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from Performance *Vilification* to Performance *Verification*

Update from the GLIF Performance Verification Task Force

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March 27, 2015

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Performance Verification Status

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Once upon a time…

- The Performance Verification Task Force was originally chartered to explore and prototype greenfield service verification architecture to support NSI services, GOLEs services, and other similar emerging connection oriented network services generally.
- The Chairs (Steve Wolff and Sobieski) soon discovered they had oversubscribed themselves …
  - Little activity beyond initial discussions and draft plans...

  The chairs have unsuccessfully, albeit reluctantly, tried to cede this leadership role to some other more effective member(s) of the community ...

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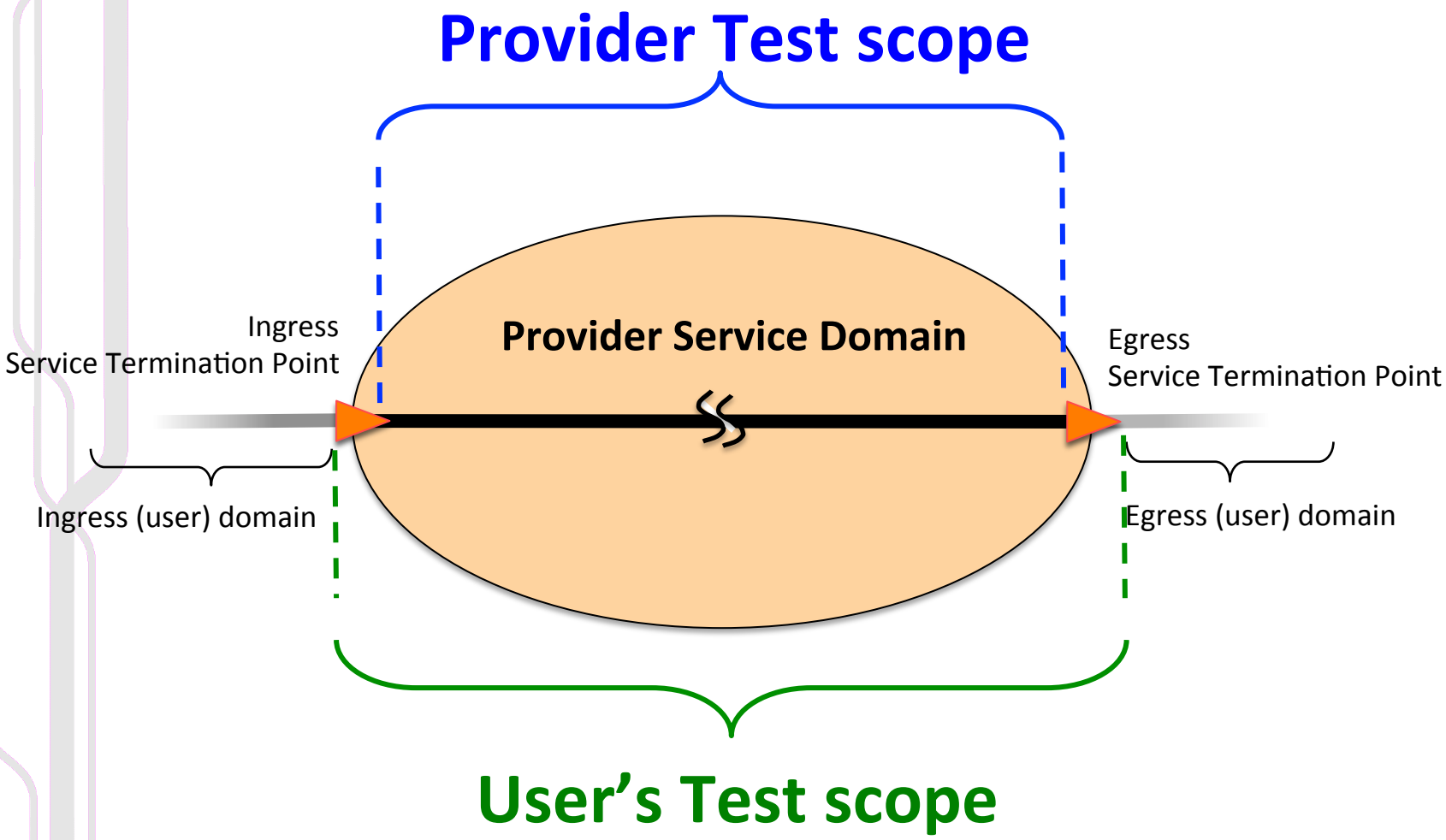
PV "Test Scope"



