中国移动 China Mobile

High Reliability in WAN Network

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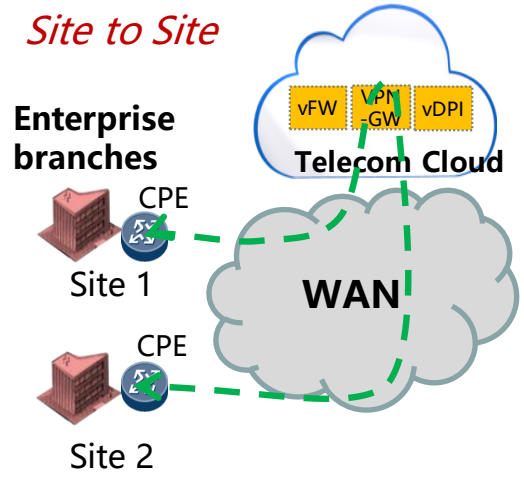
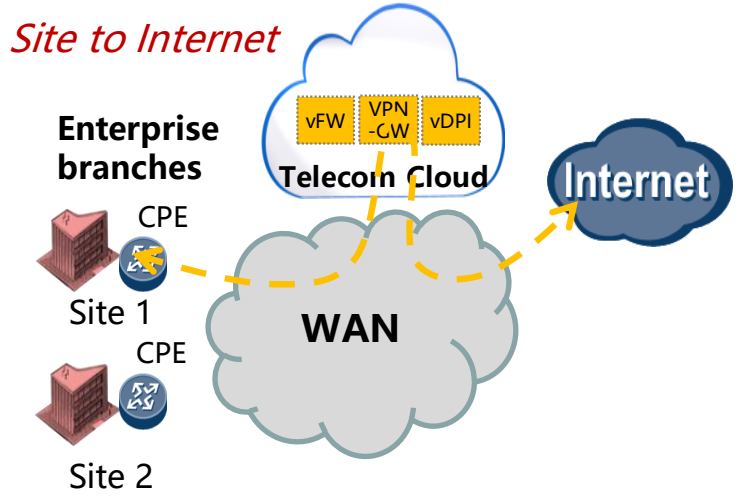
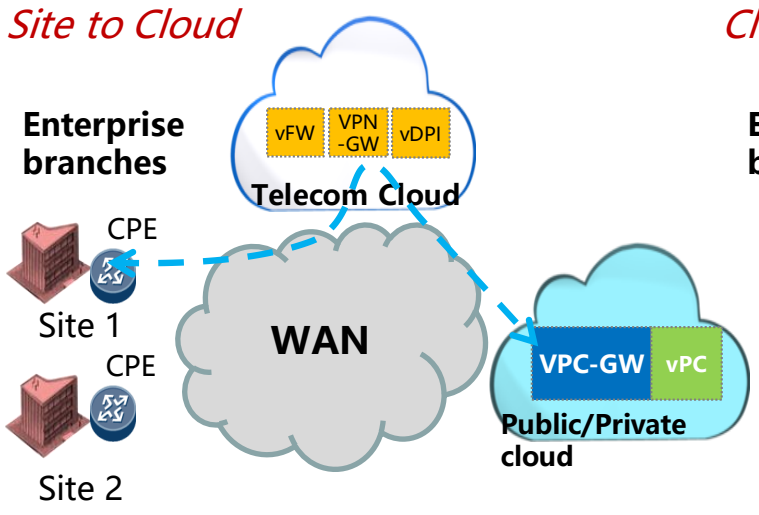
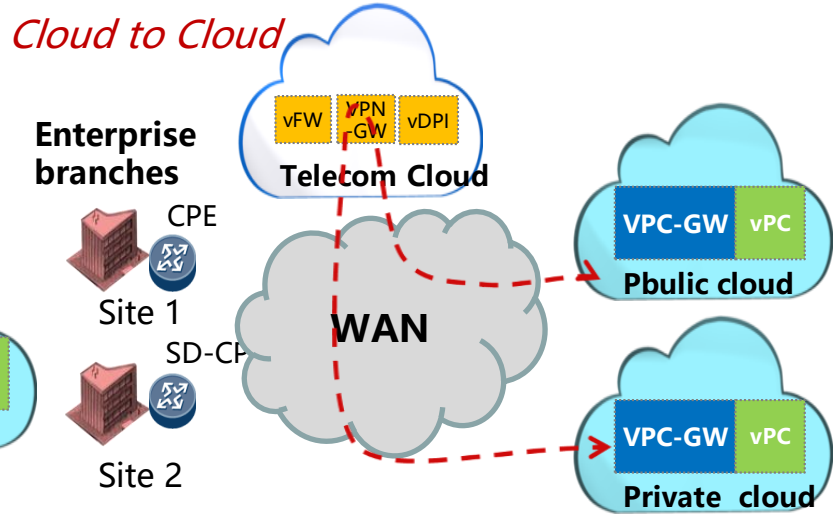
High Reliable Internet Connections in Software-Defined WAN Scenarios

