Project Name: RPR Working Group IEEE802.17

Title: Jitter and Wander of High-priority Traffic in RPR Environment

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Abstract: RPR based networks should support various services, such as best effort data, guaranteed bandwidth data, and delay-sensitive (e.g voice, video, TDM). In this contribution, we investigate the implications of supporting delay and jitter sensitive traffic on the RPR traffic management schemes. We present simulation results that show that this requires a special priority queue dedicated to delay-sensitive traffic, as well as limiting the length of lower priority frames.

Jitter and Wander of High-priority Traffic in RPR Environment

Agenda

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- Delay variation of High-priority traffic in 2.5Gbps RPR with Best-Effort Jumbo frames
- Delay variation of High-priority traffic in 2.5Gbps RPR without Best-Effort Jumbo frames
- Delay variation of High-priority traffic in 10Gbps RPR with Best-Effort Jumbo frames
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Scope

It is Corrignet strong belief that RPR based networks will be used to deliver different Classes of Service, such as Best Effort data, guaranteed bandwidth data, and delay sensitive service. As such, RPR based networks that will be used to support different services such as data, voice, video, circuit-emulation, etc., will have to support the characteristics of each service type without affecting the performance of other delivered services. The RPR based networks as a new platform, will have to provide a build-in, state of the art QoS with intelligent traffic engineering capabilities to emphasize its superiority and to be accepted as a stable, competitive and flexible platform.

Delivering real-time delay-sensitive frames over the network requires minimum delay, and minimum delay variation. A network that transfers both loss-sensitive and delay-sensitive traffic, will have to intelligently hide the load and the resources that the loss-sensitive traffic consumes from the delay-sensitive traffic, otherwise, service providers will be reluctant to use such delay-sensitive frames, and their applications will be limited.

As known, an excessive amount of jitter and wander can adversely affect both digital and analog signals used to transport voice and video services. Network output wander specifications compliance at synchronous network nodes are necessary to ensure satisfactory network performance (e.g slips, error bursts).

When delivering delay-sensitive services over RPR, the delay variation in case of asynchronous clocks between the two end points must be kept in a reasonable limit to ensure proper operation of the network. For example, the maximum wander allowed in PDH services (the total network budget) is 18usec in 24 hours

The purpose of this contribution is to demonstrate the potential effect of low priority Jumbo frames on delay-sensitive frames over RPR and the need to define a special priority queue for delay sensitive frames.

The simulation results show that Jumbo frames may cause high delay variation of the delay-sensitive frames that compete for the resources in the same segment. Limiting the length of low priority frames will improve the capability of RPR based networks to provide an integrated solution for networks transporting mixed traffic of data and delay-sensitive services.

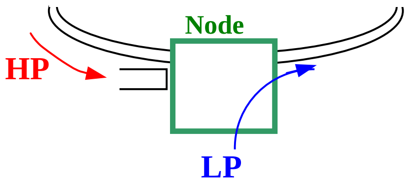
Based on the same assumptions it is also inferred that delay-sensitive frames should be handled as the highest priority traffic, and separated from guaranteed bandwidth traffic to avoid a similar effect.

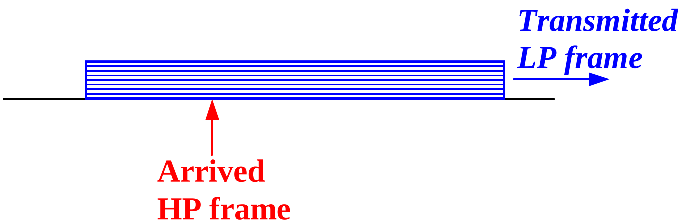
Basic assumptions for the simulations

The simulation assumes ten nodes between the source and destination network elements on an RPR. In order to isolate the effects of the Jumbo frames on delay-sensitive frames, the simulation assumes each node has zero fixed delay, and the link segments have also zero fixed delay.

