Practical deployment strategy for a citywide cellular testbed

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***Abstract*—A significant obstacle to realizing a city-wide cellular testbed involves the practicalities of how such a system would be deployed and managed. In this abstract we propose a strategy for such a deployment that relies on the emergence of sliceable edge networks, virtualization technologies and suitable control and management software. We propose extensions to these systems that would enable practical city-wide cellular testbed deployment. We argue that actual deployments of the base infrastructure is taking place, making this a feasible strategy.**

I. Overview

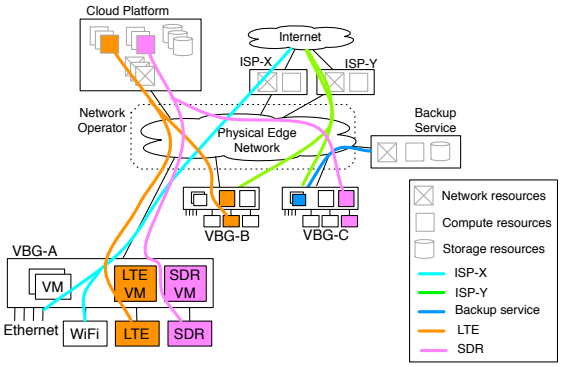

Fig. 1: Deployment strategy

Municipalities are increasingly deploying their own fiber network infrastructures in support of community broadband and other local services [1]. Equipped with an appropriate control framework, the virtualization capabilities of modern network equipment enables an environment where multiple network services can exist on the same network infrastructure, each in its own slice [2].

Figure 1 depicts such a scenario where a physical edge network (e.g., deployed by a municipality) allows two separate broadband services providers (ISP-X and ISP-Y) to co-exist. In addition to broadband Internet access, such an infrastructure can also support local broadband services (e.g., the "backup service" shown in the figure).

Figure 1 also depicts virtualization being applied to the customer premises equipment. Specifically, rather than terminating the network at a typical (dumb) optical network terminal (ONT), the network is terminated at an active network component, the Virtual Broadband Gateway (VBG) [3]. As expected this device contains a set of Ethernet ports, as well as USB connectors for connectivity of peripheral devices. In addition the device contains a general purpose compute platform, capable of running a number of virtual machines (VMs). VMs on the VBG can be associated with specific network slices, for example to enable service specific monitoring and control at the network edge.

Infrastructures such as these are being deployed by communities [4] and we argue that this forms an ideal and pragmatic platform to enable city-wide cellular testbed deployments. Specifically, as shown in Figure 1, we envision various cellular related peripheral devices being connected to the VBGs in a city-wide fiber deployment. A suggested in the figure, such equipment might be LTE small cells, or software-defined radio (SDR) kits. Such peripherals can be associated with their own VMs in the VBG, their own network slice and their own cloud-based resources to enable an instrumented city-wide deployment.

II. Authors' Background

Van der Merwe is the Jay Lepreau Professor in the School of Computing at the University of Utah. He is the PI of the OpenEdge project which developed control architecture to realize a dynamic and secure open service edge network architecture [2]. He is also PI for the PhantomNet project which is developing a mobile testbed to enable research at the intersection of mobile networking, cloud computing and software-defined-networking [5].

Christensen and *Peterson* are respectively the President and Chief Technology Strategist for EntryPoint Networks [6]. EntryPoint is developing software and hardware products to enable the development and management of services in broadband networks. In particular, EntryPoint's FlowOps, SecureOps and Virtual Broadband Gateway (VBG) products form the basis of the proposed cellular deployment strategy.

Patterson is the Technology Director for the City of Ammon, Idaho. The City of Ammon operates a fiber network as a Software Defined Infrastructure using the technologies described above [4]. As a US Ignite community member Ammon was awarded an NSF award, in partnership with the University of Idaho, to develop "network slicing for emergency communications" and recently won the National Institute of Justices Ultra High Speed App Challenge.

References

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