SDXs as Resource Marketplaces
(Application for the SDI/SDX Workshop)

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Research Direction

Software-Defined Internet Exchange Points (SDXs) have been proposed as a way for multiple providers to collectively control the routing decisions at Internet Exchange Points (IXPs) in more fine-grained ways than IXPs do today [1]. Much of the SDX research has focused on the issues associated with composing SDN policies and resolving conflicting policies [2] or scalability issues associated with flow-level policies for large numbers of flows [1]. However, questions regarding an SDX's ability to enable dynamic business agreements that lead to new innovative services remain to be addressed.

SDXs offer mechanisms that could be used to enforce certain types of policy agreements reached by providers (e.g., policies that define routes, or policies that define traffic limits). Moreover, these mechanisms can operate on a much more dynamic and short-term timescale than is common today. To leverage this capability, we are developing mechanisms that could enable SDXs to support dynamically-established time-limited business relationships (i.e., agreements) among service providers. Although our primary focus is on mechanisms to enable dynamic forwarding agreements that define interdomain transit service, we also want to identify mechanisms that can be used to generalize the SDX concept for other types of resources and services—for example, computing and storage.

Our high-level goal is to create a conceptual framework (and corresponding software support) for an "Economic SDX" (ESDX) that incorporates the economic considerations and relationships that drive (inter-domain routing) policies as a fundamental building block of the ESDX. An Economic SDX serves as a *marketplace* for access to (SDX) resources upon which services can be built. Initially our focus is on forwarding services that provide connectivity, but we believe the concepts can extend to other resources (compute, storage) and more broadly to services enabled by Network Function Virtualization (NFV). We believe a necessary building block for such an ecosystem is a set of common ESDX *use plane enforcement mechanisms* that can be used to verify and enforce economic contracts established by providers. These mechanisms need to relate coarse-grained contracts for network services to policy enforcement/compliance in the network, potentially at fast time scales (say on a per-packet basis). Some types of contracts will have stricter enforcement requirements than others, leading to a variety of mechanisms offering different tradeoffs between security (policy enforcement) and performance. Our work builds on and extends our past work in the ChoiceNet architecture [3] which supports an economy plane and marketplace services.

My Background

I am a Professor and Associate Chair in the Department of Computer Science at the University of Kentucky, and I also am the Director of the Laboratory for Advanced Networking. My research involves several areas of computer networking with a focus on future internet architectures. I have worked (together with Ken Calvert) on the Postmodern Internet project (part of the NSF FIND program) which looked at new routing and forwarding approaches for future internets, and more recently on the ChoiceNet research project (part of the NSF FIA program) looking at ways to incorporate economics into the network layer so that ISPs can be compenstated for creating and offering innovative services. I have also been heavily involved in the design and implementation of GENI and its measurement/monitoring system, and have helped lead efforts on the UK campus to make SDN a foundational component of the campus production network, benefitting all users with dynamically configured flows tailored to their research.

References

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[3] T. Wolf, J. Griffioen, K. L. Calvert, R. Dutta, G. N. Rouskas, I. Baldine, and A. Nagurney. ChoiceNet: toward an economy plane for the Internet. *ACM SIGCOMM Computer Communication Review*, 44(3):58–65, July 2014.