

Intelligence Defined Network (IDN)

Proposed NMLRG
IETF 97, November 17th, 2016

Sheng Jiang
(Speaker, Co-chair)

Intelligence (ML) Defined Network

- Towards Full Autonomic Network

Manually Defined Network

■ Basic approach

- › Step 1: network planning
- › Step 2: CLI configuration
- › Step 3: network optimization, diagnostic, debug

■ Characteristics

- › Fully depend on human's experience and knowledge
- › High cost
- › Network throughput totally decided by human plan. It is rigid afterwards

Software Defined Network

■ Basic approach

- › South bound: using Netconf/YANG, or OpenFlow to configure the network forwarding table
- › North bound: abstract description for the application requirements, thus deriving the forwarding table

■ Characteristics

- › Semi-autonomic
- › Cost reduced
- › Network throughput increased

Intelligence Defined/Driven Network

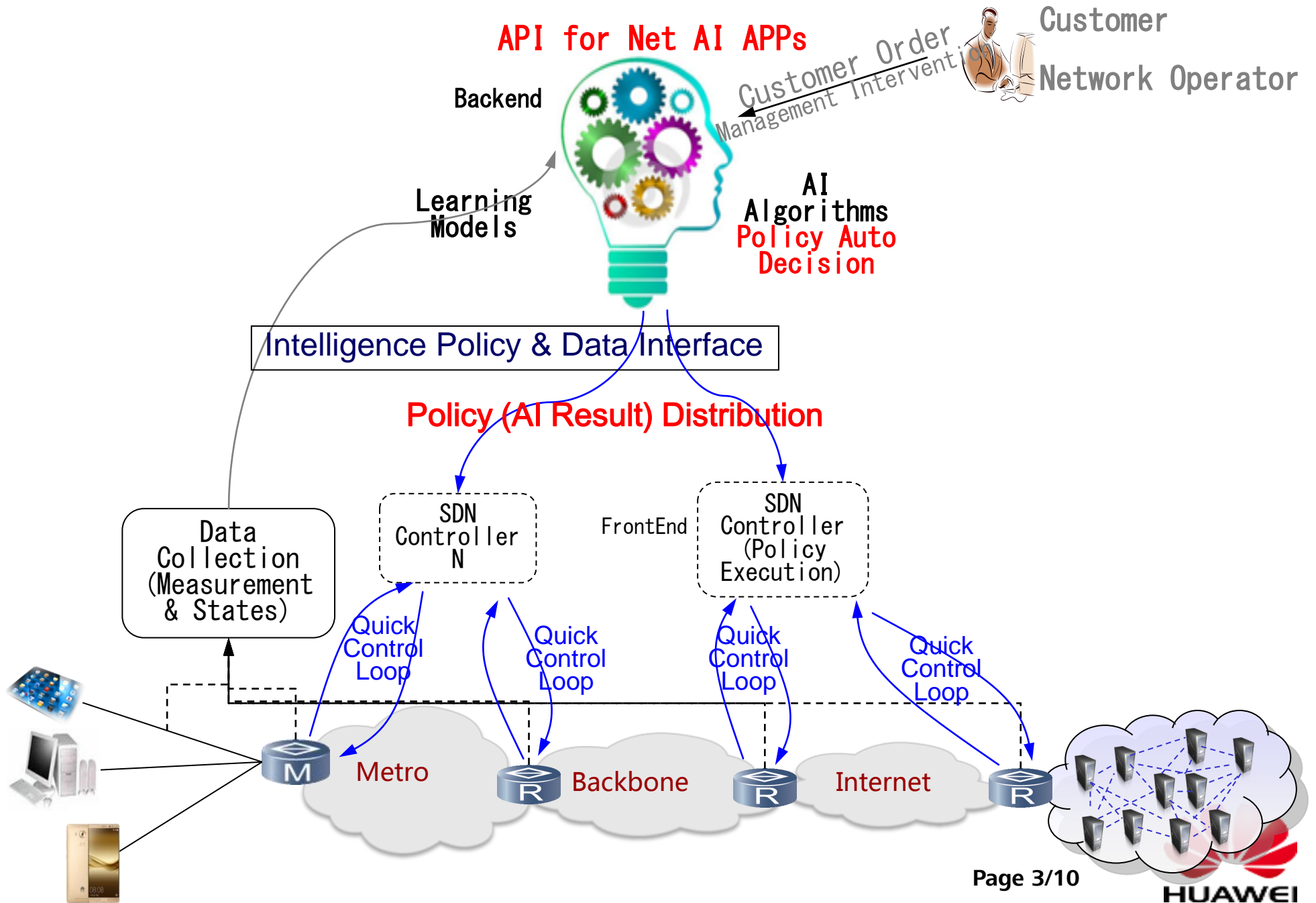
■ Basic approach

- › Machine learning: network traffic patterns and application patterns
- › Finding a model to match the learnt patterns/experiences
- › Re-define and drive the network by machine learning algorithms and technologies.

■ Characteristics

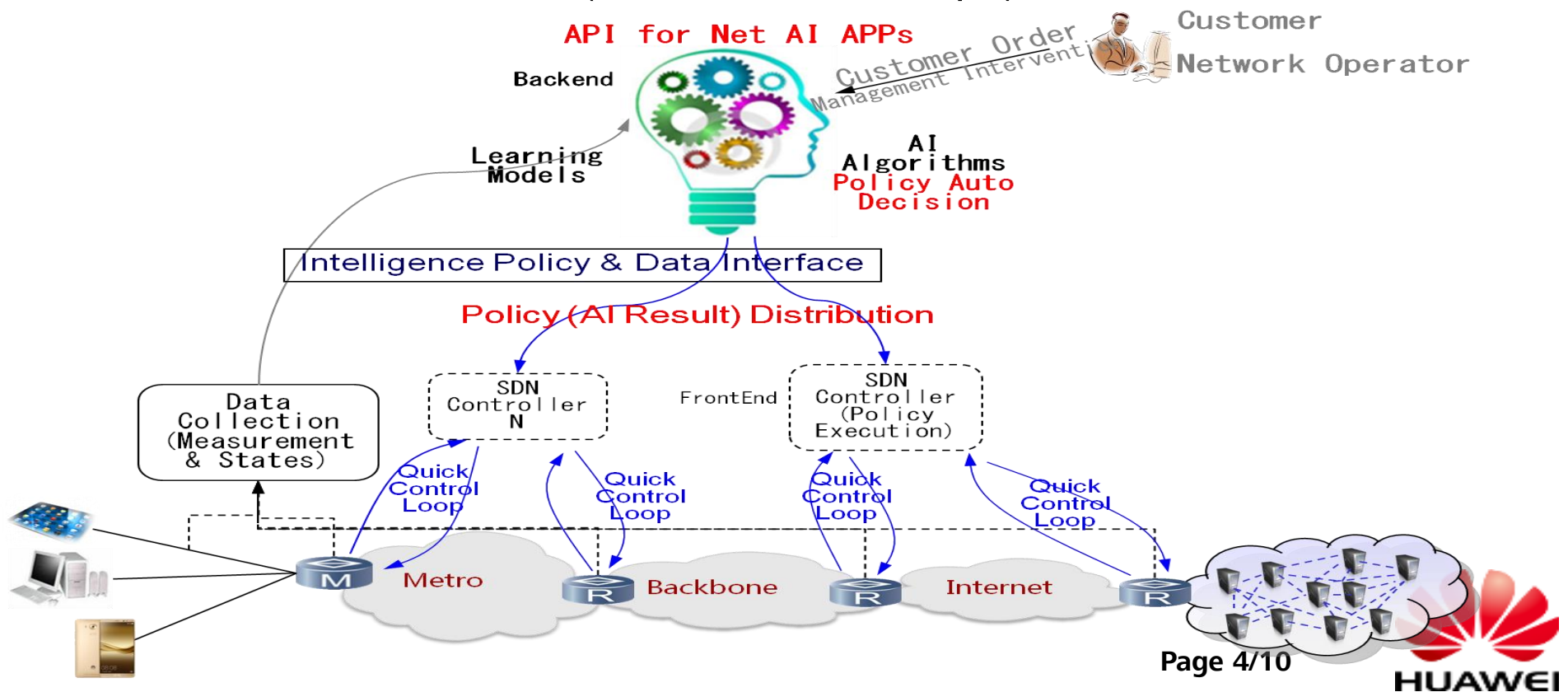
- › Full-autonomic
- › Minimum cost
- › Maximum throughput

