

SC22 Network Research Exhibition: Demonstration Preliminary Abstract

[High Speed Network with International P4 Experimental Networks for The Global Research Platform and Other Research Platforms]

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Abstract

Recent successes of implemented “research platforms” have been demonstrated as key enablers of large-scale data intensive science. These platforms are based on architecture consisting of various orchestration techniques (e.g., Kubernetes), low management overhead, and tenant-oriented applications. This approach develops services focused on meeting requirements of research science communities, especially data intensive science. For major research platforms usage scenarios, high performance WAN networking is a high priority concern. Recently, P4 has become a major enabler for these types of services. Consequently, research testbeds such as the International P4 Experimental Networks testbed, have become important resources for exploring potential contributions of techniques for programmable data planes to high performance networking for science.

Goals

This SC22 NRE demonstration will illustrate the challenges to enabling Kubernetes integration with P4 Experimental Network Services over the Global Research Platform (GRP) over high-speed network. This demonstration will also showcase solutions to those challenges:

- (1) P4 software only Experimental Network Services in a container/Kubernetes environment with a cluster in the Global Research Platform over high-performance WANs.
- (2) P4 hardware only Experimental Network Services in a Container/Kubernetes environment with a dedicated cluster in the Global Research Platform across high performance WANs.
- (3) P4 integrated hardware and software as Experimental Network Services in a Container/Kubernetes for the Global Research Platform across high performance WANs.

(4) Prototype Kubernetes L2 and L3 network integration with P4 Experimental Network Services for the Global Research Platform across high performance WANs.

