Mplify Standard

Mplify 164

Internet Access

Product Attributes and Use Cases

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Table of Contents

List of Figures

List of Tables

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2   Abstract

This Mplify Standard defines a set of agreement points, referred to as Product Attributes, between a Buyer and a Seller that constitute the basis for the commercial interactions for Internet Access. The Product Attributes are defined in a relatively formal way since the goal of specifying this information is to allow automation of these business interactions using Mplify LSO APIs.

In addition to the exposition of the Product Attributes a set of generic Internet Access Use Cases are described that define the breadth of Internet Access Products covered by the Product Attributes. This standard specifies the requirements to enable the definition of a Mplify Product Specification for Internet Access Products. The Use Cases represent Product Offerings that Sellers could derive from the Mplify Product Specification.

3   Terminology and Abbreviations

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

Product Attributes and Use Cases

Term	Definition	Reference
Address	A way of specifying an absolute fixed location on earth using pre-established boundary and identifier information such as country, city, postal code, and street information	Mplify 150 [16]
Business Function	In the context of this document Business Functions refer to *Product Offering Qualification* (POQ), *Order Management*, *Quote Management*, and *Address Validation*	This document
Buyer	The organization acting as the customer in a transaction over the Cantata or Sonata Interface Reference Points.	MEF 55.1.1 [8]
Guaranteed Bandwidth	The amount of bandwidth that the Buyer can use on a sustained basis with the expectation of very low packet loss. Guaranteed Bandwidth is contractually committed to the Buyer by the Seller.	This document
Local Network Address	An IP address used by IP hosts in the Buyers network.	This document
Product	The realization of a Product Offering to create a single instance for a specific Buyer.	MEF 55.1.1
Product Attribute	Specific information that is exchanged and agreed to between the buyer and seller of a Product as part of a business transaction	This document
Product Offering	Commercial realization of a Product Specification achieved by defining Product Offering Terms and specifying constraints on the possible values of the Product-Specific Attributes and relationships.	MEF 55.1.1
Product Offering Configuration	An identifiable set of Product-specific Attributes and their values	MEF 55.1.1
Product Specification	A specification comprising the following, for use with MPLIFY APIs: • a set of schemas that define all the attributes of a Product and their possible values • definitions of relationships with other Products and/or locations • ordering milestones • accompanying documentation containing the detailed description of product characteristics and behavior used in the definition of Product Offerings.	MEF 55.1.1
Private Address	An IP address that is in one of the blocks of IP addresses reserved by IANA for "private" or "network local" IP Addresses	Adapted from RFC 1918 [1]
Public Address	A Registered Address that is advertised to the internet (possibly as a member of an aggregated block) and provides Internet Access to a specific location or IP Host	This document
Registered Address	An IP address allocated to an organization by a local, regional, or national registration authority	This document
Seller	The organization acting as the supplier in a transaction over the Cantata or Sonata Interface Reference Points.	MEF 55.1.1

Service	The Customer experience of a Product that has been realized within a Service Provider's and /or a Partner's infrastructure.	MEF 55.1.1
Service Attribute	Specific information that is agreed to between the provider and user of a Service that describes some aspect of the Service behavior or capability	MEF 10.4 [6]
Transit Address	An IP address in the Seller's network that is routed to and from the Buyer's Public Addresses.	This document

Table 1 – Terminology

Abbreviations	Definition	Reference
DOCSIS	Data Over Cable System Interface Specification	
PON	Passive Optical Network	

Table 2 – 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 [4]) 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   Numerical Prefix Conventions

This document uses the prefix notation to indicate multiplier values as shown in Table 3.

Decimal		Binary	
Symbol	Value	Symbol	Value
k	10^3	Ki	2^{10}
M	10^6	Mi	2^{20}
G	10^9	Gi	2^{30}
T	10^{12}	Ti	2^{40}
P	10^{15}	Pi	2^{50}
E	10^{18}	Ei	2^{60}
Z	10^{21}	Zi	2^{70}
Y	10^{24}	Yi	2^{80}

Table 3 – Numerical Prefix Conventions

6   Introduction

The LSO framework as depicted in Figure 1 (see MEF 55.1 [7]) follows the TM Forum convention by differentiating between 'Products' and 'Services' where Products are acted upon in the business systems layer and Services are acted upon in the operations system layer and below. Products are transacted while Services are implemented. In the context of LSO APIs, Products are transacted via the LSO Interface Reference Points *LSO Cantata* and *LSO Sonata*, while services are orchestrated via the LSO Interface Reference Points *LSO Legato*, *LSO Allegro*, and *LSO Interlude*.
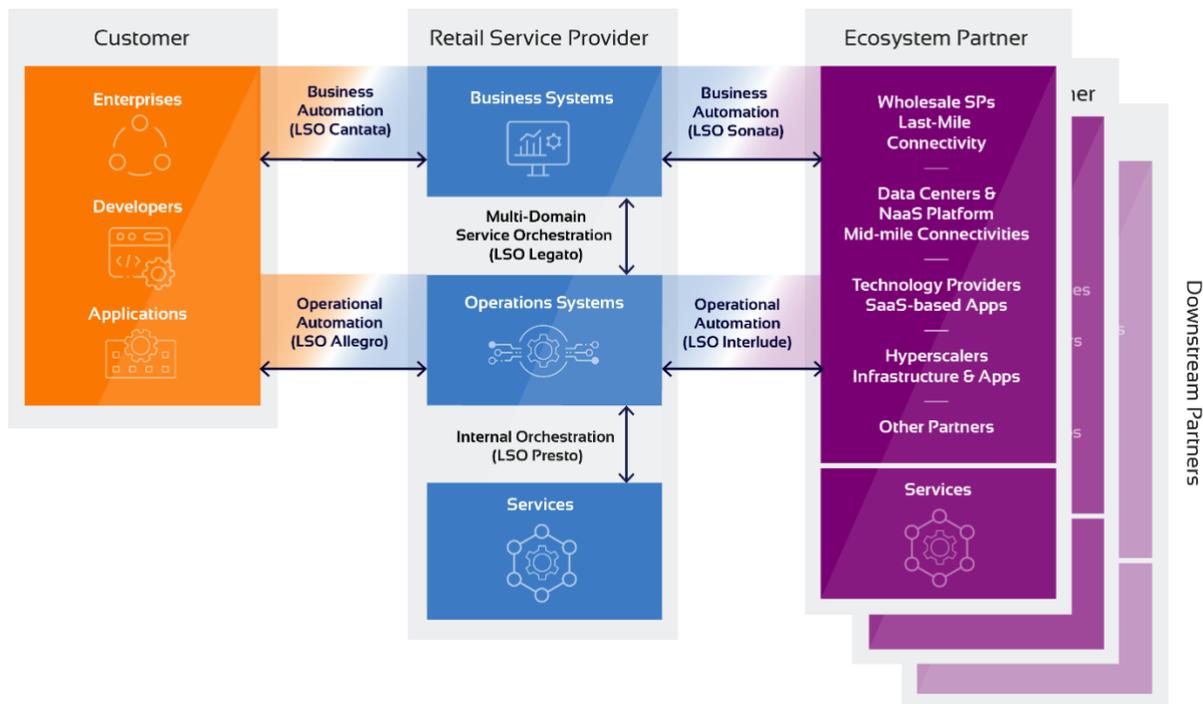
Figure 1 – LSO Framework

LSO Business APIs are designed with product-agnostic "envelopes" for functions such as Product Offering Qualification (POQ), Quote, Product Order and Product Inventory which are blended with product data schemas known as LSO Product Payloads. The same LSO Business APIs can therefore be used with a wide range of product data schemas regardless of the product being acted upon.

LSO Operational APIs are designed to be used with service data schemas known as LSO Service Payloads. An LSO Service Payload closely adheres to the Mplify standardized service attributes and service definitions for the service, in the case of Internet Access these are MEF 61.1 [10], MEF 61.1.1 [11] and MEF 69.1[12]. However, the information needed to <u>configure and operate</u> a Service is different from the information needed to <u>buy or sell</u> the Service.

The Service Attributes defined for each family of Mplify Services (e.g., Carrier Ethernet, IP, etc.) are fine grained — there are a lot of them — and although many have simple scalar values, many

of them have values represented by complex data structures. This level of detail is justified because it is needed to configure the networking devices (switches, routers, etc.) necessary to implement the Service. But this level of detail does not reflect what is needed to sell the Product to the Buyer. A commercial relationship between the Buyer and Seller usually comprises a relatively small number of simple parameters referred to herein as Product Attributes (in contrast to Service Attributes), and these Product Attributes (individually or in aggregate) are, in effect, expanded into the larger set of Service Attributes necessary for the configuration and operation of the Service. This expansion/mapping is driven by context, defaults, catalogs, on-boarding, etc.

To reduce business friction between Buyers and Sellers of products that use LSO APIs during the partner onboarding process, this document recommends the content of the LSO Product Payload based on widely used and understood business requirements for Internet Access Services. The mapping between the LSO Product Payload and an associated LSO Service Payload for Internet Access is out of scope for this document.

This Mplify Standard defines the Product Attributes for Internet Access Services.

