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YANG Data Model for NVO3 Protocols
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Abstract

This document describes the base YANG data model that can be used by operators to configure and manage NVO3 protocols.

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1. Introduction

Network Virtualization Overlays (NVO3) enable network virtualization for data center networks environment that assumes an IP-based underlay.

YANG [RFC6020] is a data definition language that was introduced to define the contents of a conceptual data store that allows networked devices to be managed using NETCONF [RFC6241]. This document specifies a YANG data model that can be used to configure and manage NVO3 protocols. The model covers the configuration of preliminary NVO3 instances as well as their operation states. We call it the base model for NVO3 in this document.

Two default data plane encapsulation techniques for NVO3 are incorporated in the base module. It allows other possible encapsulations developed in the industry later on to be included by introducing a new encapsulation as a new 'choice'. As new solutions for NVO3 are developed, corresponding YANG data modules may be specified. The base module can be augmented to accommodate these new solutions.

2. Acronyms and Terminology

2.1. Acronyms

NVO3: Network Virtualization Overlays
VNI: Virtual Network Instance
BUM: Broadcast, Unknown Unicast, Multicast traffic

2.2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Familiarity with [RFC7364], [RFC7365], [I-D.ietf-nvo3-dataplane-requirements] and [RFC7348] is assumed in this document.

3. The YANG Data Model for NVO3

The NVO3 base YANG module is divided in three containers. The first container contains writable parameters. The second container contains the writable enablers per VNI for the statistical operational states as well as the status of these enablers. The third container contains the statistical operational states.

3.1. The Configuration Parameters

3.1.1. NVE ID

The 'nvo3Nves' list contains NVEs under the management. The NVE is identified using the 'srcAddr', which is the underlay IP address of the NVE.

3.1.2. Encapsulation Type

The encapsulation type of NVO3 is to be determined by the operators according to their network. NVO3 encapsulation arising from the industry is not unique. The value of 'encapType' determines the encapsulation. Besides the default VxLAN encapsulation [RFC7348], the module also allows other possible encapsulation, for example the NVGRE encapsulation [I-D.sridharan-virtualization-nvgre]. It can be extended to include more encapsulation choices.

3.1.3. Source and Destination UDP Port

If the encapsulation type is VxLAN, it's recommended the source UDP port is calculated using a hash of fields (e.g., source IP address, destination IP address, protocol type, source MAC address and destination MAC address) from the inner packet. The bit value of 'srcUdpPortGenRuleFlags' indicates whether each field is used in the hashing function with the high-order bit indicating the first hashing field.

The value of destination UDP port is set to be 'destUdpPort'. For VxLAN, IANA has assigned the value 4789 for the UDP destination port, and this value SHOULD be used by default as the destination UDP port

[RFC7348].

3.1.4. Virtual Network Instance

A Virtual Network Instance ('VNI') is a specific VN instance on an NVE [RFC7365]. At each NVE, a Tenant System is connect to VNIs through Virtual Access Points (VAP). VAPs can be physical ports or virtual ports identified by the bridge domain Identifier ('bdId'). The mapping between VNI and bdId is managed by the operator.

3.1.5. Flags in the Header

Flags in the NVO3 header are to be configured. For VxLAN, the I bit of 'flag' MUST be set to 1 while other 7 bits are reserved and MUST be set to zero on transmission and ignored on receipt. For NVGRE, bits in position 0 and 3 MUST be set to zero. The bit in position 2 MUST be set to 1. Bits from position 4 through 12 are reserved and MUST be set to zero on transmission and ignored on receipt.

3.1.6. BUM Mode

An NVE SHOULD support either ingress replication or point to multipoint tunnels [I-D.ietf-nvo3-dataplane-requirements] on a per-VNI basis. It is possible that both modes be used simultaneously in one NVO3 network by different NVEs.

If ingress replication is used, the receiver addresses are listed in 'peerAddr'. If the choice is point to multipoint tunnels, the multicast address is given as 'multiAddr'.

3.2. Statistics

Operators can determine whether a NVE should gather statistic values on a per-VNI base. The enablers are contained in the 'nvo3Info' list as 'statisticsEnable' leaf.

If the gathering for a VNI is enabled, the statistical information about the local NVEs, the remote NVEs, the flows and the MAC addresses will be collected by the NVEs in this VNI.

