SDN Architecture and Use Case for PCE-based Central Control

draft-zhao-teas-pce-control-function-01
draft-zhao-pce-central-controller-user-cases-01

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What is a PCE?

• PCE: Path Computation Element
  • “An entity (component, application, or network node) that is capable of computing a network path or route based on a network graph and applying computational constraints” from RFC 4655.

• That means that a PCE is a functional component in an abstract architecture.
  • It’s purpose is to determine paths though a network
  • It operates on a topology map (the Traffic Engineering Database – TED)
  • It can be realised as a component of an existing device or as a dedicated server (or virtualised service)

• Benefits of the PCE
  • Offload CPU-heavy computations
    • Provide advanced and sophisticated algorithms
  • Coordinate computation across multiple paths
  • Operate on an enhance TED

• Primary initial purpose was for Traffic Engineered MPLS LSPs
  • Rapidly picked up for optical transport networks

• One of the earliest south-bound protocols – Path Computation Element Protocol – to be implemented in various Open Source Controller platforms
The PCE evolved very quickly after it was invented
  • Advanced PCEP encodings for non-packet environments
  • PCEP extensions for coordinated path computations
    • Path protection
    • Network re-optimisation
  • Cooperating PCEs for multi-domain applications
  • Applicability to sophisticated services such as point-to-multipoint
  • Hierarchical PCE for selection of paths across multiple domains
  • PCE Evolution continues today within the SDN Controller projects
What is the relationship with SDN?

• What is the relationship with SDN?
  • PCEP can be considered the earliest SDN southbound protocol
    • PCE is an SDN controller plus the application logic for path computation
    • PCE provides end-to-end paths (when requested)
    • PCC installs a received path specification
  • An MPLS-TE network could be considered to be an SDN-based network if:
    • MPLS LSRs are built with full separation of control and forwarding planes
    • LSR performs exact match on a single field in the packet header
    • LSR processing is simple: stack operation and forward without routing protocols (e.g., MPLS-TP)
      • All paths are configured from a central platform via a control plane
Stateful & Active PCE

• A Stateful PCE is aware of other LSPs in the network
  • A PCE could retain knowledge of paths it previously computed
  • Or it may gather information about LSPs as exported from the network
    • “Yes, I used that path you gave me”
    • “Here are some other LSPs I know about”
• An Active PCE is able to advise the network
  • About more optimal paths
  • When congestion is a problem
• As far as the protocol is concerned, it is only a small step
  • The PCC can say “Please worry about these LSPs for me.”
    • Delegation of LSPs from the PCC to the PCE
  • The PCE can say “Here is a path you didn’t ask for.”
    • For delegated LSPs or for new LSPs
Architectures for PCE as the Central Controller

- Using a PCECC to augment a distributed control plane

- Using PCE for Node-by-Node Central Control
Multiple PCECCs on a Partitioned Network

- Using cooperating PCECC-based controllers for horizontal control

- Hierarchical PCECC controllers
PCECC Use Cases

• Control Plane Operated Networks
  • A common approach for an active, stateful PCE to control a traffic engineered MPLS or GMPLS network

• Static MPLS-based Label Switch Paths
  • Provisioned without the use of a control plane

• Transport SDN
  • MPLS-TP, TE-based Optical Networks

• Traffic Classification
  • What traffic to send on the LSP

• Detailed discussion on the Use Cases for Using PCE as the Central Controller(PCECC) may be found in:

• Mobile backhaul example discussed this week in TEAS