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Internet Draft

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Path Computation Service discovery via Border Gateway Protocol  
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## Abstract

This draft describes a simple mechanism that ease discovery of remote Autonomous Systems (AS) supporting inter-domain MPLS-based constrained tunnels service (this service is also denoted by Path Computation Service (PCSV)) thanks to the use of Path Computation Elements (PCEs). Remote ASS could be managed by a single or distinct Internet Network Providers (INP). Particularly, this draft describes how Border Gateway Protocol (BGP) is used to announce Path Computation Service unique identifiers

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across the Internet in order for other PCEs to be able to discover a path towards every AS supporting this Path Computation Service.

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## [2.](#) Changes since last version:

- The main changes occurred in this version are:
- o Rewording of several sections of the draft

## [3.](#) Terminology

This memo makes use of the following terms:

- o Path Computation Element (PCE): an entity that is responsible for computing/finding inter/intra domain paths for establishing LSPs. This entity can simultaneously act as client and a server. Several PCEs could be deployed in a given AS.

- o Path Computation Client (PCC): a PCE acting as a client. This entity is responsible for issuing path computation requests that fulfill the Service Management constraints for the establishment of inter/intra domain LSPs.
- o Path Computation Server (PCS): a PCE acting as a server. This entity is responsible for handling path computation requests in order to satisfy PCC constraints.
- o High-level service: is the service using a PCE-based system as an underlying infrastructure (an inter-domain QoS VPNs service for instance)
- o High-level service customer: is a customer that subscribes to a High-level service.
- o pSLS: A provider SLS is an SLS established between two Internet Network Providers (INP) with the purpose of extending the geographical span of their service offers.
- o SLS Management: This management entity is responsible for SLS-related activities, including pSLS ordering (i.e establishing contracts between peers) and SLS invocation (i.e committing resources before traffic can be admitted)
- o q-BGP: QoS-inferred BGP. A modified BGP protocol that takes into account QoS information as input for its route selection process.
- o Domain: within this draft it denotes an Autonomous system.

## [4.](#) Introduction

### [4.1.](#) General

Recently, several proposals describing the use of a Path Computation Element (PCE) as additional element to existent IP network entities have been submitted to the IETF. The main objective of introducing a PCE element is to ease computation of constrained paths in sophisticated schemes like inter-domain (both in intra-provider or inter-provider) and then driving the establishment of inter-domain LSPs.

A framework for establishing and controlling Multi-Protocol Label Switching Protocol (MPLS) and Generalized MPLS (GMPLS) Label Switching Paths (LSPs) in multi-domain networks has been defined in [[CCAMP-FWRK](#)]. The notion of domain in this framework draft encloses both Interior Gateway Protocol (IGP) areas and Autonomous System (AS) contrary to the current draft that restricts the notion of domain to a single AS.

Another draft that proposes a solution to compute inter-domain constrained paths has been submitted to the IETF [[INTERAS-PCE](#)]. This draft takes into account the inter-provider specific service considerations. In addition, the draft [[INTERAS-PCP](#)] describes a new protocol allowing communication between two PCEs located in different domains in order to compute inter-domain paths satisfying a set of constraints.

All aforementioned drafts require a Path Computation Service (PCsv) discovery function that allows discovery of remote ASs supporting this type of service (the path computation service could be implemented by one or several PCE elements) together with their associated capabilities like QoS capabilities, inter-domain bandwidth, reachable IP prefixes, type of links, etc. Discovery of such capabilities could also be passive and be restricted to a simple service advertisement (like web-pages). PCsv locations and associated capabilities discovery depends on providers search. We will refer to this method as passive discovery method.

It is evident that passive method allows finding remote PCsv locations and their associated capabilities, but this information is not usable alone within a distributed PCE architecture, when a set of end-to-end constraints must be satisfied. Therefore, computation of end-to-end constraints must be achieved based on advertised individual PCE capabilities. The knowledge of the PCE path is then



The LSP creation request is propagated downstream to appropriate PCEs. The requests include the AS's ASBR and the tail-end address of the LSP. This procedure is repeated until the request reaches the destination PCE.

