

# RETHINKING R&E NETWORKS TO ACCELERATE SCIENTIFIC DISCOVERY

Research and Education (R&E) networks are the circulatory system of global learning and innovation. From digital classrooms and distance learning to large-scale research collaborations in areas ranging from physics and climate studies, to astronomy and combustion research, R&E users need high-performance, highly available, high-bandwidth networks and services.

As in all industries, users have come to expect access to everything at any time, from any location. R&E network operators must deliver new apps and services, along with bandwidth to keep pace with new services and bandwidth demand, while simultaneously overcoming inherent deficiencies in legacy platforms and technologies. Facing tight budgetary constraints and limited human resources, R&E networks are often a complex ecosystem of multiple vendors' software and devices, each with differing, highly specialized functions. As demand for flexible, agile services grows, network complexity is simultaneously expanding, making it difficult to quickly and efficiently deliver such services and keep pace with the demand for network resources.

Luckily, the scientific community's quest for knowledge is also propelling an evolutionary shift in network technologies to Software-Defined Networking (SDN) and Network Functions Virtualization (NFV). In the R&E community, open source SDN controllers are powerful, widely used tools that accelerate service delivery and help better manage high-performance networks. Many R&E network operators have built highly customized networks to meet specific requirements, leaving performance and support services to academic best efforts. Meanwhile, industry suppliers now offer commercially hardened SDN controllers. In multi-vendor R&E networks, this often results in a multiple-SDN controller environment, which in turn generates vendor-specific management silos. Even the orchestration of NFV and other data center resources

remains in separate domains. As a result, despite advances in SDN controllers, network operators still lack the ability to orchestrate networks from end to end, across virtual and physical domains. Instead, they must choose management solutions for each domain, and somehow stitch everything together to deliver new services.

## **Learning to Orchestrate Networks across Domains**

R&E organizations need more automated, on-demand network services that will allow them a higher degree of 'self-service' control. For R&E network operators, satisfying their customers means not only meeting performance demands, but also improving service quality. Creating and deploying services is currently a complex, manual process that requires updating multiple vendor- and domain-specific element managers, SDN controllers, or orchestrators and integrating those changes into the Operational Support System (OSS). In addition to being a complex and error-prone process, this type of service delivery preserves management 'silos,' adding complexity and inefficiency to SDN and NFV networks. What is needed instead is an open, programmable structure that can integrate across multiple diverse domains to provide 'single-pane-of-glass' visibility into all management operations.

With Multi-Domain Service Orchestration (MDSO), R&E network operators can manage services seamlessly across physical and virtual domains. Greater visibility into network operations facilitates a better understanding of network performance, enabling more rapid troubleshooting and fewer/shorter outages. In addition, once software controls functionality, service orchestration can be used to help R&E network operators transition from custom, manual controls to automated network processes that leverage the DevOps tools popularly used in research organizations today, to enhance operational and service agility.