Each node that the delay-sensitive frame traverses transmits a low priority frame with uniform distributed length between the "minimum transmission unit" and the "maximum transmission unit". In each intermediate node, at the time point that the delay-sensitive frame arrived, the low priority frame has already started to be transmitted. The transmitted part of the low priority frame is uniformly distributed between zero and the low priority frame length.

Intermediate node always has Best Effort frame waiting to be transmitted:





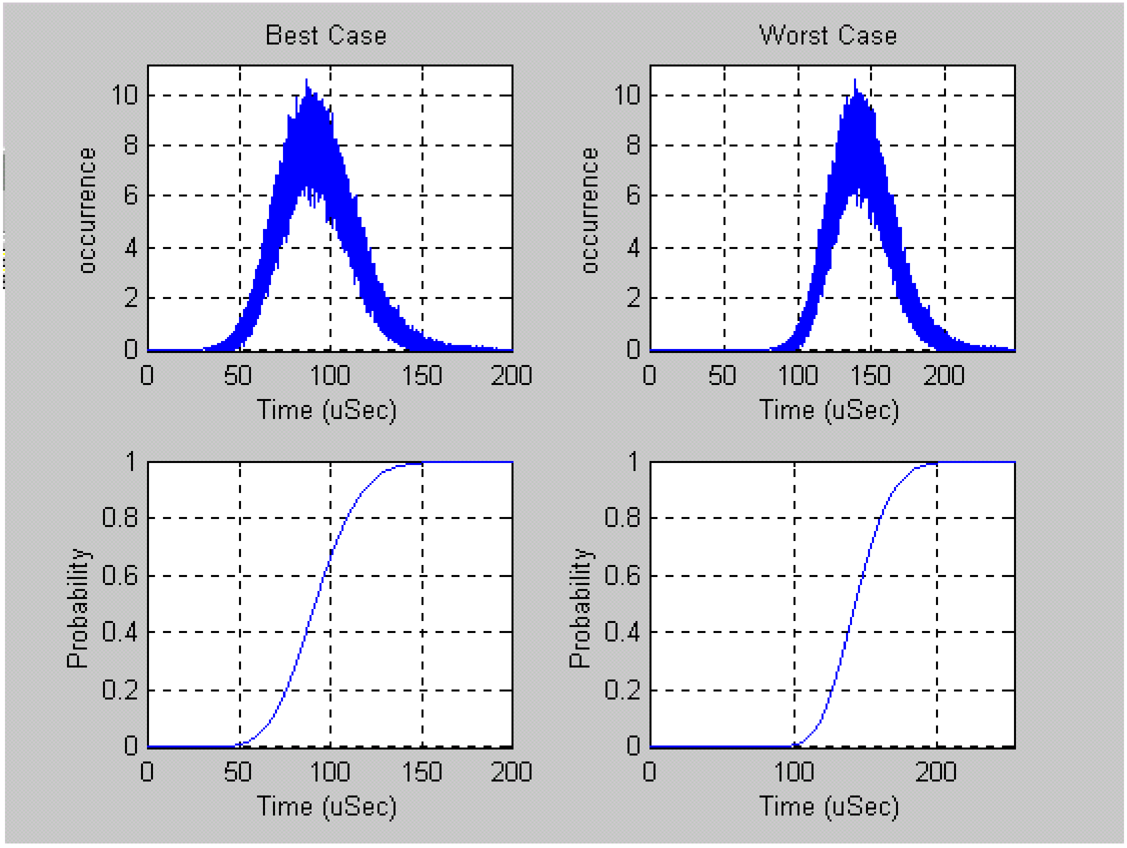
Low-priority (LP) normal frame length is uniformly distributed between 64 and 1518 bytes
Low-priority (LP) Jumbo frame length is uniformly distributed between 64 and 9216 bytes
Maximum transmission unit of high-priority (HP) delay-sensitive frame is 800 bytes.

The simulation ran for million iterations, under two scenarios:

Best Case Scenario:
The monitored high priority frame is the only high priority frame traversing over the ring.

Worst Case Scenario:
Each node bursts two high priority HP_MTU length frames (back to back) to the ring. Transit high-priority frames have precedence over local high-priority frames.

