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ONU management and control interface (OMCI) specification

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9.4 Layer 3 data services

9.4.1 IP host config data

The IP host config data configures IPv4 based services offered on the ONU. The ONU automatically creates instances of this managed entity if IP host services are available. A possible IPv6 stack is supported through the IPv6 host config data managed entity. In this clause, references to IP addresses are understood to mean IPv4.

Relationships

An instance of this managed entity is associated with the ONU managed entity. Any number of TCP/UDP config data MEs can point to the IP host config data, to model any number of ports and protocols. Performance may be monitored through an implicitly linked IP host PM history data ME.

Attributes

Managed entity id: This attribute uniquely identifies each instance of this managed entity. The ONU creates as many instances as there are independent IPv4 stacks on the ONU. To facilitate discovery, IP host config data MEs should be numbered from 0 upward. The ONU should create IP(v4) and IPv6 host config data MEs with separate ME IDs, such that other MEs can use a single TP type attribute to link with either. (R) (mandatory) (2 bytes)

IP options: This attribute is a bit map that enables or disables IP-related options. The value 1 enables the option while 0 disables it. The default value of this attribute is 0.

0x01	Enable DHCP
0x02	Respond to pings
0x04	Respond to traceroute messages
0x08	Enable IP stack
0x10..0x80	Reserved

(R, W) (mandatory) (1 byte)

MAC address: This attribute indicates the MAC address used by the IP node. (R) (mandatory) (6 bytes)

Onu identifier: A unique ONU identifier string. If set to a non-null value, this string is used instead of the MAC address in retrieving DHCP parameters. If the string is shorter than 25 characters, it must be null terminated. Its default value is 25 null bytes. (R, W) (mandatory) (25 bytes)

Several attributes of this managed entity may be paired together into two categories, manual settings and current values.

Manual settings	Current values
IP address	
Mask	
Gateway	
Primary DNS	
Secondary DNS	

While the IP stack is disabled, there is no IP entity instance.

Clause 9.4 included because it is the shortest of many. It illustrates highly standardized structure, format, and wording. While consistency in this standard was achieved through manual editing, the structure would clearly lend itself to structure-based tools such as DITA.

While DHCP is disabled, the current values are always the same as the manual settings. While DHCP is enabled, the current values are those assigned by DHCP, or undefined (0) if DHCP has never assigned values.

IP address: The address used for IP host services; this attribute has default value 0. (R, W) (mandatory) (4 bytes)

Mask: The subnet mask for IP host services; this attribute has default value 0. (R, W) (mandatory) (4 bytes)

Gateway: The default gateway address used for IP host services; this attribute has default value 0. (R, W) (mandatory) (4 bytes)

Primary DNS: The address of the primary DNS server; this attribute has default value 0. (R, W) (mandatory) (4 bytes)

Secondary DNS: The address of the secondary DNS server; this attribute has default value 0. (R, W) (mandatory) (4 bytes)

Current address: Current address of the IP host service. (R) (optional) (4 bytes)

Current mask: Current subnet mask for the IP host service. (R) (optional) (4 bytes)

Current gateway: Current default gateway address for the IP host service. (R) (optional) (4 bytes)

Current primary DNS: Current primary DNS server address. (R) (optional) (4 bytes)

Current secondary DNS: Current secondary DNS server address. (R) (optional) (4 bytes)

Domain name: If DHCP indicates a domain name, it is presented here. If no domain name is indicated, this attribute is set to a null string. If the string is shorter than 25 bytes, it must be null terminated. The default value is 25 null bytes. (R) (mandatory) (25 bytes)

Host name: If DHCP indicates a host name, it is presented here. If no host name is indicated, this attribute is set to a null string. If the string is shorter than 25 bytes, it must be null terminated. The default value is 25 null bytes. (R) (mandatory) (25 bytes)

Relay agent options: This attribute is a pointer to a large string managed entity whose content specifies one or more DHCP relay agent options. (R, W) (optional) (2 bytes)

The content of the large string is parsed by the ONU and converted into text strings. Variable substitution is based on defined three-character groups, each of which begins with the ‘%’ character. The string ‘%%’ is an escape mechanism whose output is a single ‘%’ character. When the ONU cannot perform variable substitution on a substring of the large string, it generates the specified option as an exact quotation of the provisioned substring value.

Provisioning of the large string is separate from the operation of setting the pointer in this attribute. It is the responsibility of the OLT to ensure that the large string contents are correct and meaningful.

