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TITLE: Proposal for a one-phase connection request with address resolution

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ABSTRACT:
This contribution provides a proposal for a one-phase connection request with address resolution, i.e., without using the two-phase query+connection request process that is presently documented in the OIF UNI 1.0 specification. This one phase process requires extensions to RSVP and LDP through the introduction of a Client-Name Object.

The protocol behavior is minimally modified with the introduction of the new object. However, this method results in a clean separation of the client and network name spaces which is one of the primary requirements for the UNI as specified in the OIF carrier's group document.

1 Introduction

During the last OIF meeting in Maui, HI, there were two contributions [1,2] that were submitted on the issue of using client names for making connection requests and identifying the need for supporting an address resolution function within the optical network. During the meeting, a new proposal for address resolution was formulated and voted in as the procedure for performing address resolution. This is also documented in the OIF UNI 1.0 spec [3]. The address resolution as presented in the document is done in two steps:

(a) Client registration: Client registers the client name and the network assigns the client, the optical networking routing address as a Optical Network Administered – IP address (ONA-IP address).
(b) Client query: The client queries for the ONA IP address of the destination client name and obtains it from the network. It further uses this ONA IP address in the connection request message.

We believe that this procedure has three major drawbacks:

(a) The fact that the ONA IP address is the actual routing address causes problems in the long term for the operator resulting from client caching of these addresses. The problem is associated with an inability to evolve the network to larger/different address spaces and reallocation of addresses.
(b) The address resolution mechanism is not completely specified, as the procedure for determining ONA IP addresses across multiple operator domains eventually leads to exchange of topology information across multiple operator domains. This is forbidden by the requirements, which clearly state that no routing information can be exchanged across any public interface (whether it is a UNI or an inter-operator NNI).
(c) There is still a need for a protocol to carry the multiply different client names (AESA, NSAP, etc.) during the client query procedure. Thus, although the proposed solution might be convenient for RSVP/CR-LDP signaling, there is still a need to find a new protocol/augment existing protocols for the client query.

To help fix the above drawbacks, in this contribution, we propose a new one-phase UNI connection request and address resolution mechanism which essentially uses two levels of indirection to obtain the routing addresses across which an NNI link is established to complete the end-to-end UNI connection. The proposed method calls for extensions to the existing signaling protocols to include a support for a name object for the A-end name and Z-end name.

We additionally propose replacement for the existing address resolution text in Section 6 of the OIF UNI 1.0 specification.

2 Terminology

- **A-end** Sender client
- **ONA** Optical Network Administered
- **ONE** Optical Network Element

- **TLV** Type-Length-Value Encoding
- **UNI** User Network Interface
- **Z-end** Destination client

3 Extensions to Signaling Protocols

We introduce the notion of client names that will be used in the connection request message of RSVP/LDP protocols. The OIF UNI 1.0 specification refers to the following client name types.

1. IPv4
2. IPv6
3. ITU-T E.164 ATM End System Address (AESA)
4. British Standards Institute ICD AESA
5. ANSI DCC AESA
6. NSAP address
7. Arbitrary strings

We recognize that the name can have a variable number of octets, but is nevertheless structured as a string of octets. We propose a generic name object, as follows

Name-object	Name Length	Name

Name-object: A new object identifier is defined for each name type.

Name Type: The following client name types are considered.
1. IPv4
2. IPv6
3. ITU-T E.164 ATM End System Address (AESA)
4. British Standards Institute ICD AESA
5. ANSI DCC AESA
6. NSAP address
7. Arbitrary strings

Name Length: This field is one octet long and gives the size of name in octets. Note that the maximum size of name is 256 octets.

Name: This is the actual client name. Note that this does not have to be the same as the client layer address, but if it is the client layer address, then the uniqueness is guaranteed in that client name space.

3.1 Protocol Behavior Extension

In the case of RSVP, we extend the SENDER_TEMPLATE Object which contains the sender name (A-end name). Similarly we extend the SESSION object which contains the destination name (Z-end name). The A-end name and Z-end name objects are to be used in the connection request. Upon reception of a RSVP/LDP UNI connection request message, the UNI-N extracts the A-end name (sender name) and Z-end name (destination name) and starts the address resolution process. In LDP, we extend the Source ID TLV and Destination ID TLV.