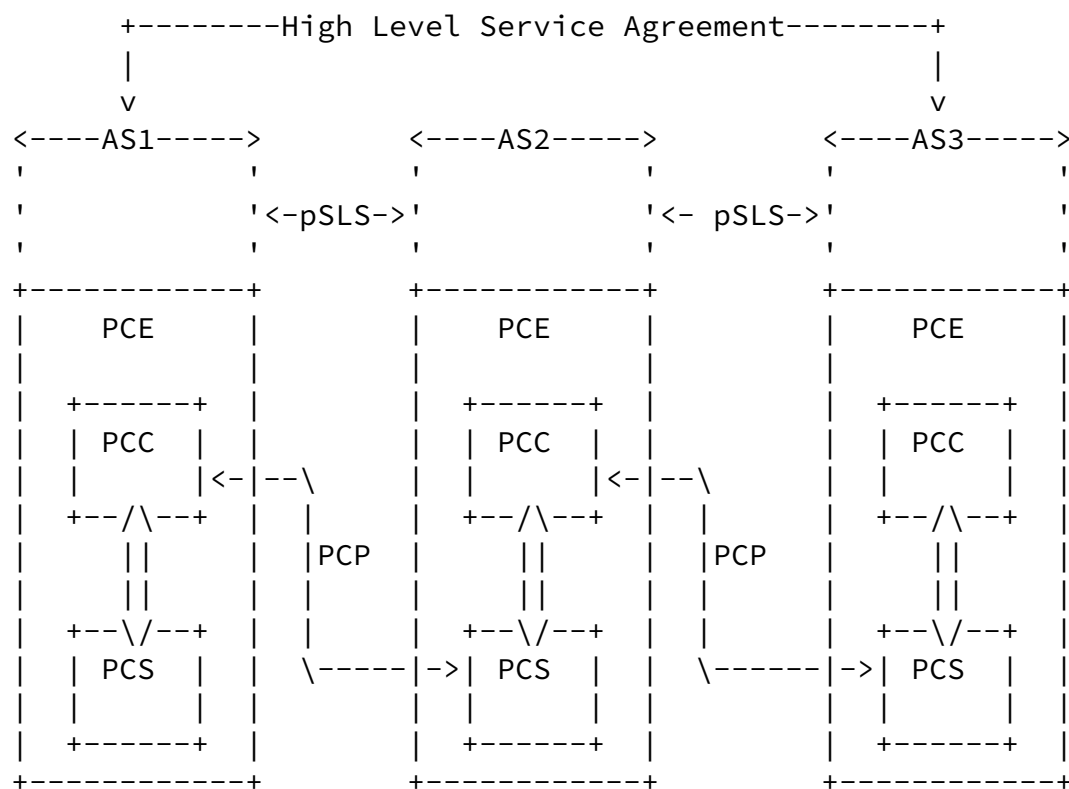


Figure 1: Service Overview

After authenticating the identity of LSP originating PCE, the destination PCE send a reply message back to the downstream domain's

PCE accepting the request and include the LSP loose path (destination, ASBR) addresses in the message. The next downstream domain's PCE does the same and adds its own relevant ASBR addresses to the loose path. The originating PCE inserts its intra-domain path and then initializes an RSVP reservation request for LSP establishment using the returned loose path.

At the service/application level (in order to differentiate this service from extending scope of IP connectivity service, we will denote it as high level service), when originating AS wants to establish an LSP to a destination in a remote ASs, there MUST be an

agreement between the two ASs.

## 8. Service Advertisement and Discovery

Within this draft, we make a difference between the Service Advertisement and Discovery (SAD) and PCSv discovery function. SAD is a function that is achieved before establishing a service agreement between two peers. The SAD operation consists mainly at advertising/learning from/to the rest of the Internet the capabilities supported by a given AS in term of offered services (like Inter-domain LSP establishment service). PCSv advertisement is conditioned by the existence of a pSLS between two peers.