RPR of 2.5Gbps with Jumbo BE frames



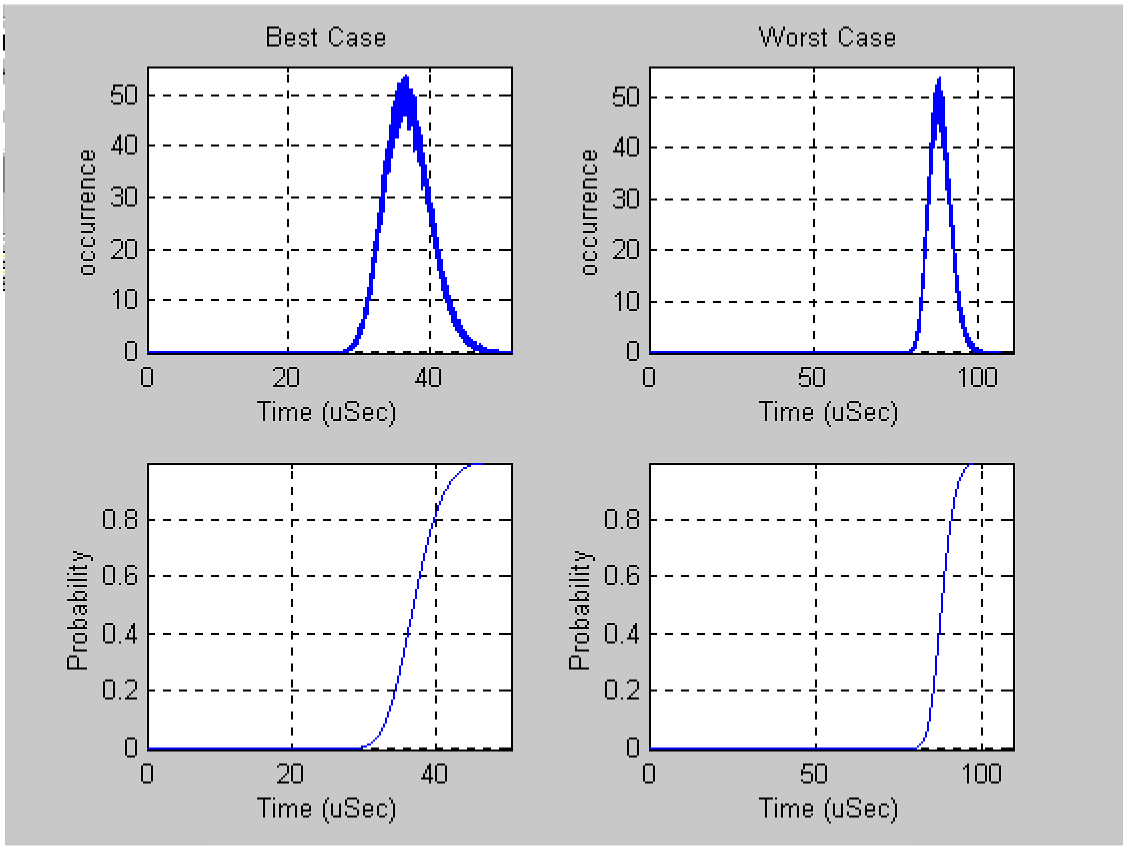
Best Case results:

Mean delay	= 92.4 uSec
Delay variation	= 20 uSec

Worst Case results:

Mean delay	= 143.6 uSec
Delay variation	= 20 uSec

RPR of 2.5Gbps without Jumbo BE frames



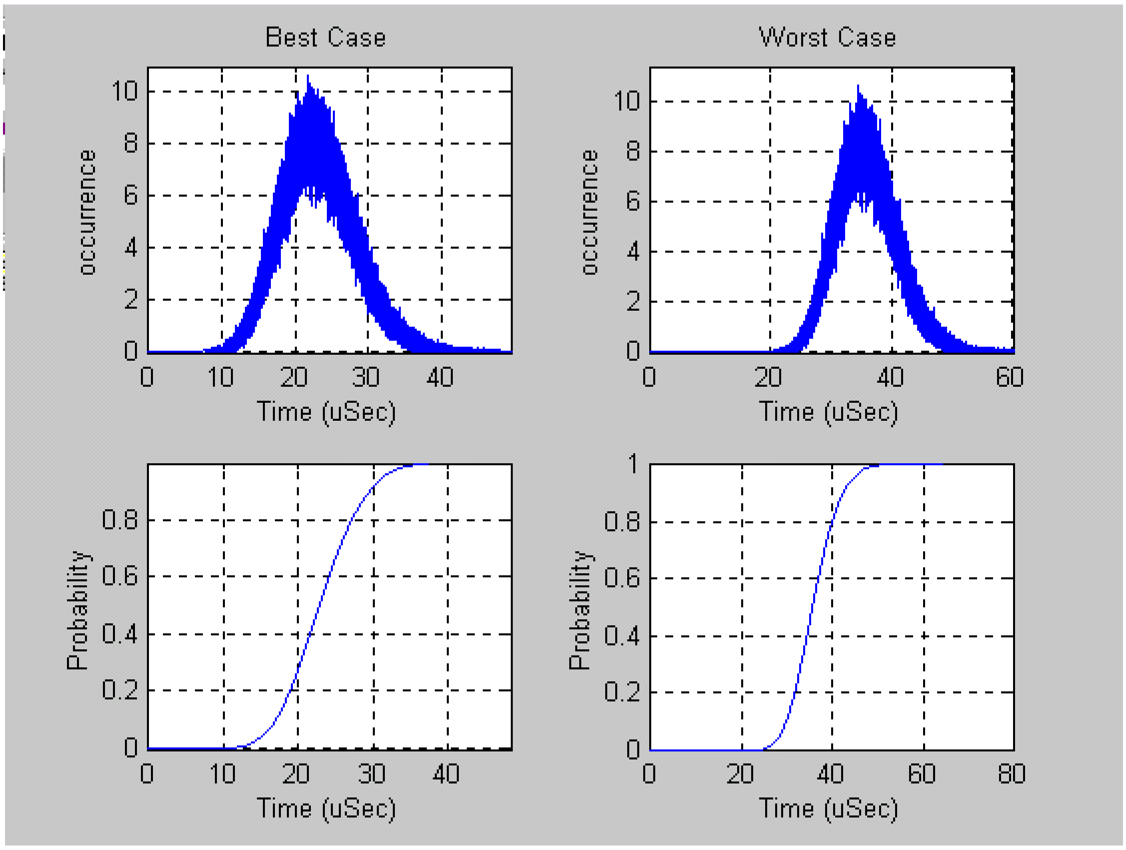
Best Case results:

Mean delay	= 37 uSec
Delay variation	= 3.28 uSec

Worst Case results:

Mean delay	= 88.2 uSec
Delay variation	= 3.28 uSec

RPR of 10Gbps with Jumbo BE frames



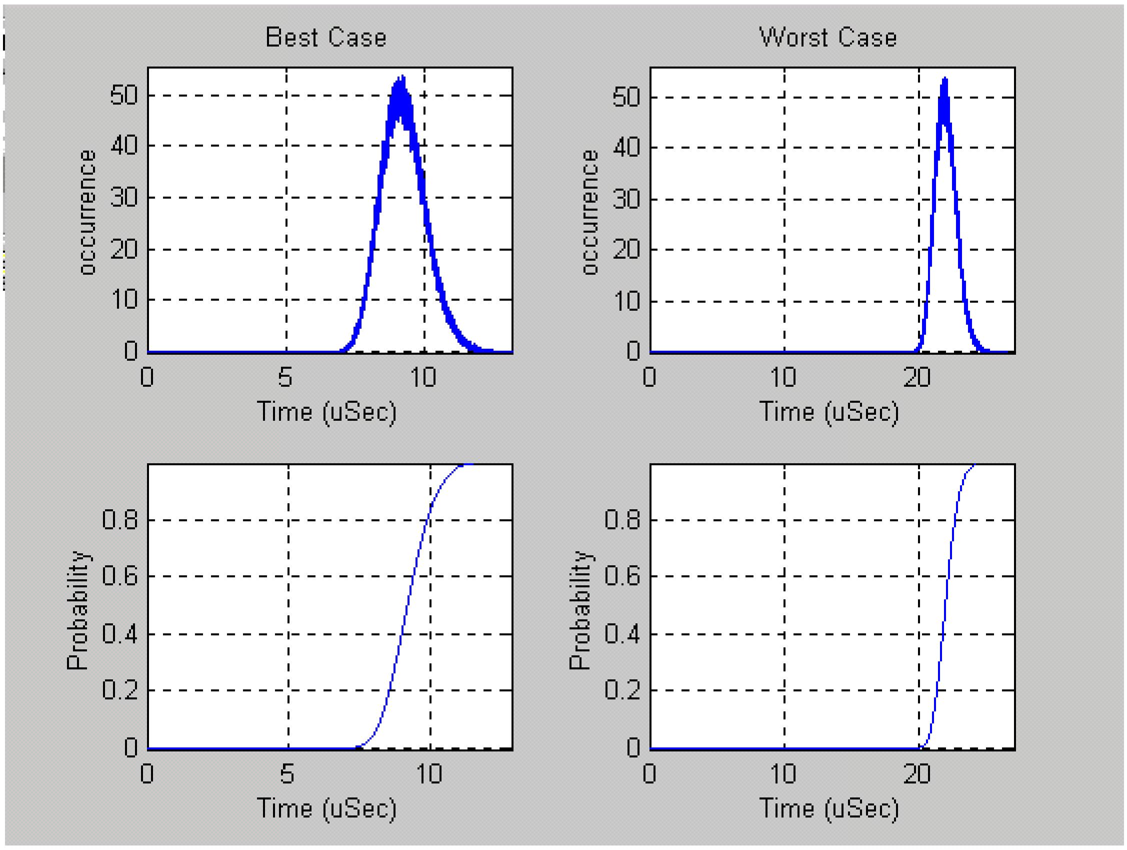
Best Case results:

Mean delay	= 23.1 uSec
Delay variation	= 5 uSec

Worst Case results:

Mean delay	= 35.9 uSec
Delay variation	= 5 uSec

RPR of 10Gbps without Jumbo BE frames



Best Case results:
Mean delay = 9.25 uSec
Delay variation = 0.82 uSec

Worst Case results:
Mean delay = 22 uSec
Delay variation = 0.82 uSec

Conclusions

Jumbo frames effects on delay-sensitive traffic

Low priority Jumbo frames transferred over RPR, significantly increase the delay of high priority frames, and cause different delays to consecutive high priority frames delivered from source to destination nodes, thereby increasing the delay variation.
Delay-sensitive traffic requires limited wander. A large delay variation caused due to Jumbo frames might consume most of the network budget and therefore increasing probability of slips and error bursts. Low priority Jumbo frames might prevent RPR from delivering delay-sensitive traffic.

CoS required for delay-sensitive traffic over RPR

Based on the simulation results, we can reach an additional conclusion: when delay and jitter sensitive traffic is used in conjunction with loss-sensitive data, two priority buffers are not sufficient.

Mapping delay-sensitive (e.g voice, video, and TDM) and loss-sensitive (data) traffic guaranteed frames to a common High-priority buffer (while mapping BE frames to Low-priority buffer) result in significantly increased delay and delay variation to the delay-sensitive frames. Moreover, many service providers are oversubscribing guarantied-bandwidth data, knowing that data links are normally underutilized. However, when done in the same queue used for the delay-sensitive traffic, there is a danger of congestion in the high-priority buffers that will have a severe effect on the delay-sensitive traffic.

We conclude that at least three buffers (delay-sensitive, guaranteed bandwidth data, and best effort data) should be implemented in RPR.