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.
  - Exposing some network information to Cloud Controller for service orchestration.
  - Extending RFC8969

Dynamic-Load-Balancer YANG Model:

E.g., JSON code to request changing the load balance algorithm to optimize forwarding for a specific flow (like Flow X) dynamically across the network:

```
{
  "flow-optimization": {
    "flow-id": "Flow-X",
    "traffic-type": "ML",
    "priority": "high",
    "action": "optimize",
    "algorithm": "ml-optimized",
    "congestion-awareness": {
      "enabled": true,
      "state-feedback": "global"
    }
  }
}
```

```
module: dynamic-load-balancer
  +--rw load-balancer
     +--rw router* [router-id]
        +--rw router-id              string
        +--rw algorithm              enumeration
        |  +-- round-robin           evenly across all paths.
        |  +-- least-connections     select path with the fewest flows.
        |  +-- ip-hash               based on a hash of IP.
        |  +-- ml-optimized          Optimizes for ML flows.
        |  +-- packet-level          per-packet basis.
        +--rw paths* [path-id]
           +--rw path-id             string
           +--rw destination         inet:ipv4-prefix
           +--rw bandwidth           uint64
           +--rw latency             uint32
           +--rw congestion-awareness
              +--rw enabled          boolean
              +--rw state-feedback enumeration
                 +-- local           Only local path congestion state is used.
                 +-- global          Global network path congestion state is
used.
```

The Network Controller sends directives to routers along the path between the source and destination of Flow X, instructing them to adjust their load balancing strategies in real-time, ensuring Flow X takes the highest bandwidth path while deprioritizing other flows as necessary. The network dynamically responds to congestion states to maintain optimal performance for Flow X.

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

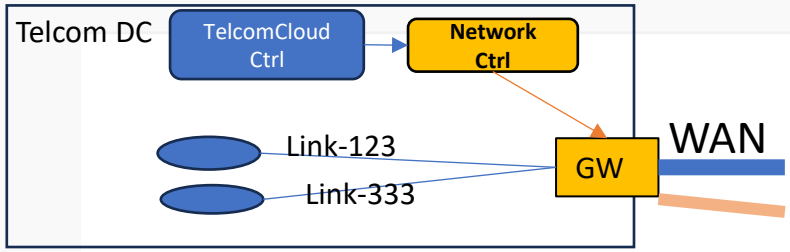
- cloud-service-trigger: identifies the specific cloud service event that necessitates the ACL change. It is optional (?)
- Priority: sets the priority level of the Access Control Event (ACE), helping to determine the order in which the ACEs are evaluated. It is also optional.

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.

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.