DREAMSCAPE: Dual Routing Engine Architecture in Multi-layer/multi-domain Scalable Constraint-Aware Policy-Enabled optical networks

(Invited)

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Abstract Architecture of DREAMSCAPE is introduced into optical networks combined with ASON/GMPLS, and a selection scheme is proposed for group engine (GE) and unit engine (UE). Then the cooperation relationship of modules in GE and the verification platform are described.

Introduction

In order to enhance the scalability and flexibility of large-scale optical networks, especially optimize the routing performance, optical networks need to be partitioned into multi-layer/multi-domain. Optical Internetworking Forum (OIF) first gave a realization method of ASON hierarchical routing and the corresponding inter-domain routing protocol (DDRP) in the draft standards OIF2002.23. Then, Internet Engineering Task Force (IETF) proposed GMPLS-based architecture of multi-layer/multi-domain optical networks [1], in which GMPLS is adopted for the single-domain routing, and traffic engineering parameters related to the GMPLS-based routing are flooded only in the region, while the routing information is collected through DDRP to support the inter-domain hierarchical routing. However, there are some problems for the hierarchical routing, for example, the routing information collected through DDRP is not so accurate that traffic engineering, information flooding, protection and restoration, especially routing under multi-layer/ multi-domain can not be solved effectively.

Then, IETF proposed PCE-based network architecture to solve the routing problem under multi-layer/multi-domain [2]. As the function object of path computation, PCE can compute the best path according to the known network topology and constraints. The performance of routing under multi-layer/multi-domain by PCE has been verified [3]. However, the architecture of PCE is not advantageous for the distributed network control.

Combining the advantages of traditional control plane and PCE, we propose the architecture of dual routing engines (DRE) for multi-layer/multi-domain scalable constraint-aware policy-enabled optical networks. The architecture can not only reduce flooding information and complete the distribution control over networks, but also achieve the effective routing under multi-constraints for multi-layer/multi-domain optical networks and be scalable for large scales. A selection scheme is proposed for GE and UE, and then the cooperation relationship of modules in GE and the verification platform are described.

DRE architecture based on GMPLS and PCE

As Fig.1 shows, a novel routing architecture is proposed base on GMPLS/PCE. The routing module in traditional ASON acts as Unit Engine (UE), which provides the functions, such as topology discovery and routing control. The Group Engine (GE) is set based on PCE, which provides the service of path computation under complex constraints. GE and UE have different Traffic Engineering Databases (TEDs) which correspond to the network with different scales. Routing Engine Selector (RES) takes charge of selecting the proper routing engine. The Group Computation Agent (GCA) corresponds to the PCC in PCE architecture. When a route request arrives, the RES selects GE or UE to complete the path computation. Sometimes, some GEs can cooperate with some UEs to complete the path computation fast and accurately.

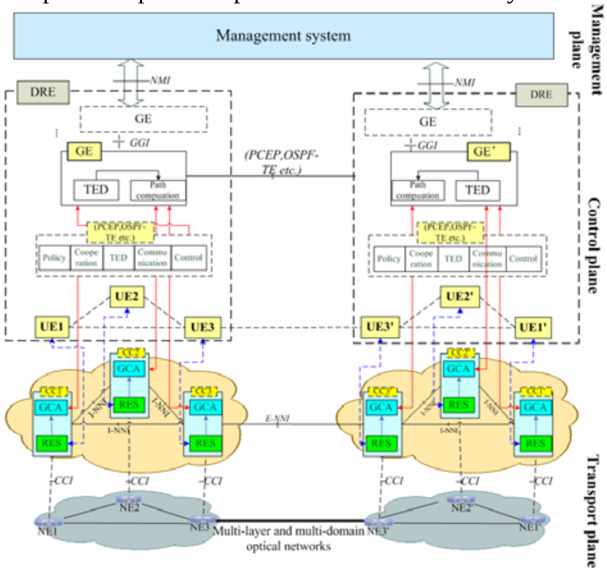

Fig.1 DRE architecture based on GMPLS and PCE

Selection scheme of DRE for GE and UE

As shown in Fig.2, when a service request arrives, DRE is checked whether there is any fault. If there is a failure for a routing engine, the other engine will be selected for backup. Then multi-constraints will be judged, such as policy and physical constraints. GE will be selected when there are some constraints. Otherwise, the destination will be checked. If the destination is in local domain, UE will be selected, or else GE is selected.

