IPv6-based Cloud-oriented Networking(CON)

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Motivation

- **With the development of cloud computing, new connections between enterprise sites to cloud data centers and inter-cloud are added, which bring new requirements and challenges for existing networks.**

- **[I-D.ietf-rtgwg-net2cloud-problem-statement] describes the problems that enterprises face today when interconnecting their branch offices with dynamic workloads in third party data centers (a.k.a. Cloud DCs).**

- **This document also describes other challenges**
  - It is hard to support end-to-end path programming in IPv4/MPLS based SD-WAN due to the complicated configurations in Option A.
  - Underlay path can not be specified when using VXLAN in WAN, strict TE requirements like deterministic delay, specified path forwarding can not be guaranteed.

- **This document propose IPv6-based Cloud-Oriented Networking (CON). It also describes**
  - the challenges for existing networks when clouds and networks are converged,
  - requirements that IPv6-based CON should satisfy
  - the solutions in IPv6-based CON that satisfy the requirements.

Problem Statement

- **As the develop of Telco clouds, Edge clouds, and Third-party OTT clouds, the traffic pattern in the carrier networks have been changed. It also introduces new challenges for existing networks.**
  - **Underlay:**
    - hard to establish a quick connection due to complicated MPLS/IPv4 configuration,
    - hard to support SFC.
  - **Overlay**
    - Underlay path can not be specified when using VXLAN in SD-WAN, strict TE requirements like deterministic delay, specified path forwarding can not be guaranteed.
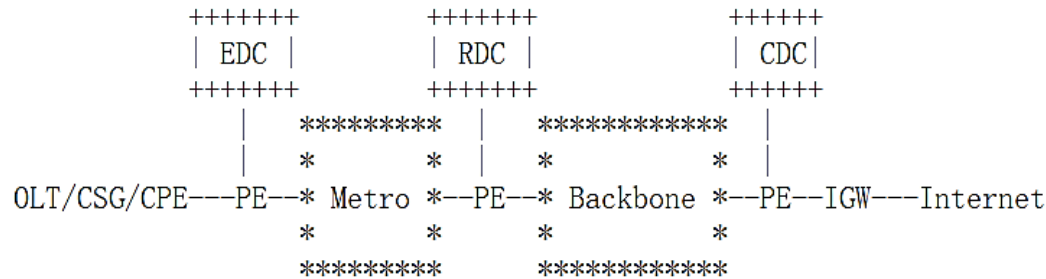
```
       +++++++           +++++++              ++++++
       | EDC |           | RDC |              | CDC|
       +++++++           +++++++              ++++++
          |      *********   |   ***********     |
          |      *        *  |  *          *     |
OLT/CSG/CPE---PE--* Metro *--PE--* Backbone *--PE--IGW---Internet
          |      *        *  |  *          *     |
          |      *********   |   ***********     |
```

Figure 1.Typical topology of telco cloud

```
Site CPE1--POP GW1 ----------------------------POP GW2---Site CPE2
                     |                           |
                     |       SD-WAN Backbone     |
                     |                           |
Cloud1---POP GW3---------------------------------POP GW4--Cloud2
```
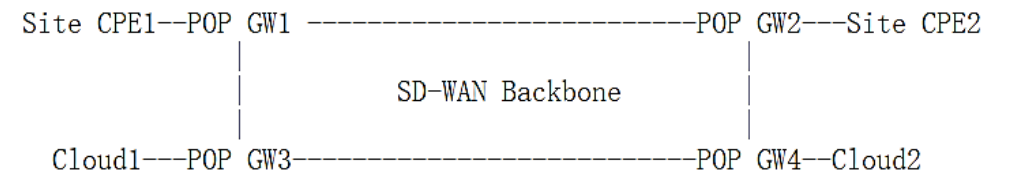
Figure 2. Typical topology of SD-WAN

Requirements in IPv6-based CON

- Quick Connection
- Hybrid Network Connection
- Path Programming
- Resource Assurance
- Deterministic Delay
- Service Function Chaining

- Performance Measurement
- Reliability
- Security
- Forwarding Efficiency
- Application-Aware Networking

Solutions in IPv6-based CON

- VPN

- Path Programming

- Service Function Chaining

- IPv6-based Network Slicing

- IPv6-based On-path Measurement

- Reliability

- Security

- IPv6 Forwarding Efficiency

- Application-Aware IPv6 Networking

Quick Connection

- Requirement:
  - Enterprise sites can locate at any location around the world, they need to connect to the clouds or other sites in any time, from any where. Therefore quick connection is required in IPv6-based CON.

