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Requirements of applying path-aware networking for dynamic path selection

draft-fu-panrg-path-selection-req-00

Abstract

Emerging new services have new business characteristics, different from traditional C/S business model, whose most traffic is downstream traffic, more and more new business with gradually increasing upstream traffic have appeared, such as short videos, live sales etc, . Due to the new traffic characteristics of these services, more requirements have been put forward for the choice of network paths. In addition, emerging services also put forward new requirements for computing. Only selecting the network path or the service node cannot meet the stringent requirements. The perception of network paths and path selection also need to consider the characteristics of the service, and further need to coordinate the state of the network side and the service node side. The application of path-aware networking can assist the terminal to better perceive the network status, and also combine the status of the service node to achieve on-demand, more fine-grained path selection.

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 in [RFC 2119](#) [[RFC2119](#)].

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[1.](#) Introduction

In path-aware networking architecture, endpoints have the ability to select or influence the path through the network used by any given packet or flow. The network and transport layers explicitly expose information about the path or paths available from one endpoint to another, and to those endpoints and the applications running on them, so that they can make this selection [[draft-irtf-panrg-questions-09](#)]. This draft targets at the third question in [[draft-irtf-panrg-questions-09](#)]: how can endpoints select paths to use for traffic in a way that can be trusted by the network, the endpoints, and the applications using them?

And this draft targets at the path selection use case of path-aware networking, and we both consider the scenario that a set of paths to the same destination and also the scenario that several destinations with several paths. According to [[draft-irtf-panrg-path-properties-02](#)], entities may select their paths to fulfill a specific goal,

e.g., related to security or performance, as an example of performance related path selection, an entity may prefer paths with performance properties that best match its traffic requirements. In this draft, we target at the services with various traffic requirements for upstream and downstream traffic and also with requirements to service endpoint. Different types of services have different requirements to network;

1. For transmission-intensive services, the amount of data transmitted is large, so the choice of network path affects the entire service larger.
2. For computing-intensive services, the computing tasks of service endpoint are complex and the choice of endpoint affect the entire service is large
3. And traditional transmission-intensive services tend to have a lot of downstream traffic, so they usually specify the downstream path.
4. For transmission-intensive services with large upstream traffic, such as short video and live broadcast, the upstream path matters a lot so the perception and specification of upstream path is necessary to meet service requirements.

So the terminal needs to be aware of both the status of the uplink path and the downlink path, and specify the uplink path and the downlink path based on service characteristics. What's more, for computing-intensive services, the terminal still needs to be aware of the status of service endpoint, and the path-aware networking also need to consider the status of endpoint when select network path.

[2.](#) On-demand awareness on paths and path properties

For services with different requirements, when path-aware networking is applied to realize path perception, it is necessary to dynamically

determine the perceived target paths and target path attributes, such as perceiving the given upstream path or the given downstream path, and perceiving path latency or path bandwidth [[draft-irtf-panrg-path-properties-02](#)]. When user initiates a service request, path-aware networking needs to analyse service requirements related to path-awareness, including time sensitivity, traffic amount, and traffic characteristics etc, and decide to be aware of which set of paths and which path properties of them. So path-aware networking needs to specify the following information:

1. Service requirements towards path-awareness

2. Target paths to be perceived
3. Target path properties to be perceived

For example, when a service with large amount of uplink traffic and strict requirements on service latency is requested, path-aware networking assign a set of uplink paths which are to be perceived, and determine the target path property is path latency, and then specify the above mentioned upstream paths to user, and then user initiate uplink path detection packet towards given paths carrying target path properties , and then the network nodes along the path writes the required path properties information. With path-aware networking, the given paths and corresponding properties are obtained, and user can select optimal uplink path which meet service requirements.

[3.](#) Definition and application of path property weight

In path-aware network, instead of using single MED value, other properties such as Link Capacity or Link Usage could additionally be used to improve load balancing or performance [I-D.ietf-idr-performance-routing]. And more properties are required to be considered for new emerging services [[draft-irtf-panrg-path-properties-02](#)].

The transmission of upstream traffic and downstream traffic, and also data processing by the service endpoint form a complete service process (face recognition, CLOUD A/VR, etc.). So the completion of the service needs to consider multi-dimensional factors.

For path-aware networking, facing diverse service requirements and multi-dimensional path properties, to solve the problem of how to comprehensive select path considering service requirements, a new parameter needs to be introduced: path property weight values, which represent the weight of each path properties and are used to comprehensively define the perceived multi-dimensional path properties. And then the path-aware networking needs to specify the following information:

1. Service requirements towards path-awareness
2. Target paths to be perceived
3. Target path properties to be perceived
4. Path property weight values of target path properties

For example, for requested services that require large uplink bandwidth, path-aware networking need to define larger uplink path bandwidth weight, and calculates the target "uplink path + downlink path" pair based on the given weight value.

[4.](#) Service endpoint consideration in path-aware networking

Many emerging services not only put forward new requirements for the network, but also put forward requirements for computing. For services such as AR/VR, the budgets for computing delay and network delay are almost equivalent [\[draft-liu-dyncast-ps-usecases-01\]](#) , therefore, when path-aware network perceives paths, designates path and selects paths, it also needs to consider the status of the service endpoint. And then the path-aware networking needs to specify the following information:

1. Service requirements towards path-awareness, including service endpoint
2. Target service endpoints and properties
3. Target paths to be perceived corresponding to target service

endpoints

4. Target path properties to be perceived

5. Path property weight values of target path properties including service endpoint

And when the requested service is a computationally intensive service, the status of the service endpoint will have a greater impact in the entire process. Therefore, it is also necessary to select an optimal service endpoint to provide services. Path-aware networking needs to generate multiple target paths for multiple candidate service endpoints, and specify new path parameter weight values towards target path properties and target service endpoint status.

[5.](#) Summary

The dynamic path selection considering service requirements and service characteristics has become one of the current technical development directions. This draft analyzes the application of path-aware networking to achieve the on-demand path awareness and service endpoint awareness, and provides optimal path selection.

[6.](#) IANA Considerations

This document makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an RFC.

[7.](#) Security Considerations

TBD

[8.](#) Acknowledgements

TBD

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Authors' Addresses

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