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An Architecture of Network Artificial Intelligence(NAI)
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Abstract

Artificial intelligence is an important technical trend in the industry. With the development of network, it is necessary to introduce artificial intelligence technology to achieve self-adjustment, self- optimization, self-recovery of the network through collection of huge data of network state and machine learning. This draft defines the architecture of Network Artificial Intelligence (NAI), including the key components and the key protocol extension requirements.

Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described inRFC 2119 [RFC2119]

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

Artificial Intelligence is an important technical trend in the industry. The two key aspects of Artificial Intelligence are perception and cognition. Artificial Intelligence has evolved from an early non-learning expert system to a learning-capable machine learning era. In recent years, the rapid development of the deep learning branch based on the neural network and the maturity of the big data technology and software distributed architecture make the Artificial Intelligence in many fields (such as transportation, medical treatment, education, etc.) have been applied. With the development of network, it is necessary to introduce artificial intelligence technology to achieve self-adjustment, self-optimization, self-recovery of the network through collection of huge data of network state and machine learning. The areas of machine learning which are easier to be used in the network field may

include: root cause analysis of network failures, network traffic prediction, traffic adjustment and optimization, security defense, security auditing, etc., to implement network perception and cognition.

This draft defines the architecture of Network Artificial Intelligence (NAI), including the key components and the key protocol extension requirements.

2. Terminology

AI: Artificial Intelligence

NAI: Network Artificial Intelligence

3. Architecture

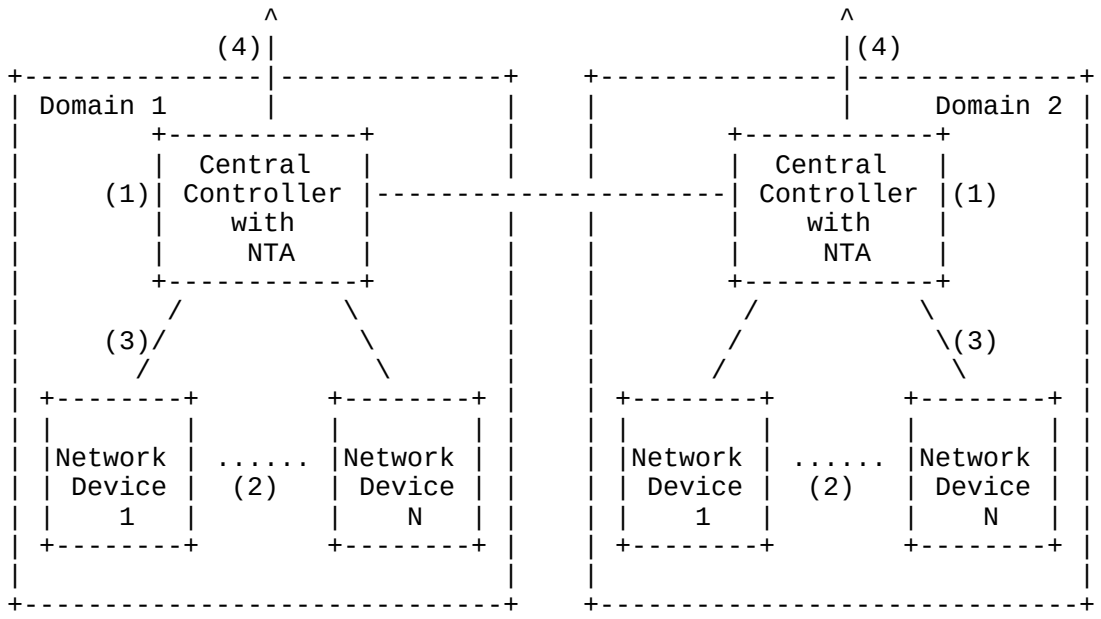

Figure 1: An Architecture of Network Artificial Intelligence(NAI)

The architecture of Network artificial intelligence includes following key components:

(1) Central Controller: Centralized controller is the core part of Network Artificial Intelligence which can be called as 'Network

Brain'. The Network Telemetry and Analytics (NTA) engines can be introduced acompanying with the central controller. The Network Telemetry and Analytics (NTA) engine inclues data collector, analytics framework, data persistence, and NAI applications.