This Mplify Standard also describes four generic Use Cases that characterize the breadth of Internet Access Products covered by the specified Product Attributes. Each of the Product Attribute descriptions includes a reference to one or more of the generic Use Cases for which it is applicable.

6.1 Product Attributes in the LSO Context

The Product Attributes descriptions include information to facilitate the development of data models for automation of the sales process using Mplify LSO APIs.

The interactions relevant to this document are at the LSO Cantata and LSO Sonata Interface Reference Points (IRPs) shown in Figure 1. These interfaces represent the interaction at the "Business Applications" level between a Buyer and a Seller — the sales process. In the case of LSO Cantata, it is between an external customer and a Service Provider and in the case of LSO Sonata it is between a Service Provider and another (partner) network provider that is providing Services required by the Service Provider to deliver a Product to the Customer. Operations at this level include Product Offering Qualification (POQ), Quote, Product Order, Product Inventory. Whereas all of the other IRPs in this model deal with operation and configuration and hence justify the use of Service Attributes in the API payloads, these IRPs represent the business interactions and hence the use of a more limited and higher-level set of Product Attributes is reasonable.

7 Product Model Concepts and Product Attributes

7.1 Product Model Concepts

Three terms describe a taxonomy for networking Products described in this document: Product Specification, Product Offering, and Product Offering Configuration.

A Product Specification describes a class of items that are sold, e.g., Internet Access. MEF 55.1.1 [8] defines a Product Specification as a specification for use with Mplify APIs that includes items such as schemas, product and place relationships, demarcation points, ordering milestones, and documentation.

MEF 55.1 defines a Product Offering as "an externally facing representation of a Service and/or Resource procurable by the Customer". Important characteristics of a Product Offering include:
- Derived from and complies to a Product Specification
- Can be a constrained subset of the Product Specification
- Something that is sold by a Seller
- Has a pricing model associated with it

MEF 55.1.1 defines a Product Offering Configuration as "an identifiable set of Product-specific Attributes and their values".

Figure 2 provides a simplified depiction of this analogy between a motor vehicle dealer and a network Service Provider.
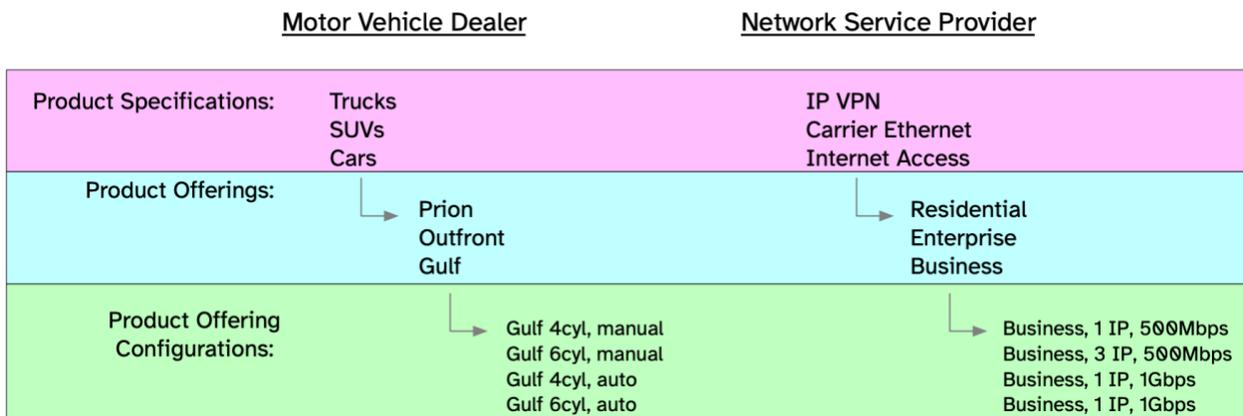

Figure 2 – Product Model Concepts

7.2 Product Attributes

The Product Specification defines a set of Product Attributes and their allowable values which, for Internet Access, are defined in section 11 of this document. Each Product Offering describes a set of constraints on the definition of the Product Attributes.

Each Product Offering Configuration is one of possibly many variations of Product Attribute values that meet the constraints described by the Product Offering.

A Product Attribute is specific information that is agreed to between the Seller and the Buyer of the Product Offering, that describes some aspect of the Product Offering behavior or capability. The agreement on the value of a Product Attribute can be achieved in several ways such as:
1. The Seller mandates a specific value
2. The Buyer selects from a set of options specified by the Seller
3. The Buyer requests a particular value, and the Seller accepts the value
4. The Seller and the Buyer negotiate to reach a mutually acceptable value

The choice of value for each Product Attribute can affect the price, performance, resiliency, and functionality of the delivered Product. How the agreement is reached can vary from Product Offering to Product Offering. With Internet Access, for example, a Residential Product Offering might only support one IP address (option 1) whereas a Business Product Offering might allow the Buyer to select one, two, or four IP addresses (option 2). A Business Internet Access Buyer could request 10 IP addresses, and the Seller could agree to that for a higher price (option 3).

This document specifies the Product Attributes for Internet Access Product Offerings in section 11. Section 9 defines some basic Use Cases for Internet Access that provide context for how the Product Attributes can be used. Each Product Attribute description refers to the Use Cases for which its use is appropriate.
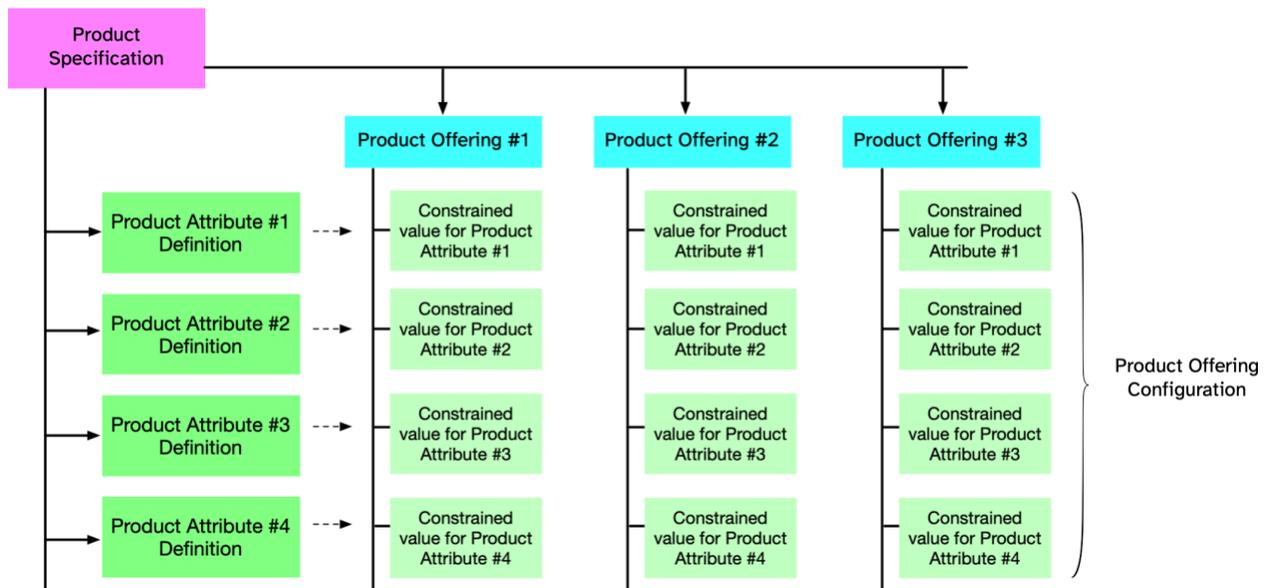
The model is shown in Figure 3.

Figure 3 – Deriving Product Offerings from the Product Specification

8 Business Functions and LSO Interaction

The interaction between the Buyer and Seller relating to the purchase of a Product has three components, Qualification, Pricing, and Product Order which are described in the following sections. Each of these interactions refers to Product Offering Configurations defined by the values for the Product Attributes specified in this document.

8.1 Qualification

There are two interactions between the Buyer and Seller related to qualification of the Buyer's needs. The first is Product Offering Qualification and the second is Product Offering Availability.

Product Offering Qualification or POQ is the function that allows the Buyer to specify a desired configuration of a Product Offering to the level of detail agreed with the Seller. The Seller responds, indicating that the Product Offering as specified can be delivered or not, and the lead time for its delivery. The Seller can optionally suggest alternative Product Offering Configurations that might be appropriate for the Buyer.

Product Offering Qualification is described in Mplify 79.1 [13] and consists of one or more articles that describe a Product of a particular type. The objective is to determine if it is feasible for the Seller to deliver this item as described and for the Seller to inform the Buyer of the estimated time interval to complete this delivery.

The Seller returns a feasible/not feasible determination, and if feasible the Seller returns a list of one or more product offerings that meet or "are close to" the Buyer's request.

A request is not feasible if the Seller does not have a Product Offering Configuration that is "close to" the Buyer's request. This determination is the responsibility of the Seller. Sometimes this is obvious, for example, if the Buyer requests 10Gbps and the Seller can only deliver 1Gbps to the specified address, then the request is clearly not feasible.

