Smart Information Network: A Testbed Architecture for Future Internet

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Abstract. This paper introduces a testbed architecture for future Internet, which is called smart information network (SIN). The testbed opens up capabilities of network nodes through programmable platform, builds a uniform schedule system and various decision applications. The testbed can be easily employed to design and verify future Internet concepts.

Keywords: testbed, future network, cognitive network, programmability.

1 Introduction

Recently, future Internet research has attracted attentions, which is towards the design of new Internet architecture from clean slate. Many programs about future Internet research have been established, e.g. FIND [1], GENI [2], FIA [3], FIRE [4], and so on. In these programs, FIRE and GENI are two major initiatives for developing large scale future Internet testbeds.

One important trend in the field of testbed is programmability [5], which allows user to program network nodes. For example, OpenFlow [6] is employed in GENI to provide programmability. However, OpenFlow only provides a interface to modify flow table entries.

There are other trends in the field of testbed, e.g. virtualization and federation [5], which increase the complexity of testbed. As a result, the testbed is difficult to manage, and automatic management techniques are needed. Recently, cognitive network has been presented to decrease human intervention, which can sense current reality, plan for the future, make a decision and act accordingly [7]. We believe that it is beneficial to automate testbed management.

2 System Overview

SIN is presented in this paper, which exposures more capabilities, builds up a scheduler platform for different equipments, and establishes various programmable

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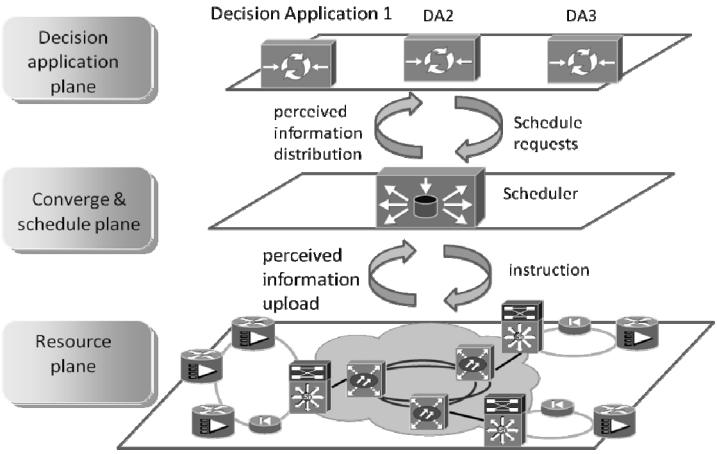

Fig. 1. The architecture of SIN

decision applications (DA) with cognitive loop, as shown in figure 1. SIN achieves smart configuration, control and information transmission.

2.1 Resource Plane

Resource plane is responsible for perceiving network status, transferring data flow and opening up network capabilities. Resource nodes can perceive the status of interior module, dada packet, link, path and so on. Rules are constructed inside network nodes, which denote the process manner of perceived information, such as forward, upload, modify, drop, and so on. For the information without a match rule, it will be delivered to scheduler to decide whether a rule should be added.

Network nodes with open capabilities can be constructed using NetMagic programmable platform [8]. Using pass through mode of NetMagic, all flows from input interface are transmitted to user module (UM). Capabilities are programmed and embedded in UM, such as perceive set, port management, route table control and so on. In control module of NetMagic, management functions can be called, and then configure and execution in network nodes can be changed.

Subsumption architecture [9] is employed in network nodes to decompose complicated intelligent behaviors into simple behavior modules, which can improve action speed and avoid conflict. Behavior module subsumes underlying modules, e.g. if two module's results have conflict, higher module's result will be accepted, and lower module's result will be rejected.

2.2 Converge and Schedule Plane

This plane distributes perceived information, controls network nodes, and maintains network topology view. For each DA, a distribution space is determined in this plane,

which denotes that perceived information in such space should be transmitted to a DA, i.e. a mapping from a set of DAs to a set of perceived information field range.

Scheduler classifies perceived information, and distributes the information to DAs. To improve distribution speed by parallel processing, mapping from each perceived information field to DAs should be determined from above mentioned mapping. If perceived information is received by a scheduler, it will be analyzed by filed resolvers. Each resolver produces a set of DAs, and the intersection of all sets is the final set of DAs that should process the information.

2.3 Decision Application Plane

This plane is responsible for analyzing perceived information, making decision and invoking actions, which consists of various DAs. Diverse DAs can be constructed, such as energy efficiency DA, safe network DA, and so on. Energy efficiency DA can close low load ports, links and modules temporarily to reduce energy consumption. Safe network DA can determine if a host is attacked by flow rate analysis, e.g. DDOS attack, and suspend the attack flows.

3 Conclusion

The design and architecture of SIN is presented in this paper. Functions and characters of three planes of SIN are also illustrated. SIN is innovative for designing and verifying future Internet concepts. In the future, we will design key technologies and build the testbed.

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