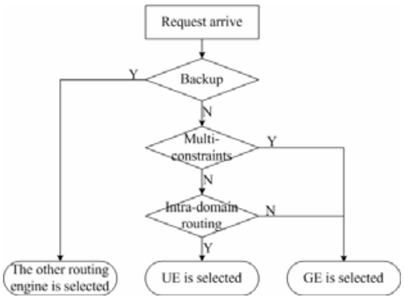

Fig.2 Procedure of routing engine selection

Cooperation relationship of modules in GE

As Fig.3 shows, there are eight function modules in GE, namely network communicator, message parser, path computer, policy parser, authentication/authorization/ counter, north interface processor, link resource manager, internal resource manager, and three resource modules, traffic Engineering Library (TED), policy database, authentication/authorization/account table (AAA). The functions of eight modules are described as follows:

a) Network communicator: communication interface for GE with others.

b) Message parser: parse the information flow from network communicator, interpret them for GE, and then transfer them to the corresponding modules;

c) Authentication/authorization/counter: assure the security of GE, decide whether the service sender has been authorized, and counted;

d) Policy parser: all the policies are stored in the information flow by some rules, and need to be parsed according to the policy database;

e) Path computer: respond the path computation request in GE. Three results may be returned: strict route, suggestion for overlooking some constraints, or failure;

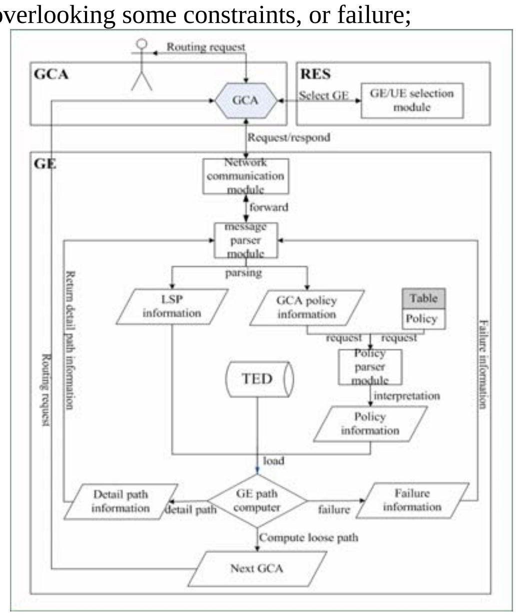

Fig.3 Cooperation relationship of all the modules in GE

f) Internal resource manager: respond GCA resource discovery request, get some information, such as topology information and computation ability, and notify GCA;

g) Link resource manager: respond GE resource discovery request, get some information, such as topology information and computation ability, and notify GE;

h) North interface processor: respond network management request, get some information, such as topology information and computation ability, and notify the management plane;

Fig.3 describes the interaction between GCA and GE and the cooperation among the modules in GE. There is a C/S structure between GCA and GE, in which GCA sends path computation request to GE and GE serves for GCA, completing path computation and returning the results.

Platform design

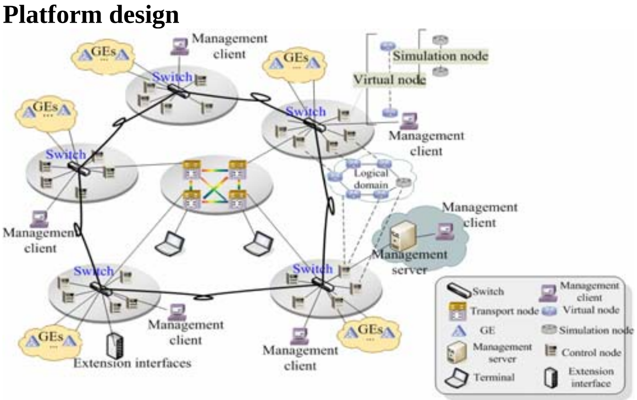

Fig.4 Verification platform of DRE

As Fig.4 shows, the verification platform consists of transport nodes, control nodes, virtual nodes, simulation nodes and management plane, and supports large scale multi-layer/ multi-domain optical network experiment. The platform will contain more than 1000 nodes, 16 to 25 domains and 2 to 4 layers. DRE will be applied in the platform to improve the performance of the network.

Conclusion

DRE is proposed for multi-constraints multi-layer/multi-domain GMPLS-based optical networks, combining the advantages of GMPLS and PCE. A selection scheme is proposed for GE and UE. The cooperation relationship of modules in GE and the verification platform are described.

Acknowledgement

This work has been supported in part by National 863 program (2009AA01Z255), National 973 Program (No. 2007CB310705), PCSIRT program (IRT0609) and 111 Project (B07005) of China. Corresponding author is Jie Zhang (lgr24@bupt.edu.cn).

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