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Router Terminology: Functions and Paths
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Abstract

This document distinguishes between the terms "function" and "path". It also recommends against use of the terms "fast path", "slow path", and "host path" in IETF documents. However, it defines the terms "congestion vulnerable path" and "congestion critical path".

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on December 30, 2021.

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1. Introduction

Routers execute the following functions upon packets:

- Forward the packet.
- Consume the packet as part of a control function.
- Consume the packet as part of a management function.

A packet follows a path through a router. The path contains hardware components and can be determined by the function that the router executes upon the packet.

Many routers dedicate hardware components to functions. This has caused the IETF community to use the terms "function" and "path" interchangeably. It has also caused the IETF community to use the terms "fast path" and "slow path".

This document distinguishes between the terms "function" and "path". It also recommends against use of the terms "fast path", and "slow path", and "host path" in IETF documents. However, it defines the terms "congestion vulnerable path" and "congestion critical path".

2. Functions

Routers perform forwarding, control, and management functions. The forwarding function accepts a packet from an incoming interface, identifies an outgoing interface, and transmits the packet through the outgoing interface. Most routers benefit from statistical multiplexing. As a side effect of statistical multiplexing, the forwarding function is subject to congestion and packet loss.

The control function builds a Forwarding Information Base (FIB) that the forwarding function uses. The FIB identifies the interface through which a packet should be transmitted. Control functions include routing and signaling protocols. While routing and signaling protocols can tolerate transient congestion and packet loss, prolonged congestion can cause serious forwarding plane failures.

The management function allows controllers and network management stations to manage router behaviors. It includes fault, configuration, and performance management protocols. While management protocols can tolerate transient congestion and packet loss, they must always be available. Loss of management function impairs an operator's ability to recover from failures.

3. Paths

A packet follows a path through a router. The path contains various hardware components and depends upon router architecture.

Some routers dedicate hardware components to functions. For example, some Internet core routers have network processor cards and line cards. A line card has one or more network interfaces and supports much higher throughput than the network processor card. These core routers forward packets from one interface to another without traversing the network processor card. This path through the router is sometimes called the "fast path". While congestion is not desirable on the fast path, it is not catastrophic.

Those same core routers send management and control packets to the network processor card. This path through the router is sometimes called the "slow path" or the "host path". While transient host path congestion is tolerable, persistent congestion can cause catastrophic failure.

Other routers (e.g., home routers) do not dedicate hardware components to functions. All packets traverse the same path through the router, regardless of their function. Therefore, they do not have a "fast path" or a "slow path".

4. Recommendations

4.1. Function Versus Path

The terms "function" and "path" have distinct meanings. They should not be used interchangeably.

A packet's function is an externally observable behavior and is independent of router architecture. A packet's path through the

router is not externally observable and depends upon router architecture.

4.2. Function Versus Plane

The following terms are used interchangeably in the IETF:

- Forwarding Function and Forwarding Plane
- Control Function and Control Plane
- Management Function and Management Plane

While these terms can be used interchangeably, the term "function" is more descriptive.

4.3. Path Through A Router

IETF documents should document a network device's externally observable behaviors. They should avoid discussion of a network device's internal architecture. Therefore, IETF documents should avoid the following terms:

- Slow path
- Fast path
- Host path

However, some paths through a router can be more vulnerable to congestion than others. These include:

- Low bandwidth paths
- Paths that cannot be protected by user configurable classifiers and rate limits
- Paths that, by default, are not protected by user configurable classifiers and rate limits

IETF documents should refer to these as "congestion vulnerable paths". When control or management traffic traverses a congestion vulnerable path, the path becomes a "congestion critical path".

4.4. Path Through A Network

IETF documents should continue to use the term "path" when it refers to a packet's path through a network. A packets path through a network does not depend on the architecture of any network device.

5. Security Considerations

This document addresses IETF terminology and does not introduce any security considerations.

6. IANA Considerations

This document makes no requests of IANA.

7. Acknowledgements

Thanks to John Scudder for reading this draft.

8. Normative References

[RFC8126] Cotton, M., Leiba, B., and T. Narten, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 8126, DOI 10.17487/RFC8126, June 2017, <https://www.rfc-editor.org/info/rfc8126>.

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