3.3. Model Structure

```
module: nvo3-base
   +--rw nvo3Nves
   |  +--rw nvo3Nve* [ifName]
   |     +--rw ifName                string
   |     +--rw srcAddr?              inet:ip-address
   |     +--rw (encapType)?
   |     |  +--:(vxlan)
   |     |     +--rw srcUdpPortGenRule?   uint8
   |     |     +--rw destUdpPort?         uint16
   |     +--rw members
   |        +--rw member* [VNI]
   |           +--rw VNI           uint32
   |           +--rw bdId          uint32
   |           +--rw (encapType)?
   |           |  +--:(vxlan)
   |           |  |  +--rw vxlanFlag?   flags-vxlan
   |           |  +--:(nvgre)
   |           |     +--rw nvgreFlag?   flags-nvgre
   |           |     +--rw flowId?      uint8
   |           +--rw (bumMode)?
   |              +--:(headEnd)
   |              |  +--rw peerAddr*    inet:ip-address
   |              +--:(multiGroup)
   |                 +--rw multiAddr?   inet:ip-address
   +--rw nvo3Infos
```



```
   |  +--rw nvo3Info* [VNI]
   |     +--rw VNI                 uint32
   |     +--rw statisticsEnable?   enumeration
   |     +--ro status?             enumeration
   +--rw nvo3Statistics
      +--ro localNVE*
      |  +--ro count?    uint64
      |  +--ro ipAddr*   inet:ip-address
      +--ro remoteNVE*
      |  +--ro count?    uint64
      |  +--ro ipAddr*   inet:ip-address
      +--rw flowStatistics
      |  +--ro instanceCount?   uint64
      |  +--ro flowStatistic*
      |     +--ro VNI?                      uint32
```

```
|     +--ro inPacketsCount?            uint64
|     +--ro inBytesCount?              uint64
|     +--ro inUnicasts?                uint64
|     +--ro inMulticasts?              uint64
|     +--ro inBroadcasts?              uint64
|     +--ro inUnknownUnicastDrops?     uint64
|     +--ro inUnknownMulticastDrops?   uint64
|     +--ro inBroadcastsDrops?         uint64
|     +--ro outPacketsCount?           uint64
|     +--ro outBytesCount?             uint64
|     +--ro outUnicasts?               uint64
|     +--ro outMulticasts?             uint64
|     +--ro outBroadcasts?             uint64
|    +--rw MacStatistics
|       +--ro MacStatistic*
|          +--ro VNI?          uint32
|          +--ro vmMacCount?   uint64
```

