

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 consider a work in progress.
- An updated version the presentation will be posted after discussion to correct it, but it will remain a work in progress.

Problem

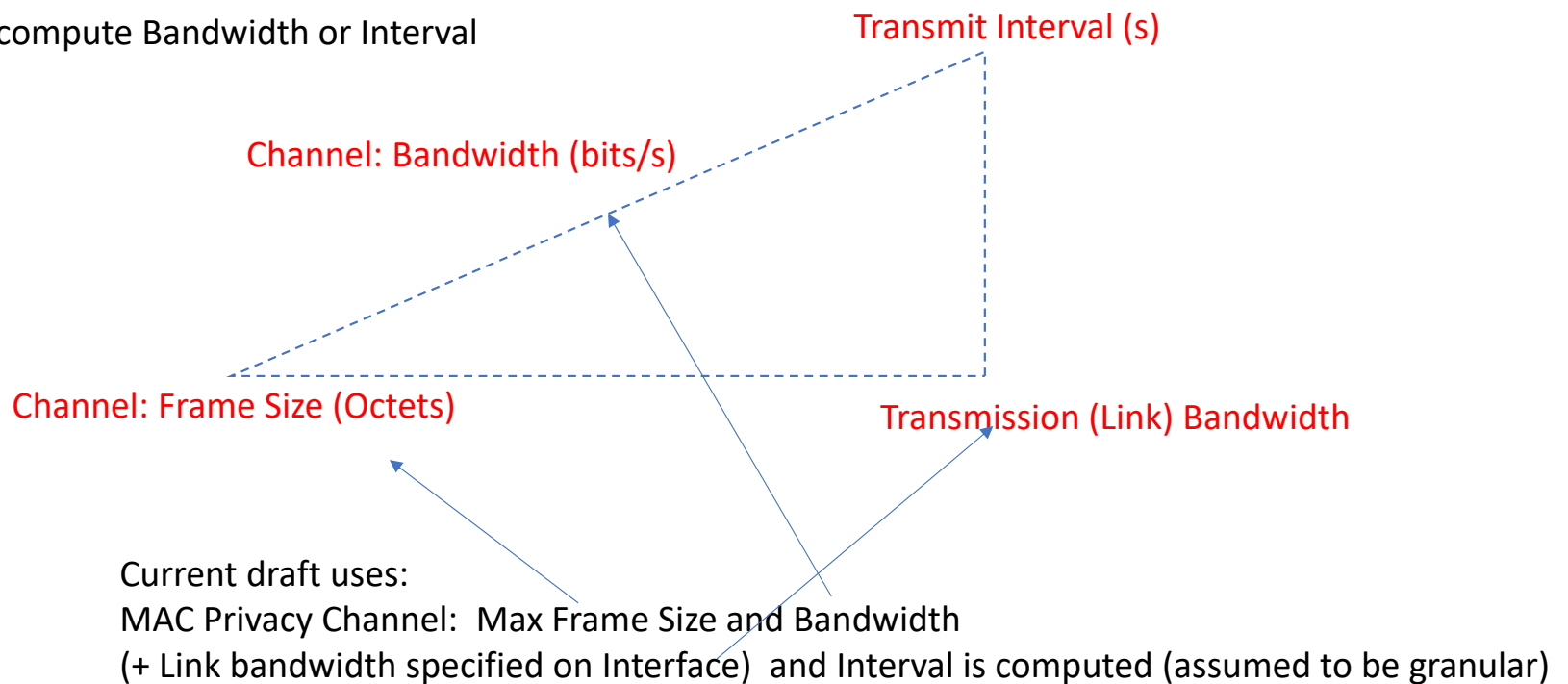
- Need to specify a continuous rate for channel frames.
 - One rate for now possibly two – high and low rate
- This must work for all Link speeds and PrY environments
- It should be friendly for TSN environments – work with QoS shapers
- It could be the complete link bandwidth or any portion of a traffic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

