EntryPoint Response Below

Power Sector Transformation
Grid Connectivity and Capabilities Work Stream
Advanced Grid Capabilities and Questions for Stakeholders
August 31, 2017

In response to technical meetings held on May 9th, June 15th and July 31st, stakeholders are invited to provide responses to the following questions. Stakeholders may choose to respond to a selection of the questions. Responses should be submitted by email by September 8th, 2017.

1) Utility proposals for advanced meter functionality and distribution automation should seek to achieve a defined list of capabilities. Please review the accompanying list of capabilities and provide any comment on the completeness of the chart, the accuracy of the definitions, and the relative importance of each goal and capability within each goal.

2) Advanced meter functionality can enable a wide range of system and customer benefits. Please provide any information you may have to help us evaluate the qualitative system and customer benefits from each capability.

3) Advanced meters, like any technology, carry risks of becoming obsolete. Please describe ownership and operating models for advanced meters that address the risk of obsolescence.

4) Please describe any complementary measures necessary to ensure that the benefits of advanced meter applications are accessible to all customer classes, especially income eligible.

5) Advanced meters offer a platform on which the utility, or a third party, can provide software services, such as demand response or energy efficiency. Please provide any information to help design such a platform, including how accessible it should be to multiple providers.

    a. EntryPoint Networks Response: (See Response to Question 6 Below)

6) Development of a shared communications network among existing wireless network operators, the electric utility, and other infrastructure providers can significantly reduce capital costs for ratepayers. Please provide any considerations to inform formation of a shared communications network.

EntryPoint Networks Response:

Facilitating Consumer Choice

The standards for network communications which facilitate and enable Consumer Choice should include at least the following core capabilities:

1. **Virtualization** is used to create independent slices or channels to enable multiple services simultaneously (multi-tenant) over the same wire and to keep those services isolated from each other in a private and secure manner.

2. **Software Defined Networking (SDN)** should be used with automation to control the Flows that realize the networks and add and remove flows dynamically on the Virtual Broadband Gateway at the customer premise. The two main SDN standards should be the Open Flow protocol (or some equivalent) and an SDN controller.

3. **Orchestration** provides coordination of the Virtualization and SDN components to enable network flexibility, multi-tenant capabilities and to enable a platform which moves software control to the user at the edge. The user may be an innovator or subscriber. In both cases, we want to enable control at the edge to help them do the things they want to do in a private, secure, and authorized manner.

4. **Scalability -** In order to dynamically provide networks on demand for multiple services, the following protocols should be integrated into the system for scalability: 802.1ad, 802.1ah, MPLS, PBP, VXLAN, and Segment Routing.

5. **Separation of Infrastructure and Services.** In order to enable dynamic networks on demand, the infrastructure bust be separated from the services running over that infrastructure.

Background

FlowOps is EntryPoint's instantiation of the Orchestration framework. FlowOps implements the network abstraction offered to service and application providers and realizes the underpinnings of that abstraction on the physical network. FlowOps provides an API that allows service/application providers to treat the entire network as a big switch. This leaves the service providers free to focus on the semantics and logic of the service/application they want to provide. The FlowOps API means that the network operator is free to implement underlying connectivity using any technology they desire. The only requirement is that strong isolation is provided between network resources associated with different services.

The second component, *FlowOps* Authentication Protocol manages authenticated access to the network and automatically authorizes the services/applications available on the network. The authentication design is inspired by the security framework used in cellular networks. Specifically, access to a network service is authenticated via security credentials contained in a virtual Subscriber Identity Module (vSIM). Unlike a physical SIM, the vSIM

allows separate credentials for different services, allowing a more fine-grained service model. Our vSIM can be realized solely in software, or made more secure by utilizing Trusted Platform Module (TPM) functionality.