A Reference Model for the IDN



IDN Re-defines Network Controlling & Management

- Restructure the network towards a better ML-based autonomic controlling & management
- It is network research rather than machine learning research
- The rollout could be incremental from the SDN-based network
- There will be many new requirements for networks towards IDN, some of them needs new standards (out of NMLRG scope)



Does Networks & Network Devices Ready to be Managed by ML

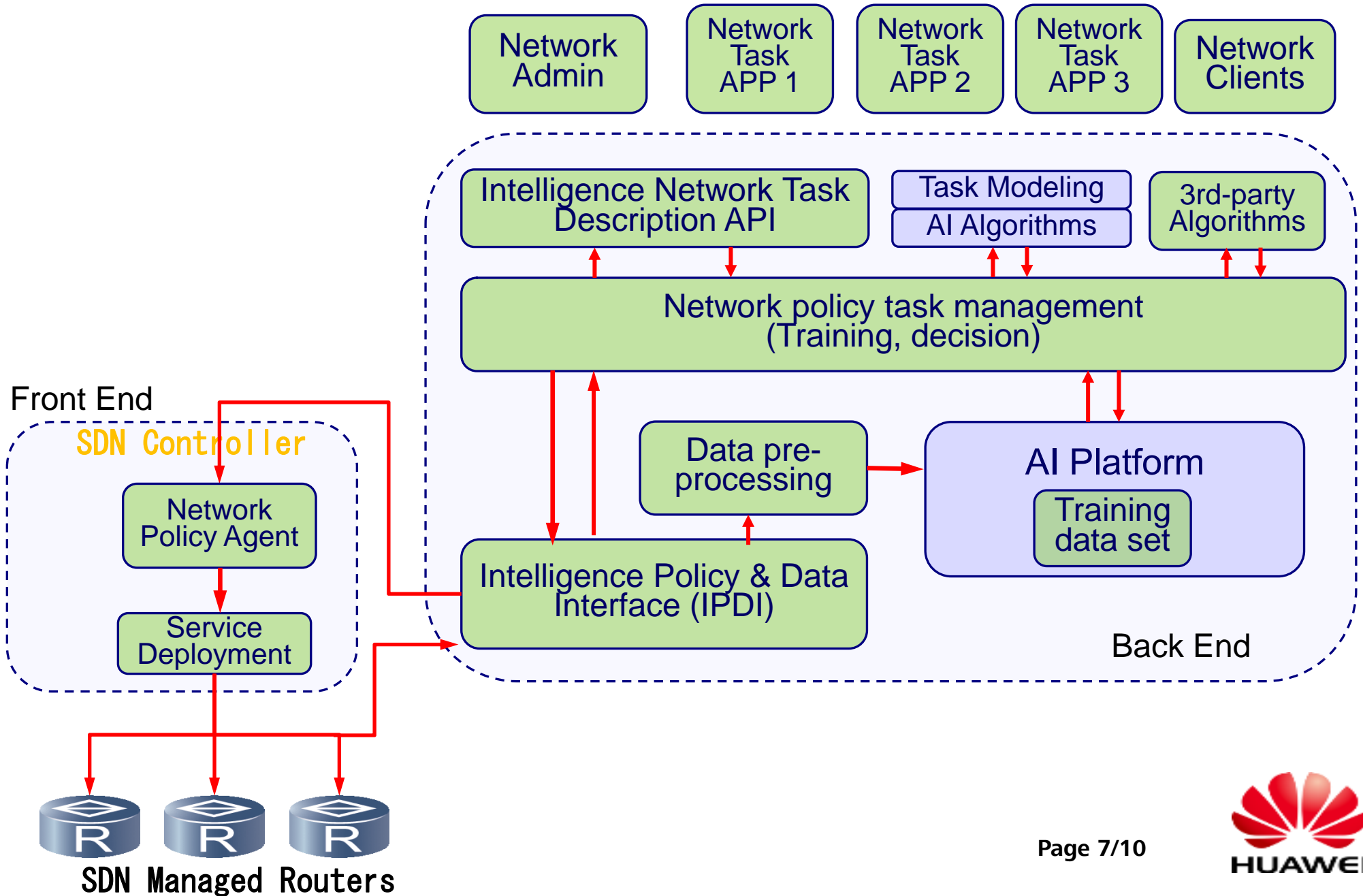
- The availability of network data
 - Packet size, latency, path (measurement)
 - Awareness of flow and their attributes, awareness and coordination of contents/applications
 - Unified format for all data?
 - The quality of data (sampling vs. representability)
 - Network complexity, the coordination of multiple tasks and multiple perspective
 - Data selection & minimizing the transported data vs. the integrality (unknown knowledge)
 - Quantity of data (sufficient? Data storage?)