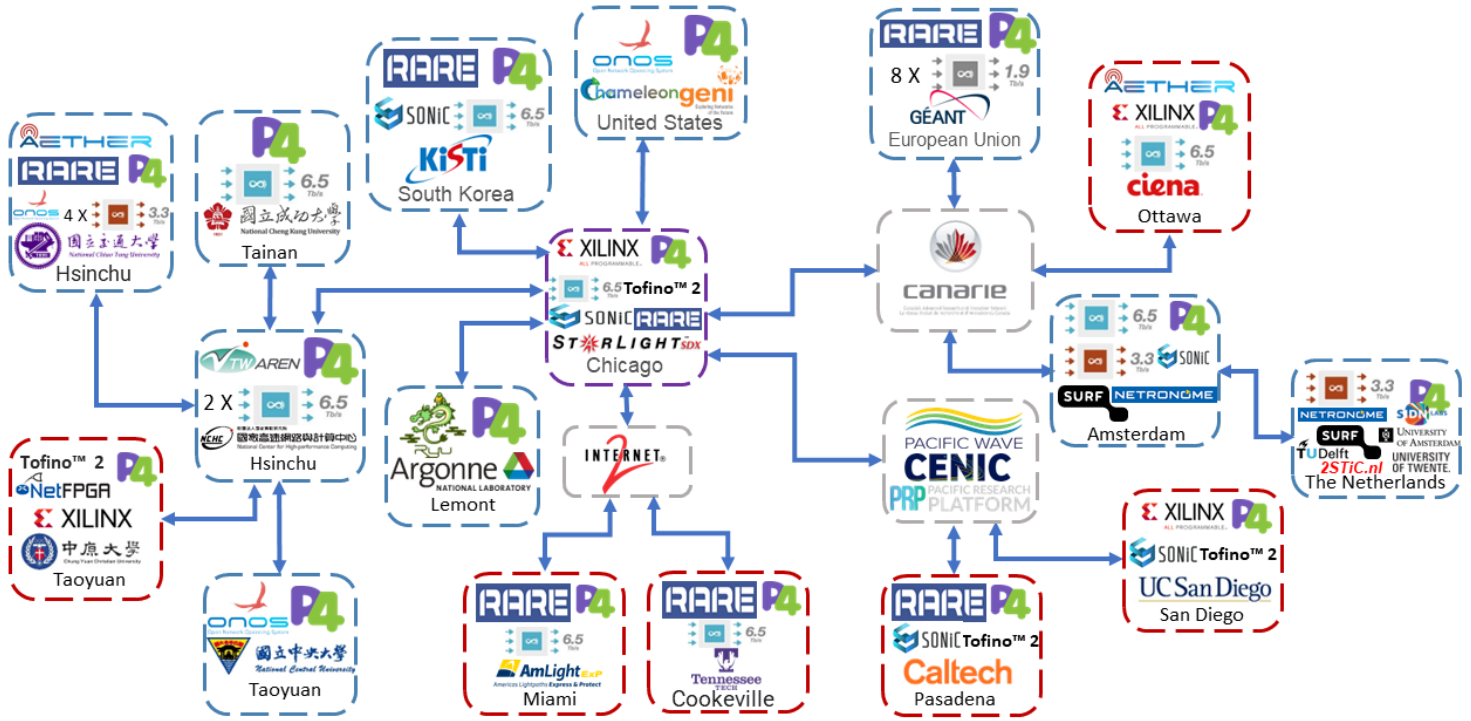
Resources

- (1) Selected US and international iP4EN sites will participate in these demonstrations. The current International P4 Experimental Networks and testbeds configuration is shown at the end of this document.
- (2) The StarLight International/National Communications Exchange Facility.
- (3) Required resources from SCinet WAN are 1 Tbps E2E WAN services from the StarLight International/National Communications Exchange Facility in Chicago to the SC22 venue, between StarLight and the JBTD Facility in McLean, between the JBTD Facility and the SC22 venue and among all sites.
- (4) With support from the SC22 SCinet team, vlans will be implemented from StarLight over 100G/200G/400G paths to showcase floor and public L3 routes from the StarLight booth to PRP/TNRP/GRP sites and other partner booths at SC22.

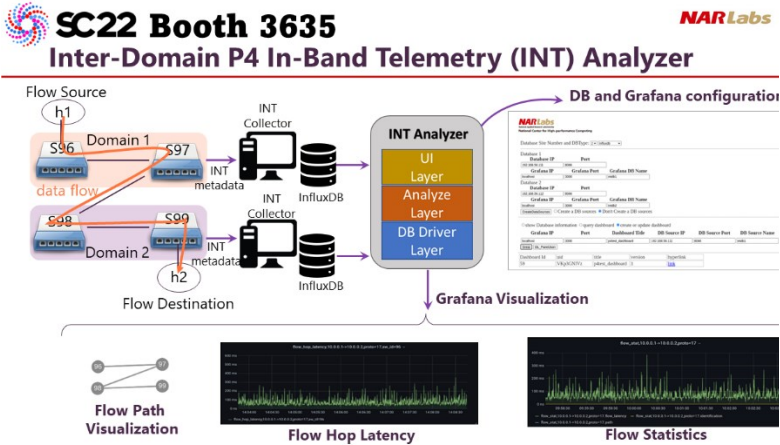
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International P4 Experimental Networks (iP4EN)



**Example #1: P4 prototype with BMv2 and Tofino switch:
Inter-Domain P4 In-Band Telemetry (INT) Analyzer**



**Example #2: P4 prototype with BMv2, Tofino and Tofino2
Switches and Xilinx FPGAs:**

Real-Time DDoS Attack Detection @40G/100G/400G

SC22 Booth 2847



- "Tabular Interpolation Approach Based on Stable Random Projection for Estimating Empirical Entropy of High-Speed Network Traffic" IEEE Access, 27 September 2022, Y. Lai, et al.
- A tabulation-based method, designated as the k-parallel lookup with m-hash, for estimating the empirical Shannon entropy using Indyk's stable random projection framework.
- The key component of the proposed method is the use of an inverse transform sampling technique to construct an empirical distribution function in a read-only lookup table.
- The practical applicability is demonstrated via stream-based implementation in the programmable data planes of Xilinx U200 FPGA and Tofino P4 switch, respectively. The PoC design is capable of processing minimum-sized Ethernet frames at 100 Gbps wire-speed.

- "Real-Time DDoS Attack Detection using Sketch-based Entropy Estimation on the NetFPGA SUME Platform" 12th APSIPA, Dec 7-10, 2020, Auckland, New Zealand, Y. Lai, et al.
- Shannon Entropy estimation in real-time of selected network traffic headers
- Long Short-Term Memory Recurrent Neural Networks (LSTM-RNN)

- "Sketch-based Entropy Estimation: a Tabular Interpolation Approach Using P4", Y. Lai, et al EuroP4 2022 workshop, CoNEXT 2022
- The scheme is deployed in a Barefoot Tofino2 switch connected to the national testbed.
- The system can estimate the entropy of network traffic accurately at 400 Gbps throughput.