But sometimes it is a judgement call. For example, if the Seller can provide 300Mbps, 500 Mbps, and 1Gbps and the Buyer requests Business Internet Access for a specific location:

- 400Mbps, the POQ could respond with offerings that include 300Mbps and 500Mbps
- 1.2Gbps, the POQ could respond with one offering that includes 1Gbps
- 10Gbps, the POQ could respond with "not feasible"

The decision process for how to respond to a particular request is fully within the purview of the Seller's implementation.

When Product Offering Availability (described in Mplify 110 [15]) is requested, the Buyer specifies a Product Specification and Delivery Context (locations, relationships to other installed Products) and the Seller responds with every Product Offering Configuration that they can fulfil that meet those requirements, and the lead time for each.

For example, if the Buyer requests Product Offering Available for Business Internet Access at a specific location, the Seller could respond with:

- 300Mbps, 1 IP address, 2 weeks
- 500Mbps, 1 IP address, 2 weeks
- 300Mbps, 3 IP addresses, 4 weeks
- Etc.

8.2   Pricing

There are two interactions between the Buyer and Seller related to pricing of the Buyer's needs. The first is Quoting and the second is Pricing Discovery.

Quoting is described in MEF 80 [14] and allows the Buyer to request a price quotation for a given Product Offering Configuration for a given term and allows the Seller to respond with the quotation. If the Seller cannot provide a quotation for the requested term, the Seller can provider a quotation for an alternative term.

When Pricing Discovery (described in Mplify 110 [15]) is requested, the Buyer specifies a Product Offering Configuration, and the Seller responds with a list of available commercial terms and prices for the requested Product Offering Configuration.

8.3   Ordering

Once the Buyer and Seller agree on Product Offering Configuration and commercial terms such as Pricing and lead time, the Buyer can issue a Product Order which is described in MEF 57.2 [9].

9   Internet Access Use Cases

This section defines a set of generic Internet Access Product Offerings (Use Cases) that can be used by Sellers as the basis for their Product Offerings. Each of Product Attributes described in Section 11 indicates which of these Use Cases the Product Attribute is applicable to.

9.1   Mplify Broadband Internet Access, Basic

This Product is the simplest type of Internet Access Product and is commonly used for Residential Internet Access. Internet Access is provided via a Broadband Network which can be, for example, DOCSIS, PON, Satellite, Cellular. The Product includes the Internet Access Device necessary for the type of Broadband Network. Most basic Internet Access Products provide options for bandwidth, but some also provide additional options such as fixed IP addresses, cellular backup, various security options, etc.

9.2   Mplify Broadband Internet Access, Advanced

This Product is similar to the Basic Internet Access Product (see 9.1). It is delivered over a Broadband Network and includes the Internet Access Device, but it is often more business-focused and designed for small businesses with a single location or a small number of locations with relatively modest technical requirements. It usually provides some options not available in Basic Internet Access such as multiple Public IP Addresses, and better Service Level Agreements, better availability, etc.

9.3   Mplify Dedicated Internet Access, no Router

This Product is a Dedicated Internet Access Product usually delivered on a wavelength (or part of a wavelength) on a fiber optic interface although it could be delivered over other media such as microwave, satellite, etc. It is designed for larger organizations that have substantial technical requirements for their Internet Access including (for example) substantial flexibility in deployment of IP addresses, advertising routes, dual homing, redundancy, etc. For this product, the Buyer provides the router.

9.4   Mplify Dedicated Internet Access, with Router

This Product is the same as the "Mplify Dedicated Internet Access, no Router" (see section 9.3) but the Seller is providing the router. The router can be physical or virtual (see section 12.7). Therefore, the required and optional Product Attributes are the same as the previous Use Case with the addition of Product Attributes related to the router and features that can be enabled on the router.

10 Product Attribute Descriptions

Section 11 includes the Product Attributes Internet Access Products. Each Product Attribute includes a description of the Product Attribute and the following information about each:

Name: The descriptive name of the Product Attribute

Value: The allowed value(s) of the Product Attribute along with an indication of how the value(s) is specified, i.e., is it an integer or a string or a list of items, etc.

There are four specific complex types referred to in the descriptions:
- *Information Rate* – This type, typically referred to as bandwidth, describes a transmission speed. It has two components, an integer value and a string that specifies the unit of measurement. For example, 2 Mbps or 10 Gbps.
- *Data Size* – This type describes the size of a block of memory or data, It has two components, an integer value and a string that specifies the unit of measurement. For example, 3 KB or 17 TB.
- *Duration* – This type describes a length of time. It has two components, an integer value and a string that specifies the unit of measurement. For example, 10 SEC or 3 DAY.
- *Money* – This type describes an amount of money. It has two components, the currency code as specified in ISO 4217:2015 [5] and the amount specified as a real number. For example, 3 USD or 10 EUR.

The value of some Product Attributes has more than one component. For example, the Guaranteed Bandwidth Product Attribute has an upstream guaranteed bandwidth and a downstream guaranteed bandwidth. In this case both components are Information Rates, but it is not necessary for all of the components be of the same type.

Applicable Use Cases: This item is primarily to enhance understanding. It indicates with which of the Use Cases described in section 9 the Product Attribute is appropriate for use.

11 IP Address Allocation in Internet Access Products

The use of IP addresses is one of the more complicated aspects of the Product Specification. This is demonstrated by the fact that roughly 25% of the Product Attributes defined in section 12 relate to IP addresses as well as several of the features defined in the Internet Access List of Features Product Attribute. This section provides information on how IP Addresses are allocated and how the various Product Attributes relate to each other.

Broadly speaking there are two types of address used on the Internet:
- Registered Addresses are IP addresses that are allocated to an organization by a local, regional, or national registration authority. These addresses are usually globally routable (although they don't have to be advertised).
- Private Addresses are allocated from one of three IPv4 address blocks reserved by IANA for this purpose, 10.0.0.0/8, 172.16.0.0/12, and 192.168.0.0/16 (see RFC 1918 [1]). Also, one IPv6 address block, FC::/7, is reserved by IANA for this purpose (see RFC 4193 [3]). These addresses are restricted to a single network and are not advertised outside that network. They depend on Network Address Translation (NAT) to map them to and from Registered Addresses. As a result, any block of Private Addresses can be used by any number of networks. Private Addresses are used to conserve IP Addresses or provide some additional security, or both.

There are three pools of IP addresses that are referenced in the Internet Access Product Attributes.
- Public Addresses, see section 11.1
- Transit Addresses, see section 11.2
- Local Network Addresses, see section 11.3

11.1 Public Addresses

A location where the Internet Access Product is delivered must have at least one Public Address. Public Addresses are the globally routed (registered) IP addresses that are the IP source addresses in IP Packets sent from the Buyer's network to the Internet, and the IP destination addresses in IP Packets sent from the Internet to the Buyer.

Public Addresses are frequently allocated to the Buyer by the Seller, but the Buyer can also own a pool of Public Addresses (which it had obtained from a registry). For a particular Internet Access Product instance, the alternative is indicated by the Internet Access Provider Independent Addresses Product Attribute (see section 12.16). If the value of this Product Attribute is *Enabled*, then the Buyer is providing the addresses (i.e., they are Provider Independent) and the Buyer notifies the Seller which addresses are allocated using the Internet Access Public Addresses Product Attribute (see section 12.20). The Seller requires this information in order to correctly route to the Buyer's network. If the Seller is providing the Public Addresses, the Buyer indicates the desired number of addresses using the Internet Access Public Addresses Prefix Length Product Attribute (see section 12.19).

There are two additional Product Attributes related to the Public Addresses. If the Buyer is providing the Public Addresses, the Buyer must provide information about its Autonomous System

Number using the Internet Access Autonomous System Number Product Attribute (see section 12.17). If the Seller is providing the Public Addresses, the Buyer can request either static addresses (the Public Addresses do not change over the life of the contract) or dynamic addresses (the Seller can periodically allocate different Public addresses to the Buyer). This is specified using the Internet Access IP Address Type Product Attribute (see section 12.18).

11.2   Transit Addresses

Transit Addresses are addresses in the Seller's network that are routed to and from the Buyer's Public Addresses. These could be Registered Addresses or Private Addresses. In either case, they are accessible only between the Buyer and the Seller.

Transit Addresses are IP addresses used for communication between the Seller's provider network edge router and the customer network edge router.

