MEF 69

Subscriber IP Service Definitions

November 2019

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1 List of Contributing Members

The following members of the MEF participated in the development of this document and have requested to be included in this list.

- Amdocs
- Bell Canada
- CenturyLink
- Cisco
- Spirent
- TELUS
- Zayo

2 Abstract

This document defines two Subscriber IP Services, Basic Internet Access and Advanced Internet Access, using constraints on certain Service Attributes and parameters as specified in MEF 61.1, “IP Service Attributes” [6].

3 Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents.

In addition, terms defined in MEF 61.1 [6] are included in this document by reference, and are not repeated in the table below.

Term	Definition	Reference
Advanced Internet Access Service	An Internet Access Service typically delivered to business locations, and designed for reliability and monitoring.	This document
Basic Internet Access Service	An Internet Access Service typically delivered to Subscriber dwellings, and designed for low-cost, ease of use.	This document
DHCP	Dynamic Host Configuration Protocol	RFC 2131 [4]
Internet Access Service	Public Internet connectivity service purchased by a Subscriber from an Internet Service Provider.	This document
ISP	Internet Service Provider	This document

Table 1 – Terminology and Abbreviations

4 Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 (RFC 2119 [1], RFC 8174 [2]) when, and only when, they appear in all capitals, as shown here. All key words must be in bold text.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words **MAY** or **OPTIONAL**) are labeled as **[Ox]** for optional**.**

5 Introduction

This document defines two public Internet Access Services, Basic Internet Access, and Advanced Internet Access, which are purchased by a Subscriber from an Internet Service Provider (ISP). These services are Subscriber IP services constructed using the Service Attributes defined in MEF 61.1 [6] where certain Attribute values have been constrained as per this document.

Figure 1 shows an example of an Internet Access Service. A Service Provider (SP) offers connectivity to the public Internet to a Subscriber with this service. The SP that offers this service is defined as an Internet Service Provider (ISP). An IPVC used for an Internet access service provides the Subscriber with connectivity to the global Internet. If there is a single UNI attached to the IPVC, then the IPVC provides Internet access for the Subscriber Network connected at that UNI. If there are multiple UNIs attached to the IPVC, the IPVC provides Internet access for the part of the Subscriber Network connected at each UNI.

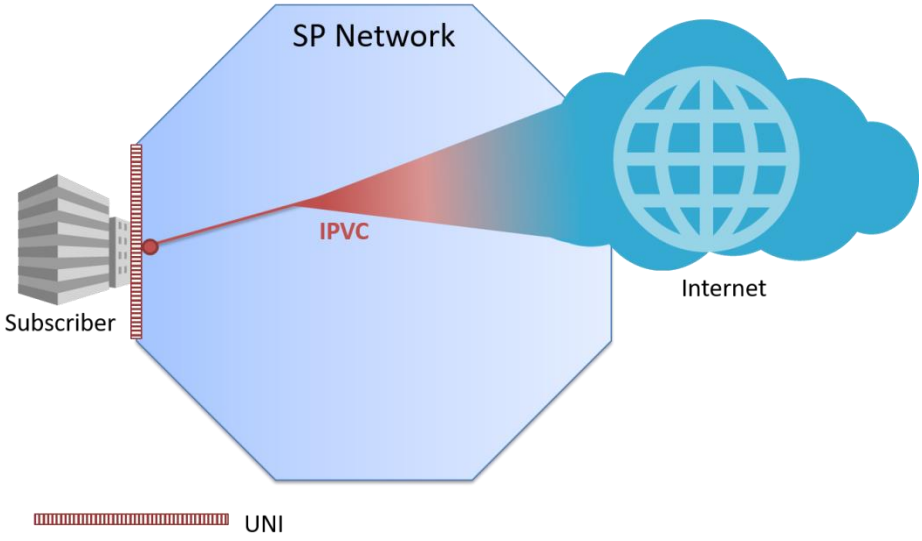

Figure 1 - Internet Access Service

Services providing access to the Internet are available in many forms. This document defines a subset of these services, where:

- The primary service requested by the Subscriber is Internet Access.
- The Internet service is provided to the Subscriber's site, which is a fixed location.