The third component, the Virtual Broadband Gateway (VBG), is a device that replaces the traditional Optical Network Terminal (ONT) to terminate broadband networks at the subscriber premise. A VBG consists of a single hardware device which presents multiple logical routers and switches rather than requiring multiple physical routers and switches. The goals which drove research and development of the VBG included: (i) moving control of the network from the core to the network edge, (ii) enabling multi-tenancy for service providers, (iii) creating a demarcation point between the network provider, the subscriber(s), and the service provider(s), and (iv) enabling self-provisioning for network stakeholders.

The distinctiveness of the *FlowOps* solution is that it:

1) Combines the concept of Open Access with SDN, NFV, and network automation and integrates the solution with a device at the premise that enables automated virtual channels to the premise under the control of SDN.

2) The solution provides a path to separate the broadband infrastructure from the services. To do this, control of the network must be moved to the network edge and appropriately shared with all network stakeholders. This separation requires that the network operator's network address space be independent of the service provider's network address space. This addressing must be fully automated so that the power of this architecture can be realized. FlowOps and the VBG enable this capability.

3) The tools enable cloud-like attributes at the Subscriber Edge. By this we mean that *FlowOps*:

    a) ***Makes the edge network itself more cloud-like:*** *FlowOps* moves much greater control to the subscriber edge and makes the edge network more cloud-like via FlowOps and SecureOps because the platform enables attributes which give users at the premise the same kind of functionality that currently exists in data centers. These attributes include: automation, programmability, virtualization, anytime-anywhere access, and measurement tools for real time visualization and control. The benefits from these capabilities include on-demand self-service, rapid provisioning, management efficiencies, multi-tenancy, and nimble response times because cloud moves at the speed of software.

    b) ***Transforms the premises equipment into a mini-cloud:*** The VBG itself can be a mini-edge cloud which hosts virtual services such as virtual firewalls, virtual proxies, VPNs, virtual intrusion detection, virtual load balancing, virtual WAN optimization, Virtual ATA, and a Virtual PBX.

    c) ***Provides "regular" cloud capabilities in (or close to) the edge network:*** *FlowOps* presents users with regular cloud infrastructure at the provider edge so that subscribers will have the ability to easily reach out into a dynamic market

place of service providers and select a provider from a growing number of services in categories like Virtual Classrooms, Telemedicine, Emergency Communications, Gaming, and Smart Homes in addition to traditional broadband services.

The contribution of the system is not the distinctiveness of its attributes. Rather, its contribution is that *FlowOps* brings these distinctive elements together to do what was originally intended: create choice, open up possibilities, and enable options to users of broadband networks in ways that are not available in today's closed networks.

Anticipated Public Benefits

When *FlowOps* is used in an open access environment, the network essentially becomes a marketplace for service providers to establish a presence and deliver meaningful services to whomever wishes to subscribe. We refer to this services marketplace as a Software Defined Market Exchange (SDMX) and is analogous to the Apple and Android app stores which allow services to be treated as stand-alone applications that leverage the broadband connectivity of the network. Similar to other cloud services, subscribers can allocate what they want, when they want, and the barrier to those events has been made so trivial that subscribing to a service simply requires the click of a button. We expect this marketplace to empower the benefits of competition including lower prices, movement toward abundant bandwidth, compelling new services, and growing innovation activity.

An additional and significant benefit of *FlowOps* is that services are provisioned using private networks with internet-like interfaces and unique privacy, security and reliability advantages. These automated private networks make it possible for customers to use a virtualized Ethernet switch to link multiple remote sites as if they were on the same physical switch. Ethernet packets are tunneled through the provider network, independent of traffic from other Internet users. The objective is to give users the ability to choose whether a particular service should be handled over the public internet or over a private network and to have security, privacy, or reliability considerations drive that decision rather than technical difficulty. As the Internet of Things evolves, it will be important to have the option of dynamic connectivity through private networks as a value added supplement to existing connectivity through the public internet. Also, for those services that currently happen over the top via the public internet this capability allows the service provider to have a dedicated path to each customer without relying on another service being present.