Future Generation Computer Systems 79 (2018) 166–168

Contents lists available at ScienceDirect

Future Generation Computer Systems

journal homepage: www.elsevier.com/locate/fgcs

Editorial INDIS special section FGCS

The annual SC conference [1], held in the US, is the primary venue for computer scientists and computing equipment manufacturers to share the latest advances in the field. An essential element of this innovation has to do with networks, network protocols and network applications.

The core role of networking in the context of (high performance) computing research and development is clear. Many fields of science have been experiencing and continue to experience a large influx of data. Managing, transporting, and architecting systems, as well as building tools to deal with the delivery of these data has become increasingly important. Additionally, the ecosystem of information and communications systems are becoming more complex. Wide area networks are now an integral and essential part of this data-driven supercomputing ecosystem connecting information sources, data stores, processing, simulation, visualization and user communities together. Furthermore, networks are required to connect research instruments such as detectors at synchrotron facilities, telescopes, and large visualization displays.

Networks for data-intensive science have more extreme requirements than general-purpose networks. These requirements not only closely impact the design of processor interconnects in supercomputers and cluster computers, but they also impact campus networks, regional networks and national backbone networks.

The current developments in network technologies are tremendous. Speeds of many hundreds of Gigabits and deep programmability of network infrastructure are now common. This enables a fundamentally different approach of integrating networks in supercomputing applications.

The SC conference series has traditionally been home to demonstrating cutting-edge developments in high-performance networking (HPN) since 1991 through SCinet, the conference's dedicated high performance network. At SC14, SCinet launched the first "Innovating the Network for Data Intensive Science" (INDIS) workshop which brought leading experts in computing and networking together to present and discuss upcoming and existing technologies. Over the last four years, this workshop has become an academic forum for leaders, operators and researchers in networking with the goal of highlighting the network innovations of the experiments running over SCinet, (Fig. 1) [2–4]. SCinet serves as the platform for exhibitors to demonstrate the advanced computing resources of their home institutions and elsewhere by supporting a wide variety of bandwidth-driven applications, including supercomputing and cloud computing.

At the same time the SCinet team is aware that the network platform itself also needs to evolve to drive innovation in wide-area networks. New features such as Software Defined Networking and Software Defined Exchanges (SDN & SDX) [5,6], Optical Rings on the exhibition floor, Openflow, Network Function Virtualization (NVF), Science De-Militarized Zones (Science DMZ) and data processing integrated services including computing and storage will change the face of SCinet [7]. The INDIS workshop, organized by the SCinet team, brings those developments from research and industry onto the exhibit floor and into the booths [8,9].

In this special issue we present 8 articles which provide an overview of the latest innovations, optimizations and operational performance for networks.

A number of articles focus on the evolutions of future network architectures. Nickolay et al. present a comprehensive study of the traffic load on research and education networks in "Bridging the Gap between Peak and Average Loads on Science Networks" [10] to understand how much overprovisioning is needed to accommodate peaks. Kiran et al. propose to empower users of networks to express their intent and desired service in natural language, opening up the networks to non-experts in "Enabling Intent to Configure Scientific Networks for High Performance Demands" [11]. In "Advance Reservation Access Control Using Software-Defined Networking and Tokens" Chung et al. show that end-to-end paths across the network can be created by using tokens that carry information about desired network reservations [12].

Other authors have focused on how to adapt to the increasing data rates. Wu et al. show in "Network Measurement for 100 Gbps Links Using Multicore Processors" that it is possible to monitor data flows at 100 Gbps speeds in a programmatic manner [13]. Mills et al. in "Maximizing the Performance of Scientific Data Transfer by Optimizing the Interface Between Parallel File Systems and Advanced Research Networks" show how to optimize data transfers in GridFTP such that data intensive applications like genomics can optimally use the network [14]. Zhang et al. in "mdtmFTP and Its Evaluation on ESNET SDN Testbed" develop a new data transfer tool that is able to optimally transfer small data files, a traditional challenge in high-performance networking [15].