Three-character variable definitions are as follows. The first variable in the large string must specify one of the option types. Both options for a given IP version may be present if desired, each introduced by its option identifier. Terminology is taken from [b-BBF TR-101] clause 3.9.3.

%01, %18

Specifies that the following string is for option 82 sub-option 1, agent circuit-ID (IPv4) or option 18, interface-ID (IPv6). The equivalence permits the same large string to be used in both IP environments.

%02, %37

Specifies that the following string is for option 82 sub-option 2, relay agent remote-ID (IPv4) or option 37, relay agent remote-ID (IPv6). The equivalence permits the same large string to be used in both IP environments.

%SL In TR-101, this is called a slot. In an ONU, this variable refers to a shelf. It would be meaningful if the ONU has multiple shelves internally or is daisy-chained to multiple equipment modules. The range of this variable is “0”.. “99”

%SU In TR-101, this is called a sub-slot. In fact, it represents a cardholder. The range of this variable is “0”.. “99”

%PO UNI port number. The range of this variable is “0”.. “999”

%AE ATM or Ethernet. This variable can take on the values “atm” or “eth”.

%SV S-VID for Ethernet UNI, or ATM VPI for ATM UNI, as it exists on the DHCP request received upstream across the UNI. Range “0”.. “4096” for S-VID; range “0”.. “255” for VPI. The value “4096” indicates no S-VID tag.

%CV C-VID (Q-VID) for Ethernet UNI, or ATM VCI for ATM UNI, as it exists on the DHCP request received upstream across the UNI. Range “0”.. “4096” for C-VID; range “0”.. “65535” for VCI. The value “4096” indicates no C-VID tag.

Spaces in the provisioned string are significant.

Example: if the large string were provisioned with the value

%01%SL/%SU/%PO:%AE/%SV.%CV<null>,

then the ONU would generate the following DHCP option 82 agent circuit-ID string for an Ethernet UNI that sent a DHCP request with no S tag and C tag = 3210 on shelf 2, slot 3, port 4.

2/3/4:eth/4096.3210

With the same provisioning, the ONU would generate the following DHCP option 82 agent circuit-ID string for an ATM UNI that sent a DHCP request on VPI = 123 and VCI = 4567 on shelf 2, slot 3, port 4.

2/3/4:atm/123.4567

Actions

Get, set

Test: Invoke an ICMP message from this IP host. The test message can be configured to generate a ping or traceroute. Annex A defines the test, test response and test result messages.

Notifications

Attribute value change

Number	Attribute value change	Description
1..8	N/A	
9	Current address	The new value assigned via DHCP
10	Current mask	The new value assigned via DHCP
11	Current gateway	The new value assigned via DHCP
12	Current primary DNS	The new value assigned via DHCP
13	Current secondary DNS	The new value assigned via DHCP
14	Domain name	The new value assigned via DHCP
15	Host name	The new value assigned via DHCP
16	Reserved	

9.4.2 IP host performance monitoring history data

This managed entity collects performance monitoring data related to an IP host. Instances of this managed entity are created and deleted by the OLT.

For a complete discussion of generic PM architecture, refer to clause I.4.

Relationships

An instance of this managed entity is associated with an instance of the IP host config data or IPv6 host config data managed entity.

Attributes

Managed entity id: This attribute uniquely identifies each instance of this managed entity. Through an identical ID, this managed entity is implicitly linked to an instance of the IP host configuration data or IPv6 host configuration data ME. (R, Set-by-create) (mandatory) (2 bytes)

Interval end time: This attribute identifies the most recently finished 15-minute interval. (R) (mandatory) (1 byte)

Threshold data 1/2 id: This attribute points to an instance of the threshold data 1 managed entity that contains PM threshold values. Since no threshold value attribute number exceeds 7, a threshold data 2 ME is optional. (R, W, Set-by-create) (mandatory) (2 bytes)

ICMP errors: This attribute counts ICMP errors received. (R) (mandatory) (4 bytes)

DNS errors: This attribute counts DNS errors received. (R) (mandatory) (4 bytes)

DHCP timeouts: This attribute counts DHCP timeouts. (R) (optional) (2 bytes)

IP address conflict: This attribute is incremented whenever the ONU detects a conflicting IP address on the network. A conflicting IP address is one that has the same value as the one currently assigned to the ONU. (R) (optional) (2 bytes)

Out of memory: This attribute is incremented whenever the ONU encounters an out of memory condition in the IP stack. (R) (optional) (2 bytes)

Internal error: This attribute is incremented whenever the ONU encounters an internal error condition such as a driver interface failure in the IP stack. (R) (optional) (2 bytes)

Actions

Create, delete, get, set

Get current data (optional)

Notifications

Threshold crossing alert

Alarm number	Threshold crossing alert	Threshold value attribute # (Note)
1	IPNPM ICMP error	1
2	IPNPM DNS error	2
3	DHCP timeout	3
4	IP address conflict	4
5	Out of memory	5
6	Internal error	6
Note – This number associates the TCA with the specified threshold value attribute of the threshold data 1 managed entity.		