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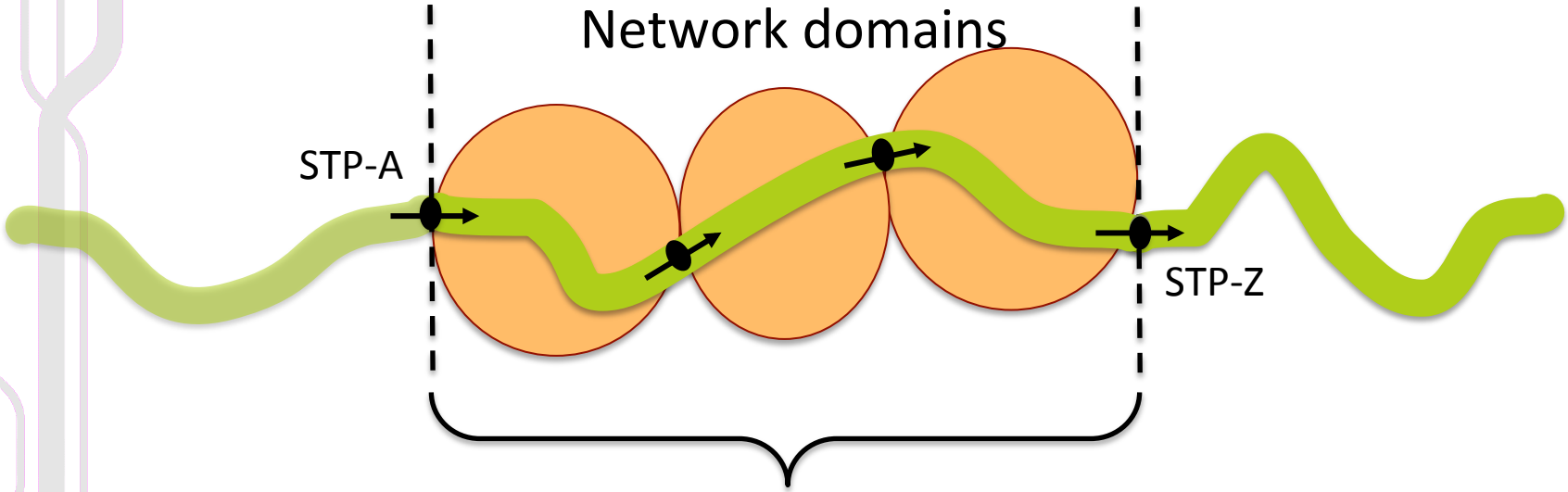
Deterministic Performance Verification

- Can we *deterministically* measure the performance of a Connection?
- Can we do so without perturbing the flow?
- Can we do so in such a fashion that we can determine where along the path performance problems are occurring?



How do we verify the throughput from STP-A to STP-Z?

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Why *Verification* is an issue

- "Measuring" by itself is not "Verification"
  - Measuring records some exhibited property of a service E.g. bits transported over some period of time, or latency or jitter over some sequence of packet arrival times.
  - But ...Measuring does not tell you if the service is functioning *properly*
- Verification compares a measured value of some service attribute(s) against some expected value for that attribute(s)
  - E.g. Measured bytes transferred over 30 seconds across some virtual circuit as compared to a committed or expected transfer rate.
- Formally- PV is a two agent process where a user agent measures the performance of a service instance and compares that measured performance to the promised (guaranteed) performance committed to by the provider agent.
  - There is a possible alternate model where a trusted third party is involved..
  - But this does not solve the problem of deterministic SLAs and deterministic processes to verify those SLAs.

Fault Analysis

- Fault:= When performance verification process determines a service instance does not meet expected performance thresholds
- Fault analysis and localization
  - Given a verification failure, FA is a process that tries to identify component(s) of the delivered service that is responsible for the substandard measured performance.
  - Since the underlyingl infrastructure may not be visible, there must be a cooperative protocol among service providers that functions to identify a faulty service component
    - A service components may be large scale: “a network”
    - Or it may be very specific: a hardware device or even a port...