The ISP may offer IPv4 routing, IPv6 routing or both. An Internet access service can include Network Address Translation (NAT) to enable the Subscriber to use private IP addresses within their networks.

Internet Access Services include a Bandwidth Profile (BWP), defined in MEF 61.1 [6], which governs the temporal properties of IP packets at the UNI. The Subscriber observes the outcome of this BWP as a metering of the traffic rate of IP flows carried by the Internet Access Service. The value of this metering rate may be agreed between the Subscriber and ISP, and applied by conditioning functions in ISP equipment (eg: traffic shapers, traffic policers). This is often referred

to as the “Service Speed”. It may be expressed as two speeds: one in the downstream direction towards the Subscriber, one in the upstream direction from the Subscriber. This metering rate can also be opaque to the Subscriber, and governed only by the capacity of the media upon which the UNI is constructed, which may not be dedicated to the Subscriber. MEF 61.1 [6] defines Bandwidth Profile Flows and Bandwidth Profile Envelopes each of which can be used in multiples to produce IP Services with differentiated classes of service. The Internet Access Services defined in this document have only a single Bandwidth Profile Flow and Bandwidth Profile Envelope, as all traffic flows delivered by the service have equal treatment.

Two types of Internet Access Service can be offered: Basic and Advanced. The possible values for certain Service Attributes differ between these two types. Basic Internet Access is typically delivered to Subscriber dwellings. It may also be offered to small/medium businesses. Its service characteristics typically include: plug-and-play ease of use, low-cost, and few (or shared) publicly routed IPv4 Addresses. Advanced Internet Access is typically delivered to business locations. Its service characteristics include: redundancy features, options for Subscriber-supplied IP addressing, and proactive monitoring to support a Service Level Specification (SLS).

Both Basic and Advanced Internet Access Services are normatively defined in Section 6.

6 Internet Access Service Requirements

This section specifies the requirements for Internet Access Services. Unless otherwise specified, the requirements apply to both Basic and Advanced Internet Access Services.

6.1 Internet Access Service: IPVC Requirements

Table 2 contains the subset of the MEF 61.1 [6] IPVC Service Attributes that are constrained for Internet Access Services. For all other IPVC Service Attributes described in MEF 61.1 [6], there are no additional constraints for an Internet Access Service - in other words, any of the values specified in MEF 61.1 [6] for these Service Attributes can be agreed between the SP and the Subscriber, subject to the requirements in MEF 61.1 [6]. The first column lists the IPVC Service Attribute, and the second column specifies the requirements.

IPVC Service Attribute	IPVC Requirements
IPVC Topology	**[R1]** For an Internet Access Service, IPVC Topology **MUST** be *Cloud Access*
IPVC End Point List	**[R2]** For an Internet Access Service, IPVC End Point List **MUST** have exactly one entry.
IPVC Packet Delivery	**[R3]** For an Internet Access Service, IPVC Packet Delivery **MUST** be *Standard Routing*.
IPVC List of Class of Service Names	**[R4]** For an Internet Access Service, IPVC List of Class of Service Names **MUST** have exactly one entry.
IPVC Fragmentation	**[R5]** For an Internet Access Service, IPVC Fragmentation **MUST** be *Enabled*. Note: Fragmentation is necessary for an Internet Access Service as the Subscriber has no control over the size of frames received from the public Internet. IPVC Fragmentation *Enabled* ensures the ISP will not discard any frames destined to the Subscriber that exceed the allowable IPVC MTU size.

IPVC Service Attribute	IPVC Requirements
IPVC Cloud	**[R6]** For an Internet Access Service, IPVC Cloud **MUST** be *Internet Access*. **[R7]** For an Internet Access Service, Cloud Ingress Class of Service Map (*F*, *M*, *D*), map *M* **MUST** be empty. **[R8]** For an Internet Access Service, Cloud Ingress Class of Service Map (*F*, *M*, *D*), default CoS name, *D*, **MUST NOT** be *Discard*. Note that the combination of [R3], [R7] and [R8], along with [R50] in MEF 61.1 [6], mean that all IP Packets received from the Internet are mapped to a single Class of Service Name. **[R9]** For a Basic Internet Access Service, Cloud DNS **MUST NOT** be *None*. Note: Cloud DNS provided by the ISP to the Subscriber fulfills one aspect of the plug-and-play characteristics of a Basic service. For an Advanced Internet Access Service, a value of *None* for Cloud DNS is not precluded. **[R10]** For an Internet Access Service, if the Cloud DNS parameter of the IPVC Cloud Service Attribute is *Static*, the associated list of DNS Servers **MUST** have at least one entry. **[D1]** For an Internet Access Service, if the Cloud DNS parameter of the IPVC Cloud Service Attribute is *Static*, the associated list of DNS Servers **SHOULD** contain at least two DNS servers.
IPVC Reserved Prefixes	**[R11]** For an Internet Access Service, IPVC Reserved Prefixes **MUST** be either empty, or free from any public address prefixes.