Four basic scenarios









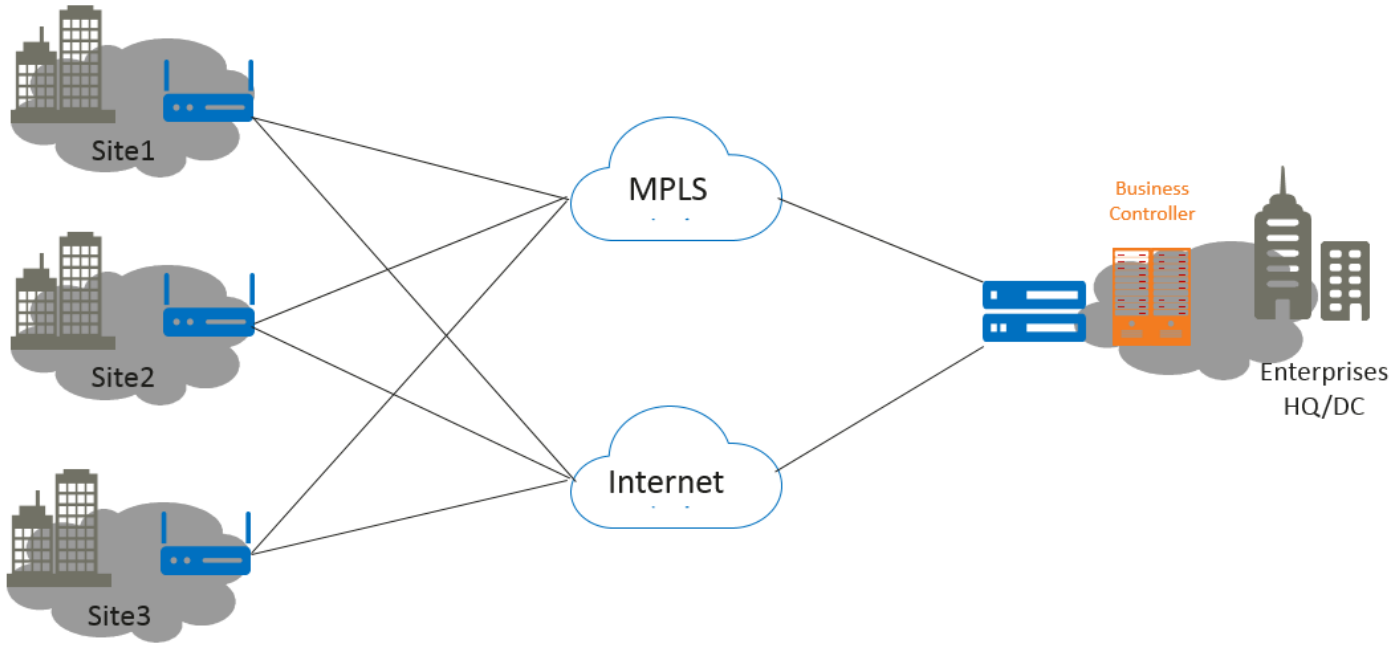
Four basic scenarios in Software-Defined WAN,

- Site to site
- Site to internet
- Site to cloud
- Cloud to could

Highly reliable enterprise connections are appealing for service provider networks;

