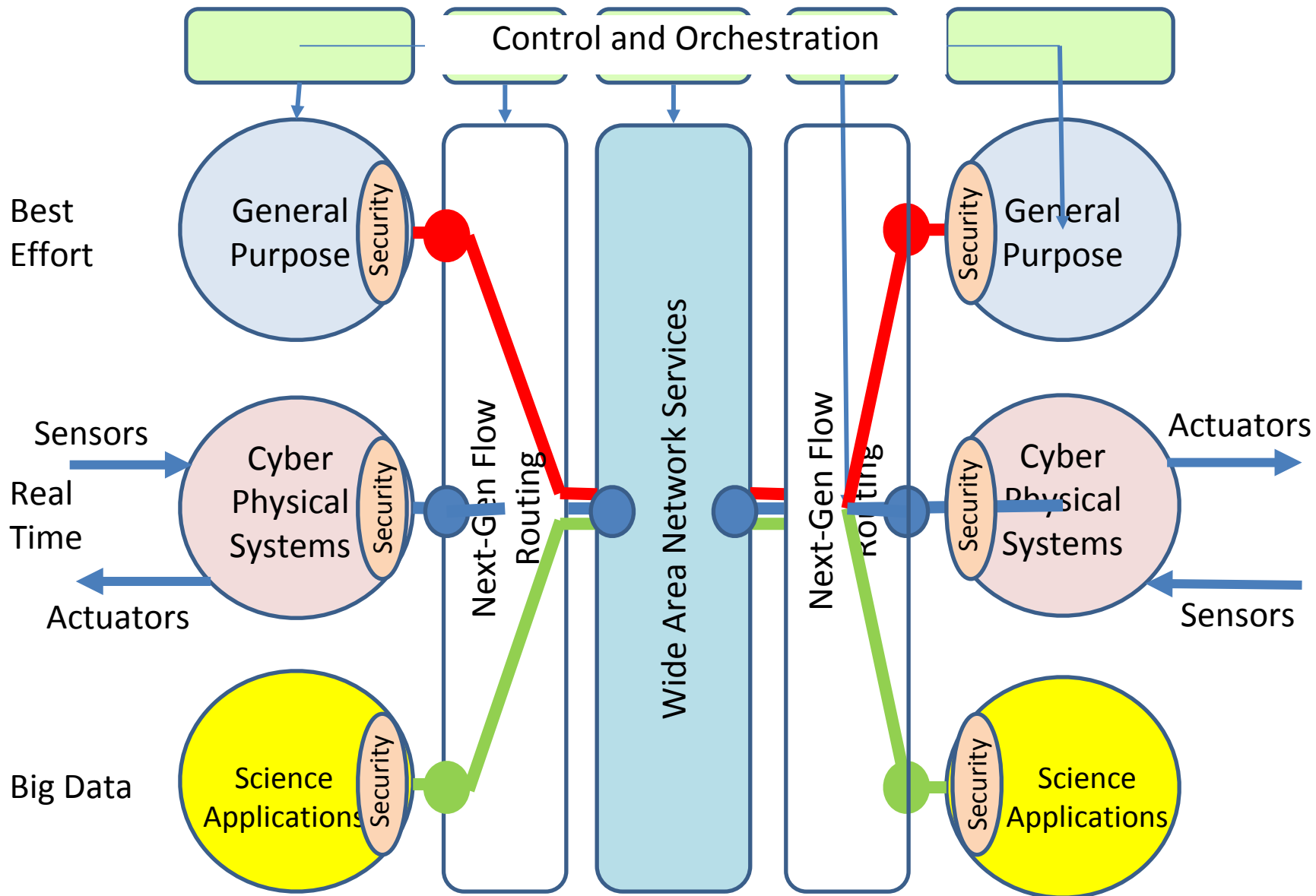
Science DMZ
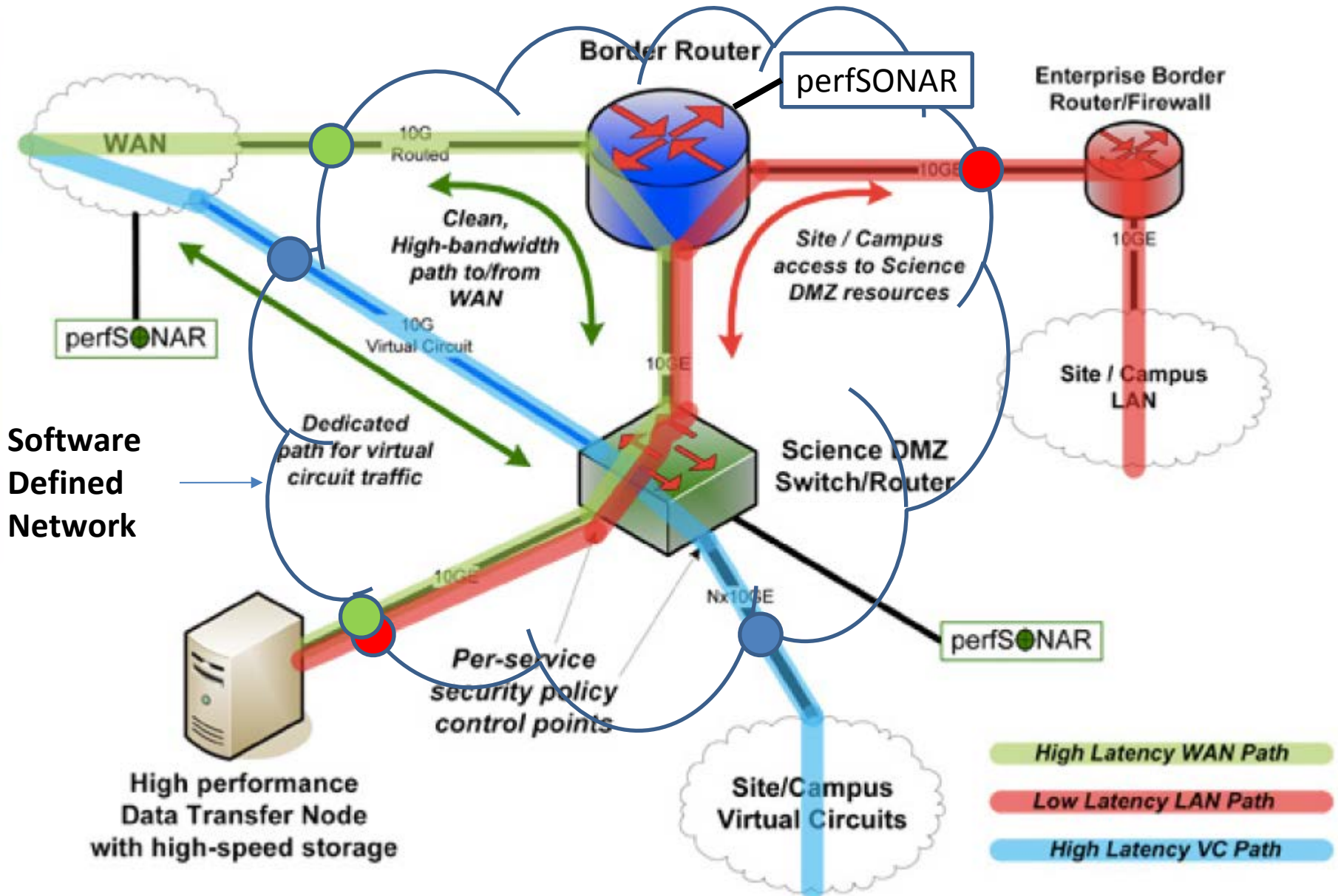
Source: http://fasterdata.es.net/science-dmz/science-dmz-architecture/

