

Limitations of Threshold Enforcing Per-Class Ingress Policing

IEEE 802.1 TSN

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Background

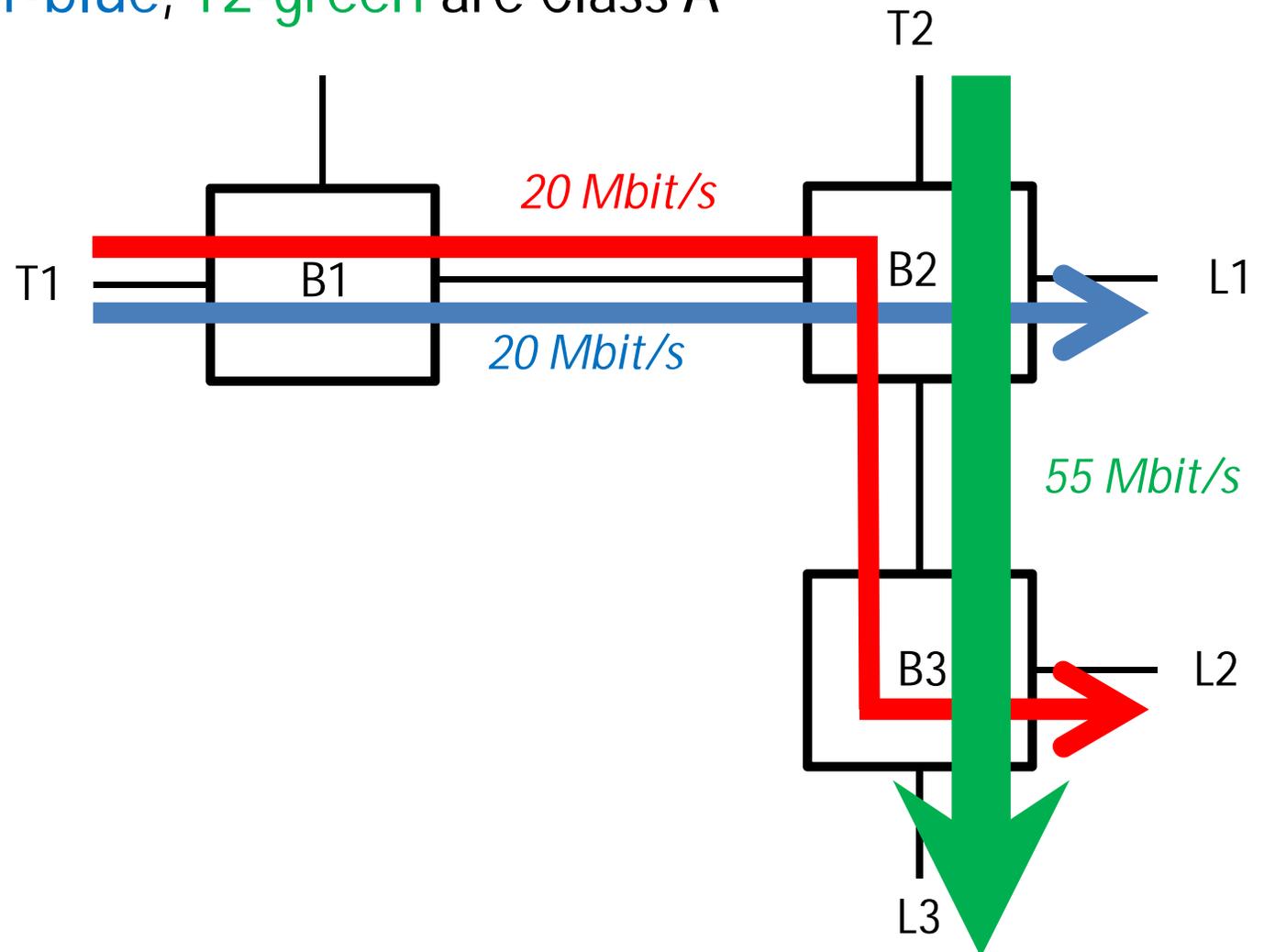
- During the IEEE 802.1 Plenary in Geneva (July 2013) different Ingress Policing strategies have been discussed:
 - Per-Class Ingress Policing
 - Per-Stream Ingress Policing
- The intention of this presentation is to show:

A (threshold enforcing) per-class ingress policing mechanism cannot prevent babbling idiot type of faults from propagating through the network.