9.4.3 TCP/UDP config data

The TCP/UDP config data managed entity configures TCP- and UDP-based services that are offered from an IP host. If a non-OMCI interface is used to manage an IP service, this ME is unnecessary; the non-OMCI interface supplies the necessary data.

An instance of this managed entity is created and deleted on request of the OLT.

Relationships

One or more instances of this managed entity may be associated with an instance of an IP host config data or IPv6 host config data managed entity.

Attributes

- Managed entity id:** This attribute uniquely identifies each instance of this managed entity. It is recommended that the managed entity id be the same as the port number. (R, Set-by-create) (mandatory) (2 bytes)
- Port id:** This attribute specifies the port number that offers the TCP/UDP service. (R, W, Set-by-create) (mandatory) (2 bytes)
- Protocol:** This attribute specifies the protocol type as defined by IANA (protocol numbers at www.iana.org), for example UDP (0x11). (R, W, Set-by-create) (mandatory) (1 byte)
- TOS/diffserv field:** This attribute specifies the value of the TOS/diffserv field of the IPv4 header. The contents of this attribute may contain the type of service per [IETF RFC 2474] or a differentiated services code point (DSCP). Valid values for DSCP are as defined by IANA (differentiated services field code points at www.iana.org). (R, W, Set-by-create) (mandatory) (1 byte)
- IP host pointer:** This attribute points to the IP host config data or IPv6 host config data ME associated with this TCP/UDP data. Any number of ports and protocols may be associated with an IP host. (R, W, Set-by-create) (mandatory) (2 bytes)

Actions

Create, delete, get, set

Notifications

None.

9.4.4 TCP/UDP performance monitoring history data

This managed entity collects performance monitoring data related to a TCP or UDP port. Instances of this managed entity are created and deleted by the OLT.

For a complete discussion of generic PM architecture, refer to clause I.4.

Relationships

An instance of this managed entity is associated with an instance of the TCP/UDP config data managed entity.

Attributes

Managed entity id: This attribute uniquely identifies each instance of this managed entity. Through an identical ID, this managed entity is implicitly linked to an instance of the TCP/UDP config data ME. (R, Set-by-create) (mandatory) (2 bytes)

Interval end time: This attribute identifies the most recently finished 15-minute interval. (R) (mandatory) (1 byte)

Threshold data 1/2 id: This attribute points to an instance of the threshold data 1 managed entity that contains PM threshold values. Since no threshold value attribute number exceeds 7, a threshold data 2 ME is optional. (R, W, Set-by-create) (mandatory) (2 bytes)

Socket failed: This attribute is incremented when an attempt to create a socket associated with a port fails. (R) (mandatory) (2 bytes)

Listen failed: This attribute is incremented when an attempt by a service to listen for a request on a port fails. (R) (mandatory) (2 bytes)

Bind failed: This attribute is incremented when an attempt by a service to bind to a port fails. (R) (mandatory) (2 bytes)

Accept failed: This attribute is incremented when an attempt to accept a connection on a port fails. (R) (mandatory) (2 bytes)

Select failed: This attribute is incremented when an attempt to perform a select on a group of ports fails. (R) (mandatory) (2 bytes)

Actions

Create, delete, get, set

Get current data (optional)

Notifications

Threshold crossing alert

Alarm number	Threshold crossing alert	Threshold value attribute # (Note)
0	N/A	
1	Socket Failed	1
2	Listen Failed	2
3	Bind Failed	3
4	Accept Failed	4

5	Select Failed	5
NOTE – This number associates the TCA with the specified threshold value attribute of the threshold data 1 managed entity.		

9.4.5 IPv6 host config data

The IPv6 host config data configures IPv6 based services offered on the ONU. The ONU automatically creates instances of this managed entity if IPv6 host services are available. If an IPv4 stack is present, it is independently supported through the IP host config data managed entity.