Figure 3.1. The tree structure of YANG module for NVO3 configuration

3.4. YANG Module

```
<CODE BEGINS>
module nvo3-base {
  namespace "http://www.huawei.com/netconf/nvo3";
  //namespace need to be assigned by IANA
  prefix "nvo3";
  import ietf-inet-types {
    prefix "inet";
  }
  organization "IETF NVO3 Working Group";
  contact "vero.zheng@huawei.com
    zhangmingui@huawei.com
```



```
    habby.zheng@huawei.com";
  description "nvo3 yang module";
  revision "2014-10-21";

  typedef flags-vxlan {
    type bits {
      bit validVni {
        position 4;
```

```
      }
    }
  }

  typedef  flags-nvgre {
    type bits {
      bit zero{
        position 0;
      }
      bit KeyPresent{
        position 2;
      }
      bit three{
        position 3;
      }
    }
  }

  container nvo3Nves {
    list nvo3Nve {
      key "ifName";
      leaf ifName {
        description
          "Interface name.";
        type string;
        mandatory "true";
      }
      leaf srcAddr {
        description
          "Local NVE address.";
        type inet:ip-address;
      }
      choice encapType{
        case vxlan{
          leaf srcUdpPortGenRule {
            description
              "The rule of generating source udp port.";
            type uint8;
          }
          leaf destUdpPort {
```



```
            description
```

```
            "Destination udp port.";
          default "4789";
          type uint16{
            range "0 .. 65535";
          }
        }
      }
    }
    container members {
      list member {
        key "VNI";
        leaf VNI {
          description
            "Virutal Network Instance (VNI). For VxLAN, it is
            VXLAN Network Identifier; For NVGRE, it is Virtual
            Subnet Identifier.";
          mandatory "true";
          type uint32 {
            range "1 .. 16777215";
          }
        }
        leaf bdId {
          description
            "Bridge Domain ID";
          mandatory "true";
          type uint32 {
            range "1 .. 32768";
          }
        }
        choice encapType{
          case vxlan{
            leaf vxlanFlag {
              description
                "The 8 bits flags of VXLAN. The I flag MUST be
                set to 1 for a valid VNI. Others are reserved.";
              type flags-vxlan;
            }
          }
          case nvgre{
            leaf nvgreFlag {
                description
                  "The 13 bits flags of NVGRE. Bit 0 and 3 are set
                  to 0 while bit 2 is set to 1. Others are reserved";
                type flags-nvgre;
            }
            leaf flowId {
              description
```

```
                    "This is an 8-bit value that is used to provide
                    per-flow entropy for flows in the same VSID.
                    If a FlowID is not generated, it MUST be set to
                    all zero.";
                  type uint8;
                }
              }
            }
            choice bumMode{
              case headEnd{
                leaf-list peerAddr {
                  description
                    "Remote NVE address.";
                  type inet:ip-address;
                }
              }
              case multiGroup{
                leaf multiAddr {
                  description
                    "The multicast group address.";
                  type inet:ip-address;
                }
              }
            }

          }
        }//container members
      }
    }//container nvo3Nves

    container nvo3Infos {
      list nvo3Info {
        key "VNI";
        leaf VNI {
          description
            "Virutal Network Instance (VNI). For VxLAN, it is
            VXLAN Network Identifier; For NVGRE, it is Virtual
            Subnet Identifier.";
          mandatory "true";
          type uint32 {
          range "1 .. 16777215";
          }
        }
        leaf statisticsEnable {
          type enumeration {
            enum enable {
```

```
                value "0";
                description
```



```
                  "Enable";
              }
              enum disable {
                value "1";
                description
                  "Disable";
              }
            }
          }
          leaf status {
            config "false";
            type enumeration {
              enum up {
                value "0";
                description
                  "Up";
              }
              enum down {
                value "1";
                description
                  "Down";
              }
            }
          }
        }
      }//container nvo3Infos

      container nvo3Statistics {
        list localNVE {
          config "false";
          leaf count {
            description
              "The value of count.";
            config "false";
            type uint64;
          }
          leaf-list ipAddr {
            description
              "List of local NVE address.";
```

```
          config "false";
          type inet:ip-address;
        }
      }
      list remoteNVE {
        config "false";
        leaf count {
          description
            "The value of count.";
```



```
          config "false";
          type uint64;
        }
        leaf-list ipAddr {
          description
            "List of remote NVE address.";
          config "false";
          type inet:ip-address;
        }
      }
      container flowStatistics {
        grouping inputStatistics {
          leaf inPacketsCount {
            config "false";
            type uint64;
          }
          leaf inBytesCount {
            config "false";
            type uint64;
          }
          leaf inUnicasts {
            config "false";
            type uint64;
          }
          leaf inMulticasts {
            config "false";
            type uint64;
          }
          leaf inBroadcasts {
            config "false";
            type uint64;
          }
```

```
          leaf inUnknownUnicastDrops {
            config "false";
            type uint64;
          }
          leaf inUnknownMulticastDrops {
            config "false";
            type uint64;
          }
          leaf inBroadcastsDrops {
            config "false";
            type uint64;
          }
        }
        grouping outputStatistics {
          leaf outPacketsCount {
            config "false";
```



```
            type uint64;
          }
          leaf outBytesCount {
            config "false";
            type uint64;
          }
          leaf outUnicasts {
            config "false";
            type uint64;
          }
          leaf outMulticasts {
            config "false";
            type uint64;
          }
          leaf outBroadcasts {
            config "false";
            type uint64;
          }
        }
        leaf instanceCount {
          config "false";
          type uint64;
        }
        list flowStatistic{
          config "false";
```

```
          leaf VNI {
            description
              "Virutal Network Instance (VNI). For VxLAN, it is
              VXLAN Network Identifier; For NVGRE, it is Virtual
              Subnet Identifier.";
            config "false";
            type uint32;
          }
          uses inputStatistics;
          uses outputStatistics;
        }
      }//container flowStatistics
      container MacStatistics {
        list MacStatistic{
          config "false";
          leaf VNI {
            description
              "Virutal Network Instance (VNI). For VxLAN, it is
              VXLAN Network Identifier; For NVGRE, it is Virtual
              Subnet Identifier.";
            config "false";
            type uint32;
          }
```



```
          leaf vmMacCount {
            description
              "Count of learning Mac addresses for the VNI.";
            config "false";
            type uint64;
          }
        }
      }//container MacStatistics
    }//container nvo3Statistics
  }
  <CODE ENDS>
```

4. Security Considerations

This document raises no new security issues.

5. IANA Considerations

The namespace URI defined in Section 3.3 need be registered in the IETF XML registry [RFC3688].

This document need to register the 'nvo3-base' YANG module in the YANG Module Names registry [RFC6020].

Acknowledgements

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