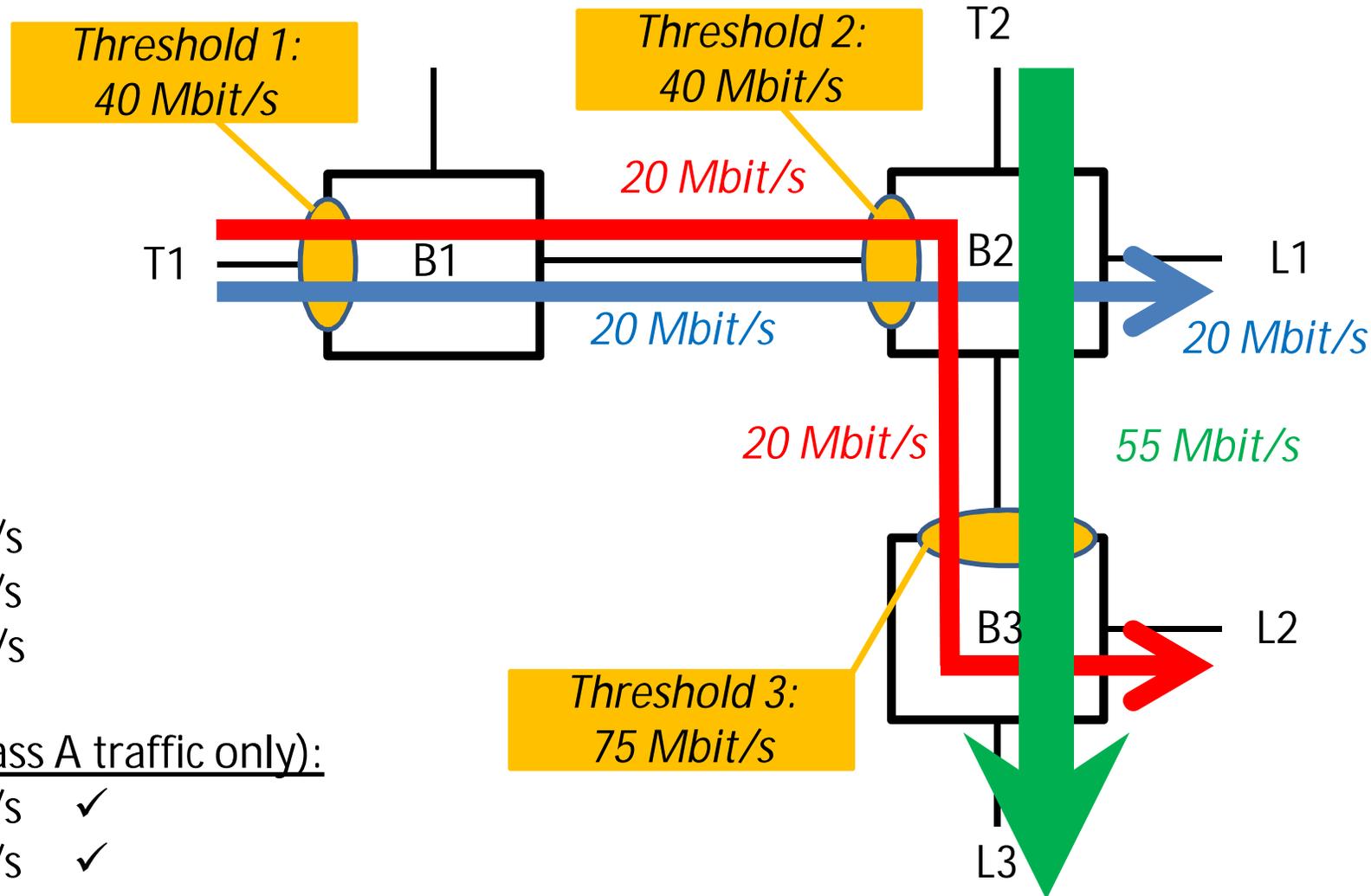
Example

Assumptions this example is based on:

- Only Best Effort Traffic and AVB Class A Traffic
- Streams **T1-red**, **T1-blue**, **T2-green** are Class A



Per-Class Ingress Policing: Fault Free Case



Streams:

T1-red: 20 Mbit/s

T1-blue: 20 Mbit/s

T2-green: 55 Mbit/s

Link Utilization (Class A traffic only):