The Seller allocates at least one Transit Address to the Buyer. It can allocate more than one Transit Address, if requested by the Buyer, using the Internet Access Transit Addresses Product Attribute (see section 12.21). Each customer network edge router requires a Transit Address in the Seller's network, and if there are multiple customer network edge routers for resiliency, multiple Transit Addresses are needed. Figure 4 shows 3 examples of Transit Addresses.
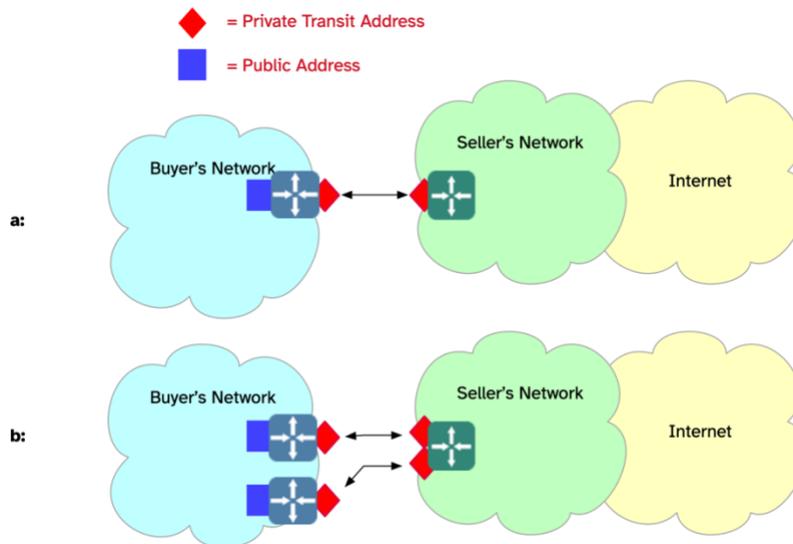
Figure 4 – Transit Address Examples

The top picture in Figure 4 (a) shows a with a single Transit Address configured on the provider edge network router. There is at least one Transit address on each side (Buyer and Seller) but depending on the resiliency requirements either side (or both) could have multiple Transit addresses. The lower picture (b) depicts a situation where the Buyer has requested two Transit addresses. Each one is paired with a device on the Buyer's edge. This provides additional resilience for the Buyer. In both examples there is a Public Address on the Buyer's side of the customer network edge router. This can be paired with a Public Address on the Buyer's router, or it can be paired with Public Addresses in the Buyer's network as shown in Figure 5, below.

11.3   Local Network Addresses

The addresses used in the Buyer's network, the Local Network Addresses, are usually Private Addresses, but they can also be Public Addresses.

The Local Network Addresses are Public Addresses if the Buyer's network is hosting network accessible servers. The Buyer's network could have three Public Addresses, and each Public Address could be assigned to one of three servers. Public Addresses are also used as the Local Network Addresses if the Buyer is using IPv6. Since IP address exhaustion isn't an issue for IPv6, one of the major motivations for using Private Addresses is removed. Buyers may, nonetheless, use IPv6 Private Addresses for an additional level of security.

If the Buyer is using Public Addresses in its Local Network the configuration would look something like Figure 5.
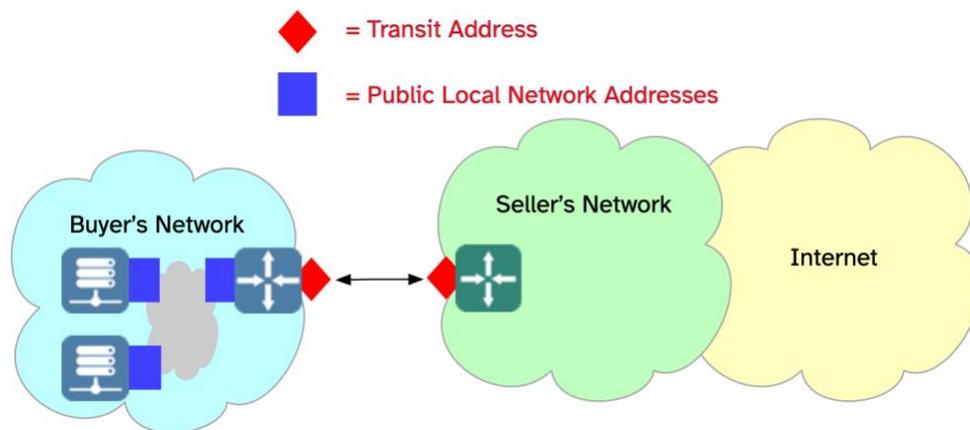
Figure 5 – Example of Public Addresses in the Buyer's Local Network

If the Buyer is using Public Addresses in its Local Network, then no additional information needs to be exchanged between the Buyer and Seller beyond the information related to the Public and Transit addresses.

However, as noted above, it is common for the Buyer to use Private Addresses in its Local Network. The Private Addresses are usually distributed to IP hosts in the Buyer's network using DHCP (although they can be assigned manually). DHCP normally assigns IP addresses dynamically from a specified subnet of the private Local Network Addresses, but it is also common to configure DHCP to statically assign IP addresses to specific hosts (specified by Ethernet MAC Address).

These private Local Network Addresses are translated to and from the Buyer's Public Address(es) using Network Address Translation (NAT). An example of this configuration is shown in Figure 6.
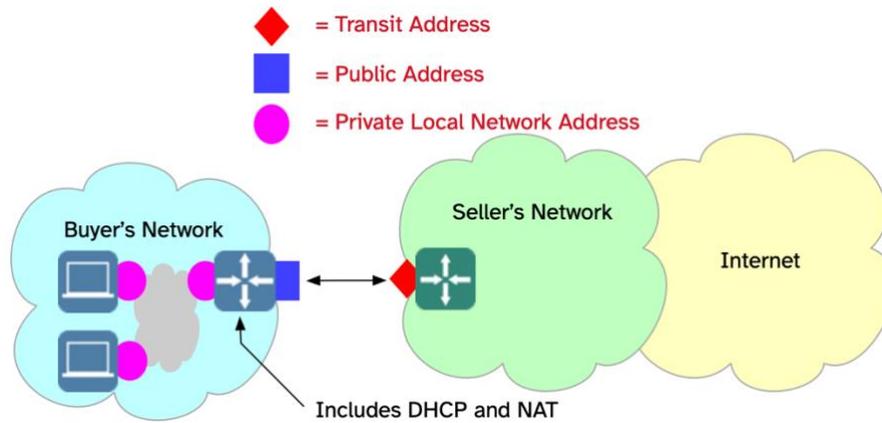
Figure 6 – Example of Private Addresses in Buyer's Local Network

Management of (Private) Local Network Addresses and of DHCP and NAT can be entirely within the Buyer's responsibility, in which case no information needs to be exchanged between the Buyer and the Seller.

However, if the Seller's equipment is providing these functions, the following information needs to be agreed to:

- Which of the Private Address blocks are the addresses to be allocated from?
- How large a block is allocated?
- Which addresses in the allocated block are dynamically assigned by DHCP?
- Which addresses in the allocated block are statically assigned by DHCP (and to which hosts?)
- Which Public Address (if more than one) are the Local Network Addresses translated to?

This information is provided in the Internet Access Local Network Addresses Product Attribute (see section 12.14). Figure 7 provides an example of how these details are used.
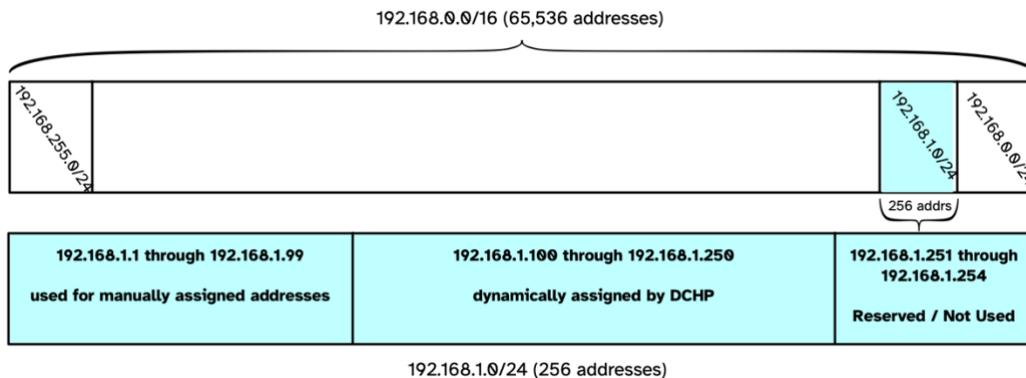
Figure 7 – Local Network Address Example

At the top of Figure 7 is the full block of the 192.168.0.0/16 Private Addresses. The diagram shows that this could be broken into smaller blocks. In the diagram it shows blocks of 256 addresses each. In this example, the Buyer wants to use 256 Local Network Addresses from the 192.168.1.0/24

block. The entire block of 256 Local Network Addresses (actually 254 since the first and last are used for loopback and broadcast) could be assigned to DHCP for dynamic assignment of IP addresses to IP hosts. However, the Buyer might want to sub-divide the block. In the example, the block is decomposed into three sections, one for manually assigned addresses, one for dynamically assigned addresses, and one that is not used. Statically assigned DHCP addresses could be anywhere in the block.

12 Internet Access Product Attributes

The Product Attributes for the Internet Access Product are listed in Table 4 along with a summary of their values. Details for each Product Attribute are included in the subsequent sub-sections.

Inclusion of a Product Attribute in a request is optional unless an explicit requirement indicates otherwise.

> **[R1]**   All Product Attributes specified in a Product Order **MUST** be included in the Product Inventory.

Requirement [R1] indicates that all Product Attributes that are specified in a Product Order are included in the Product Inventory, but other Product Attributes (e.g., Demarcation Point) are included in the Product Inventory even if they are not specified explicitly in a Product Order.