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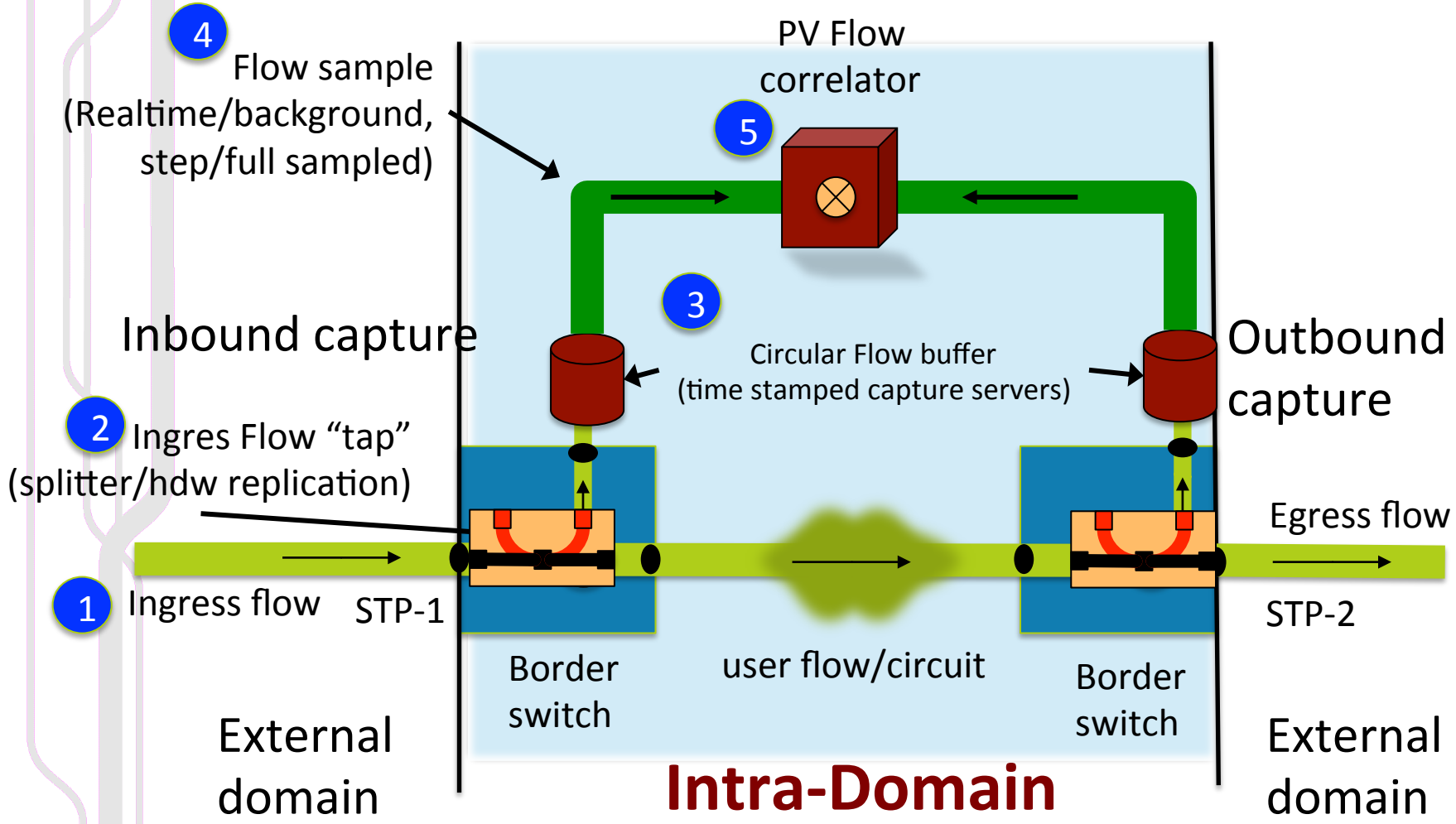
A "Performance Flow Correlator"