B1 -> B2: 40 Mbit/s ✓

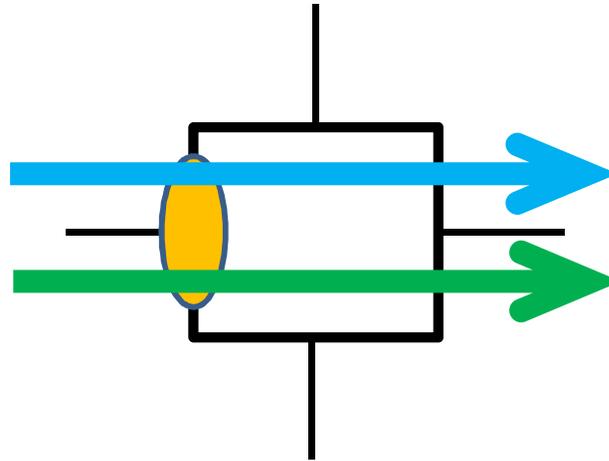
B2 -> B3: 75 Mbit/s ✓

 = Symbol for Ingress Policing Filter (IPF)

Possible Effects of a Babbler on Per-Class Ingress Policing

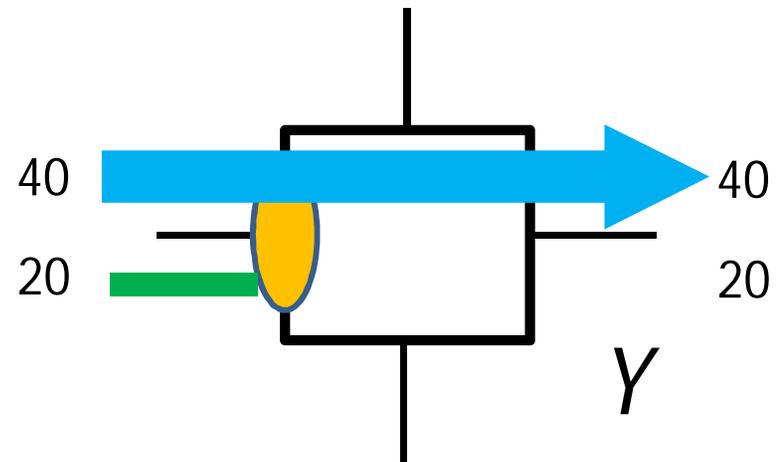
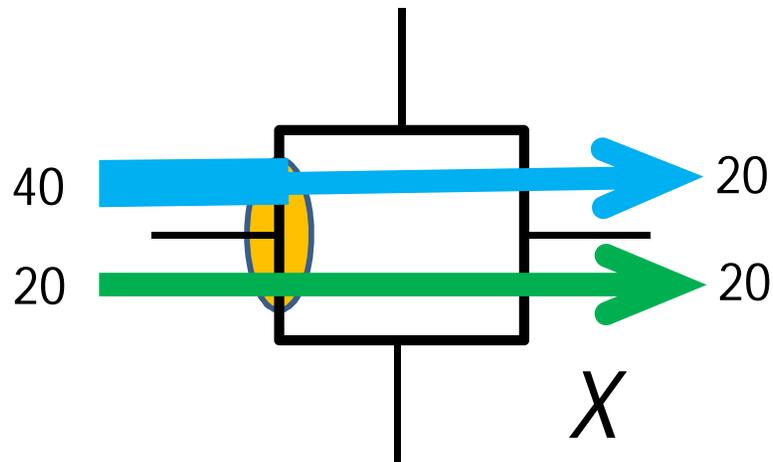
Example :