Product Attributes and Use Cases

Section	Product Attribute	Value Summary
12.1	Internet Access Installation Location	An installation location as specified in Mplify 150
12.2	Internet Access Demarcation Point	Location type and Location specifier
12.3	Internet Buyer Contact Information	Contact information as specified in MEF 57.2 [9]
12.4	Internet Access Requested Lead Time	Lead time
12.5	Internet Access Requested Installation Date	Installation date
12.6	Internet Access Contract Term	Contract Term, End of Term Action, Roll Interval
12.7	Internet Access Delivery Mechanism	One of the enumerated Delivery Mechanisms
12.8	Internet Access Service Access Interface	List of Physical Interfaces, List of Connector Types, Resiliency Mechanism
12.9	Internet Access VLAN	Integer from 0 - 4094
12.10	Internet Access List of Features	List of Features and associated parameters
12.11	Internet Access Bandwidth	Downstream Bandwidth, Upstream Bandwidth
12.12	Internet Access Guaranteed Bandwidth	Downstream Guaranteed Bandwidth, Upstream Guaranteed Bandwidth
12.13	Internet Access Billing	Billing Model, Billing Plan Name
12.14	Internet Access Pricing	Pricing information for the requesting Billing Model
12.15	Internet Access Local Network Addresses	IPv4 and IPv6 private address blocks, DHCP, and NAT information
12.16	Internet Access Provider Independent IP Addresses	*Enabled* or *Disabled*
12.17	Internet Access Autonomous System Number	Autonomous System Type, Autonomous System Number
12.18	Internet Access IP Address Type	*Static* or *Dynamic*
12.19	Internet Access Public Addresses Prefix Length	IPv4 WAN Address Prefix Length, IPv6 WAN Address Prefix Length
12.20	Internet Access Public Address Block	IPv4 WAN Address Block IPv6 WAN Address Block
12.21	Internet Access Transit Addresses	IPv4 Transit Address Prefix Length IPv4 Transit Address Block IPv6 Transit Address Prefix Length IPv6 Transit Address Block

Table 4 – Internet Access Product Attributes

12.1   Internet Access Installation Location Product Attribute

The value of this Product Attribute is the location where the Internet Access is delivered. It is the input to the Address Validation process. If the Address Validation Process succeeds, the returned Address Identifier is used in subsequent exchanges related to the Product Order.

- Name: Internet Access Installation Location
- Value: One of:
  - *Installation Location* as described in Mplify150
  - Reference to an instance of *Service Access Interface* as described in Mplify 165
- Use cases: All

[R2]   The Internet Access Installation Location Product Attribute **MUST** be specified for POQ, Quote, and Product Order.

[R3]   For Broadband Internet Access Basic and Advanced, the value of the Internet Access Installation Location Product Attribute **MUST NOT** be a reference to a Service Access Interface.

[R4]   For Dedicated Internet Access with and without Router, the value of the Internet Access Installation Product Attribute **MUST** be a reference to a Service Access Interface.

12.2   Internet Access Demarcation Point Product Attribute

The value of this Product Attribute specifies the location of the demarcation point between the responsibility of the Buyer and the responsibility of the Seller upon delivery of the Internet Access Product.

- Name: Internet Access Demarcation Point
- Value: *Demarcation Location* specified as non-empty list of name/value pairs:
  - *location-type*, specified as a string
  - *location-specifier*, specified as a string
- Applicable Use Cases: Broadband Internet Access, Basic and Advanced

There is not a fixed list of *location-type* values. Examples are "rack", "panel", "slot", "device", "port", etc. The value of the *location-specifier* is a string that appropriately identifies the specified *location-type*.

[R5]   For Broadband Internet Access Products, the Internet Access Demarcation Point Product Attribute **MUST** be included in the Product Inventory.

[R6]   The Internet Access Demarcation Point Product Attribute **MUST NOT** be provided for Dedicated Internet Access Products.

[O1]   For Broadband Internet Access Products, the Internet Access Demarcation Point Product Attribute **MAY** be specified by the Buyer in the Product Order.

If the Buyer does not include Product Attribute in the Product Order, the value will be set by the Seller.

12.3   Internet Access Buyer Contact Information Product Attribute

The value of this Product Attribute specifies a list of contacts where each element in the list indicates the contact role and the contact information for an individual or group responsible for a specified function, action, or role. A list of contact roles is found in table 38 in MEF 57.2.

- Name: Internet Access Buyer Contact Information
- Value: *Contact List* specified as a list of contact names and contact attributes as described in MEF 57.2 [9]. The list of contact roles specified in MEF 57.2 is extended to include a Buyer Administrative Contact.

Applicable Use Cases: All

A Buyer Administrative Contact is typically the representative of a single administrative entity (such as a university, a business enterprise or a business division) responsible for managing the service contract and handling administrative tasks related to the service such as service changes, billing, and payments, and, when necessary, management and registration of the Buyer's IP Addresses.

12.4   Internet Access Requested Lead Time Product Attribute

The value of this Product Attribute is used by the Buyer to indicate the desired lead time for installation of the Internet Access Product.

- Name: Internet Access Requested Lead Time
- Value: *Lead Time* specified as a *Duration* (see section 10)
- Applicable Use Cases: All

The offered *Lead Time* is provided by the Seller in the POQ response. The Buyer requests a desired Lead Time in the Quote request, and the Seller responds with the nearest Lead Time that the Seller can meet, which may be shorter or longer than the requested Lead Time.

[R7]   The Internet Access Requested Lead Time Product Attribute **MUST** be provided by the Buyer only for Quote.

12.5   Internet Access Requested Installation Date Product Attribute

The value of this Product Attribute specifies the installation date requested by the Buyer.

- Name: Internet Access Requested Installation Date
- Value: *Installation Date* specified as a date
- Applicable Use Cases: All

[R8]   The Internet Access Requested Installation Date Product Attribute **MUST** be provided by the Buyer only for Product Order.

Mplify 164
Page 24

[R9]   The value of the Internet Access Requested Installation Date Product Attribute **MUST NOT** be sooner than the order date plus the lead time specified by the Seller in the Quote response.

12.6   Internet Access Contract Term Product Attribute

The value of this Product Attribute specifies the terms of the contract for the Internet Access Product.

The Buyer requests a desired Contract Term in the Quote, and the Seller responds with the closest Contract Term that the Seller can meet, which may be different than the requested Contract Term.

The value has three components. The first component is the duration of the contract, and the second component is the end-of-term action, that is to say, the action the Seller will take once the term expires. The third component specifies the duration of the contract if it rolls over at the end of its term.

- Name: Internet Access Contract Term
- Value:
  - *Term* specified as a *Duration* (see section 10)
  - *End Of Term Action*, specified as one of the following options:
    - *Roll*
    - *Auto Disconnect*
    - *Auto Renew*
  - *Roll Interval* specified as a *Duration*
- Applicable Use Cases: All

The End of Term Action values are defined as follows (see Mplify 57.2 [9]):
- *Roll* if the Product's contract will continue on a rolling basis once the contract's current term expires
- *Auto Disconnect* if the Internet Access will automatically be disconnected (and the contract terminated) by the Seller once the contract term expires
- *Auto Renew* if the Product's contract will be renewed for another term equivalent to the original contract term

[R10]   The Internet Access Contract Term Product Attribute **MUST** be provided for Quote and Product Order.

[R11]   A value for the *Roll Interval* parameter **MUST** be provided if and only if the value of the *End Of Term Action* parameter is *Roll*.

[R12]   The value for the Internet Access Contract Term Product Attribute specified by the Buyer in the Product Order **MUST** be the same as the value provided by the Seller for the Product Attribute in the Quote response.

12.7   Internet Access Delivery Mechanism Product Attribute

The value of this Product Attribute generically describes the type of equipment provided by the Seller as part of the Internet Access Product.

- Name: Internet Access Delivery Mechanism
- Value: *Delivery Mechanism*, specified as one of the following options:
    - *Demarcation Only*
    - *Physical Router*
    - *Remote Virtual Router*
    - *Local Virtual Router*
- Applicable Use Cases: All

The Delivery Mechanism values are defined as follows:

- *Demarcation Only* – The product is delivered to the customer without IP routing. It is the buyer's responsibility to provide the mandatory routing function.
- *Physical Router* – The product delivered to the buyer includes a physical IP Router installed at the customer premises.
- *Remote Virtual Router* – The product delivered to the buyer includes an IP routing function which is executed in a virtual environment not at the customer premises. The network connectivity from the buyer's location to the virtual router provides transport only.
- *Local Virtual Router* – The product delivered to the buyer includes an IP routing function running in a virtual environment at the buyer's premises. The virtual environment (frequently referred to as a universal CPE, white-box CPE, or edge device) is provided by the Seller and can be pre-existing or can be delivered with the Internet Access Product.

> **[R13]**   The Internet Access Delivery Mechanism Product Attribute **MUST** be provided for POQ, Quote, and Product Order.

12.8   Internet Access Service Access Interface Product Attribute

For Broadband Internet Access (Basic and Advanced), the Service Access Interface is included as part of the Internet Access Product. (Note that this does not result in a separate Service Access Interface product.) This Product Attribute is used to describe the important characteristics of the Service Access Interface. The value of this Product Attribute has three components: a list of physical interface types, a list of connector types, and the type of resiliency used if more than one interface is specified.