Table 2 – Internet Access IPVC Attributes Requirements

Note: For DSCP Preservation there are no additional constraints beyond MEF 61.1 [6]. However, DSCP Preservation cannot be guaranteed by an ISP to the Subscriber for resources located outside the ISP's network.

6.2 Internet Access Service: IPVC End Point Requirements

Table 3 contains the subset of the MEF 61.1 [6] IPVC Service Attributes that are constrained for Internet Access Services. The first column lists the IPVC EP Service Attribute, and the second column specifies the requirements. For all other IPVC EP Service Attributes described in MEF

61.1 [6] there are no additional constraints for an Internet Access Service - in other words, any of the values specified in MEF 61.1 [6] for these Service Attributes can be agreed between the SP and the Subscriber, subject to the requirements in MEF 61.1 [6].

IPVC End Point Service Attribute	IPVC End Point Requirements
IPVC EP Role	**[R12]** For an Internet Access Service, IPVC EP Role **MUST** be *Root*.
IPVC EP Ingress Class of Service Map	**[R13]** For an Internet Access Service, IPVC EP Ingress Class of Service Map (*F*, *M*, *D*), map *M* **MUST** be empty. **[R14]** For an Internet Access Service, IPVC Ingress EP Class of Service Map (*F*, *M*, *D*), default CoS name, *D*, **MUST NOT** be *Discard*. Note that the combination of R4, R13 and R14, along with R50 in MEF 61.1 [6], mean that all Ingress IP Packets for the Internet Access Service are mapped to a single Class of Service Name.
IPVC EP Ingress Bandwidth Profile Envelope	**[D2]** For a Basic Internet Access Service, the IPVC EP Ingress Bandwidth Profile Envelope **SHOULD** be *None*.
IPVC EP Egress Bandwidth Profile Envelope	**[D3]** For a Basic Internet Access Service, the IPVC EP Egress Bandwidth Profile Envelope **SHOULD** be *None*. Note that [D2], [D3], [D8] and [D9] constrain Basic Internet Access Service to allow only one ingress and/or egress Bandwidth Profile at the UNI. This defines the simple nature of this service, in that it is incapable of supporting additional Connectivity Services across the same UNI.
IPVC EP Prefix Mapping	**[R15]** For a Basic Internet Access Service, the IPVC EP Prefix Mapping **MUST** be Empty.

Table 3 – Internet Access IPVC EP Attributes Requirements

6.3 Internet Access Service: UNI Requirements

Table 4 contains the subset of the MEF 61.1 [6] IPVC Service Attributes that are constrained for Internet Access Services. The first column lists the UNI Service Attribute, and the second column specifies the requirements. For all other UNI Service Attributes described in MEF 61.1 [6], there are no additional constraints for an Internet Access Service - in other words, any of the values specified in MEF 61.1 [6] for these Service Attributes can be agreed between the SP and the Subscriber, subject to the requirements in MEF 61.1 [6].