Blue: 20 Mbit/s
Green: 20 Mbit/s



Blue: 20 Mbit/s
Green: 20 Mbit/s

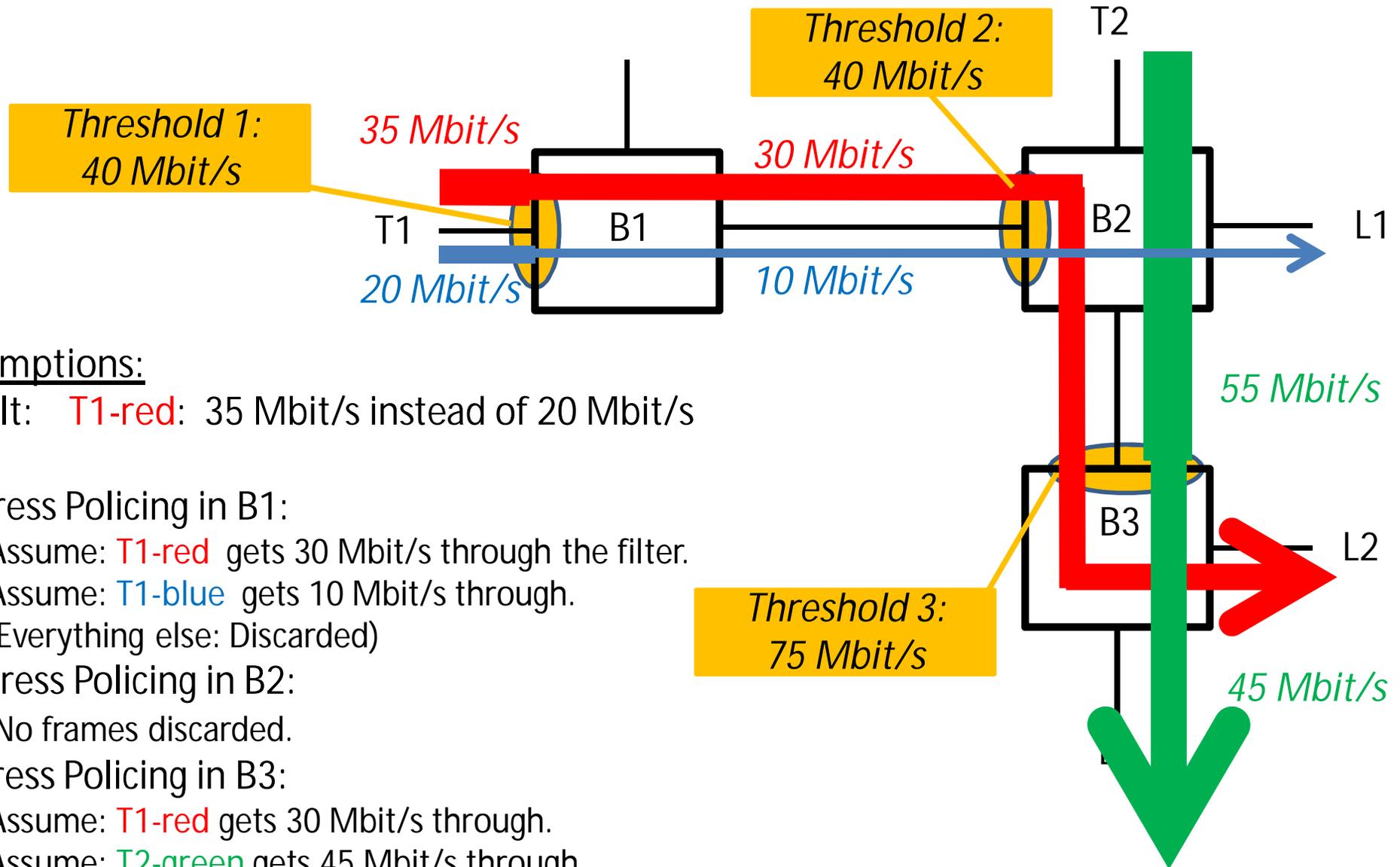
Fault: Blue stream increases from 20Mbit/s to 40 Mbit/s



S1: All kinds of behavior (X or Y or anything in between) are possible!

Since a per class ingress policing mechanism is not aware of any streams, it can only discard arbitrary class A frames once the established bandwidth threshold is exceeded. The discarded frames could be blue frames only, or green frames only, or any mix of blue and green frames we can think of.

Per-Class Ingress Policing: Faulty Stream T1,red



Assumptions:

- Fault: **T1-red**: 35 Mbit/s instead of 20 Mbit/s

- Ingress Policing in B1:

* Assume: **T1-red** gets 30 Mbit/s through the filter.

* Assume: **T1-blue** gets 10 Mbit/s through.

(Everything else: Discarded)

- Ingress Policing in B2:

* No frames discarded.