- Name: Internet Access Service Access Interface
- Value: *Physical Interfaces* specified as non-empty list of 2-tuples:
    - *Physical Layer* specified as one of the physical layers listed in Table 6 of Mplify 165 [17]
    - *Connector Type* specified as one of the connector types listed in Table 7 of Mplify 165
    - *Resiliency*, specified as one of the following options:

- ▪ *None*
  - ▪ *All Active*
  - ▪ *2 Link Active Standby*
  - ▪ *Other*
- Applicable Use Cases: Broadband Internet Access, Basic and Advanced

[R14] For Broadband Internet Access Basic and Advanced, the value of the Internet Access Service Access Interface Product Attribute including *Resiliency* and at least one *Physical Interface* **MUST** be provided in the Product Order.

[O2] For Broadband Internet Access Basic and Advanced, the value of the Internet Access Service Access Interface Product Attribute **MAY** be provided in the POQ or Quote.

[R15] For Dedicated Internet Access with and without Router, the Service Access Interface Product Attribute **MUST NOT** be provided in any function.

The *Resiliency* values are defined as follows:

All Active indicates that Link Aggregation is used, and all the specified physical interfaces can be active and carrying traffic simultaneously.

2 Link Active Standby indicates that Link Aggregation is used and that there are two physical interfaces and only one of them can be carrying traffic.

Other indicates that the buyer and seller have agreed on a resiliency approach other than Link Aggregation.

[R16] The value *None* for *Resiliency* in the value of the Internet Access Service Access Interface **MUST** be selected if and only if the list of physical interfaces contains exactly one entry.

[R17] If the value *2 Link Active Standby* is selected for *Resiliency* in the value of the Internet Access Service Interface Product Attribute, then the list of *Physical Interfaces* **MUST** contain exactly 2 entries.

[R18] If the list of *Physical Interfaces* in the value of the Internet Access Service Interface Product Attribute contains more than two entries, then the value for *Resiliency* **MUST** be either *All Active* or *Other*.

12.9 Internet Access VLAN Product Attribute

The value of this Product Attribute is the C-tag VLAN ID that is used for the Internet Access at the Service Access Interface. It is an integer with a value between 1 and 4094. The value 0 indicates that untagged Ethernet frames are used for Internet Access.
- Name: Internet Access VLAN
- Value: *Vlan* specified as an integer in the range 0 – 4094

- Applicable Use Cases: Dedicated Internet Access, with and without router

[D1]   The Internet Access VLAN Product Attribute **SHOULD** be omitted for POQ and Quote.

[R19]   The Internet Access VLAN Product Attribute **MUST** be provided for Product Order.

Requirement [R19] indicates that the Buyer is required to tell the Seller whether it is using untagged frames (value 0) or VLAN-tagged frames (value greater than 0) in the Product Order.

12.10   Internet Access List of Features Product Attribute

The value of this Product Attribute indicates the major functional and protocol features provided for the Internet Access Service, e.g., DNS, Resiliency, etc. The value is a list of features (which may be empty) where each entry in the list represents a specific feature and has four components.
- Name: Internet Access List Of Features
- Value: Features, specified as a list of 0 or more feature descriptions described below
- Applicable Use Cases:
  - Broadband Internet Access, Advanced
  - Dedicated Internet Access, with and without router

Basic Broadband Internet Access does not include support for the advanced features itemized in this Product Attribute, and therefore this Product Attribute is not provided (or the value is an empty list) for this use case.

Each Feature has four components:
- *Feature Name*, specified as a string, e.g. "NAT"
- *Feature Supported*, specified as either *True* or *False*, and indicates whether support of the feature by the Seller is required
- *Feature Enabled*, specified as either *True* or *False*, and indicates whether Buyer requests that the Feature is enabled
- *Feature Parameters*, specified by a list of 0 or more values specifying options associated with the specific Feature.

[R20]   A specific value for *Feature Name* in the Internet Access List of Features Product Attribute **MUST** appear in no more than one entry in the list.

[R21]   For each entry in the value of the Internet Access List of Features Product Attribute, if the value of *Feature Enabled* is *True*, then the value of *Feature Supported* in that entry **MUST** be *True*.

A Buyer can request that a particular feature be supported but not enabled (at the time of the request). If the Buyer requests that a particular feature be enabled, support for the feature is clearly required.

The following table indicates the currently defined features.

[R22]   If a feature in Table 5 is specified in a request, the Subscriber **MUST** specify the parameters for that feature as described in the table.

Product Attributes and Use Cases

Feature	Definition and Parameters

ASSISTANCE	**Definition:** The level of Installation, Operation, and Configuration Changes done by Seller
	
	Feature Parameters for POQ: *Assistance Type* specified as a string with one of the following values:
	• *Self-Managed*
	• *Co-Managed*
	• *Fully-Managed*
	Feature Parameters for Quote:
	1. *Assistance Type* as specified for POQ
	2. For *Co-Managed* and *Fully-Managed*
	   • the number of simple requests allowed per month
	   • the number of complex requests allowed per month
	Feature Parameters for Product Order: Same as Quote

CLOUD PRIORITIZATION	**Definition:** The Seller enables prioritization, traffic congestion control, and SLAs for cloud traffic. **Feature Parameters for POQ:** *Cloud Service Providers* specified as a list of strings **Feature Parameters for Quote:** Same as POQ **Feature Parameters for Product Order:** Same as POQ
DDOS-MITIGATION	**Definition:** The Seller provides enhanced protection of the customer network from Distributed Denial of Service (DDoS) attacks. **Feature Parameters for POQ:** No additional parameters **Feature Parameters for Quote:** No additional parameters **Feature Parameters for Product Order:** No additional parameters
DEDICATED FIREWALL	**Definition:** The Seller provides a firewall service. **Feature Parameters for POQ:** *Firewall Capability* specified as a string with one of the following values: • *Basic* • *Advanced* **Feature Parameters for Quote:** Same as POQ **Feature Parameters for Product Order:** Same as POQ The value *Basic* denotes a simple Firewall based on IP 5-tuples and/or Access Control Lists. The value *Advanced* denotes more sophisticated Firewall capabilities such as Deep Packet Inspection. The parameters for each of the two options are specified during product installation.
DNS	**Definition:** The seller is providing a Domain Name Service to translate Domain Names to IP addresses. **Feature Parameters for POQ:** No additional parameters **Feature Parameters for Quote:** No additional parameters **Feature Parameters for Product Order:** *Search Domain List* – a possibly empty ordered list of domain names, specified as strings, that are sequentially appended to the specified domain name if the specified domain name does not include a dot (.), until the first successful DNS lookup.

Product Attributes and Use Cases

FACILITY DIVERSITY	**Definition:** The Seller ensures that this Internet Access Product has no common points of failure with another Internet Access Service. **Feature Parameters for POQ:** No additional parameters **Feature Parameters for Quote:** No additional parameters **Feature Parameters for Product Order:** Identifier for the other Internet Access Product
LAYER 3 RESILIENCY	**Definition:** The Seller providers Layer 3 resiliency for the access connection to the Buyer. **Feature Parameters for POQ:** *Resiliency Type* specified as a string with one of the following values: • *Dual Access All Active* • *Dual Access Active Standby* • *Wireless Backup* **Feature Parameters for Quote:** Same as POQ **Feature Parameters for Product Order:** Same as POQ **[R23]** If *Feature Available* for the LAYER 3 RESILIENCY with *Wireless Backup* feature is *True*, then *Feature Supported* for MOBILE BACKUP **MUST** be *True*. **[R24]** If *Feature Enabled* for LAYER 3 RESILIENCY feature with *Wireless Backup* is *True*, then *Feature Enabled* for MOBILE BACKUP **MUST** also be *True*.
MOBILE BACKUP	**Definition:** The Seller provides a method for backing up the Internet Access Service via a 4G or 5G cellular service. **Feature Parameters for POQ:** • *Minimum Expected Downstream Bandwidth* specified as an *Information Rate* • *Minimum Expected Upstream Bandwidth* specified as an *Information Rate* **Feature Parameters for Quote:** Same as POQ **Feature Parameters for Product Order:** Same as POQ
MONITORING	**Definition:** The Seller is monitoring the Internet Access Service for the Buyer. **Feature Parameters for POQ:** *Monitoring Type* specified as a string with one of the following values: • *Proactive* • *Reactive* **Feature Parameters for Quote:** Same as POQ **Feature Parameters for Product Order:** Same as POQ
PERFORMANCE-REPORTING	**Definition:** Performance Metrics are delivered to the Buyer for the Internet Access Product. **Feature Parameters for POQ:** No additional parameters **Feature Parameters for Quote:** No additional parameters **Feature Parameters for Product Order:** No additional parameters

ROUTING	**Definition:** The method by which IP routes are exchanged between the Buyer and the Seller.
	Feature Parameters for POQ: *Routing Type* specified as a string with one of the following values:
	• *BGP*
	• *Static*
	Feature Parameters for Quote: Same as POQ
	Feature Parameters for Product Order:
	1. *Routing Type* as specified for POQ
	2. If *Static*, a list of static routes, otherwise null, where each entry in the list is a 3-tuple: <IPv4 or IPv6 Address Block specified in CIDR notation>, <next hop address specified as an IPv4 or IPv6 address>,<optional administrative distance>.
	3. If *BGP*, the following BGP parameters listed below, otherwise null
	The BGP Parameters are derived from MEF 61.1 [10], section 10.7.3. A few parameters from that section are not included here since they are not appropriate for the Product Model. Details and requirements associated with these parameters are found in that section.
	<u>BGP Parameters</u>:
	Subscriber's AS Number (*)
	Connection Address Family (*IPv4* or *IPv6*) (*)
	Peering Addresses (*Connection Addresses* or *Loopbacks* plus a list of pairs of IP addresses) (*)
	Authentication (*None* or *MD5* plus a password) (*)
	BGP Community List (see MEF 61.1)
	BGP Extended List (see MEF 61.1)
	Hold Time (in seconds)
	AS Override (*Enabled* or *Disabled*)
	The four parameters identified with (*) are required to be specified by the Buyer in the request. The remaining four parameters are optional. If the Buyer does not specify Hold Time or AS Override, the Seller will specify a default value.
SNMP READ	**Definition:** The Seller providers SNMP v2/v3 read access to the router including MIB-2.
	Feature Parameters for POQ: No additional parameters
	Feature Parameters for Quote: No additional parameters
	Feature Parameters for Product Order: No additional parameters

Table 5 – Internet Access Feature List

Note that specific features requested in this Product Attribute may be dependent on the device that is terminating the Internet Access Service.