- Solution:
  - SRv6
    - Supports quick VPN connection.
    - Forwarding based on IPv6, E2E connection, easy to be deployed in inter-AS/inter-domain scenarios.
  - More?

Hybrid Network Connection

- Requirement:
  - The enterprise VPN traffic can be forwarded around the world, which may travel heterogeneous networks, such as IPv4, MPLS and IPv6.

- Solution:
  - E2E SRv6 over everything?
  - Interworking solutions for SRv6 and SR-MPLS and IPv4?
  - G-SRv6 [1][2][3]?

[1] [I-D.cl-spring-generalized-srv6-np] [2][I-D.lc-6man-generalized-srh] [3][I-D.cl-spring-generalized-srv6-for-cmpr]

Path Programming

- Requirement:

    - When the enterprise VPN traffic is forwarded among sites or clouds, it may be forwarded along different paths. Each path has different performance such as different bandwidth, delay, etc.

    - In order to meet the different SLA requirements, IPv6-based CON MUST support path programming.

- Solution:

    - SRv6 network programming supports E2E path programming.

Resource Assurance

- Requirement:

  - In RSVP-TE MPLS, resources like bandwidth can be reserved for an LSP. When the traffic is forwarded along the LSP, the bandwidth can be guaranteed, which makes sure that the traffic will not be affected by other traffic. In order to provide SLA guaranteed services, IPv6-based CON MUST support Resource Assurance

- Solution:

  - IPv6-based Network Slicing, such as VPN+ [I-D.ietf-teas-enhanced-vpn]

  - More?

Deterministic Delay

- Requirement:

  - In the traditional network, the shortest forwarding path is calculated based on the metric, and the metric is usually associated to the physical hops instead of latency. However, minimum delay forwarding is required for delay-sensitive traffic, like real-time video broadcast and video meeting.

- Solution:

  - DETNET?

  - STN?

Service Function Chaining

- Requirement:

  - Typically, different tenant's traffic in cloud data center will traverse different services function chain containing Firewall, DPI or other VAS. Therefore, IPv6-based CON MUST have the capability to support SFC

- Solution:

  - SRv6 based SFC [I-D.ietf-spring-sr-service-programming]

Performance Measurement

- Requirement:

    - Many OAM mechanisms are used to support network operation. Performance Measurement (PM) is one of the most important part of OAM. With PM, the real-time QoS of the forwarding path, like delay, packet loss ratio and throughput, can be measured.

    - On-path telemetry is an hybrid mode OAM/PM mechanism, which provides better accuracy than active PM. Therefore, on-path Performance Measurement MUST be supported in IPv6-based CON.

- Solution:

    - IPv6 Alternate Marking [I-D.ietf-6man-ipv6-alt-mark]

    - IFIT [I-D.song-opsawg-ifit-framework]

    - IOAM [I-D.ietf-ippm-ioam-ipv6-options]

Reliability

- Requirement:
    - In Cloud-Network Interconnection scenarios, the enterprise traffic is forwarded over the WAN paths. The traffic can be sensitive to delay or packet losing, so high reliability is required in these scenarios. Therefore, protection of node and links MUST be supported in IPv6-based CON.

- Solution:
    - BFD for E2E protection
    - FRR for local protection
        - Midpoint protection
        - Egress protection
    - Redundancy protection

Security

- Requirement:
  - IPv6-based CON MUST support secure connection, and MUST provide security assurance for the traffic in transmission.

- Solution:
  - Existing IPv6/SRv6 security mechanisms

Forwarding Efficiency

- Requirement:

  - Tenants/Customers rent the physical or logical WAN links/paths from network operators for building they cloud-network interconnection enterprise network, so the forwarding efficiency is important for the WAN path tenant.

  - Therefore, the IPv6-based CON MUST support PMTU probing and configuration. In addition, it MUST support SRv6 compression.

- Solution:

  - PMTU discovery

  - SRv6 compression: G-SRv6

Application-aware Networking

- Requirement:

  - In IPv6-based CON, many types of applications' traffic is exchanged between sites and clouds. They have various requirements of QoS, and should be treated differently. In order to provide finer granularity traffic engineering to reduce the cost of WAN services, application- aware networking SHOULD be supported in IPv6-based CON.

- Solution:

  - APN6 [I-D.li-6man-app-aware-ipv6-network]

  - More?

Next Step

- Comments are welcome!

- Collaboration are welcome!

- Will add more content as the development of Cloud-Oriented Networking(CON).

Thank you