- High resolution video conference;
- 8K video surveillance;
- …

Reliable Enterprise Connections in SD-WAN Network



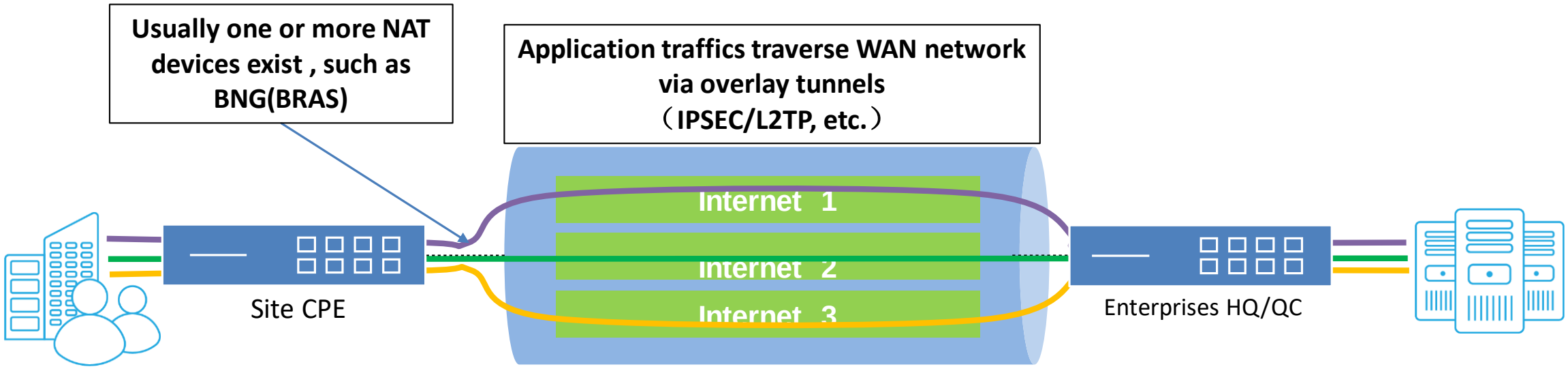
It is a tendency to use multiple internet connections for high reliable P2P connections between different remote sites or between branch site and cloud servers, rather than lease line, for better cost-efficiency;

Rough calculation for reliability on multiple IP connections is, with n replication path;

$$R = 1-(1-r_1)*(1-r_2)*(1-r_3) \ldots *(1-r_n);$$ r_1 is reliability on link 1 and so on;

Is there a better way, by using frame replicate and eliminate for reliability?

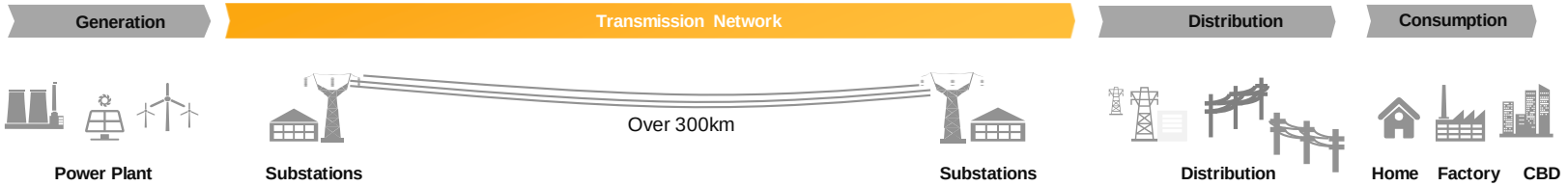
A Typical SD-WAN Connection Between Branch Site to HQ