- Ingress Policing in B3:

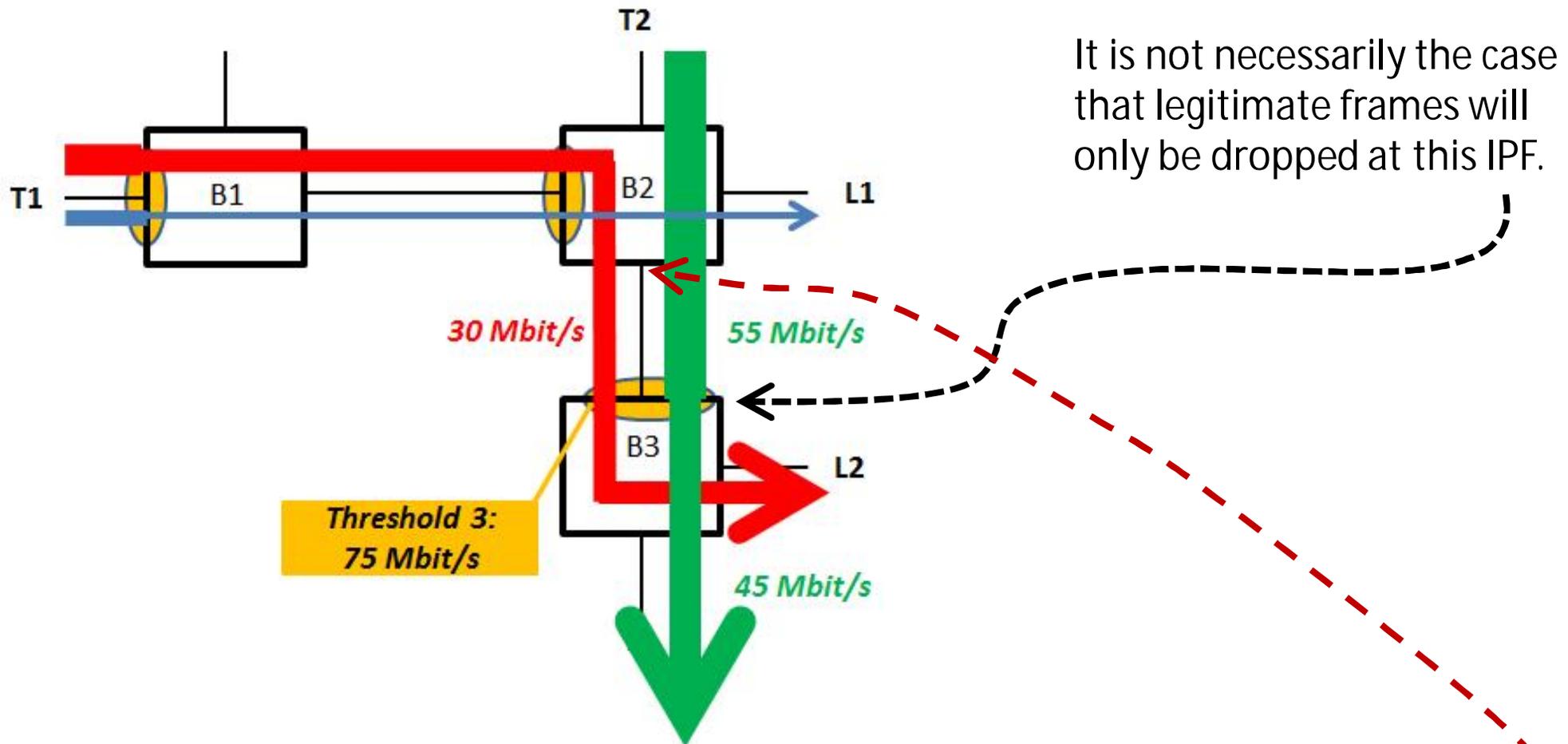
* Assume: **T1-red** gets 30 Mbit/s through.

* Assume: **T2-green** gets 45 Mbit/s through.

About 18% of the green frames are discarded !

Note: This diagram shows one out of many different ways of how things could play out. (See statement S1 on previous slide)

Per-Class Ingress Policing: **Additional Observation**



It is not necessarily the case that legitimate frames will only be dropped at this IPF.

- As a result of the propagating effects of the babbling idiot fault, frames may also be randomly dropped on an egress port.
- In the example the class A bandwidth on this egress port violates AVB's "Max. 75% Class A Traffic" recommendation.
- Assume a more drastic example with T2-green = 70 Mbit/s, T1-red = 40 Mbit/s. (→ Fast Eth. link speed between B2 and B3 exceeded! Frames guaranteed to be dropped!)

