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Application-Oriented Network Traffic Analysis based on GPUs

Software-Defined Networking (SDN) has emerged as a major development direction in network technology. Conceptually, SDN enables customization of forwarding through network infrastructure on a per-flow basis. With SDN, a high impact LHC data flow could be allocated a "slice" of the network infrastructure. Functionally, the data flow would have a private path through the network infrastructure, potentially with performance guarantees. SDN offers a technology path to meet extreme data movement requirements, like LHC, over highly capacious, general use network infrastructure. Standardized implementations of SDN, specifically OpenFlow, are now becoming available on network routers and switches.

Conventionally, SDN configuration is implemented by users or applications. User-driven SDN configuration is manual, and therefore tends to be static and inherently inefficient. It doesn't scale well to complex traffic patterns, such as the traffic patterns generated by LHC experiments. Application-driven SDN configuration is typically dynamic, representing a more efficient on-demand type of approach for network resources. However, building SDN-awareness into applications is highly complex and extremely challenging. It places ongoing software adaptation and maintenance burdens on the application developers. Finally, there will always be major policy issues or constraints on an application's ability to modify the network.

We believe networks need an application-awareness capability. With such a capability, traffic identified as "special" by the network could be provided with a custom network "slice" without manual intervention or modification to applications. To facilitate this capability, we are currently developing a network traffic analysis tool to identify "special" types of network traffic. Our tool is designed to perform this analysis in real-time. We accomplish this through GPU technology, which is extremely well-suited to parallelize the processing and analysis of the network traffic. Our traffic analysis uses basic traffic characteristics such as packet size, packet spacing, flow duration, and multi-stream flow presence to develop the traffic pattern signatures and templates necessary for traffic classification and/or identification. Our ultimate objective is to create a tool that could facilitate dynamic customization of SDN-capable network infrastructure, based on real-time traffic analysis and detection.

A prototype of our analysis tool is currently in development. This talk will describe the tool's architectural and design principles, how it works in implementation, the challenges faced in high speed (40GE/100GE) network environments, and our initial trial results. In addition, future directions for the project, as well as wider applicability for the underlying technology, will be discussed.

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