(2) Network Device: IP network operation and maintenance are always a big challenge since the network can only provide limited state information. The network states includes but are not limited to topology, traffic engineering, operation and maintenance information, network failure information and related information to locate the network failure. In order to provide these information, the network must be able to support more OAM mechanisms to acquire more state information and report to the controller. Then the controller can get the complete state information of the network which is the base of Network Artificial Intelligence(NAI).

(3) Southbound Protocol and Models of Controller: As network devices provide huge network state information, it proposes a number of new requirements for protocols and models between controllers and network devices. The traditional southbound protocol such as Netconf and SNMP can not meet the performance requirements. It is necessary to introduce some new high-performance protocols to collect network state data. At the same time, the models of network data should be completed. Moreover with the introduction of new OAM mechanisms of network devices, new models of network data should be introduced.

(4) Northbound Model of Controller: The goal of the Network Artificial Intelligence is to reduce the technical requirements on the network administrators and release them from the heavy network management, control, maintenance work. The abstract northbound model of the controller for different network services should be simple and easy to be understood.

4. Process

NAI consists of following processes:

-- Data Collection

From the time aspect, data collection can be divided into real-time data collection and non-real-time collection.

From the content aspect, data collection can be divided into network information collection (including topology, tunnels, routing, equipment configuration, etc.) and traffic collection (the collection network traffic, network load, device KPI, etc.).

-- Data Storage

Store data collected from network. Many existing big data storage technologies can be used here.

-- Data Processing

This is preliminary data processing too select effective data and simply analyse data relationship.

-- Analyse

Analyse engine will provide the data analysis results using machine learning algorithm.

-- Closed Loop Control

According to the results of intelligent analysis and policy set by user, the centrol controller will implement closed-loop control of the network.

5. Classification

NAI can be divided into off-line process and on-line process in accordance to the time aspect of the data collection and analysis.

Off-line process refers to process of the existing data, or non-real-time collection data. Although the analysis process will also focus on the relationship between data and time, but it does not require real-time analysis. Off-line process is mainly used for two purposes: (1) training or verification of real-time process design; (2) trouble shooting or reason analysis for events that have already occurred.

On-line process is efficient real-time collection, processing and analysis of the data, to operate network monitoring and event forecasting. The main purpose of the on-line process are: (1) network capacity monitoring and precise optimizing; (2) network event prediction and fast trouble shooting; (3) real-time network optimization according to the policy.

6. Requirement of Protocol Extensions

6.1. Requirement of Southbound Protocols

REQ 01: The southbound protocol of the controller should be introduced to meet the performance requirements of collecting huge data of network states.

The soundbound protocol can be based on the extensions of the existing traditional protocols such link state colloction protocols, PCEP[RFC5440], BMP[RFC7854], etc. Or the new protocol like Telemetry[I-D.kumar-rtgwg-grpc-protocol] can be introduced as the soundbound protocols. The protocol choice will be based on the application scenarios of NAI.

6.2. Requirement of Data Collection

REQ 02: The data collected from the network devices includes but not limites to following information:

-- network topology information

-- routing protocol status

-- IP routes and MAC routes

-- LSP information

-- network traffic inforamtion

-- network configuration

-- network device KPIs

-- log of network elements

-- trap of network elements

-- OAM information

6.3. Requirement of Devices

REQ 03: New OAM mechanisms should be introduced for the network devices in order to acquire more types of network state data.

6.4. Requirement of Northbound Interface

REQ 04: The abstract network-based service models should be provided by the controller as the northbound models to satisfy the requirements of different services.

7. IANA Considerations

This document makes no request of IANA.

8. Security Considerations

TBD.

9. Normative References

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