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Open-source ACTN
(Abstraction and Control of TE Networks)

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What is ACTN?

ACTN refers to the set of virtual network operations needed to orchestrate, control and manage large-scale multi-domain multi-layer TE networks of both packet and optical so as to facilitate:

- network programmability
- automation
- efficient resource sharing
- end-to-end service aware connectivity
Scope of ACTN

- IETF
- ITU-T

Open Source Project

- ONOS
- ODL

Standards Work

- Multi-vendor
- Multi-platform
- Multi-domain Multi-layer technology

Demo/Implementation
Key Features of ACTN

• A practical approach of Packet/Optical SDN
  – Enable heterogeneous packet/optical transport network control/management technologies (e.g., GMPLS/ASON, PCE, NMS/EMS, OpenFlow)

• SDN controllers’ hierarchy and roles
  – Customer network controllers (CNC)
  – Multi-domain service coordinators (MDSC)
  – Physical network controllers (PNC)

• Multi-domain service coordination based on abstraction/virtualization.
  – Distributed data centers dispersed over different domains including wireless backhaul transport, metro and core networks.

• Support for service-policy enabled network connectivity
Architecture Goals

• Network Architecture
  – Carrier-grade controller reliability
  – High-performance
  – Large-scale support: number of devices
  – Federation of controllers
  – Recursiveness

• Controller Platform System Architecture
  – Modularity
  – Multiple API support
  – Heterogeneous Controllers: ODL, ONOS, others.
Reference Architecture

- Customer Network Controller
- Multi-domain Service Coordinator
- Physical Network Controller
- CNC
- MDSC
- PNC
- CMI
- MPI
- SBI

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Customer Network Controller

In charge of mapping customer VN setup requests with traffic matrix and customer policy

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Multi-Domain Service Coordinator

To provide end-to-end path computation based on E2E abstraction and path/service provisioning and virtual service coordination function.
Physical Network Controller

This is the function performed by the domain controller that is responsible for control plane function of the domain.
Virtual Network Creation Process

1. VN Instantiate
2. VN Instantiate
3. PCEP LSP Initiate
4. PCEP LSP Report
5. VN Instantiate Response
6. VN Instantiate Response

VN Traffic Matrix is a set of E2E connectivity

Endpoint A

Domain 1

Domain 2

Domain 3

Endpoint B

Endpoint C
Interface Recursiveness

VN Query

VN Path Compute

VN Instantiate

VN Modify/Delete

Pre VN Instantiation

Post VN Instantiation

Pull Model

Push Model

CNC

MDSC

PNC

Pre VN Instantiation

Post VN Instantiation

Pull Model

Push Model
ACTN PNC Cluster Model

- Multi-ONOS instances
- Full Redundancy between PNC and Device.
  - This implies that each device is connected to all PNCs.
  - PNCs send all its resource discovery to each connected PNC.
- Full Redundancy among the PNC controller cluster.
  - No hierarchy in the PNC cluster.
- Incremental Update directly from device to the controller for faster topology update

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Controller-Controller Redundancy (Multi-Domain)

How to keep Network Data consistent across all control layers impacts interface/protocol primitives based on policy (push/pull, incremental update, subscription, failure recovery, etc.)

Load Balancing Strategy to increase network reliability. Also impacts interface/protocol primitives.

Domain 1

Domain 2

Domain 3
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# ACTN Building Blocks

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PCEP Implementation

- Recursive Interfaces
- Binary interface
- Hierarchical PCE

**PCEP/GRPC(?)**
(Controller-Controller)

**PCEP Interface**
(Controller-Device)

- Resource Discovery
- Resource Reservation

**MDSC: Super Controller**

- Stateful H-PCE logic
- Multi-Domain Coordination
- Virtual Network Operation

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Building ACTN Modules (ONOS)

Abstract

Topology

PCInit

PCRpt/BGP-LS (Topo)

PCRpt (LSP Incre)

Open

PCRreq

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ACTN Timeline [ONOS]

Packet
- May’16: Stateful PCE with Initiation
  - Basic ACTN
    - Stateful H-PCE
    - VN Association
    - No abstraction
- July’16: ACTN Complete
  - Abstraction
  - RestConf/Yang
  - Policy

Optical
- Support of PCEP-LS in SBI and Linc-OE changes
- Nov’16: ACTN Complete with Optical
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IETF Bits-n-Bytes Seoul
Inter-Operability Demo Architecture

Current Participants:
- Ericsson, Huawei, ETRI, SKT

Service initiation Point (CNC)

Packet-PNC (Vendor A)
Optical-PNC (Vendor C)
Optical-PNC (Vendor D)
Packet-PNC (Vendor B)

PCEP/RestConf
PCEP/RestConf
PCEP/RestConf

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Summary & Current Status

- Working together with standards body, open-source projects and PoC demos for an early implementation
- Open ACTN wiki: https://sites.google.com/site/openactn/ for specification and reference information
- ONOS GitHub:
  - https://github.com/opennetworkinglab/onos/tree/master/protocols/pcep
  - https://github.com/opennetworkinglab/onos/tree/master/protocols/bgp
- First industry open-source multi-layer, multi-domain packet optical demo across multiple platform is planned in November 2016 (IETF 97, Seoul, Korea.)
Thank you