# Toward Collaborative Networks and Applications (CNA) as a Key Component for Huge Data Networking

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Although substantial progress has been made in handling “big-data” (e.g., modern data center design such as VL2, big-data programming model such as map-reduce and spark) , the existing “big-data” work focuses on settings that are quite different from those of huge data; for example, instead of typically operated by a single domain operated by a single commercial entity for its own bespoke applications such as search/social-network as in “big-data”, huge data may span multiple, non-profit, autonomous-but-collaborative research networks (domains), with community scientific and/or engineering workload. As a result, much of existing work does not directly apply.

In this white paper, we propose the exploration of collaborative networks and applications (CNA) as a key component for huge data networking. By CNA, we mean the introduction of protocols and interfaces to foster much stronger network-application collaboration and network-network collaboration than current main-stream networking. This proposal is not clean slate design; instead, it targets to leverage maturing of network-application collaboration protocols such as the ALTO protocol [1], the recent design and large-scale deployment of CNA systems such as the Flow Director system [2] to steer hyper-giant flows, and the recent emergence of new, flexible networking mechanisms such as APN6, PANRG, P4, NPL, INT, and SmartNIC.

Specifically, we propose the exploration of two key components of CNA for huge data: (1) *information/service* exposure for network-application collaboration, and (2) *control exposure* for network-network collaboration.

**Information/service exposure for network-application collaboration**: Network information exposure to allow network and application collaboration is beneficial but challenging, due to challenges such as privacy, distributed control, and scalability. Although much progress has been made in allowing a network to expose its state, the existing work is limited in exposing only limited resources such as routing costs or limited bandwidth. We anticipate that huge data can benefit from a more complete framework including processing capabilities [3] and handling more dynamic resource predictions [4]. During the workshop, we plan to discuss a more complete framework spanning heterogeneous types of resources and *in-network* processing capabilities.

**Control exposure for network-application collaboration:** Spanning multiple networks is a key characteristic of some huge network settings (e.g., LHC), but multi-domain network is largely limited (e.g., using the traditional BGP model or one hop SD-WAN). During the workshop, we plan to discuss the possibility of extending traditional SDN to wide-area network. It will be based on our recent work [4] but goes beyond to address huge data challenges such as not only routing but also processing.

[1] The ALTO Protocol, RFC 7285.
[2] Steering hyper-giants’ traffic at scale, by Enric Pujol, Ingmar Poese, Johannes Zerwas, Georgios Smaragdakis, and Anja Feldmann. In CoNEXT ’19.
[3] Content Delivery Network Interconnection (CDNI) Request Routing: CDNI Footprint and Capabilities Advertisement using ALTO. IETF working group draft. Jan. 2020.
[4] Prophet: Fast, Accurate Throughput Prediction with Reactive Flows, by K. Gao, J. Zhang, and Y. R. Yang. In INFOCOM 2018.
[4] Toward Optimal Software-Defined Interdomain Routing, by Q. Xiang, Y. Richard, et al. To appear in INFOCOM 2020.