If a feature is not specified in the value of the Internet Access List of Features Product Attribute, it is equivalent to specifying the feature with *Feature Supported = False* and *Feature Enabled = False*.

12.11   Internet Access Bandwidth Product Attribute

For Broadband Internet Access, the value of this Product Attribute represents the "nominal[1]" bandwidth. For Dedicated Internet Access, the value of this Product Attribute represents the maximum bandwidth that can be sustained by the Buyer.

- Name: Internet Access Bandwidth
- Value:
    - *Downstream Bandwidth* specified as an *Information Rate* (see section 10)
    - *Upstream Bandwidth* specified as an *Information Rate*
- Applicable Use Cases: All

    [R25]   The Internet Access Bandwidth Product Attribute including values for both *Downstream Bandwidth* and *Upstream Bandwidth* **MUST** be provided in POQ, Quote, and Product Order.

12.12   Internet Access Guaranteed Bandwidth Product Attribute

The value of this Product Attribute is the bandwidth level that can be sustained by the Buyer on a continual basis with a very high probability of successful packet delivery. This Product Attribute is required for Dedicated Internet Access and less often used for Broadband Internet Access.

- Name: Internet Access Guaranteed Bandwidth
- Value:
    - *Guaranteed Downstream Bandwidth* specified as an *Information Rate* (see section 10)
    - *Guaranteed Upstream Bandwidth* specified as an *Information Rate*
- Applicable Use Cases: All

    [R26]   The value of the Internet Access Guaranteed Bandwidth Product Attribute for each direction **MUST** be less than or equal to the value of the Internet Access Bandwidth Product Attribute for the corresponding direction.

    [R27]   The Internet Access Guaranteed Bandwidth Product Attribute **MUST** be provided for POQ, Quote, and Product Order for Dedicated Internet Access Products.

12.13   Internet Access Billing Model Product Attribute

The value of this Product Attribute allows the Buyer to indicate how it would like the Product billed. Although the charge for the Product Attribute depends on the values of many Product Attributes, it is based primarily on the bandwidth-related Product Attributes described in sections 12.11 and 12.12. Three Billing models are defined.

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[1] The term "nominal" is used to represent the name or description of the Internet Access Product. It is not necessarily a committed/guaranteed bandwidth or a maximum bandwidth although it is indicative of the expected or average bandwidth. For example, "a 400Mbps Internet Access Service". 400Mbps is the nominal bandwidth and indicates that the Subscriber will be able to achieve approximately 400Mbps of bandwidth with some level of regularlity.

- Name: Internet Access Billing
- Value:
  - *Billing Model*, specified as one of the following options (which are explained below):
    - *Flat*
    - *Burstable Percentile*
    - *Data Transfer*
  - *Billing Model Plan Name*, specified as a string
- Applicable Use Cases: All

> **[R28]**   The Buyer **MUST** specify values for *Billing Model* and *Bill Model Plan Name* parameters of the Internet Access Billing Product Attribute in Quote and Product Order requests.

For each of the Billing Models, the Seller can have one or more "plans" that it has published (e.g., in a catalog) each having specified parameters and prices.

The *Billing Model* values are defined as follows:

Flat billing is a recurring amount for a fixed time period for a nominal amount of bandwidth. For example, one *Flat* plan could be $30/month for 400 Mbps and another could be $75/month for 1Gbps.

Burstable Percentile billing is a recurring amount for a committed amount of bandwidth, The Burstable Bandwidth. For example, €20.00 per month for 400 Mbps of committed bandwidth and an additional amount per month for burstable bandwidth above that amount. The Burstable Percentile specifies how this value is determined. The Seller might only support a single plan, for example, 95th percentile computed over a month, or it could have a few different percentiles and/or sampling periods.

Data Transfer billing is based on amount of data rather than rate. For example, during each *Data Transfer Period*, this cost is $10 per 10GB up to 100GB, and $20.00 per 10GB for the next 500GB, and $40 per 1GB for all additional data transfer. The value of the *Data Transfer Tiers* parameter specifies a list of values that describe each of these tiers. In the example above there would be three entries, ⟨10GB, 100GB⟩, the second would be ⟨10GB, 500GB⟩, and the third would be| ⟨1GB, 0GB⟩.

12.14   Internet Access Pricing Product Attribute

The Seller includes this Product Attribute in Quote and Product Order response consistent with the values specified in the Internet Access Billing Product Attribute (see section 12.13).

- Name: Internet Access Pricing
- Value:
  - *Non-variable One-Time Charges*, specified as a possibly empty list of value pairs:
    - *Charge Description,* specified as a string
    - *Charge Amount*, specified as *Money*
  - *Non-variable Recurring Charges*, specified as a possibly empty list of value triples:
    - *Charge Description,* specified as a string
    - *Charge Amount*, specified as *Money*
    - *Charge Recurrence*, specified as *Duration*
  - *Burstable Price* specified as a value pair:
    - *Burstable Percentile*, specified as an integer in the range 1-99
    - *Burstable Billing Floor*, specified as an *Information Rate*
    - *Burstable Charge Amount*, specified as *Money*
    - *Burst Rate Unit*, specified as *Information Rate*
  - *Data Transfer Period* specified as a *Duration*
  - *Data Transfer Tiers* specified as an ordered list of 3-tuples:
    - *Data Transfer Unit* specified as a *Data Size*
    - *Data Transfer Tier Cap* specified as a *Data Size*. This value can be 0 in the last entry in the list to indicate all additional data transferred.
    - *Data Transfer Unit Price* specified as *Money*. This is the price for each *Data Transfer Unit* consumed in the tier.
- Applicable Use Cases: All

> **[R29]**   If any Internet Access Pricing Product Attribute parameter is included in the response by the Seller, all elements of the parameter **MUST** have values specified.

Requirement [R29] ensures that values are specified for all elements of the parameters included in the response by the Seller. For example, if the Seller includes the *Non-variable One-Time Charges* element, values for *Charge Description* and *Charge Amount* are required in each list entry.

> **[R30]**   If the value of *Billing Model* requested by the Buyer in the Internet Access Billing Product Attribute is *Flat*, the Seller **MUST** include a non-empty list for the value of at least one of the *Non-variable One-Time Charges* or *Non-variable Recurring Charges* parameters of the Internet Access Pricing Product Element.

If the Buyer requests *Flat* billing, the non-variable charges are the only prices returned. Requirement [R30] ensures that Seller is required to return at least one type of non-variable charge for the Product. If the Buyer requests one of the other billing models, the Seller can include non-variable charges but is not required to.

[R31]   The Seller **MUST** include a value for the *Burstable Price* parameter of the Internet Access Pricing Product Attribute if and only if the Buyer specified a value of *Burstable Percentile* for the *Billing Model* parameter of the Internet Access Billing Product Attribute.

[R32]   The Seller **MUST** include a value for the *Data Transfer Period and Data Transfer Tiers* parameters of the Internet Access Pricing Product Attribute if and only if the Buyer specified a value of *Data Transfer* for the *Billing Model* parameter of the Internet Access Billing Product Attribute.

12.15   Internet Access Local Network Addresses Product Attribute

The Internet Access Local Network Addresses Product Attribute is used when the Seller is responsible for assigning Private Local Network Addresses for the Buyer's Network (see section 11.3). The value of the Product Attribute specifies the private address block to be assigned to the Buyer's IP hosts, whether DHCP and NAT are used, and if so, parameters necessary to configure the DHCP and NAT servers.

- Name: Internet Access Local Network Addresses
- Value:
  - *LAN Address Block*, specified in CIDR notation (e.g. 192.168.1.0/24)
  - *DHCP Status*, specified as one of the following options:
    - *Enabled*, meaning that the Buyer wants the Seller to provide a DHCP Service
    - *Disabled*, meaning that the Buyer does not need a DHCP Service
  - *DHCP Start*, the starting IP address for dynamic DHCP, specified as an IP address
  - *DHCP End*, the ending IP address for dynamic DHCP assignment, specified as an IP address
  - *DHCP Static List*, specified as a list of value pairs:
    - *DHCP Static MAC*, specified as a MAC address
    - *DHCP Static IP*, specified as an IP address
  - *NAT Status*, specified as one of the following options:
    - *Enabled*, meaning that the Buyer wants the Seller to provide a NAT Service
    - *Disabled*, meaning that the Buyer does not need a NAT Service
  - *NAT Address,* specified as an IP address if NAT is *Enabled*
- Applicable Use Cases:
  - Broadband Internet Access, Advanced
  - Dedicated Internet Access, with router

[R33]   The Internet Access Local Address Product Attribute **MUST** be provided in the Product Order if and only if the Seller is responsible for managing Local Network Addresses for the Buyer.