Intra-Domain Passive Provider PV Flow Correlation

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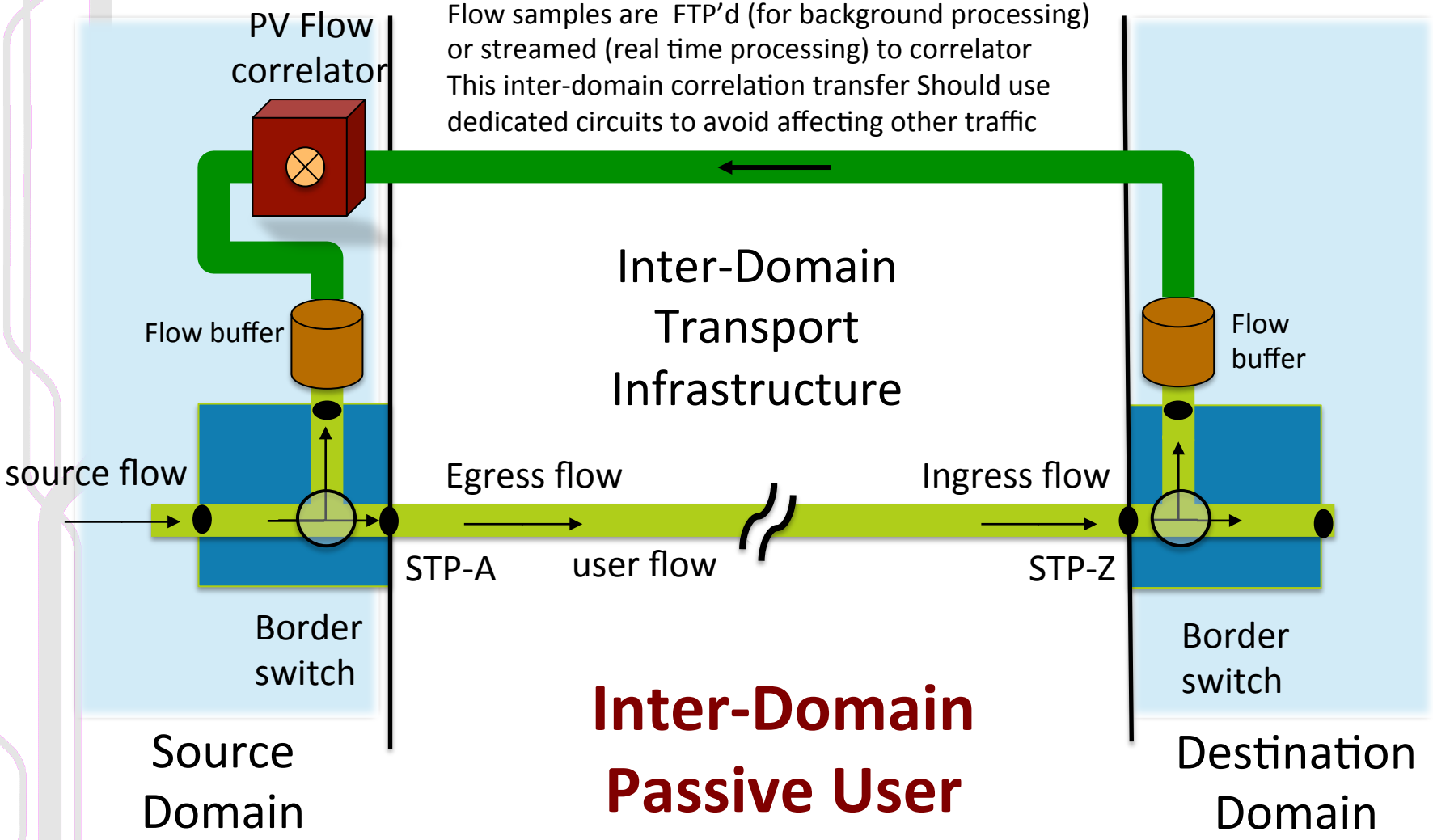
An inter-Domain "Flow Correlator"



