Automatic Network Congestion Relief in GRASP

AINIMA WG

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MENGYAO HAN, ZHAO JING, ZHANG SHUAI, ZHENG RUAN (CHINA UNICOM)

email:hanmy12@chinaunicom.cn

Background

- Nowadays, fiber optic failures occur frequently, leading to network congestion and becoming a common pain point for operators. These issues require specific personnel to conduct daily inspections of traffic and manually hourly adjust configurations, which significantly increases the difficulty of network maintenance.
- We introduce an **automatic congestion relief mechanism** based on traffic analysis and auto-regulation. In the event of congestion caused by fiber optic failures, it can **respond and self-heal in real time**, solving the network congestion and maintenance challenges faced by operators due to fiber optic failures, and ensuring the stable operation of the network.

Automatic Network Congestion Relief

This second - level congestion relief mechanism is automated within the device. Leveraging traffic analysis, it precisely calculates the volume of traffic requiring redistribution. Subsequently, it redirects this traffic to paired devices via inter-device protocol announcements and the automatic adjustment.

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| Traffic Modeling  |------>| Traffic Monitoring  |---->| Intelligent policy generation |
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                           |   Policy Reversion  |<----|       Policy Regulation     |
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Figure 1: Mechanism Framework Description

Step1: Traffic Modeling

- Real-time Traffic Sorting: the device component of the chip get traffic information and employs flow recognition algorithms to perform traffic modeling.

Automatic Network Congestion Relief

- **Step2: Traffic Monitoring**
  - GRASP Extension and Information Acquisition
- **Step3: Policy Generation**
  - When its utilization exceeds the predefined congestion threshold, the device launches intelligent module.
  - The device intelligently calculates the level of traffic to be redistributed based on traffic analysis.
- **Step4: Policy Propagation**
  - Announce the automatic adjustment mechanism of routing priorities through the GRASP protocol.
  - Completing the process within seconds
  - Without affecting existing routing policies in the network
- **Step5: Policy Reversion**

GRASP Requirements and Specification

> I believe this is not the best approach. There is no need to define new GRASP options; that would require modifications to the entire implementation of the GRASP protocol. The better approach is to define two GRASP objectives. Please see [1] for the guidelines and [2] for a complete example There is prototype code for that example at [3, 4]).

- New GRASP Objectives ~~Options:~~ Congestion Monitoring

A new Objectives is defined within the GRASP protocol to carry congestion status information transmitted between Autonomous Service Agent (ASA) nodes. As an example, a node MAY periodically transmit messages that include its local congestion metrics, such as queue length and bandwidth utilization to adjacent nodes.

- New GRASP Objectives: Bandwidth Allocation

Leveraging the negotiation mechanism inherent to the GRASP protocol, network nodes are able to negotiate the allocation of bandwidth resources. Upon the occurrence of network congestion, nodes SHALL renegotiate the bandwidth allocation scheme, reduce the bandwidth consumption of non-critical traffic flows, and release additional resources to be allocated to critical traffic flows.

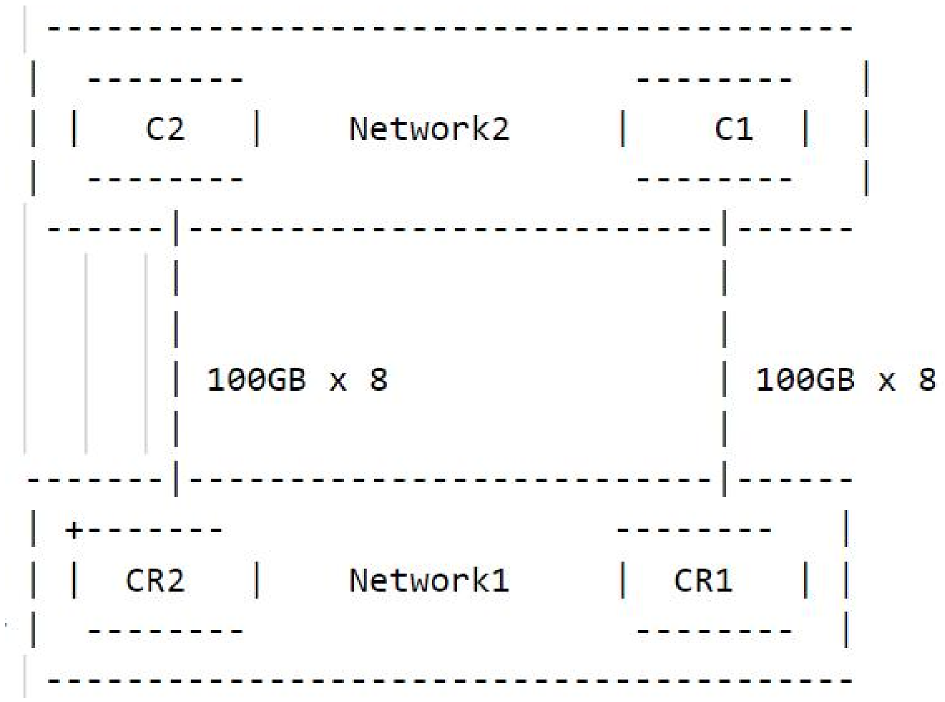
Next Steps

- After the previous discussion, the use case is a good application for GRASP.
- We receive the comments and guides from Brian, we should further consider a better approach to extend GRASP and further give more detail.
- More comments, suggestions and contributions would be welcome.

Thanks for listening!

Usecase

- **Step1: Traffic Modeling**
  - Real-time TOP-N traffic modeling.
  - 100GB x 8 total bandwidth between CR1-C1 & CR2-C2, 600GB current traffic on each.
- **Step2: Traffic Monitoring**
  - Devices auto-detects CR1-C1 link failures (5 link).
- **Step3: Intelligent Policy Generation**
  - Identifying the TOP-N routing prefixes to be adjusted.
  - The intelligent module of CR1 auto-generates policies.
- **Step4: Policy Propagation**
  - CR1 auto-sends policies to C1.
  - C1 updates the routing. Divert 200G high - priority traffic to CR2 - C2 to ease CR1 - C1 congestion.
  - Result: CR1-C1 down to 300G, CR2-C2 up to 800G, efficient resource use.
- **Step5: Policy Reversion**
  - Device detects CR1-C1 link recovery.
  - Gradually withdraws policies.



Automation Decision-Making Usecase for Automatic Network Congestion Relief