This ME may be statically provisioned or may derive its parameters from router advertisements and/or DHCPv6.

Relationships

One or more instances of this managed entity are associated with the ONU managed entity. Any number of TCP/UDP config data MEs can point to the IPv6 host config data, to model any number of ports and protocols. Performance may be monitored through an implicitly linked IP host PM history data ME.

Attributes

Managed entity id: This attribute uniquely identifies each instance of this managed entity. The ONU creates as many instances as there are independent IP stacks on the ONU. To facilitate discovery, IP and IPv6 host config data MEs should be numbered from 0 upward. The ONU must create IP(v4) and IPv6 host config data MEs with separate ME IDs, such that other MEs can use a single TP type attribute to link with either. (R) (mandatory) (2 bytes)

IP options: This attribute is a bit map that enables or disables IPv6 related options. The value 1 enables the option, while 0 disables it. The default value of this attribute is 0. (R, W) (mandatory) (1 byte)

0x01 IPv6 stack administrative unlock.

0x02 Enable RS. The host generates router solicitation (RS) messages, if necessary, and responds to router advertisements. If the router advertisement (RA) message has the M flag set to 1, the ONU is expected to request address and other configuration information via DHCPv6. If the RA message has the O flag set to 1 and M to 0, the ONU is expected to only request additional configuration information via DHCPv6, but not addresses.

0x04 Enable DHCPv6.

0x08 Respond to pings (ICMPv6 echo replies)

0x10..0x80 Reserved

The following IP stack initialization flow is expected:

1. If the IPv6 stack is administratively unlocked (0x01), establish a link-local address (self-assign address, DAD to confirm that address is unique within the local link). This process is defined in [b-IETF RFC 4862], and is a part of SLAAC. However, no IP options are set to enable or disable this function – it always happens.
2. If RS and DHCPv6 are both disabled, do nothing. Manual settings are to be used and are required for this IPv6 stack to be fully functional.
3. If RS is enabled (0x02) and DHCPv6 is disabled, send RS and listen for RA. If no RA is received, the ONU never attempts DHCPv6 and cannot complete automated initialization of IPv6. If RA is received:

- a. The ONU builds its default router table per [b-IETF RFC 4861], reported via the current default router table attribute.
 - b. If the received RA includes prefix information option(s) with “A” prefix, then ONU assigns itself an address from all such A prefixes, per [b-IETF RFC 4862] (also part of SLAAC) (reported via the current address table attribute).
 - c. If the received RA includes DNS information [b-IETF RFC 6106], the ONU accepts it (reported via the current DNS table attribute). Support for RFC 6106 is strongly recommended.
 - d. If the received RA has $M = 1$, then the ONU requests IA_NA and other options (which could include DNS) via DHCPv6. The access network provider is responsible to ensure that, if it sends DNS both in RA and DHCPv6, it sends the same DNS information; it must not rely on the ONU to figure out whether RA DNS is preferred over DHCPv6 DNS, or vice versa. If different DNS information is received via DHCPv6, it also goes into the current DNS table attribute. If the ONU gets IA_NA via DHCPv6, this goes into the current address table attribute.
 - e. If the received RA has $M = 0$ and $O = 1$, then the ONU requests stateless options (which could include DNS) via DHCPv6.
4. If RS and DHCPv6 are both enabled, the ONU does RS (as described in a-c above, if RA is received) and DHCPv6 (requesting IA_NA and other options, as described in d above) simultaneously, effectively ignoring M and O flags.
 5. If RS is disabled and DHCPv6 is enabled, then the ONU does not send RS and it does send DHCPv6 (requesting IA_NA and other options, as described in d above). If an unsolicited RA is received, it is ignored.

MAC address: This attribute indicates the MAC address used by the IP node. (R)
(mandatory) (6 bytes)

Onu identifier: A unique ONU identifier string. If set to a non-null value, this string is used instead of the MAC address in retrieving DHCPv6 parameters. If the string is shorter than 25 characters, it must be null terminated. Its default value is 25 null bytes. (R, W) (mandatory) (25 bytes)

Several attributes of this managed entity may be paired together into two categories, manual settings and current values.

Manual settings	Current values
IPv6 address	Current address table
Default router	Current default router table
Primary DNS	Current DNS table
Secondary DNS	
On-link prefix	Current on-link prefix table

While this ME instance is administratively locked, it provides no IPv6 connectivity to the external world. Especially if manual provisioning is to be used, it is important that the ME remain locked until provisioning is complete.