Inter-Domain Passive User Flow Correlation

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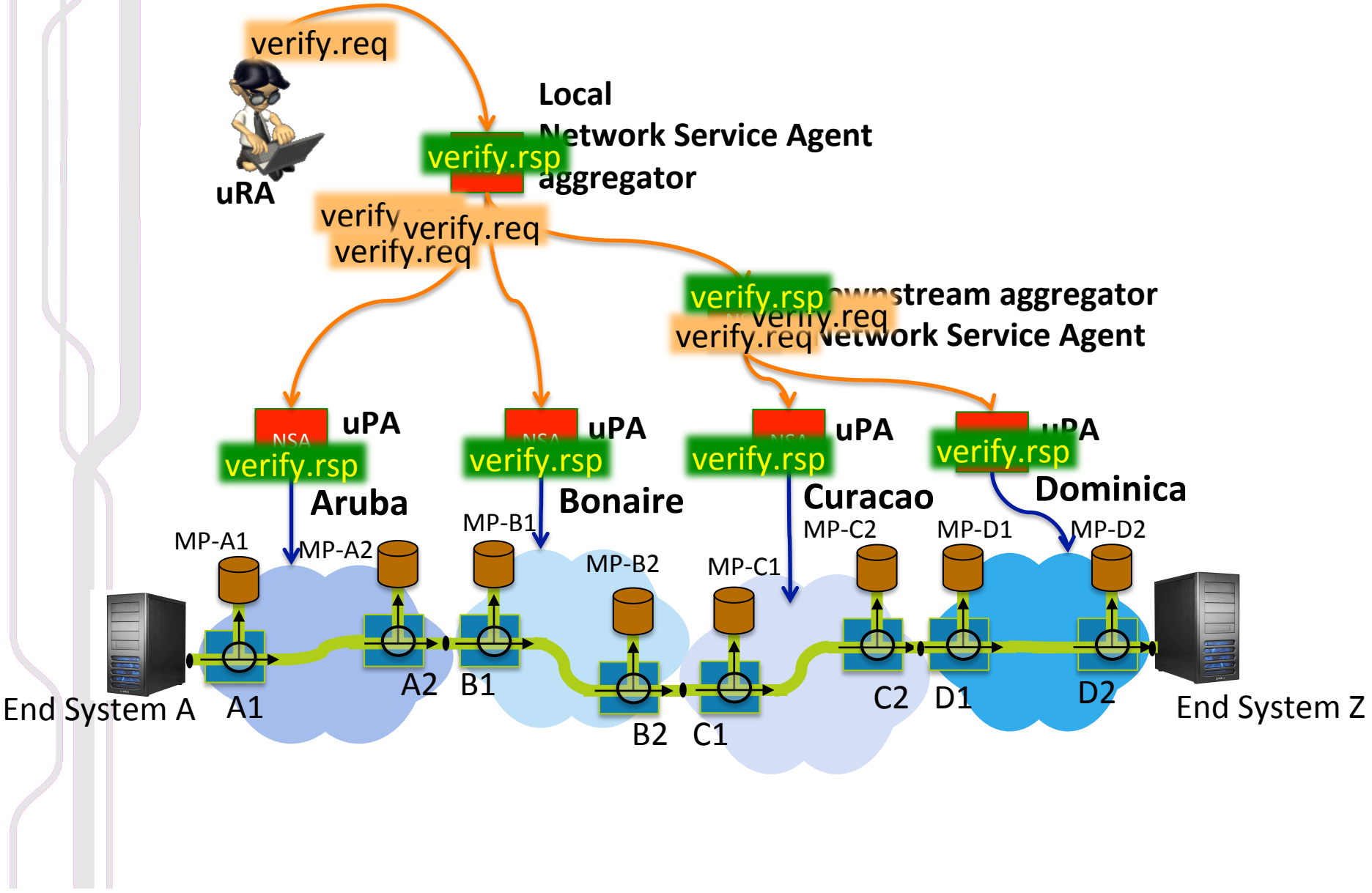
End to End PV protocol
(NSI based concept)



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Meanwhile, Technology Marches On

- The original need for *automated* *intelligent* performance verification and fault analysis and localization processes are still sorely needed
  - A holistic architecture and process framework that is integrated into future network design engineering, service implementation, and operations
- But we are also seeing new services emerging that offer new service constructs... And new forms of "performance" expectations:
  - Server elements – e.g. CPU cycles
  - Storage elements – e.g. read/write transfer rates, accessibility
  - Switching and forwarding elements – e.g. PPS, buffering/burst capacity
  - ... In addition to the original driver: Connection Services
- What are the performance criteria to be used for these emerging new service components?
- These service components are now *virtualized* as well...
- And we can now deliver *composite* services that combine a number of these new service elements
  - E.g. GTS "SDX Fabrics"
  - E.g. GENI "slices"
- How do we project such PV process across dissimilar [e.g. interworked or federated] frameworks that do not have a formal architectural service model?
  - I.e. What are implications of the control plane or data plane impedance mismatch across cooperating domains?

Detect, Identify, Notify

- The requirements:
  - Ability to measure services
  - Ability to compare the measured performance to a target performance criteria
  - Identify non-conformant service instances
  - Characterize and/or localize faults
  - Notify appropriate agents/personnel of failed services
  - Automated integrated measurement and analysis processes
  - Intelligent automated processes
  - secure
- Not [presently] a requirement:
  - Fault mitigation or recovery

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Initial focus

- Target Connection Services (NSI segmentation and topology model)
- Include IP/L2 flows in the architecture
- A scalable performance measurement architecture
- Ubiquitous passive taps/span ports on all subject links
- High performance (10-100 Gbps) data capture servers
- Highly accurate and high resolution clocking
- Automated multi-domain “divide and conquer” measurement and analysis protocol

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But wait! There's more!

- With the emergence of *virtualized* services a means to offer or predict quality of service requires a means to verify those services
- Allocate a VM...
  - How do you define (and provision) the guaranteed performance criteria of a VM?
  - How do you measure the delivered performance?
- Allocate a virtual switching fabric..
  - How do you define (and provision) the guaranteed performance criteria of a VSF?
  - How do you measure the delivered performance?
- ...Same for virtual circuits and for storage and ...
- How do you define or measure and analyze complex performance exhibited by composite constructs?
  - E.g. GENI "slices"
  - E.g. GTS SDX "Fabrics"
  - virtualized service fabrics spanning multiple underlying infrastructure domains