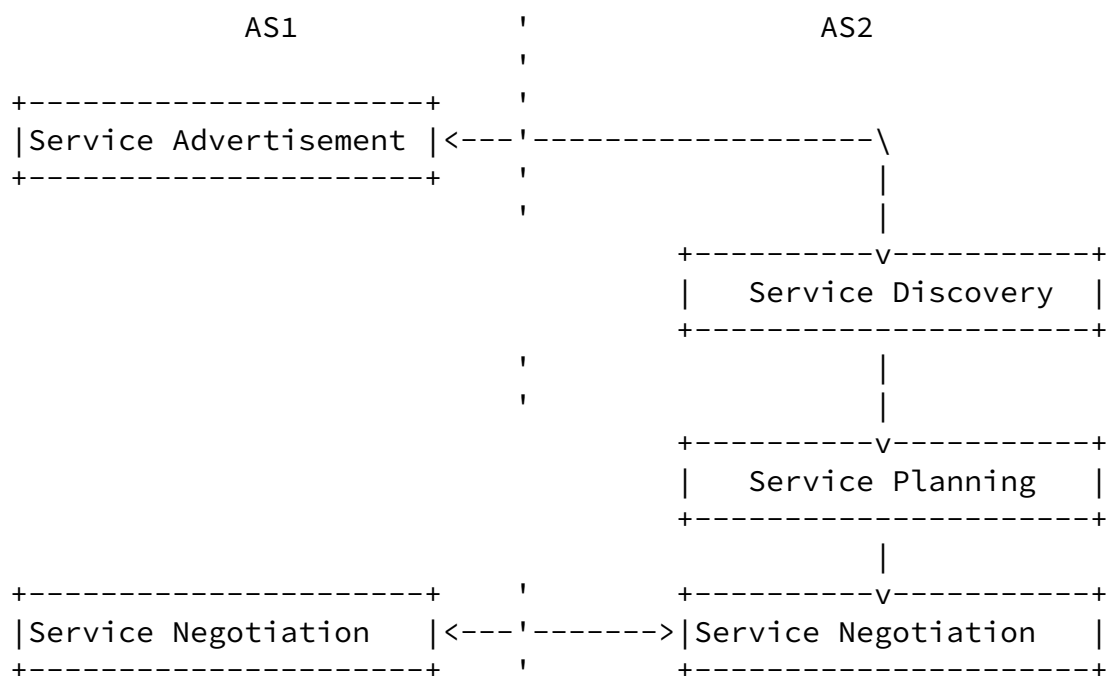


Figure 2: Service Advertisement and Discovery

Local Service Discovery block is responsible for finding remote offered services that is an essential input for Service Planning block. This functional block is responsible for choosing from discovered offered services the ones that will be used in order to

build it own services. Thus, a negotiation process SHOULD start and an SLS MAY be agreed between the two parties.

During service negotiation between two Service Providers, they MAY exchange their PCE reachability information and associated capabilities. These capabilities could include the following:

- o Supported Computation algorithms
- o Types of Constraints (e.g. QoS)
- o Set of attributes for a given constraint (one-way delay, one-way delay variation)
- o Support of P2MP path computation techniques,

As a consequence each INP has a full knowledge of the PCE capabilities of its adjacent providers.

#### 9. Why PCE discovery is needed

Path Computation elements are responsible for finding inter-domain paths satisfying a set of constraints (like QoS performance guarantees) to establish inter-domain constraint-based LSPs. The computation of this path is distributed and needs PCEs from different domains to communicate. Communication between two PCE entities is enabled thanks to inter PCE Communication Protocol (PCP) [INTERAS-PCP].

When receiving a request from the "High-Level" Service Management to compute/find a path towards a given tail-end address, the local PCE has to determine the next PCE to contact. In the worst case, local PCE can contact all its neighboring PCEs that are known to Service Management System. Nevertheless, it has no criteria to choose between those PCEs the next PCE to be contacted in order to send its path computation request. The risk of a request failure is then important.

In order to help the PCE decision-making process to choose the next PCE to be contacted, local PCE need to discover remote PCSvs reachable beyond the immediate neighbor PCEs. This information will help the next hop PCE decision. PCE need at least access to intra and inter-domain Routing Information Bases (RIB) in order to check the reachability status of destination prefixes if are propagated thanks to routing protocols.

#### 10. Solution for PCSv discovery

Within this draft, we assume that during service negotiation phase between two peers, they MUST exchange IP addresses of their PCE(s). SLS Management Systems of the two peers MUST store this information.



In order to help the PCE computation process, routing information MUST be made available for the PCE. Thus, reachability information associated with capabilities (like QoS intra and/or inter-domain capabilities) SHOULD be propagated in the routing level. In the case of QoS-based service, each potential tail-end address (practically all routers interfaces) SHOULD be announced in all offered QoS Class plans (i.e. as many as used DSCP values). As a consequence, routing tables sizes will drastically increase.

From this perspective, instead of announcing all potential tail-end addresses in BGP, only an identifier needs to be announced. It is called the Path Computation Service Identifier (PCSID). This particular BGP announcement is identified by a well-known community value (to be defined by IANA) and is represented by a routable IP address, which can be different from the real IP address of the PCE.

As a consequence, this particular route SHOULD NOT be installed in the Forwarding Information Base (FIB) since this PCSID is not necessarily the IP address of the PCE.

BGP announcements of PCSID will ease to discover the set of remote ASs supporting the inter-AS MPLS-based constrained tunnels service together with their associated end-to-end capabilities for reaching them. In order to compute a path towards a specific domain supporting this inter-AS MPLS-based constrained tunnels service, the local PCE chooses a route that serves the PCSID of that domain and extracts from the AS\_PATH attribute the AS number of the next hop ASBR. Then, the local PCE queries its SLS Management system and gets back the PCE's IP address of the next neighboring PCE to contact. Finally, the local PCE forms and forwards a path computation request to this next PCE. The process is iteratively repeated until the request reaches the PCE of the target AS identified by its PCSID.

This solution decreases the number of BGP announcements that are reduced to one announcement per AS.

## 11. IANA Considerations

The solution proposed in this draft uses a well-known community attribute value that SHOULD be attributed by IANA [[RFC2434](#)] in order to facilitate recognition of BGP announcements that announce PCSv and associated capabilities.

## 12. Security Considerations

This additional draft does not change the underlying security issues in the existing BGP-4 protocol specification [[RFC2385](#)].

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