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MPLS-VNS Interworking

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Abstract

This document specifies MPLS [1,2] to VNS [3] interworking in an efficient manner that preserves the label switching property when crossing an MPLS/VNS boundary. The interworking function also ensures that COS characteristics of an LSP are preserved when going from VNS to MPLS and vice versa.

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1. Introduction

Nortel's Virtual Network Switching (VNS) is defined in [3]. VNS offers several unique capabilities such as the transport of IP, IPX and Bridging traffic in a multi-service network (voice, video, and data). It has been deployed in many live networks around the globe.

Multi-Protocol Label Switching (MPLS) architecture and framework are defined in [1] and [2] respectively. MPLS is an emerging protocol being standardized by the IETF. As the development of MPLS progresses and its deployment in customer networks takes place, it becomes necessary to provide a solution for interworking MPLS and VNS networks.

MPLS and VNS are two technologies that forward IP traffic based on a fixed size label to avoid processing IP headers at tandem nodes between the source and the destination.

This document specifies MPLS-VNS interworking in an efficient manner that preserves the fast forwarding of packets based on labels when crossing an MPLS/VNS boundary. The interworking function also ensures that COS characteristics of an LSP are preserved when going from VNS to MPLS and vice versa.

It is possible to interwork MPLS and VNS at the IP layer by terminating an MPLS label switched path (LSP), mapping the IP destination address to a VNS label, and forwarding packets inside the VNS domain based on the VNS label. However, this solution would invoke L3 forwarding at the boundary between MPLS and VNS.

The solution described in this draft ensures that label forwarding is preserved at the interworking point between MPLS and VNS. Two interworking scenarios are identified. In the first scenario, traffic is exchanged between two MPLS nodes through a VNS network. For example between nodes 1 and 4 shown in Figure 1. In the second scenario, traffic is exchanged between an MPLS node and a VNS node (e.g., between nodes 1 and 2 of Figure 3).

Interworking through VNS is described in Section 2. Interworking between VNS and MPLS is described in section 3. Section 4 concludes this draft.

This document should be read along with a companion document, Nortel's Virtual Network Switching (VNS) Overview [3].

2. Interworking through VNS

This section describes the interworking functions that are required in order to connect two MPLS nodes through a VNS network. Section 2.1 specifies the label distribution protocol. Section 2.2 specifies the label stack encoding.

```
                           LDP Sessions
                      +--------------------+
                      |                    |
    MPLS Domain       |     VNS Domain     |          MPLS Domain
    +-------+        +-------+           +-------+        +-------+
    |       |        |       |  +-----+  |       |        |       |
    |       |        |M     V|  |     |  |V     M|        |       |
    |       |---+----|P     N|---     ----|N     P|---+----|       |
    |       |        |L     S|  |     |  |S     L|        |       |
    |       |        |S      |  +-----+  |      S|        |       |
    |   1   |        |   2   |           |   3   |        |   4   |
    +-------+        +-------+           +-------+        +-------+
```

Figure 1. MPLS--VNS Interworking

2.1 Label Distribution Protocol

In a VNS Network, three separate nodal functions are defined. An ingress function, an egress function, and a tandem (or core) function. The ingress and egress nodes define the boundary between an MPLS domain and the VNS domain as shown in Figure 1 (nodes 2 and 3).

In MPLS, label to stream binding information is communicated through a label distribution protocol [4] between peer Label Switching Routers (LSRs). In the example of Figure 1, nodes 2 and 3 are LDP peers. Therefore, in order for MPLS label information to be communicated across a VNS domain, an LDP session is established between all the ingress and egress VNS nodes of a logical network. Tandem (or core) VNS nodes do not need to participate in LDP.

VNS supports a multicast forwarding service for traffic within a Logical Network (LN) [3] at the VNS layer. Multicast packets are delivered to all nodes supporting the logical network to which the multicast packet belongs.

The LDP session establishment takes advantage of this VNS multicast capability to send "Hello" packets. Edge nodes performing the VNS-MPLS interworking function are able to dynamically discover each other through VNS multicast.

Inside the VNS network, VNS uses it own label distribution mechanism

which is based on a distributed serverless topology driven approach. Standard ARP is used to distribute a mapping between network layer addresses and VNS labels.