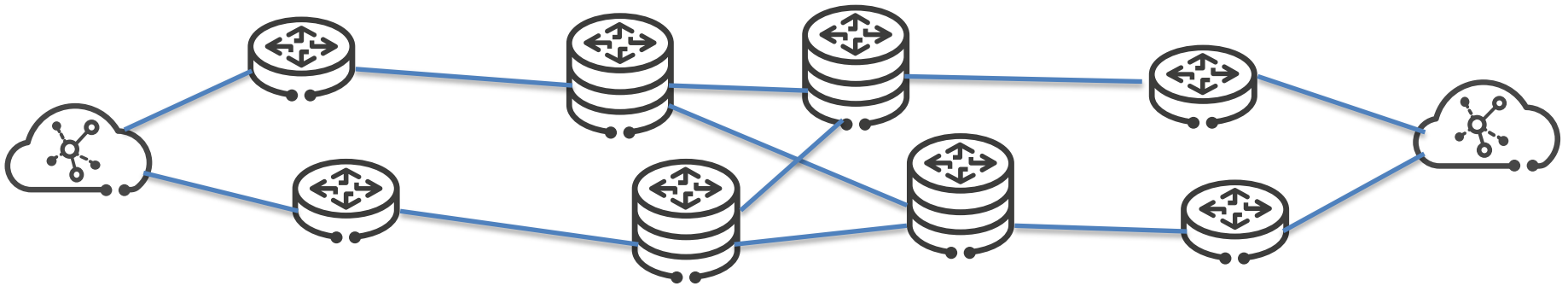


- Typically it creates path tunnels over WAN networks between two SD-WAN devices, different internet connections with various quality (PON, 3G/4G, Metro Ethernet, etc.);
- Establish encrypted WAN paths through WAN overlay tunnels;
- User traffic may need to traverse one or more NAT devices (such as BNG/BRAS, etc.);

Is FRER helpful in these scenarios? And how?

Another Use Case With High Reliability Requirement: Smart Grid Applications





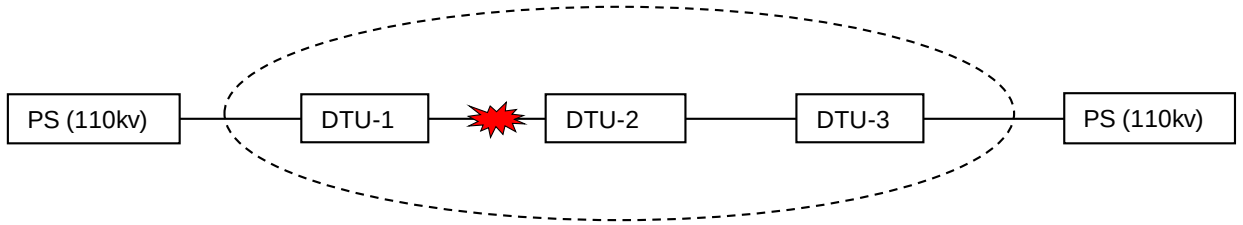
Traditional ICT supports smart grid monitoring and controlling, usually by dedicate wires and separate networks.

Typical smart grid service services require bounded latency, traffic isolation and high reliability;

- Distributed feeder automation
- Millisecond level previse load control
- …

Smart Grid Applications over 5G + TSN Networks

Recent progress in 5G technologies enable 5G + TSN solution for some vertical applications over service provider network, e.g. in smart grid area, or video surveillance in factories;



PS: Power Station
DTU: Distribution Terminating Unit

Differential protection implementation in distribution grid

"As illustrated in Figure, all DTUs (e.g., DTU-1, DTU-2, DTU-3) are synchronised with neighbouring DTUs in the distribution grid with a precision of 10 μs to ensure that the current value was sampled at the same time. The DTU samples the current 24 times within each 20 ms so that a transfer interval of 0,833 ms is required to exchange the sampled information. The exchange of measurement samples is done in a strictly cyclic and deterministic manner. The messages, containing sampled current values, voltage values and so on, are transmitted from a DTU to its neighbouring DTUs with an end-to-end latency of less than 15 ms. The message size is approximately 250 bytes according to IEC 61850, resulting in a service data rate of at least 2 Mbit/s. "