Finally a number of papers introduce optimizations of network operations in a number of areas. Lenkiewicz et al. focus on the energy impact of data transfer for astronomy in the article "Energy-Efficient Data Transfers in Radio Astronomy with Software UDP RDMA" [16]. Koning et al. in "CoreFlow: Enriching Bro security events using network traffic monitoring data" present a novel framework for dealing for security incidents in networks by correlating information from multiple sources [17].

http://dx.doi.org/10.1016/j.future.2017.11.004

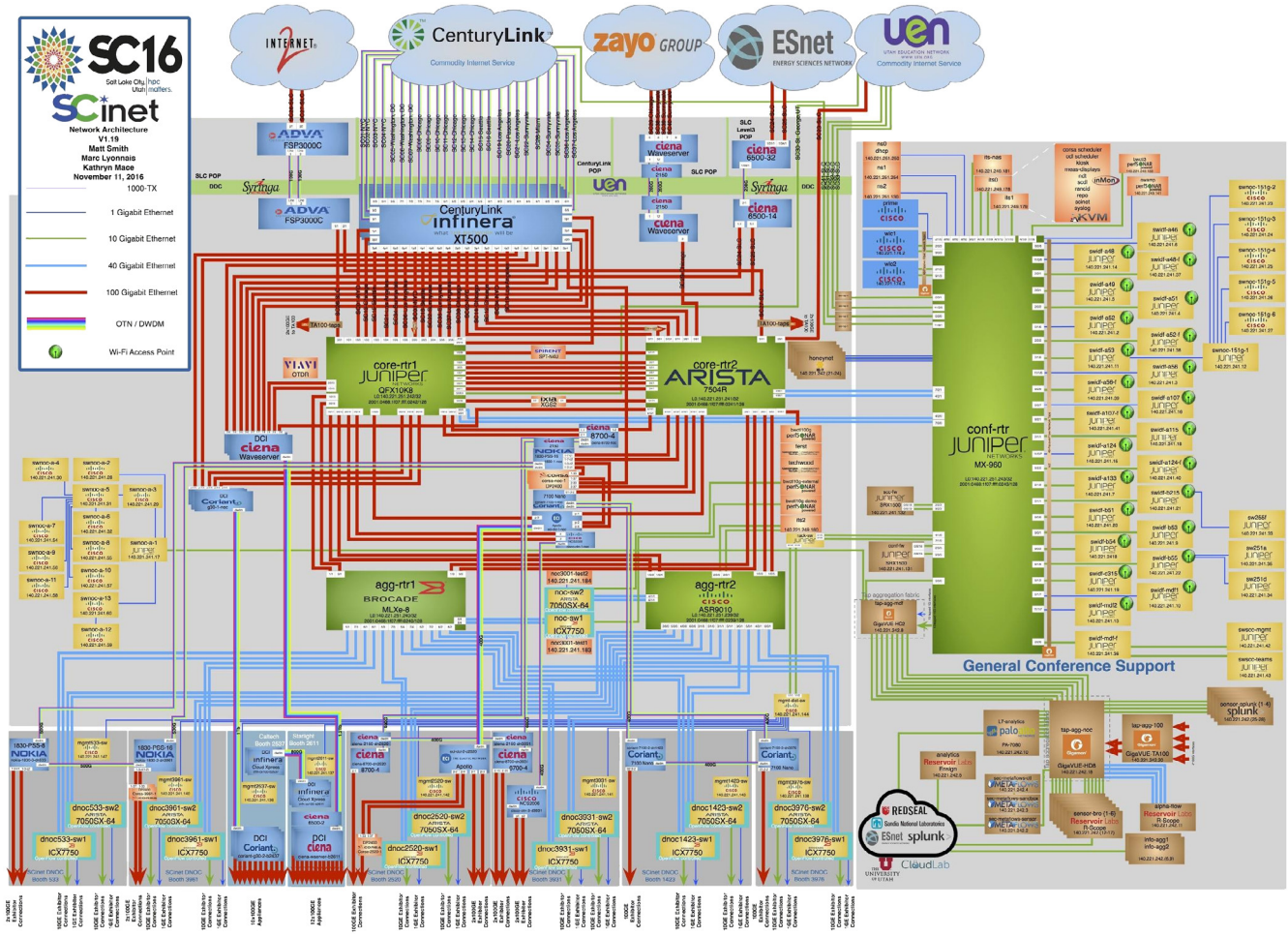

Fig. 1. The SC16 exhibit floor network architecture featuring optical transport rings, switching, routing and wireless to a total capacity of 3.4 Terabit/s bringing the universities and research institutes to the conference floor.

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