UNI Service Attribute	UNI Requirements
UNI List of UNI Access Links Service Attribute	**[R16]** For a Basic Internet Access Service, the UNI List of UNI Access Links **MUST** contain exactly one entry. Note: In the case where a Subscriber is provided both Wifi and Ethernet connectivity with their Basic service, typically that is a single subnet, and is viewed as a single common UNI on a single UNI Access Link.
UNI Ingress Bandwidth Profile Envelope	**[D4]** For a Basic Internet Access Service, if the UNI Ingress Bandwidth Profile Envelope is not *None*, it **SHOULD** have Bandwidth Profile Flows that contain all Ingress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [6] Table 28). Note: Note that a consequence of [D2] and [D8], along with [R103], [R104] and [R176] from MEF 61.1 [6], is that if an Ingress Bandwidth Profile is used, it is recommended to be specified using the UNI Ingress Bandwidth Profile Envelope.
UNI Egress Bandwidth Profile Envelope	**[D5]** For a Basic Internet Access Service, if the UNI Egress Bandwidth Profile Envelope is not *None*, it **SHOULD** have Bandwidth Profile Flows that contain all Egress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [6] Table 28). Note: Note that a consequence of [D3] and [D9], along with [R105], [R106] and [R177] from MEF 61.1 [6], is that if an Egress Bandwidth Profile is used, it is recommended to be specified using the UNI Egress Bandwidth Profile Envelope.
UNI List of Control Protocols	**[D6]** For an Internet Access Service, if the UNI Access Link IPv4 Connection Addressing is not *None*, the UNI List of Control Protocols **SHOULD** include ICMP with a list of applicable ISP IP addresses. **[D7]** For an Internet Access Service, UNI List of Control Protocols **SHOULD** include ICMPv6 with a list of applicable ISP IP addresses if UNI Access Link IPv6 Connection Addressing is not *None*.
UNI Routing Protocols	**[R17]** For a Basic Internet Access Service, the UNI Routing Protocols list **MUST** be empty.

Table 4 – Internet Access UNI Service Attributes Requirements

6.4 Internet Access Service: UNI Access Link Requirements

Table 5 contains the subset of the MEF 61.1 [6] IPVC Service Attributes that are constrained for Internet Access Services. The first column lists the UNI Access Link Attribute, and the second column specifies the requirements. For all other UNI Service Attributes described in MEF 61.1 [6], there are no additional constraints for an Internet Access Service - in other words, any of the values specified in MEF 61.1 [6] for these Service Attributes can be agreed between the SP and the Subscriber, subject to the requirements in MEF 61.1 [6].

UNI Access Link Service Attribute	**UNI Access Link Requirements**
UNI Access Link IPv4 Connection Addressing	**[R18]** For an Advanced Internet Access Service, UNI Access Link IPv4 Connection Addressing **MUST** be *Static* or *None*. **[R19]** For a Basic Internet Access Service, UNI Access Link IPv4 Connection Addressing **MUST** be *DHCP* or *None*. Note: The value of Unnumbered for UNI Access Link IPv4 Connection Addressing is intentionally excluded as Unnumbered interfaces render most of the common troubleshooting and performance monitoring tools unusable. **[R20]** For a Basic Internet Access Service, if the UNI Access Link IPv4 Connection Addressing is *DHCP*, the UNI Access Link IPv4 Connection Addressing Secondary Subnet List parameter **MUST** be empty. **[R21]** For a Basic Internet Access Service, if the UNI Access Link IPv4 Connection Addressing is *DHCP*, the UNI Access Link IPv4 Connection Addressing Primary Subnet parameter **MUST** contain only a single Service Provider IPv4 Address.

UNI Access Link Service Attribute	UNI Access Link Requirements
UNI Access Link IPv6 Connection Addressing	**[R22]** For an Advanced Internet Access Service, UNI Access Link IPv6 Connection Addressing **MUST** be *Static* or *None*. Note: The value of LL-only for UNI Access Link IPv6 Connection Addressing is intentionally excluded as Unnumbered interfaces render most of the common troubleshooting and performance monitoring tools unusable. **[R23]** For a Basic Internet Access Service, UNI Access Link IPv6 Connection Addressing **MUST** be *DHCP* or *SLAAC* or *None*. **[R24]** For a Basic Internet Access Service, if the UNI Access Link IPv6 Connection Addressing is *DHCP* or *SLAAC*, the UNI Access Link IPv6 Connection Address Subnet List parameter **MUST** contain a single entry. **[R25]** For a Basic Internet Access Service, if the UNI Access Link IPv6 Connection Addressing is *DHCP* or *SLAAC*, the UNI Access Link IPv6 Connection Addressing Subnet List parameter **MUST** contain only a single Service Provider IPv6 Address.
UNI Access Link DHCP Relay	**[R26]** For an Internet Access Service, UNI Access Link DHCP Relay **MUST** be empty.
UNI Access Link BFD	**[R27]** For a Basic Internet Access Service, UNI Access Link BFD **MUST** be *None*.
UNI Access Link Ingress Bandwidth Profile Envelope	**[D8]** For an Internet Access Service, UNI Access Link Ingress Bandwidth Profile Envelope **SHOULD** be *None*.
UNI Access Link Egress Bandwidth Profile Envelope	**[D9]** For an Internet Access Service, UNI Access Link Egress Bandwidth Profile Envelope **SHOULD** be *None*.