3.1.1 Extensions to RSVP

We extend the SESSION object as follows:

```
       0              1                  2               3
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Length (octets)              |  Class =      | C_Type =10-16 |
|                               |  (SESSION)    |     [TBA]     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Name Object  (N octets)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

and the SENDER_TEMPLATE Object as follows:

```
       0              1                  2               3
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Length (octets)              |  Class =      | C_Type =10-16 |
|                               |  (SENDER_     |               |
|                               |  TEMPLATE)    |     [TBA]     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  Name Object  (N octets)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Note that the LSP Id in the SENDER_TEMPLATE Object and Tunnel Id, Extended Tunnel Id in the SESSION Object are replaced using the Lightpath Id object [4]. A new C-type needs to be defined for each of these name types. For example, IPv4 and IPv6 have already defined C-types. The other AESA and NSAP addresses can be reserved a special C-types and the Arbitrary strings (unstructured names) can have C-type set to some default. Thus, the name type need not be explicitly encapsulated.

3.1.2 Extensions to CR-LDP

The Source ID TLV and the Destination ID TLV [5] are extended as follows:

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0|   Source Id (0x0950)      |       Length                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Port ID              | Channel Id    | Sub-channel ID|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+              Source User Group                +-+-+-+-+-+-+-+-+
|                                               |  Reserved     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Name Type    |   Name Length |        Source Name            |
|=0x01-0x07[TBA]|    = N octets |         (N octets)            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|              Source Name (continued)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Name Type:
Type of the client name, one of the 7 listed above

Name Length:
Length of the name in octets

Source Name:
The client name (one 7 types listed above) associated with the source client

Port Id:
Port Id is a two-octet unsigned integer indicating the port number in an optical network element

Channel Id:
Channel Id is a single octet unsigned integer indicating a channel with respect to the specified Port Id.

Sub-Channel Id:
Sub-Channel Id is a single octet unsigned integer indicating a sub-channel with respect to the specified Channel Id.

Source User Group:
The Source User Group identifies the logical network or group to which the optical client belongs. The Source User group is the 7-octet structure as defined in [6].

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0| Destination Id (0x0951)   |      Length                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Port ID              | Channel Id    | Sub-channel ID|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+              Source User Group                +-+-+-+-+-+-+-+-+
|                                               |  Reserved     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|  Name Type    |   Name Length |     Destination Name          |
|=0x01-0x07[TBA]|    = N octets |         (N octets)            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
|             Destination Name (continued)                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Name Type:
Type of the client name, one of the 7 listed above

Name Length:

Length of the name in octets

Destination Name:
The client name (one 7 types listed above) associated with the destination client

Port Id:
Port Id is a two-octet unsigned integer indicating the port number in an optical network element

Channel Id:
Channel Id is a single octet unsigned integer indicating a channel with respect to the specified Port Id.

Sub-Channel Id:
Sub-Channel Id is a single octet unsigned integer indicating a sub-channel with respect to the specified Channel Id.

Source User Group:
The Source User Group identifies the logical network or group to which the optical client belongs. The Source User group is the 7-octet structure as defined in [6].

4 Addressing

4.1 Address Registration

The process of address registration maps a client name to an optical network address set. This address set can be defined as {signaling address (address of the signaling interface), routing address, maintenance address…} and is implementation and application specific. For the case of signaling, the signaling address is used and for mapping to routing information, routing addresses are used. The address registration process creates entries into the directory owned by the operator to which the client is registered. Once the client is authenticated and the client registry record is included into the operator's directory, a mapping of the client-name→provider is added to a global (or to-be-distributed) database which we call the "key directory". Note that this key-directory could be owned by the operators and can be exchanged between operators and essentially contains only reachability information, or it can be held by a third party global directory provider (e.g., white pages type provider). Thus, the address registration inherently involves two directories (one network specific and one network-of-networks). Additionally hierarchies can be introduced in the directory structure to aid more optimization (on a subnet level), but is not subject to standardization.

4.2 Address Resolution

Address resolution needs to be performed to find out the routing addresses (within the optical network) for the A-end and Z-end client names. The basic address resolution methodology works on two levels of indirection. The first step involves a pointer to the provider to which Z-end name is registered (say OP2) and then a pointer to the routing address associated with the Z-end name in OP2.

4.2.1 A-end Name and Z-end Name Within the Same Provider's Network

Upon receiving the UNI connect request, the UNI-N first extracts the A-end name, performs a translation to its internal routing address (through its own address registration information), and then it extracts the Z-end name object and resolves the Z-end name. If the query is successful, it returns the internal routing address for the Z-end name and a NNI connection request is issued between the internal-routing addresses resolved in the above process. The key to the operator with whom the Z-end name is registered is found and if Z-end is found to be within its own domain, an NNI connect request between the resolved routing addresses for the A-end name and Z-end name is made.