While autoconfiguration is disabled, the current values are the same as the manual settings. While autoconfiguration is enabled, the current values are those autoconfigured on the basis of router advertisements, assigned by DHCPv6, or undefined (empty tables) if no values have (yet) been assigned.

IPv6 link local address: The address used for on-link IP host services, such as router solicitation and DHCPv6. [b-IETF RFC 4862] specifies how to automatically establish a link-local address. (R) (mandatory) (16 bytes)

IPv6 address: The manually provisioned IPv6 address used for routed IPv6 host services. The address remains valid until reprovisioned, that is, the preferred and valid lifetimes of this address are infinite. The default value of this attribute is the undefined address 0. (R, W) (mandatory) (16 bytes)

Default router: The manually provisioned IPv6 address of the default router. The default value of this attribute is the undefined address 0. (R, W) (mandatory) (16 bytes)

Primary DNS: The manually provisioned IPv6 address of the primary DNS server. The default value of this attribute is the undefined address 0. (R, W) (mandatory) (16 bytes)

Secondary DNS: The manually provisioned IPv6 address of the secondary DNS server. The default value of this attribute is the undefined address 0. (R, W) (mandatory) (16 bytes)

Current address table: This attribute is a list of the current IPv6 addresses of the IP host service. The link-local address does not appear in this table. Each row of the table is structured as follows:

IP address (16 bytes)

Preferred lifetime remaining, seconds (4 bytes)

Valid lifetime remaining, seconds (4 bytes)

If the manually provisioned IPv6 address attribute appears as the (only, by necessity) entry of the table, its preferred and valid lifetimes are infinite (0xFFFF FFFF).

(R) (mandatory) (24*N* bytes)

Current default router table: This attribute lists the IPv6 addresses of the current default routers. (R) (mandatory) (16*N* bytes)

Current DNS table: This attribute lists the IPv6 addresses of the current DNS servers. (R) (mandatory) (16*N* bytes)

DUID: This attribute is the DHCPv6 unique identifier. It is an octet string that must be globally unique and must remain stable over the lifetime of the ONU. If the string is shorter than 25 bytes, it must be null terminated. Its derivation is beyond the scope of this recommendation; see [b-IETF RFC 3315] for further definition. (R) (mandatory) (25 bytes)

On-link prefix: This attribute is the manually provisioned on-link prefix used for destination IPv6 addresses of IPv6 host services. The attribute is structured as follows:

Prefix length, number of leading bits in the prefix that are valid (1 byte)

Prefix (16 bytes)

(R,W) (optional) (17 bytes)

Current on-link prefix table: In IPv6, an address is on a specific link if the address has been assigned to an interface attached to that link. However, in order for a

node to know that a destination is on-link, it must obtain configuration information to that effect. A host maintains a prefix list that identifies ranges of addresses that are to be considered on-link ([b-IETF RFC 5942]). This attribute is a list of current on-link prefixes used for destination IPv6 addresses of IPv6 host services. Entries in this table come from RA messages received by the ONU from remote routers or manually provisioned to be on-link. Each row of the table is structured as follows:

Prefix length, number of leading bits in the prefix that are valid (1 byte)
Autonomous address-configuration flag byte. When set to 1, indicates that this prefix can be used for stateless address configuration as specified in [b-IETF RFC 4862]; otherwise 0. (1 byte)
Prefix (16 bytes)
Preferred lifetime, seconds (4 bytes)
Valid lifetime, seconds (4 bytes)

If the manually provisioned on-link prefix attribute is present in the current on-link prefix table, its preferred and valid lifetimes are infinite (0xFFFF FFFF), and its autonomous address-configuration flag is 0.

(R) (optional) (26N bytes)

Relay agent options: This attribute is a pointer to a large string managed entity whose content specifies one or more DHCP relay agent options. (R, W) (optional) (2 bytes)

The meaning and interpretation of the large string's contents is identical to that described in the IP host config data definition in clause 9.4.1.

Actions

Get, get next, set

Test: Invoke an ICMP message from this IP host. The test message can be configured to generate a ping or traceroute. Annex A defines the test, test response and test result messages.

Notifications

Attribute value change

Number	Attribute value change	Description
1..8	N/A	
9	Current address table	AVC generated when a new address is added to the table, or when an existing address becomes invalid and is removed from the table. Countdown of the lifetime fields does not generate AVCs.
10	Current default router table	
11	Current DNS table	
12..13	N/A	
14	Current on-link prefix table	
15..16	Reserved	