UNI Access Link Service Attribute	UNI Access Link Requirements
UNI Access Link Reserved VRIDs Service Attribute	**[D10]** For a Basic Internet Access Service, UNI Access Link Reserved VRIDs Service Attribute **SHOULD** be *None*. Note: The use of VRRP by the ISP is discouraged in the Basic Internet Access Service, as it requires coordination of VRID resources between the Subscriber and ISP, which compromises the simplicity and plug-and-play nature of this service type.

Table 5 – Internet Access UNI Access Link Attributes Requirements

7 References

[1] IETF RFC 2119, *Key words for use in RFCs to Indicate Requirement Levels*, March 1997

[2] IETF RFC 8174, *Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words*, May 2017

[3] IETF RFC 792, *Internet Control Message Protocol*, September 1981

[4] IETF RFC 2131, *Dynamic Host Configuration Protocol*, March 1997

[5] IETF RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*, January 2006

[6] MEF 61.1, *IP Service Attributes*, May 2019.

Appendix A Use Cases (Informative)

The following use cases provide practical examples of Internet Access Services.

A.1 Residential Internet Use Case

This residential Internet use case is based on the Basic Internet Access Service as described earlier in this document. It offers an easy-to-use, plug-and-play, low-cost Internet connectivity solution delivered to Subscriber dwellings. It is the most common example of fixed Internet Access Service. A residential Internet service is illustrated in Figure 2.

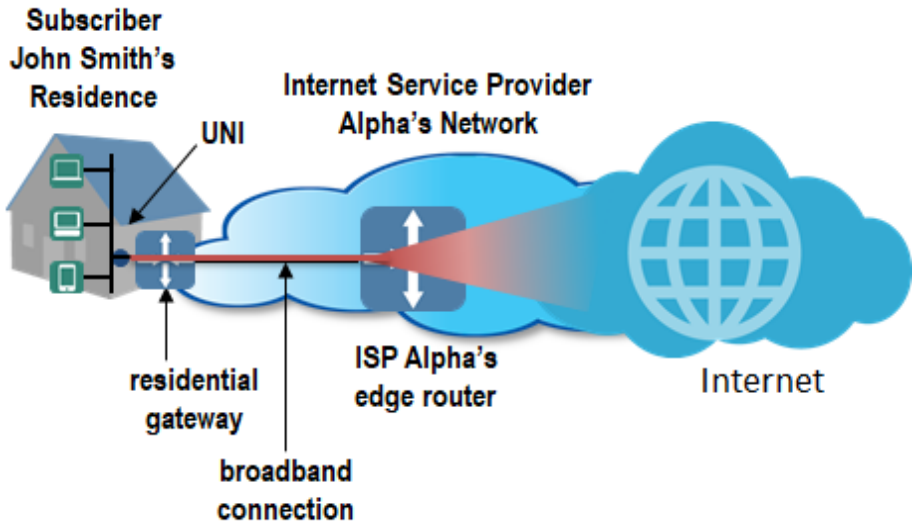

Figure 2 - Example of the Residential Internet Use Case

The Subscriber, *John Smith*, requires Basic Internet access at his residence, and asks Internet Service Provider, *ISP Alpha*, to offer a solution. *John* has several devices in the home that require Internet connectivity: a smartphone, laptop and a desktop computer. The smartphone and laptop are also used outside the home, where they make use of Internet Access Services provided by other ISPs (eg: his workplace, coffee shops, etc). *John* cannot be inconvenienced with reconfiguration of IP addressing and related parameters on these mobile devices each time they are reconnected to different Internet Access Services, so the service at his residence must support a plug-and-play user experience.

