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The Requirements for Precise Transport Networking
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Abstract

The future networks not only need to offer the Service Level Agreements (SLA) guarantees such as low lantency and jitter, low packet loss and high reliability, but also need to support the precise services such as flexible resource allocation and service isolation. This document proposes a set of performance requirements and precise properties for Precise Transport Networking in various industries such as 5G networks.

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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1. Introduction

5G network is oriented to the internet of everything. In addition to the Enhanced Mobile Broadband (eMBB) and Massive Machine Type Communications(mMTC) services, it also supports the Ultra-reliable Low Latency Communications (uRLLC) services. The uRLLC services cover the industries such as intelligent electrical network, intelligent factory, internet of vehicles, industry automation and other industrial internet scenarios, which is the key demand of digital transformation of vertical domains. These uRLLC services demand SLA guarantees such as low latency and high reliability and other deterministic and precise properties.

For the intelligent electrical network, there are deterministic requirements for communication delay, jitter and packet loss rate. For example, in the electrical current difference model, a delay of 3~10ms and a jitter variation is no more than 100us are required. The isolation requirement is also important. For example, the automatic operation, control of a process, isochronous data and low priority service need to meet the requirements of hard isolation. In addition to the requirements of delay and jitter, the differential protection (DP) service needs to be isolated from other services.

The industrial internet is the key infrastructure that coordinate various units of work over various system components, e.g. people,

machines and things in the industrial environment including big data, cloud computing, Internet of Things (IOT), Augment Reality (AR), industrial robots, Artificial Intelligence (AI) and other basic technologies. For example, automation control is one of the basic application and the the core is closed-loop control system. The control process cycle is as low as millisecond level, so the system communication delay needs to reach millisecond level or even lower to ensure the realization of precise control. There are three levels of real-time requirements for industrial interconnection: factory level is about 1s, and process level is 10~100ms, and the highest real-time requirement is motion control, which requires less than 1ms.

The future networks not only need to offer the Service Level Agreements (SLA) guarantees such as low latency and jitter, low packet loss and high reliability, but also need to support the precise services such as flexible resource allocation and service isolation. This document proposes a set of performance requirements and precise properties for Precise Transport Networking in various industries such as 5G networks.

2. Conventions used in this document

2.1. Terminology

The terminology is defined as [RFC8655].

2.2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Terms of Precise Transport Networking

IEEE 802.1 Time-Sensitive Networking (TSN) has been proposed to provide bounded latency and jitter in L2 LAN networks. According to [RFC8655], Deterministic Networking (DetNet) operates at the IP layer and delivers service with extremely low data loss rates and bounded latency.

However, under the existing IP network architecture with statistical multiplexing characteristics, the existing deterministic technologies are facing long-distance transmission, queue scheduling, dynamic flows and other controversial issues as described in [xiong-rtgwg-precise-tn-problem-statement]. And besides precise latency, jitter, and packet loss, more other precise and deterministic properties and

performances should be provided such as flexible resource allocation and service isolation and so on.

Precise Transport Networking is defined to provide precise SLA guarantees such as latency, jitter, packet loss rate, reliability, and precise control such as flexible resource allocation and service isolation and more other precise services intelligently and dynamically. The purpose of the Precise Transport Networking is based on the hierarchical structure of the transport network, taking advantage of the existing technologies including the flexible precise tunnels technology and the deterministic mechanisms, to support the end-to-end precise service through the characteristics of slicing pieces, hard isolation and preemption characteristics, so as to achieve the high-precision of the future networks.

4. Requirements of Precise Transport Networking

4.1. Precise Latency, Jitter, and Packet Loss

It is required to provide precise Latency, jitter and packet loss dynamically and flexibly in all scenarios for each characterizd flow.

The precise requirements of latency includes bounded latency and low latency. The precise requirements of jitter includes bounded jitter and low jitter. So the precise requirements of latency and jitter may be the combination of latency and jitter, typically including bounded latency and low jitter, low latency and bounded latency, and so on.

4.2. Precise SLA Guarantees for Converged Networks

It is required to provide precise SLA guarantees for converged networks including computing and network convergence, lossless and network convergence, etc.

In some scenarios, such as MEC, it is required to provide precise computing for Controlized CFN/APN. Other resources such as computing resources, energy consumption should be considered. And the utilization and optimization of network resources are extremely important.

4.3. Precise Resource Allocation

As described in [RFC8655], the primary means by which DetNet achieves its QoS assurances is to reduce, or even completely eliminate, packet loss by the provision of sufficient buffer storage at each node. But it can not be achieved by not sufficient resource which can be

allocated due to practical and cost reason. The existing solutions can not achieve the precise resource allocation.

Precise resource allocation is required along with the explicit path with more SLA guarantee parameters like bandwidth, latency, packet loss and so on. The existing technologies such as FlexE and SR tunnels should be taken into consideration.

4.4. Precise Service Isolation

It is required to provide precise service isolation for every flow. In some scenarios, such as intelligent electrical network, the isolation requirements are very important. For example, the automatic operation or control of a process or isochronous data and service with different priorities need to meet the requirements of hard isolation. In addition to the requirements of delay and jitter, the differential protection (DP) service needs to be isolated from other services and hard isolated tunnel is required.

4.5. Precise OAM

It is required to consider precise service performance detection and perception, service support and recovery mechanisms, such as millisecond level service monitoring, 0.0001% packet loss awareness, etc. The existing solutions also do not consider the statistics, analysis and reporting of service performance.

Precise OAM is required including service monitoring, perception, performance statistics, precise service support and recovery mechanism, etc. The OAM mechanisms should be taken into consideration such as In-band OAM, iOAM and so on.

5. Security Considerations

TBA

6. Acknowledgements

TBA

7. IANA Considerations

TBA

8. Normative References

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