Does Networks & Network Devices Ready to be Controlled by ML

- Applying the result of ML into network controlling
 - Executable, policy description
 - Scalability
 - Trustable (black box issue)
 - Real time requirement
- How difficult for network experts to create a intelligence task
 - How to combine the network expert knowledge with machine-based intelligence

Functions of IDN Back End

- Make it easy for network experts to create tasks



Examples: network experts to create Intelligence Tasks

- The network experts create intelligence tasks in a lightweight way with only minimum ML knowledge
- Traffic prediction
 - Describe the task (to predict [10, 30, 120 seconds after] traffics or bandwidth requirements on [selected] key nodes
 - Describe the relevant data [traffic changing in last hour, traffic changing yesterday the same time, traffic changing last week the same time] and potential relationship or any human observed result
- Traffic management
 - Describe the trigger conditions for traffic re-routing. It could based on traffic prediction
 - Describe the traffic management target [low latency, balance, etc.]
- Description in a well-defined description language

Potential Standardization Works

★ **API/Language for intelligence network task description**



★ **Unified data & collection**



Intelligence Policy & Data Interface

★ **Policy description language & distribution protocol**

Policy (AI Result) Distribution

★ **Network Measurement Data Selection**

Data Collection (Measurement & States)

SDN Controller N

FrontEnd SDN Controller (Policy Execution)



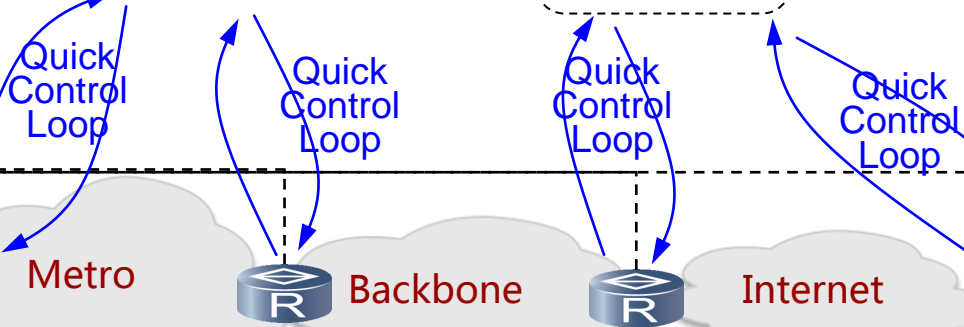
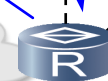
Metro



Backbone



Internet



**Let's have good discussion today
and in the future!**

Thank You!

jiangsheng@huawei.com