---------- 3GPP R16 , Study on Communications for Automation in Vertical Domains

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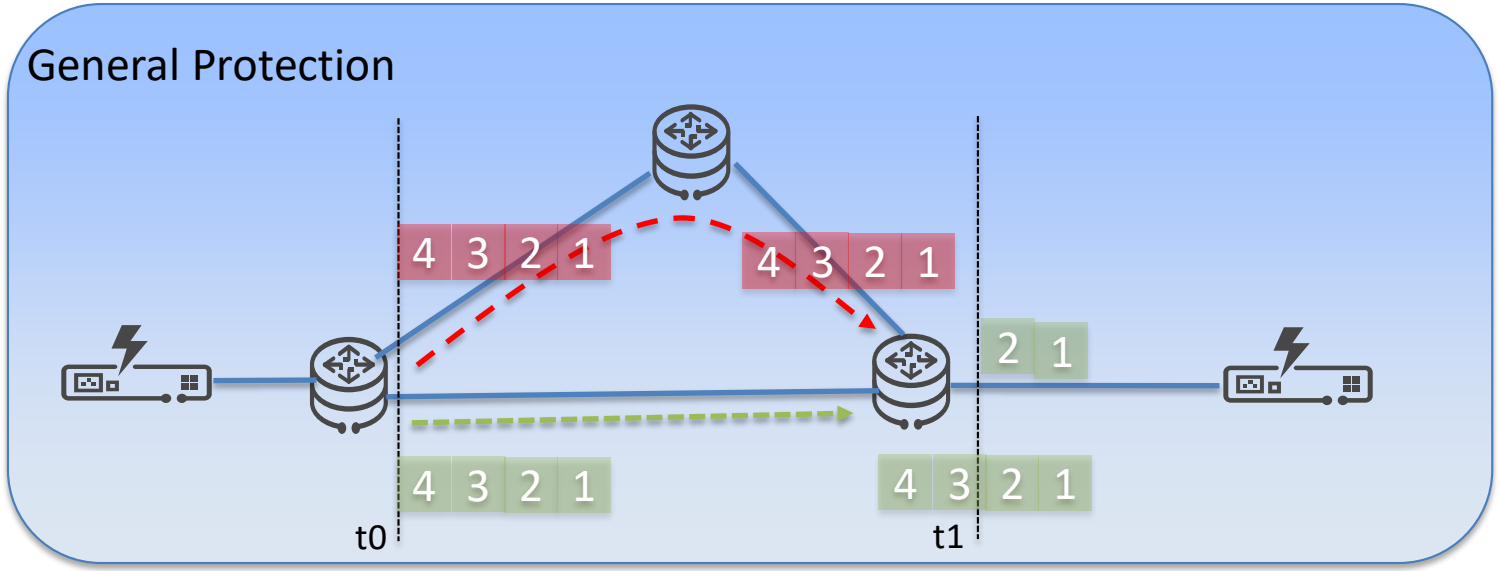
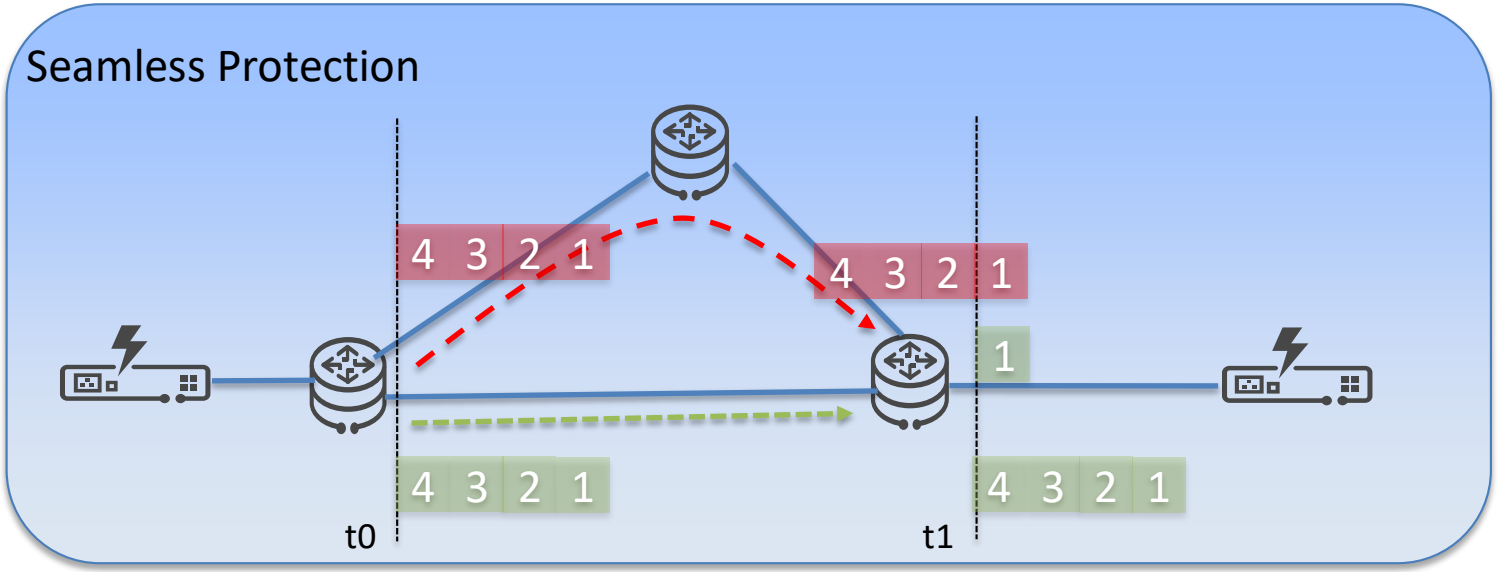
Ultra Reliability Requirement in Power Networks



The path causes inconsistent time delay with a much greater t2 than t1, resulting in large jitter of the relay protection equipment.