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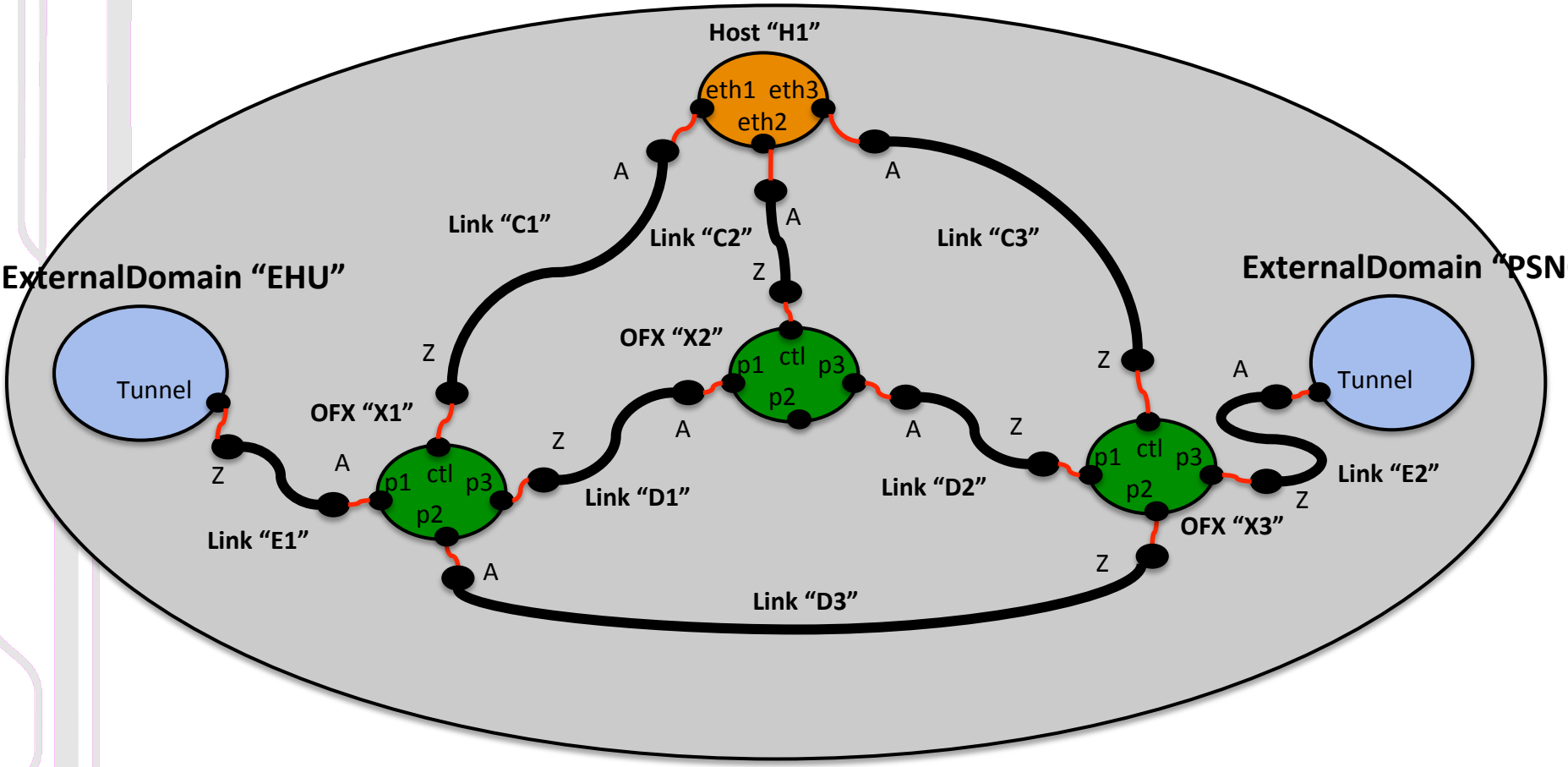
“Multi-domain SDN”

