Dynamic Network Adjustments for Cloud Service Scaling

draft-dunbar-neotec-net-adjust-cloud-scaling-02

ldunbar@futurewei.com

xiechf@chinatelecom.cn

kausik.majumdar@oracle.com

sunqiong@chinatelecom.com

IETF 121 Dublin

Problem Statement

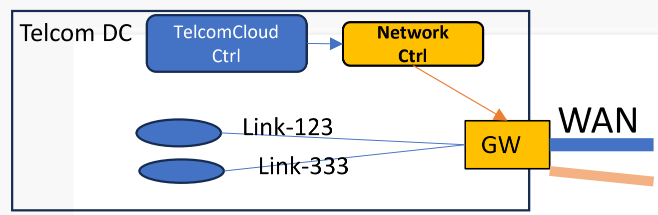
- **Key Challenges**:
  - Lack of coordination between dynamic cloud service scaling and network configuration.
  - Proprietary solutions limit interoperability across multi-vendor environments.
  - Manual adjustments lead to delays and potential service disruptions.
  - No standardized framework for automating network responses to cloud scaling.
- **Solution**:
  - A framework that automates network adjustments triggered by cloud service changes using standardized YANG models.
  - Extending RFC8969

Dynamic-Bandwidth YANG Model:

E.g. when a cloud orchestration system detects increased traffic, it can dynamically request an increase in bandwidth to 1000 Mbps (1 Gbps) on network link link-123:

```
module dynamic-bandwidth {
namespace "urn:ietf:params:xml:ns:yang:dynamic-bandwidth";
prefix dbw;

import ietf-network-topology {
  prefix nt;
}

organization "IETF";
contact "IETF Routing Area";
description
      "YANG model for dynamically updating bandwidth on network links.";

revision "2024-10-18" {
  description "Initial version.";
}

augment "/nt:networks/nt:network/nt:link" {
  description
    "Augment the network topology YANG model to update
        the bandwidth dynamically.";

  leaf requested-bandwidth {
    type uint64;
    description "Requested bandwidth in Mbps.";
  }
 }
```

```
{
  "nt:networks": {
    "nt:network": [
      {
        "network-id": "cloud-network-1",
        "nt:link": [
          {
            "link-id": "link-123",
            "source-device": "device-1",
            "destination-device": "device-2",
            "requested-bandwidth": 1000  // 1000 Mbps bandwidth
          }
        ]
      }
    ]
  }
}
```



More complicated scenario: The Blue WAN path is no longer enough for sudden surge of the Cloud service (blue), need GW to aggregate additional WAN paths to form a bigger pipe for the Blue service. Need a standard interface.

Dynamic-Load-Balancer YANG Model:

- E.g., a JSON configuration to trigger the automatic load balancer change for a newly deployed ML service that requires the ML-optimized load balancing algorithm:


```json
{
  "load-balancer": {
    "balancer": [
      {
        "balancer-id": "ml-service-lb",
        "algorithm": "ml-optimized",
        "backend-servers": [
          {
            "server-id": "ml-backend-1",
            "ip-address": "192.168.10.1",
            "port": 8080
          },
          {
            "server-id": "ml-backend-2",
            "ip-address": "192.168.10.2",
            "port": 8080
          },
          {
            "server-id": "ml-backend-3",
            "ip-address": "192.168.10.3",
            "port": 8080
          }
        ]
      }
    ]
  }
```


```
module: dynamic-load-balancer
  +--rw load-balancer
     +--rw balancer* [balancer-id]
        +--rw balancer-id        string
        +--rw algorithm          enumeration
        |     +-- round-robin          "Distributes traffic evenly
                                        across all servers in rotation."
        |     +-- least-connections    "Sends requests to the server
                                        with the fewest active connections."
        |     +-- ip-hash              "Distributes requests based on a
                                        hash of the client's IP address."
        |     +-- ml-optimized         "Routes long-lived ML flows
                                        through highest bandwidth paths."
        +--rw backend-servers* [server-id]
           +--rw server-id       string
           +--rw ip-address      inet:ipv4-address
           +--rw port            uint16
```

Dynamic-ACL Augment ietf-acl-enh YANG Model:

- E.g., JSON code to add a new rule (rule-3) to the ACL acl-123, allowing SSH traffic (port 22) from source IP 192.168.1.101 to destination IP 10.0.0.10. The existing rules, rule-1 and rule-2, control HTTPS (port 443) and block HTTP traffic (port 80), respectively

```
{
  "acl:acls": {
    "acl": [
      {
        "name": "dynamic-acl-001",
        "aces": {
          "ace": [
            {
              "name": "dynamic-rule-1",
              "actions": {
                "forwarding": "permit"
              },
              "matches": {
                "ipv4": {
                  "source-ipv4-network": "192.168.1.0/24",
                  "destination-ipv4-network": "10.0.0.0/24"
                },
                "protocol": "tcp",
                "source-port": 22
              },
              "cloud-service-trigger": "ml-service-scaling",
              "priority": 10
            }
          ]
        }
      }
    ]
```

```
module: dynamic-acl
  augment /acl:acls/acl:acl/acl:aces/acl:ace:
    +--rw cloud-service-trigger?   string
    +--rw priority?                uint32
```

- cloud-service-trigger: identifies the specific cloud service event that necessitates the ACL change. It is optional (?)
- Priority: sets the priority level of the Access Control Event (ACE), helping to determine the order in which the ACEs are evaluated. It is also optional.

Security Considerations

- **Authentication and Authorization:**
  - Use mutual authentication methods such as TLS certificates to verify the identities of both the cloud orchestrator and the network controller before any configuration commands are accepted.
  - OAuth or API Key-Based Access: For REST API-based communications, secure token-based authentication (e.g., OAuth 2.0) or unique API keys can be employed to validate requests from legitimate sources.
- **Data Integrity:**
  - Use TLS to encrypt communication channels, protecting the integrity of the transmitted data.
  - Employ checksums or hash functions on critical configuration messages to detect any tampering or unintended modifications during transit.
- **Monitoring and Auditing:**
  - Maintain detailed logs of all configuration changes initiated by cloud scaling events, including timestamps, source entities, and specific parameters modified.
  - Conduct periodic audits of the authorization policies, access logs, and configuration adjustments to ensure compliance with security policies and to detect any anomalies.