

Similarly, introducing virtualization and wide-area delays will increase the *variability* of the service provided by the network function, due to issues such as network congestion, network failures or oversubscribed clouds.

Finally, network functions may be exposed to unusual threats from their co-tenants in a cloud. This may require further hardening of services, requiring more stringent or additional firewall protection, adding to the cost and delay in NFV.

4. CONCLUSIONS AND FUTURE WORK

This paper has focused on the *deployment* issues encountered as part of designing, deploying, and evaluating a transparent Split TCP middlebox for wireless networks. There are other issues we encountered but, due to space limitations, cannot include them here. Broadly, they fall under two categories:

Debugging. These issues centered on development decisions that aided or hindered debugging running systems, particularly under high load, or after extended deployments (i.e., months).

Measurement. While it was simple to measure performance improvements in a dedicated testbed, it was much more difficult to quantify to customers how well the system worked for *their* traffic and environment. In particular, *variability* introduced by using real workloads, networks and servers made this much more challenging. Constraints required by the customers also restricted our actions.

We are currently writing up our entire experience including the above in longer form and hope to publish that as a full paper.

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