[R34]   For POQ, Quote, and Product Order the Buyer **MUST** include a value for the *DHCP Status* and *NAT Status* parameters.

[R35]   For Product Order, in addition to *DHCP Status* and *NAT Status*, the Buyer **MUST** include the following:
- *LAN Address Block*
- *DHCP Start*, *DHCP End*, and *DHCP Static List* if *DHCP Status* is *Enabled*

[R36]   Values for *DHCP Start*, *DHCP End*, and *DHCP Static List* **MUST** not be provided if value of *DHCP Status* is *Disabled*.

Requirement [R36] ensures that values for DHCP parameters are specified only if the Seller is providing DHCP.

[R37]   If the value of *DHCP Status* is *Enabled*, the IP addresses specified as values of *DHCP Start* and *DHCP End,* and any IP address specified in the *DHCP Static IP* element of the *DHCP Static List*, **MUST** be in the block of IP Addresses specified by *LAN Address Block*.

[R38]   If the value of *DHCP Status* is *Enabled*, the IP address specified as in the value of *DHCP End* **MUST** be numerically greater than the IP address specified in the value of *DHCP Start*.

Requirements [R37] and [R38] ensure that if DHCP is provided the start and end addresses of the dynamically assigned addresses are in the block of Private Addresses requested by the Buyer and that the End address is greater than the Start address.

[R39]   The value of *NAT Address*, if provided, **MUST** be one of the Public Addressed used to access the Buyer's network.

The Buyer can specify the other parameters in the Product Order but in many cases, these are configured during or after the Product installation.

12.16   Internet Access Provider Independent IP Addresses Product Attribute

The value of this Product Attribute indicates whether the Buyer is using Public (WAN) IP addresses routable over the Internet purchased directly from a registration authority for Internet Access or Public IP addresses obtained from the Seller.
- Name: Internet Access Provider Independent Addresses
- Value: *Provider Independent IP Addresses*, specified as one of the following options:
  - *Enabled*, meaning that the Buyer is providing the addresses
  - *Disabled*, meaning that the Seller is providing the addresses
- Applicable Use Cases:
  - Broadband Internet Access, Advanced
  - Dedicated Internet Access with and without router

12.17 Internet Access Autonomous System Number Product Attribute

An autonomous system (AS) is a collection of connected Internet Protocol (IP) routing prefixes under the control of one or more network operators on behalf of a single administrative entity or domain, that presents a common and clearly defined routing policy to the Internet. If the Buyer is providing the Internet-routable IP Addresses (see 12.16) then this Product Attribute is required to be specified. The value of this Product Attribute has two parameters, the type of Autonomous System and the Autonomous System Number (ASN).

- Name: Internet Access Autonomous System Number
- Value:
  - *Autonomous System Type,* specified as one of the following options:
    - *Public*
    - *Private*
  - *Autonomous System Number*, specified as an integer: 0 – 4,294,967,295 (0xff:ff:ff:ff)
- Applicable Use Cases:
  - Broadband Internet Access, Advanced
  - Dedicated Internet Access, with and without router

[D2]   If the value of the Internet Access Provider Independent IP Address Product Attribute is *Enabled*, the Internet Access Autonomous System Number Product Attribute **SHOULD** be provided.

[R40]   When specifying the Internet Access Autonomous System Number Product Attribute, the value of *Autonomous System Type* **MUST** be provided.

[R41]   If the value of the *Autonomous System Type* is *Public*, then the value of the *Autonomous System Number* **MUST** be provided by the Buyer.

12.18 Internet Access IP Address Type Product Attribute

The value of this Product Attribute indicates whether the publicly routable IP address block consists of fixed addresses or addresses that can change over time.

- Name: Internet Access IP Address Type
- Value: *IP Address Type*, specified as one of the following options:
  - *Static*
  - *Dynamic*
- Applicable Use Cases:
  - Broadband Internet Access, Advanced
  - Dedicated Internet Access, with and without router

[R42]   The Internet Access IP Address Type Product Attribute **MUST** be provided for Quote and Product Order.

[R43]   If the value of the Internet Access Provider Independent IP Address Product Attribute is *Enabled*, the value of the Internet Access IP Address Type Product Attribute **MUST** be *Static*.

12.19   Internet Access Public Addresses Prefix Length Product Attribute

If the Seller is providing the Public Addresses for the Internet Access Product (i.e., the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Disabled*) then the value of this Product Attribute specifies the size of the IPv4 address block and the IPv6 address block requested by the Buyer and provided by the Seller. The value of this Product Attribute has two parameters, a string that indicates the length (in bits) of the network mask for the IPv4 address block and a string that indicates the length of the network mask for the IPv6 address block. By extension, these strings indicate the length of the host mask for each address block.

- Name: Internet Access Public Addresses Prefix Length
- Value:
    - *IPv4 Public Addresses Prefix Length*, specified as one of the following options:
        - "/24", "/25" … "/31", "/32", "None"
    - *IPv6 Public Addresses Prefix Length*, specified as one of the following options:
        - "/96", "/100", "/104", "/108", "/112", "/116", "/120", "/124", "/128", "None"
- Applicable Use Cases:
    - Broadband Internet Access, Advanced
    - Dedicated Internet Access, with and without router

The values "/32" and "/128", respectively, indicate a host route, i.e., a single IP address. This is common for Basic Internet Access and Advanced Internet Access. The value *None* indicates that no addresses should be allocated for the specified IP version.

[R44]   If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Enabled*, the Internet Service Public Addresses Prefix Length Product Attribute **MUST** be omitted.

[R45]   If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Disabled*, the Internet Service Public Addresses Prefix Length Product Attribute **MUST** be provided for Quote and Product Order.

[R46]   If the Internet Access Public Addresses Prefix Length Product Attribute is provided, values **MUST** be specified for both *IPv4 Public Addresses Prefix Length* and *IPv6 Public Addresses Prefix Length*.

[R47]   If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Disabled*, at least one of the parameters of the Internet Service Public Addresses Prefix Length Product Attribute (*IPv4 Public Addresses*

Prefix Length or *IPv6 Public Addresses Prefix Length*) **MUST NOT** have the value *None*.

12.20 Internet Access Public Address Block Product Attribute

If the Buyer is providing the WAN (public) addresses for the Internet Service (i.e., the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Enabled*) then the value of this Product Attribute fully specifies the blocks (IPv4 or IPv6) of public addresses used by the Buyer, e.g., "72.23.28.248/29".

- Name: Internet Access Public Address Block
- Value:
  - *IPv4 Address Block*, specified using CIDR notation or *None*
  - *IPv6 Address Block*, specified using CIDR notation or *None*
- Applicable Use Cases:
  - Broadband Internet Access, Advanced,
  - Dedicated Internet Access, with and without router

[R48] If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Disabled*, the Internet Service Public Address Block Product Attribute **MUST** be omitted.

[R49] If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Enabled*, the Internet Service Public Address Block Product Attribute **MUST** be specified for Quote and Product Order.

[R50] If the Internet Access Public Address Block Product Attribute is provided, values **MUST** be specified for both *IPv4 Address Block* and *IPv6 Address. Block*.

[R51] If the value of the Internet Access Provider Independent IP Addresses Product Attribute is *Enabled*, then at least one of *IPv4 Address Block* or *IPv6 Address Block* **MUST NOT** have the value *None*.

12.21 Internet Access Transit Addresses Product Attribute

The value of this Product Attribute specifies the size of the IPv4 address block and the IPv6 address block used for Transit Addresses (see section 11.2) in the Seller's network to access the Buyer's Public Addresses. The value of this Product Attribute allows the Buyer to specify the number of Transit Addresses (IPv4 and IPv6) that it wants the Seller to allocate and the Seller to return the Transit Address blocks allocated by the Seller to the Buyer.

- Name: Internet Access Transit Addresses
- Value:
  - *IPv4 Transit Address Prefix Length* specified as one of the following strings:
    - "/24", "/25" … "/31", "/32", "None"
  - *IPv6 Transit Address Prefix Length* specified as one of the following strings:
    - "/120", "/124", "/128", "None"
  - *IPv4 Transit Address Block*, specified using CIDR notation or *None*
  - *IPv6 Transit Address Block*, specified using CIDR notation or *None*
- Applicable Use Cases:

o   Dedicated Internet Access, with and without router

A common case is that the Buyer requests a single IPv4 Transit Address (by specifying the value "/32" for *IPv4 Transit Address Prefix Length*) and the Seller responds with a single IPv4 address (e.g., 71.71.32.32/32 for the *IPv4 Transit Address Block*).

13 References

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Appendix A   Acknowledgements (Informative)

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

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