4.2.2 A-end Name and Z-end Name in Different Operator Domains

In this section we give a high level description of one approach to this issue. However, we realize that an ONE could utilize some other mechanism (e.g., based on extensions to BGP).

If the Z-end user name is not registered with the operator to which the A-end name is registered (say operator OP1), then a lookup to the key-directory that contains the user-name→operator key mapping returns the operator (say OP2) to which Z-end name is registered. Once the operator with whom the Z-end name is registered is known, an NNI connection request is issued to the gateway ONE that is connected to another gateway ONE in OP2. This way a NNI subnet connection is made in OP1 between the ONE connected to A-end name and the gateway ONE connected to OP2. This is followed by a NNI request from OP1 to OP2 to connect A-end name to Z-end name. OP2 now issues a NNI connection request to setup a subnet connection from the gateway ONE connected to OP1 to the ONE connected to Z-end name. The UNI-N on the ONE connected to Z-end name then issues a UNI request to Z-end name client asking for authentication of A-end name. If this is authenticated, then the end-to-end optical channel is setup. If the authentication fails, then the process is reversed and the NNI links are released. The A-end UNI-C is informed of the failure to authenticate.

The process flow diagram for the above is depicted in Figure 2.

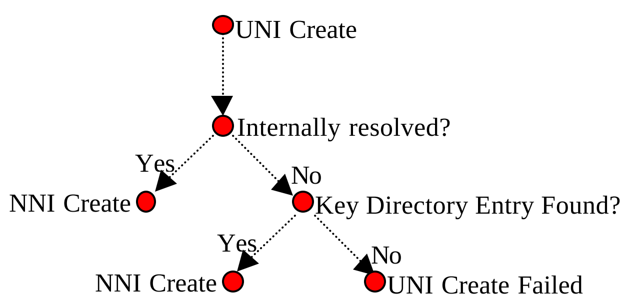

Figure 1: Process flow diagram showing UNI signaling with address resolution

5 Proposal

We propose the following specific text to replace the addressing section in OIF UNI 1.0 document.

Proposal 1: Use the following as an introductory text to Section 6.

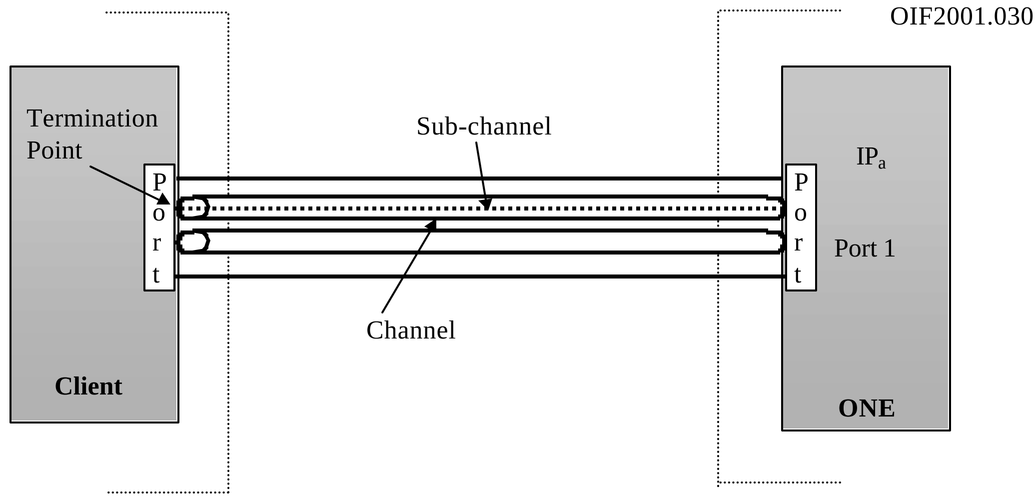

Figure 6-2: Connection Termination Points

" This section details the aspects of naming/addressing in the user/provider networks and discusses the related requirements such as separation of client/optical network (user/provider) name spaces and link connection termination point identification. In addition, the need and methods for performing address resolution within the optical network for providing a switched connection between two user names is identified."

