Use Cases and Requirements for Implementing Lossless Techniques in Wide Area Networks

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Introduction

- This document outlines the critical need for lossless data transmission in WANs across high-performance computing, genetic sequencing, and A/V production, highlighting the gap with current protocols.

Use Cases

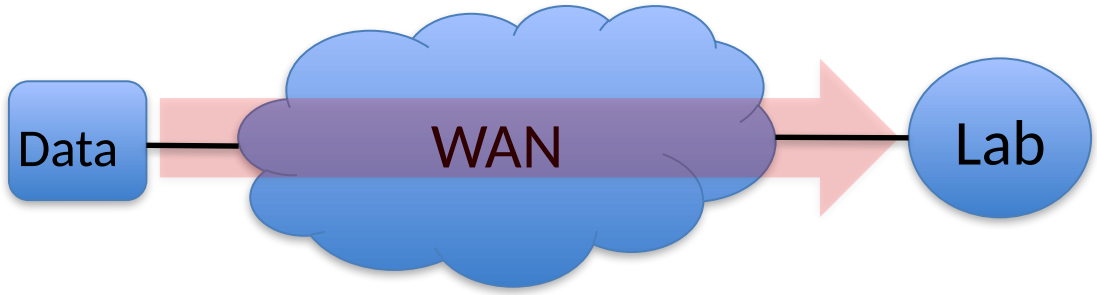
- 1. High-Performance Computing (HPC) for scientific research.
- 2. Genetic Sequencing for timely medical services.
- 3. Stable transmission for large-scale A/V data migration.

Use Case 1

- High-Performance Computing (HPC) for scientific research.

For instance, the study of PSII proteins, produce 60-100GB of data every five minutes,necessitating rapid and lossless data transfer from the equipment back to analysis labs.

The efficiency and reliability of WANs in this context are beneficial and essential for facilitating the seamless collaboration between scientists in different domains, enabling them to share and analyze the large datasets effectively.

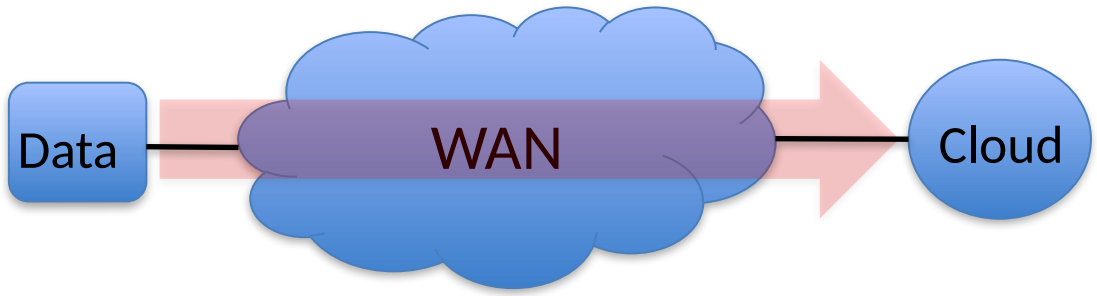


Use Case2

- Genetic Sequencing for timely medical services.

The exponential growth of genetic sequencing is matched by the burgeoning data volumes generated, which require efficient and lossless transmission to cloud or private data centers for analysis.

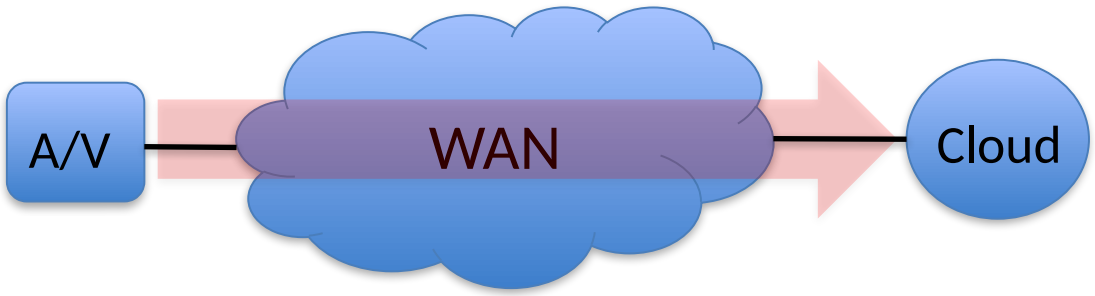
The demand for high-speed,reliable data transfer is evident. The existing WANs transfer efficiencies present significant bottlenecks, extending the turnaround times for sequencing services and impacting the timely data delivery of precision medicine.



Use Case3

- Stable transmission for large-scale A/V data migration.

Traditional methods of data transportation of Audio/Video, involving physical media and manual transfer, are not only time-consuming but also inefficient. The requirement for a WAN infrastructure capable of handling such extensive data transfers quickly and without loss is critical.

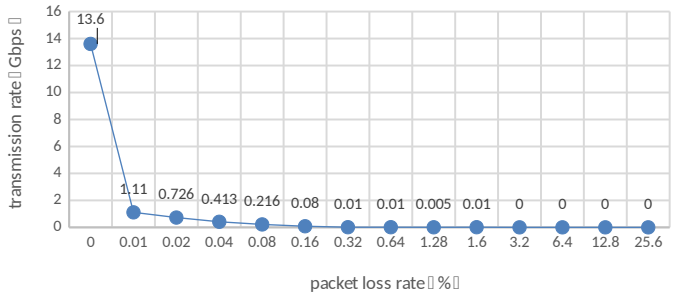


Problem Analysis

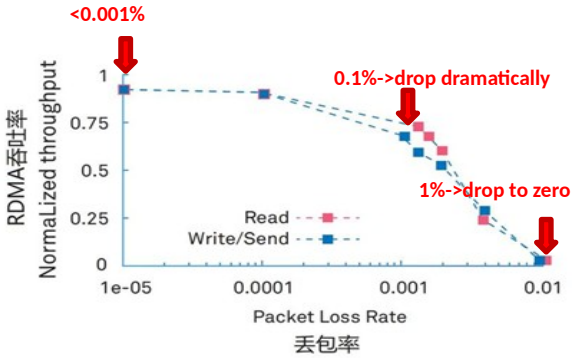
According to the usecases, we want to send giant data to a long distant location through the carrier network(WAN) efficiently and reliably.

The reliance on traditional transmission protocols

like TCP or RDMA [RoCEv2] is common. However, both protocols are adversely affected by packet loss, especially over long-haul transmissions.



TCP(RTT=30ms)



RDMA

Challenges and Requirements

- The quest for lossless data transmission in Wide Area Networks(WANs) is confronted with significant challenges.For example,elephant flows—large, bursty data transfers that can cause instantaneous congestion and packet loss within network device queues.

Challenges and Requirements

- In data centers, certain lossless technologies are deployed to enhance the performance,such as Priority-based Flow Control (PFC) and Explicit Congestion Notification (ECN) .
- However,in the WANs,PFC can lead to head-of-line blocking,deadlocks, and congestion spreading, effectiveness diminishes over longer distances typical of WANs. Effectiveness of ECN(DCQCN) diminishes over longer distances typical of WANs.

Challenges and Requirements

- Requirements:
  - Improving PFC and ECN for lossless data transmission in WANs.
  - Any other solutions?