ISP Alpha constructs a broadband network facility or circuit from the ISP POP (point of presence) to *John's* residence, providing a media over which the final segment of the Internet IPVC is carried. The broadband connection is terminated on a residential gateway owned and provided by *ISP Alpha*. This is captured by agreeing a value of the UNI Management Type Service Attribute of Provider-Managed.

John's devices utilize either wired media (eg: Ethernet) or wireless media (eg: Wifi) to connect to the Internet Access Service. The Internet Access Service UNI exists across both of these media (wired and wireless).

At service ordering time, *ISP Alpha* allows *John* to select one or both of two versions of IP protocol the Internet Access service supports: IPv4 and IPv6. His selection populates the parameters of the UNI Access Link IPv4 and IPv6 Connection Addressing service attributes. He selects the DHCP option for both protocols. *John's* devices (smartphone, laptop, desktop computer) will use the DHCP protocol [4] to peer with *ISP Alpha's* residential gateway to obtain IP configuration information dynamically (plug-and-play).

ISP Alpha offers *John* a selection of Internet speeds supported by the broadband circuit delivered to his home. John selects the "100Mbps downstream, 50Mbps upstream" Internet service speed option, which is populated into service attributes:

- UNI Egress BWP Envelope attribute MaxIR parameter = 100Mbps.
- UNI Ingress BWP Envelope attribute MaxIR parameter = 50Mbps.

ISP Alpha offers *John* a selection of monthly traffic volume plans. *John* selects the "500G down, 100G up" option. This plan allows *John* to consume up to 500 Gigabytes of data in the downstream direction, and up to 100 Gigabytes of data in the upstream direction throughout the monthly billing cycle without incurring additional charges. Should either of these thresholds be exceeded, *ISP Alpha* applies an addition charge to *John's* bill. *John* is billed for this service by *ISP Alpha* at the beginning of each month. This monthly usage cap is expressed in the IPVC Cloud Service Attribute Cloud Data Limit parameter 4-tuple as follows:

- s_{cdl} = starting at time 00:00, 1st day of the month
- T_{cdl} = 1 month duration
- u_{cdl} = 100,000,000,000 octets
- d_{cdl} = 500,000,000,000 octets

The meaning of the parameters of the 4-tuple are as follows:

- s_{cdl} specifies the start time
- T_{cdl} specifies the time duration
- u_{cdl} specifies the amount of IP traffic transmitted towards the Internet Access service (from the Subscriber)
- d_{cdl} specifies the amount of IP traffic transmitted from the Internet Access service (to the Subscriber)

A.2 Business Internet Use Case

The Business Internet use case is based on the Advanced Internet Access Service as described earlier in this document. It offers a premium Internet connectivity solution delivered to business locations (eg: office towers). It includes Service Attribute values required to deliver a more highly available and reliable service than Basic Internet Access Service, suitable for delivering Commercial applications. The Business Internet use case is illustrated in Figure 3.