As described in [3], a VNS Label is composed of the destination node ID and the Logical Network Number (LNN). When an ingress VNS node receives the ARP reply that maps an IP prefix to a VNS label, it initiates an LDP session with that destination node as specified in [4]. This LDP session is used to exchange MPLS label mappings to FECs between the two VNS edge nodes.

2.2 Label Stack Encoding

When packets are carried in an MPLS domain, the standard label stack encoding defined in [5] is used. When packets enter a VNS network, a VNS label defined in [3] is pushed on top of the MPLS stack resulting in a stack depth of at least two labels. The top label is the VNS label. The bottom label is the MPLS shim encoding defined in [5]. Packets are forwarded inside the VNS network based on the VNS header as defined in [3]. When a packet is about to leave a VNS network, the VNS header is popped and MPLS-based label forwarding is resumed. Figure 2. shows the label stack encoding of an IP packet as it traverses a VNS domain.

```
+--------------+----+------------+------------+
| Data         | IP | MPLS Header | VNS Header |
+--------------+----+------------+------------+
```

Figure 2. MPLS/VNS Label Stack Encoding

A Protocol Type field in the VNS header indicates the type of protocol being carried in the VNS packet. Examples include IP, IPX, and Bridging. If the packet is a multicast packet then this is indicated in this field.

A new codepoint is defined in this Protocol Type field to indicate that the packet being carried by VNS is an MPLS packet.

The MPLS shim encoding includes a 3-bit COS field used to indicate the Class of Service of the packet. The VNS header also includes a 3-bit COS field. A mapping function between the MPLS and the VNS COS fields ensures that packets receive a consistent queuing and scheduling treatment in both the MPLS and the VNS domains.

In addition, the VNS header includes a Discard Priority field that indicates the level of congestion at which the packet should be dropped. The MPLS shim encoding does not have a field that indicates the discard eligibility of a packet. Therefore, a mapping to the MPLS

COS field is necessary.

3. Interworking between VNS and MPLS

This section describes the interworking functions required to preserve the label switching path when traffic is terminated on an MPLS node on one end and a VNS node on the other.

```
             MPLS Domain                  VNS Domain
             +-------+                    +-------+
             |       |      +------+      |       |
             |       |      |M    V|      |       |
             |       |------|P    N|------|       |
             |       |      |L    S|      |       |
             |   1   |      |S     |      |   2   |
             +-------+      +------+      +-------+
```

Figure 3. MPLS--VNS Interworking

3.1 Label Distribution

In this interworking mode, labels are distributed within the MPLS domain as defined in [4] and within the VNS domain as defined in [3] independently of each other. At the node of intersection of the VNS and MPLS domains, the lack of an LDP session with a remote MPLS peer for a given stream indicates that label swapping is to take place at that node. Therefore, the forwarding table is populated accordingly.

3.2 Label Stack Encoding

Since in this mode of operation, traffic is terminating on a VNS node on one end and on an MPLS node on the other, label stack encoding defined in [5] is used within the MPLS domain and label encoding defined in [3] is used in the VNS domain. At the point of intersection, a swapping operation is performed between the VNS and MPLS labels.

4. Summary

VNS uses a label switching scheme to forward IP packets in a VNS domain. Many live networks are running VNS to switch their IP traffic. MPLS is an emerging standard that also uses label switching to carry IP traffic. As MPLS networks get deployed, it becomes necessary to provide an MPLS-VNS Interworking solution.

This draft describes an architectural view of how MPLS and VNS interworking can be done in an efficient manner that preserves the label switching property at the MPLS/VNS boundary nodes.

Two interworking scenarios are identified. In the first scenario, traffic is exchanged between two MPLS nodes through a VNS network. In this case, LDP is used to carry label bindings between MPLS peer nodes across a VNS domain. VNS uses its label distribution protocol to map IP reachability to VNS labels. At least a two-label-stack is used to carry traffic across a VNS domain. The top label is a VNS label (as defined in [3]) and the bottom label is an MPLS label (as defined in [5]).

In the second interworking scenario, traffic is exchanged between an MPLS node and a VNS node. In this case, a label swapping function is invoked at the VNS-MPLS boundary.

5. Security Considerations

Security issues are not discussed in this memo.

6. Acknowledgements

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7. References

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