DSL logical diagram flat testbed



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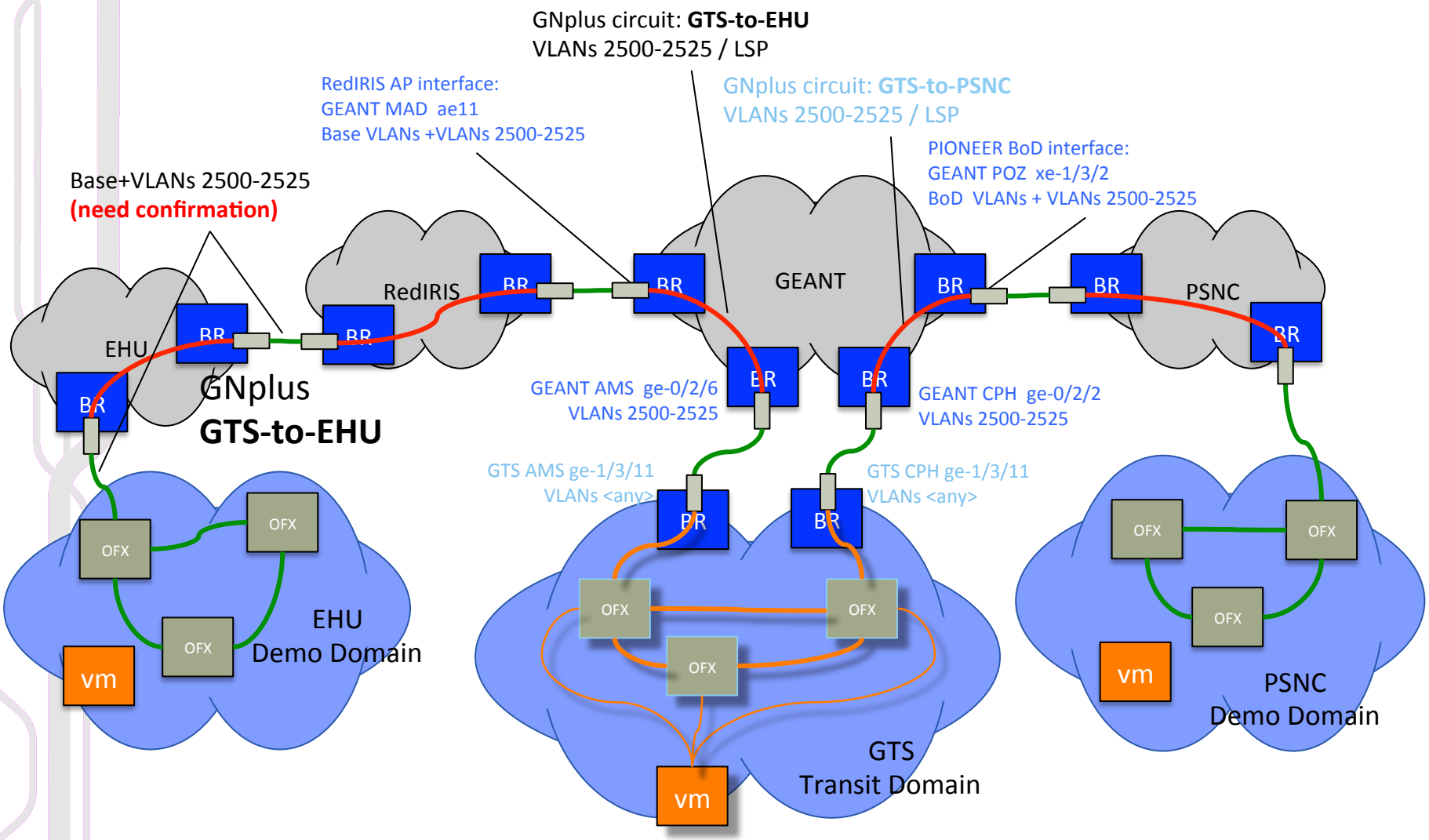
GTS: JRA2-T1 Demo for SC2014



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Testbeds and unexpected outcomes… "Software Defined eXchange"

- Software Defined eXchange "SDX"
  - SDX: A service infused open exchange facility that can provide a wide range of multi-species resources and services – e.g. computational facilities, data transport circuits, switching/forwarding elements, storage, etc – and supports SDN control principles.

    (credit: Zink & Mambretti @ FIDC 2014)
- Why limit this to a single conventional exchange point?
  - Any network domain may provide these capabilities
- Proposition: the **GEANT Testbeds Service provides SDX "fabrics"**
  - GTS can provide any "affinity group" with their own user-defined, intelligent, software defined GTS exchange fabric.
  - GTS networks span Europe (and beyond)...thus dramatically simplifying the creation of large scale bonding-fabrics among distributed applications.