Proposal 2: Change the title of Section 6.1 to read " Client vs Optical Network Name Spaces"

Proposal 3: Remove the section on Optical Network Points of Attachment, because this information would not be necessary with the proposed scheme.

Proposal 4: Change Section 6.3 on "Connection Termination Points" as follows:
" UNI signaling for connection establishment requires the identification of the termination points of the connection. The termination points are *client-side* logical interfaces at which a connection terminates. A termination point (Figure 6-2) may be identified

1. By the client name, i.e., IPv4, IPv6, E.164, NSAP type names.
2. By the client name along with a locally unique port ID.
3. By the client name along with a locally unique port ID and a locally unique channel Id
4. By identifying an ONA IP address along with a locally unique Port Id, channel and sub-channel IDs.

The detail required depends on the granularity of the service. For instance, if the connection bandwidth is same as the port speed (i.e., there is no multiplexing), the termination point can be identified (Client-Name, Port Id)). On the other hand, a connection that is derived from a multiplexed stream requires another level of identification. The channel and sub-channel indices provide two levels of de-multiplexing below the port level. The channel index must be unique with reference to the chosen port in the client. The sub-channel index must be unique with reference to the chosen channel.

Using UNI signaling, the selection of a channel and a sub-channel for a connection (when required) is a local matter between a ONE and a client. That is, the channel and sub-channel are selected on the source-side by the source UNI-C and on the network side by UNI-N. Similarly, the channel and the sub-channel are selected on the destination-side by the destination UNI-C and by the UNI-N for the far-end ONE. There is no need for the source UNI-C to specify the destination-side channel or sub-channel. The selection of the channel and sub-channel are in essence incorporated in GMPLS “label” selection during signaling, which is a local matter as defined in Sections 11 and 12 of this document. Thus, a source UNI-C need specify only the client name along with a port index.

In summary, the connection termination point is identified in UNI 1.0 signaling messages by:

- the client name and
- a port index (if necessary)

UNI signaling messages, as defined in Section 10 of this document, do provide a place for *carrying* channel and sub-channel identification from the UNI-C to the UNI-N, and from the UNI-N to the UNI-C. This allows either the UNI-C or the UNI-N to select these values and inform the other.

Suppose a connection establishment request has been sent by a UNI-C with the destination's client name (Z-end name). At the destination UNI-N, this is mapped to a specific port (and perhaps a channel and a sub-channel) through which the connection must be established to the client device. When the destination UNI-N informs the UNI-C of the incoming connection, it must identify the Z-end name to the UNI-C."

Proposal 5: Replace the text in Section 6.4 on address resolution to the following text

6.4 Address Registration

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The process flow diagram for the above is depicted in Figure 6.3.

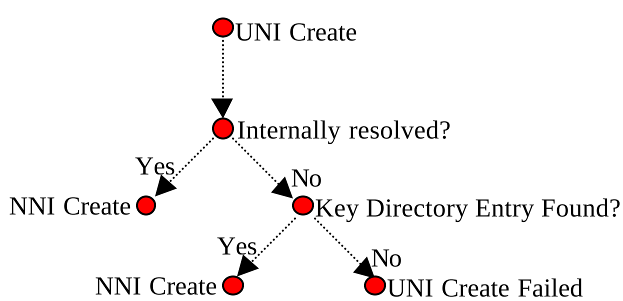

Figure 6.3 : Process flow diagram showing UNI signaling with address resolution

"

Proposal 6: Reword old Section 6.5 (the new Section 6.6) on User Group Identification as follows:

" Client devices may provide user group identification when registering client layer names with the optical network. This would allow client devices in different client networks to register the same client- layer addresses. Furthermore, policies based on user group membership may be used to restrict clients from requesting connections to other clients. For IPv4 based client names, user group identifiers under UNI 1.0 are same as IP Virtual Private Network (VPN) identifiers [4]. For client names based on other types, the definition of a user-group identification is for further study."

6 References

[1] OIF2000.248.0, "Support for Directory Service/Address Resolution function for OIF UNI 1.0", November 2000.
[2] OIF2000.261.1, "Address Resolution proposal", November 2000.
[3] OIF2000.125.3, "OIF UNI 1.0 Signaling Proposal", December 2000.
[4] OIF2000.286.1, "RSVP Extensions for Optical UNI signaling", November 2000.
[5] OIF2000.140.2, "LDP extensions for UNI 1.0", November 2000.
[6] RFC 2685, "VPN Identifiers", September 1999.