Elephant and Mice Flows
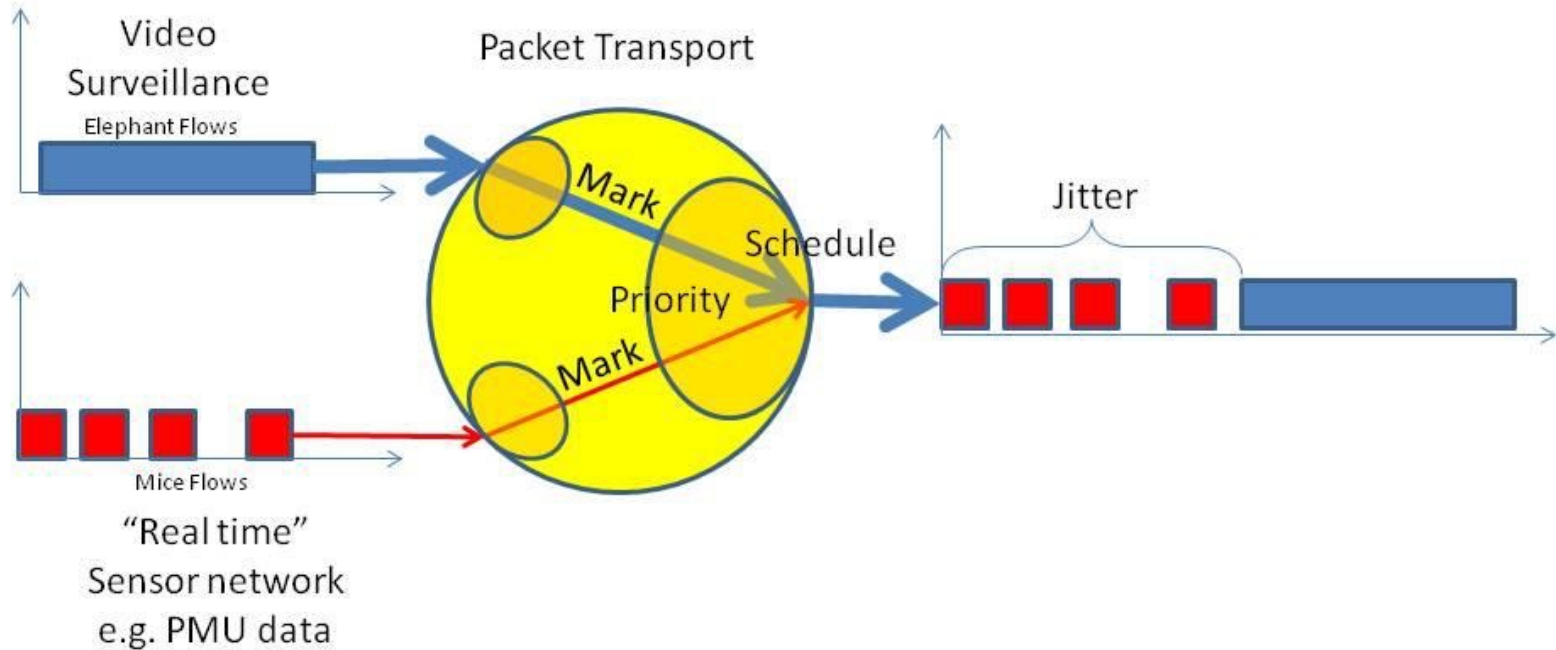
Application Data Characteristics

Next-Gen Flow Routing for Grid

Next-Gen Network for Grid

- Transport of flows of different sizes and priorities; e.g. realtime mice flows and best-effort elephant flows
- Scalable multicast with zero packet loss and fast restoration
- Management of disparate traffic flows over heterogeneous networks - Multi-domain, multi-service network overlays
- Integrated, data-centric publish and subscribe architecture
- GPS-independent "global" time
- Separation of control plane from data plane
- Security, Reliability & Resilience

…more at next NASPI meeting!

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