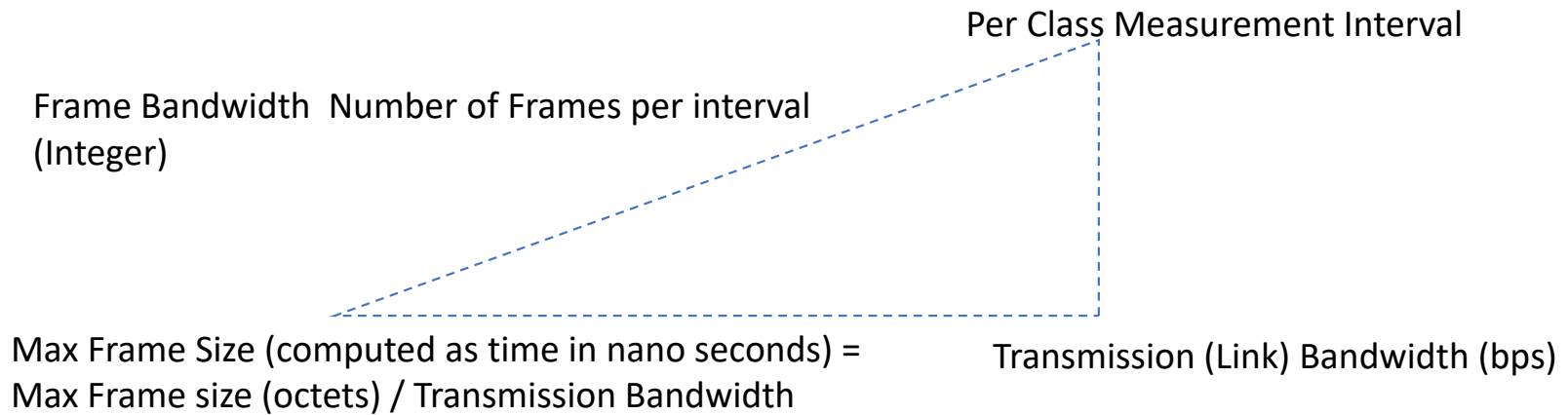


Question of how to relate this to Time Sensitive Networking (TSN) Transmission?

- 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



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.

- **ieee8021FqtssDeltaBandwidth**- 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

$assumedPayloadSize = MaxFrameSize$

$maxFrameRate = MaxIntervalFrames \times (1/classMeasurementInterval)$

$actualBandwidth = (perFrameOverhead + assumedPayloadSize) \times maxFrameRate$

Substituting:

$assumedPayloadSize = ieee8021SrpStreamTspecMaxFrameSize$

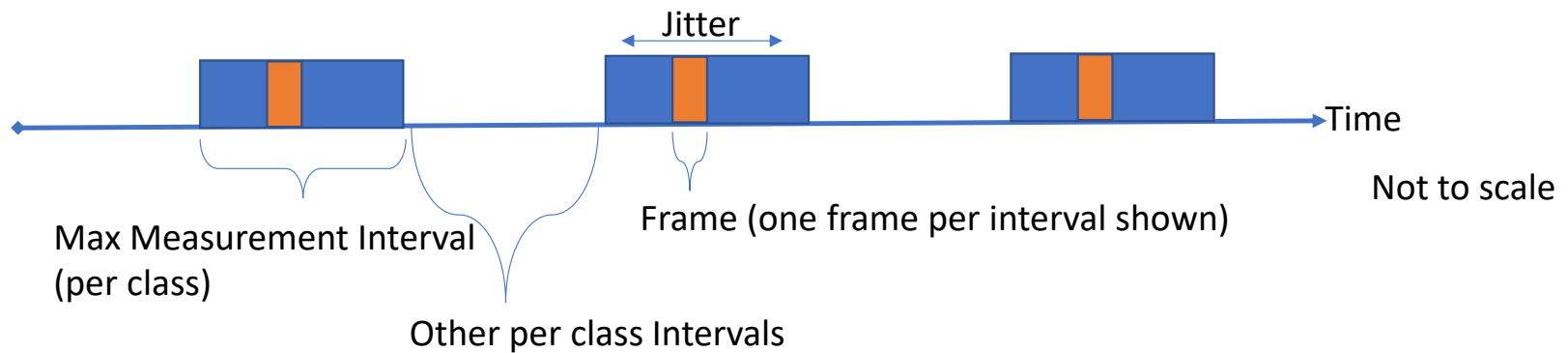
$maxFrameRate =$


$ieee8021SrpStreamTspecMaxIntervalFrames \times (1/ieee8021FqtssBAPClassMeasurementInterval)$

$actualBandwidth = (perFrameOverhead + assumedPayloadSize) \times maxFrameRate$

But: This is per class. The measurement interval is for a portion of the bandwidth : represented by $ieee8021FqtssDeltaBandwidth$

Time Sensitive Networking



- Controls / Per Class
- 
- 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)
 - The packet overhead must be computed but TSN and is different for PrY alone, PrY and SecY and per medium.

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?

Bandwidth/Interval Computation

Interval Computation									
	Link Bandwidth	FrameSize (Octets) Transmission Delay (s)	Percent Link Bandwidth	Number of frames Maximum	Class Measurement Interval	Bandwidth per Interval	Number of frames Per interval Max	Number of Frames maximum	Error
BW	bps	1500	%		Seconds	bps			%
1K	1000	12	1200	0	0.005	5	0	0	100.00%
10K	10000	1.2	120	0	0.005	50	0	0	100.00%
100K	100000	0.12	12	8	0.005	500	0	0	100.00%
1M	1000000	0.012	1.2	83	0.005	5000	0	0	100.00%
10M	10000000	0.0012	0.12	833	0.005	50000	4	800	3.96%
100M	100000000	0.00012	0.012	8333	0.005	500000	41	8200	1.60%
1G	1E+09	0.000012	0.0012	83333	0.005	5000000	416	83200	0.16%
10G	1E+10	0.0000012	0.00012	833333	0.0005	5000000	416	832000	0.16%
100G	1E+11	0.00000012	0.000012	8333333	0.00025	25000000	2083	8332000	0.02%
1T	1E+12	0.000000012	0.0000012	83333333	0.00025	250000000	20833	83332000	0.00%
	1E+13	1.2E-09	0.00000012	833333333	0.00025	2500000000	208333	833332000	0.00%