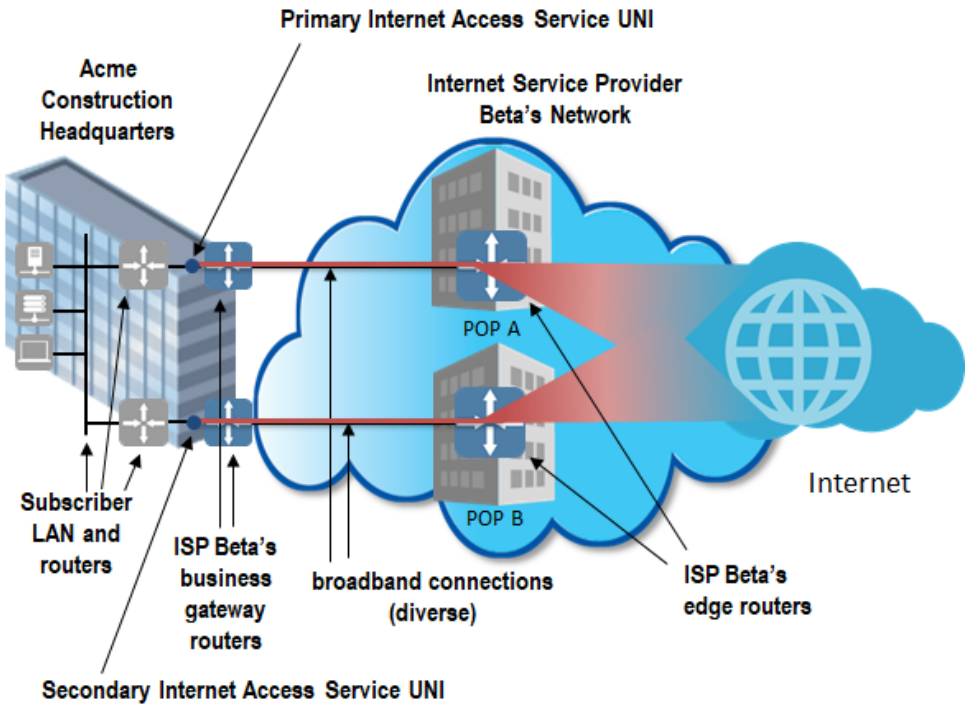

Figure 3 - Example of the Business Internet Use Case

A Subscriber, *Acme Construction*, requires Advanced Internet Access at their corporate headquarters, and asks Internet Service Provider, *ISP Beta*, to offer a solution. This service is required for the following business needs:

- Email
- Web Browsing
- Corporate website hosting

Numerous devices at *Acme Construction* will utilize this service, including employee IT devices, (smartphones, tablets and laptops) and corporate email and web hosting servers. Reliability of the Internet access is critical for Acme Construction's operations. *Acme Construction* is prepared to pay a premium for a service that is resilient to failures.

ISP Beta offers *Acme Construction* two redundant Advanced IP Access Services to meet the reliability requirements. Each IP Access Service requires a broadband network facility or circuit from an *ISP Beta* POP to the *Acme Construction* headquarters location, providing a media over which the final segment of the Internet IPVC is carried. These two services are delivered via different *ISP Beta* POPs. The two broadband circuits are physically diverse, ensuring the alternate service survives a facility "cut" of any form (eg: backhoe breaks the fiber). Each broadband connection is terminated on a business gateway owned and provided by *ISP Beta*, in other words, the UNI Management Type Service Attribute is Provider-Managed.

Acme Construction has an existing IPv4 and Ethernet network at the headquarters location. The two *ISP Beta* business gateways connect to *Acme Construction* network routers with Gigabit Ethernet links. The Internet Access Service UNIs exist on these Gigabit Ethernet links that connect the two companies. The corporate network does not yet have IPv6 capability.

Acme Construction has its own publically routable IPv4 address space, 203.0.113.0/24, which it would like to use on these new IP Access Services from *ISP Beta*. *Acme Construction* may in the future subscribe to another Advanced Internet Access Service from a different ISP, to further improve the resiliency of their connectivity to the public Internet. *Acme Construction* apportions two subnets of their address space to be used on the Gigabit Ethernet links that connect to *ISP Beta* business gateways, 203.0.113.0/30 and 203.0.113.4/30. The two companies agree that *ISP Beta* routers will use the lower numbered IP host on the subnet.

The UNI Access Link IPv4 Connection Addressing value is set as follows for the first Internet Access Service:

(Type: Static,
Primary IPv4 Prefix: 203.0.113.0/30,
Primary SP IPv4 Addresses: [203.0.113.1],
Primary Subscriber IPv4 Address: 203.0.113.2,
Primary Reserved Prefixes: [ ],
Secondary Subnets: [ ]
)

The UNI Access Link IPv6 Connection Addressing value is set to *None*.

To facilitate redundancy between the two Internet Access Services, *Acme Construction* and *ISP Beta* exchange reachability information using the BGP [5] routing protocol. *ISP Beta* allows its Subscribers to use the ICMP [3] protocol to test connectivity to business gateway routers. Therefore, the UNI List of Control Protocols attribute value for these services is set as follows:

[(Protocol: ICMP, Addressing: SP Addresses, Reference: RFC 792),
(Protocol: BGP, Addressing: SP Addresses, Reference: RFC 4271),
]

Acme Construction has its own BGP Autonomous System (AS) number, 64496. *ISP Beta* has BGP AS 64511. Therefore, the UNI Routing Protocols attribute value AS parameters for these services is set as follows:

Subscriber's AS Number = 64496
SP's AS Number = 64511

Alignment on the setting of the service parameters above provides clarity to both parties on how the service is to be configured.

