MAC Privacy Bandwidth and TSN Traffic Specification

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Outline

• Specifying MAC Privacy Protection Channel Bandwidth
Forward

• This presentation is for a discussion on detailed Channels
• It may contain errors/omission and should be considered a work in progress.
• An updated version of the presentation will be posted after discussion to correct it, but it will remain a work in progress.
Problem

• Need to specify a continuous rate for channel frames.
  • One rate for now possibly two – high and low rate
• This must work for all Link speeds and PrY environments
• It should be friendly for TSN environments – work with QoS shapers
• It could be the complete link bandwidth or any portion of a traffic class.
Possible Inputs

• Maximum frame size
• Percent of link rate
• Percent of Traffic class (which is percent of Link rate)
• Scheduling frequency/timing
Channel transmission Bandwidth and Interval

Given 3 can compute the other

Current draft uses:
MAC Privacy Channel: Max Frame Size and Bandwidth
(+ Link bandwidth specified on Interface) and Interval is computed (assumed to be granular)
Question of how to relate this to Time Sensitive Networking (TSN) Transmission?

• Note that the 4 inputs are needed to compute a transmission interval (unless the channel uses all available link bandwidth).

• Channel bandwidth also implies priority which maps to class.

• TSN is all about the interval computation for scheduling frame transmission.

• While the results are similar, specification by interval is more amiable to TSN specifications. Although this may “quantize” bandwidth more than other approaches.
Time Sensitive Networking
IEEE Std 802.1Qcc-2018

Max Frame Size (computed as time in nano seconds) = Max Frame size (octets) / Transmission Bandwidth

Note this is my interpretation
TSN configured Traffic Specification (Tspec)
IEEE Std 802.1Qcc-2018

Tspec/ Per Stream / Per Class
- ieee8021SrpStreamId,
- ieee8021SrpStreamDestinationAddress,
- ieee8021SrpStreamVlanId,
- **ieee8021SrpStreamTspecMaxFrameSize**, - MAX Frame Payload (excluding overhead)
- **ieee8021SrpStreamTspecMaxIntervalFrames**, - Number of Frames in a Measurement Interval
- ieee8021SrpStreamDataFramePriority,
- ieee8021SrpStreamRank

Other related parameters These are dependent on the Rate of the interface.
- **ieee8021FqtlssDeltaBandwidth** - Bandwidth per Class as a percentage of the full bandwidth*.
- **ieee8021FqtssBAPClassMeasurementInterval** - Measurement Interval in Nanoseconds

*Dependent on the Link Speed of a Port (specified elsewhere)
TSN Bandwidth Computations

\[
\text{assumedPayloadSize} = \text{MaxFrameSize} \\
\text{maxFrameRate} = \text{MaxIntervalFrames} \times \left(\frac{1}{\text{classMeasurementInterval}}\right) \\
\text{actualBandwidth} = \left(\text{perFrameOverhead} + \text{assumedPayloadSize}\right) \times \text{maxFrameRate}
\]

Substituting:

\[
\text{assumedPayloadSize} = \text{ieee8021SrpStreamTspecMaxFrameSize} \\
\text{maxFrameRate} = \text{ieee8021SrpStreamTspecMaxIntervalFrames} \times \left(\frac{1}{\text{ieee8021FqtssBAPClassMeasurementInterval}}\right) \\
\text{actualBandwidth} = \left(\text{perFrameOverhead} + \text{assumedPayloadSize}\right) \times \text{maxFrameRate}
\]

But: This is per class. The measurement interval is for a portion of the bandwidth: represented by \text{ieee8021FqtssDeltaBandwidth}
Time Sensitive Networking

- Measurement interval: 500us – 250us Typical
- Class Bandwidth - Percent of port bandwidth (locked or shared with other classes)
- Integral number of Frames per interval

Note this is my interpretation
What can MAC privacy specify?

A channel is analogous to a TSN Stream at a Priority

PrY Can map a channel to any priority:

• **MaxFrameSize**, - MAX Frame Payload (excluding overhead)
• **MaxIntervalFrames**, - This is a bit harder because the Interval is based on the Class and the percent bandwidth for that class.
• TSN determines the IEEE8021FqtssBAPClassMeasurementInterval and the IEEE8021FqtssDeltaBandwidth per class
  • These both are dependent on Link speed.
  • IEEE8021FqtssDeltaBandwidth is the % bandwidth to this class
  • IEEE8021FqtssBAPClassMeasurementInterval is nominally around 500 usec (larger for slower speed links)
One option

- Specify MAX Frame Size
- Specify Percent Link speed (this is almost what we have today)
- TSN can ensure that Percent of link speed is less than or equal to the class. If not, it maxes out at the class maximum.
- TSN can compute a Tspec Integral number of frames for scheduling that approximates the rate.
Another option

- Create a Tspec and a StreamID for a channel in TSN Config
- Use the StreamID in MAC PrY
- Probably still want a bandwidth number % for non-TSN or simpler environments.
Other thoughts?
### Computation

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<thead>
<tr>
<th>BW</th>
<th>Link Bandwidth</th>
<th>FrameSize (Octets)</th>
<th>Percent Link Bandwidth</th>
<th>Transmission Delay (s)</th>
<th>Number of frames Maximum</th>
<th>Class Measurement Interval</th>
<th>Bandwidth per Interval bps</th>
<th>Number of frames Per interval Max</th>
<th>Number of Frames maximum</th>
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