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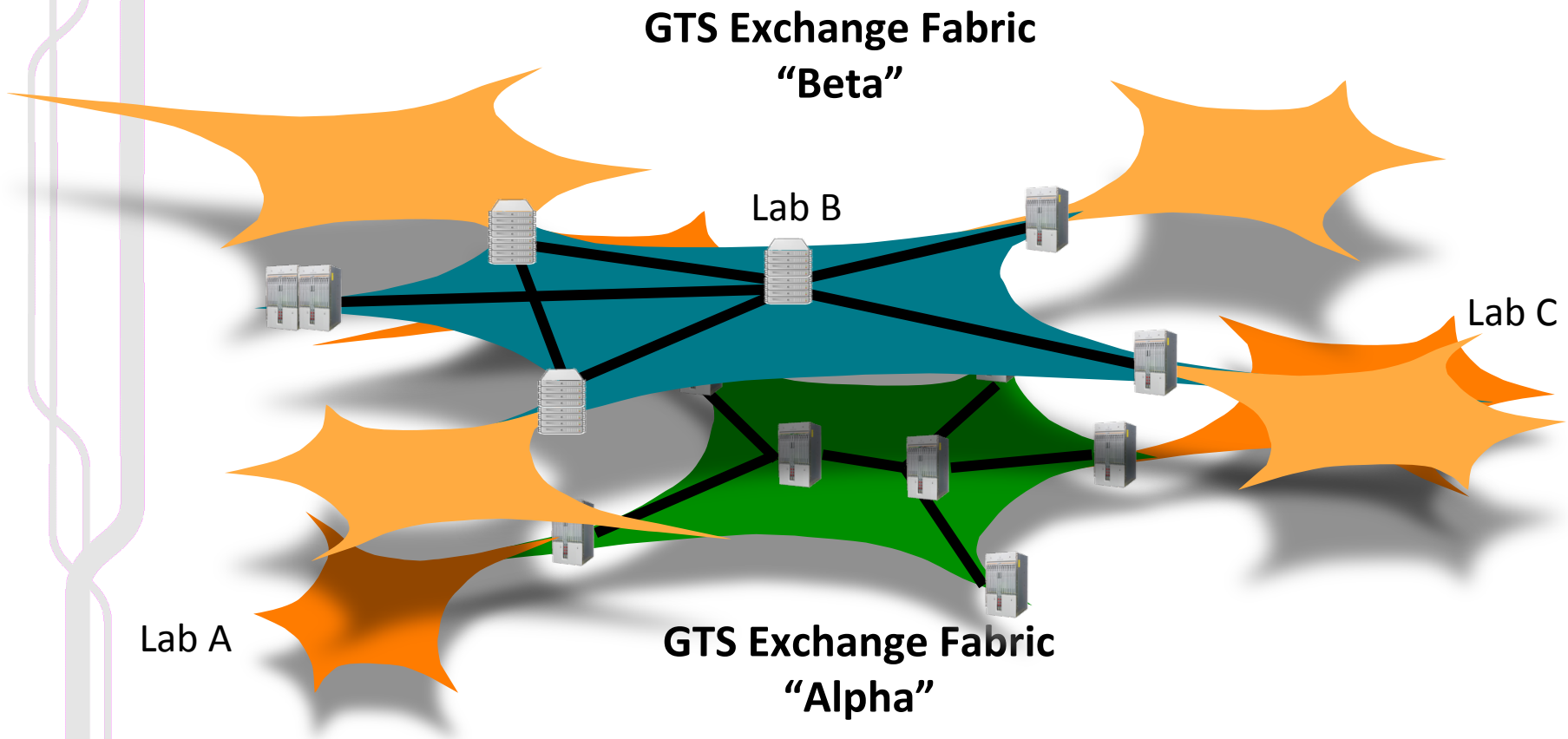
GTS "Software Defined Fabrics"



How do we define or characterize the "performance" of an SDN Fabric ?

How do we instrument such dynamic virtual facilities in order to measure the relevant performance properties ?

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Next steps

- We need a GLIF position paper that can inform GN4, GNA, FIRE/GENI efforts, ...
  - Clearly explain why deterministic, scalable, intelligent, automated PVA is so important to service delivery (user) and service engineering (providers)
  - Offer a high level framework approach that can addresses the issues within the emerging global scope (scalable, secure, private, etc.)
- We need someone to organize and drive the effort...
  - Preferably a SME in network engineering, provisioned services, protocols, and performance analysis
  - ..and time.
- Or else we can continue in present mode and try to restart the PVA discussions as a first step. (recommended.)
- Data point: GEANT4 SA3 (Connection oriented services) will initiate a Performance Verification Architecture task.
  - SA3 Activity Leader: Brian Bach-Mortensen (NORDUnet)
  - And PVA TL: Kurt Bauman (Switch)
  - (very limited resources for this task in 2015... But its something)

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Discussion or Comments

- Are we still in agreement that the PVA work is a valid topic for GLIF?
  - Are there other aspects or technical notions we should be exploring as part of this effort?
- Is there perhaps another approach we should take to make progress?
- ...or...
- Are we satisfied to simply try to restart the current TF discussions over the summer in order to fan the smoldering oily rags into a raging house fire??

Thank you!