Appendix B Summary of Constrained Attributes

Table 6 through Table 9 in this appendix provide a summary of which attributes are constrained with specific values for each of the Internet Access Services defined in this standard. A value of "constrained" in these tables indicates the attribute is constrained by this document. Where no value is given in the table, this document does not constrain the attribute. It is included for reference only and is not normative. Section 6 provides the normative detail of attributes that are constrained.

IPVC Attributes	Basic	Advanced
IPVC Identifier		
IPVC Topology	constrained	constrained
IPVC End Point List	constrained	constrained
IPVC Packet Delivery	constrained	constrained
IPVC Maximum Number of IPv4 Routes		
IPVC Maximum Number of IPv6 Routes		
IPVC DSCP Preservation		
IPVC List of Class of Service Names	constrained	constrained
IPVC Service Level Specification		
IPVC MTU		
IPVC Path MTU Discovery		
IPVC Fragmentation	constrained	constrained
IPVC Cloud		
IPVC Cloud Type	constrained	constrained
IPVC Cloud Ingress Class of Service Map	constrained	constrained
IPVC Cloud Data Limit		
IPVC Cloud Network Address Translation		
IPVC Cloud DNS	constrained	constrained
IPVC Cloud Subscriber Prefix List		
IPVC Reserved Prefixes	constrained	constrained

Table 6 – Non-Normative Summary of IP Services IPVC Attributes Constrained for Internet Access Services

IPVC Endpoint Attributes	Basic	Advanced
IPVC Endpoint Identifier		
IPVC Endpoint EI Type		
IPVC Endpoint EI		
IPVC Endpoint Role	constrained	constrained
IPVC Endpoint Prefix Mapping	constrained	
IPVC Endpoint ENNI Service Mapping Identifier		
IPVC Endpoint Maximum Number of IPv4 Routes		
IPVC Endpoint Maximum Number of IPv6 Routes		
IPVC Endpoint Ingress Class of Service Map	constrained	constrained
IPVC Endpoint Egress Class of Service Map		
IPVC Endpoint Ingress Bandwidth Profile Envelope	constrained	
IPVC Endpoint Egress Bandwidth Profile Envelope	constrained	

Table 7 – Non-Normative Summary of IP Services IPVC Endpoint Attributes Constrained for Internet Access Services

UNI Attributes	Basic	Advanced
UNI Identifier		
UNI Management Type		
UNI List of UNI Access Links	constrained	
UNI Ingress Bandwidth Profile Envelope	constrained	
UNI Egress Bandwidth Profile Envelope	constrained	
UNI List of Control Protocols	constrained	constrained
UNI Routing Protocols	constrained	
UNI Reverse Path Forwarding		

Table 8 – Non-Normative Summary of IP Services UNI Attributes Constrained for Internet Access Services

UNI Access Link Attributes	Basic	Advanced
UNI Access Link Identifier		
UNI Access Link Connection Type		
UNI Access Link L2 Technology		
UNI Access Link IPv4 Connection Addressing	constrained	constrained
UNI Access Link IPv6 Connection Addressing	constrained	constrained
UNI Access Link DHCP Relay	constrained	constrained
UNI Access Link Prefix Delegation		
UNI Access Link BFD	constrained	
UNI Access Link IP MTU		
UNI Access Link Ingress Bandwidth Profile Envelope	constrained	constrained
UNI Access Link Egress Bandwidth Profile Envelope	constrained	constrained
UNI Access Link Reserved VRIDs Service Attribute	constrained	

Table 9 – Non-Normative Summary of IP Services UNI Access Link Attributes Constrained for Internet Access Services

Note 1: Tables for ENNI Service, ENNI Common and ENNI Link Attributes are excluded as this Standard defines a Subscriber service only which does not include this EI type.

Note 2: Bandwidth Profile Attributes have been excluded for brevity, as none of these attributes are constrained by this Standard.