Detects path delay and automatically aligns with it to make sure that failover jitter < 0.1 ms.

Possibility of Using 802.1CB FRER over SP network

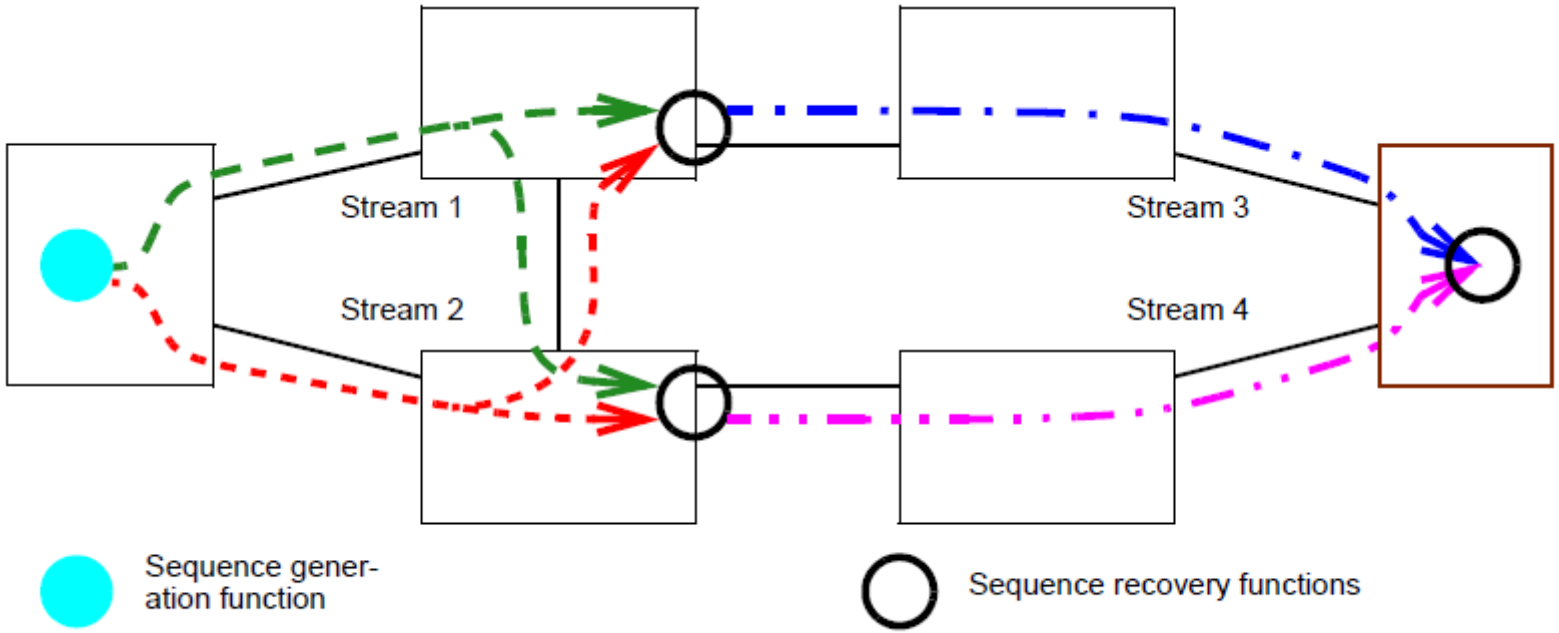


Figure 7-1—Compound Stream built from four Member Streams

Is this a possible solution in L2/L3 protocols?

Is current 802.1CB tags sufficient for enterprises users over encrypted tunnel ?

How to deal with NAT devices in SP network?

Summary

High reliability is one significant requirement in SP Networks, which can help deploying multiple use scenarios.

Prefer to have one unified SP network providing multiple solutions with differentiated SLA (latency, reliability);

- Single internet connection
- Multiple internet connections, with FRER capability
- TSN/DetNet Connections;

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Thank you.

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