Per-Class Ingress Policing: Three issues observed

1. Faulty stream from faulty node^{*1} not blocked !

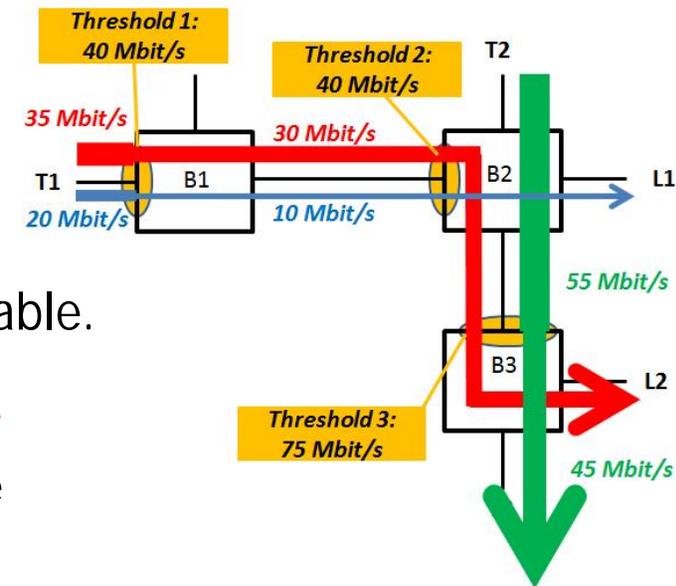
Example: Faulty stream T1-red sent by faulty source T1 was sent incomplete. Fail silent behavior would be desirable.

2. Fault free streams from faulty source affected

Example: Fault free stream T1-blue sent by faulty source incomplete (= faulty) stream. Undesirable!

3. Fault free stream from fault free node affected !

Fault free stream T2-green (send by a fault free talker) turns into an incomplete (= faulty) stream.

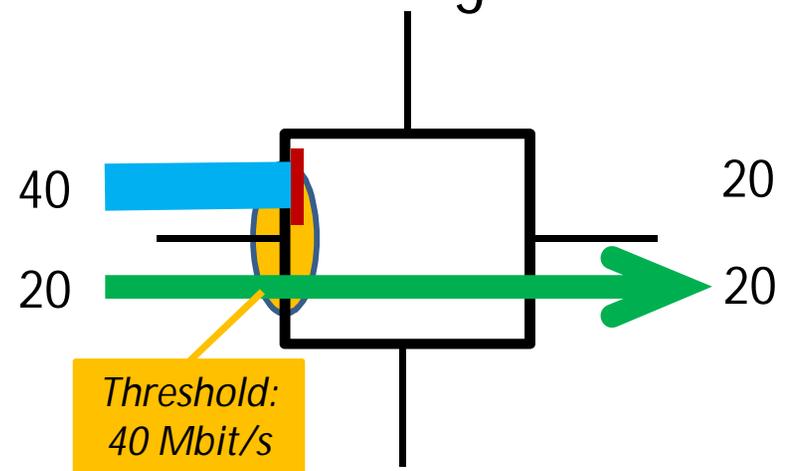
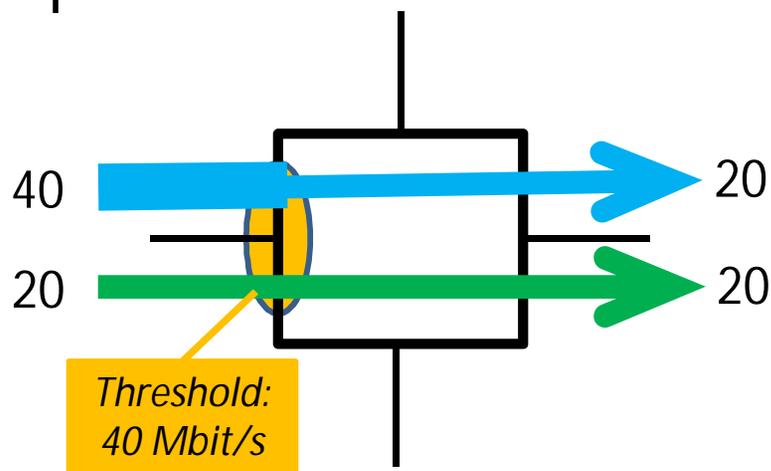


*The third issue is really really bad!
Fault propagates through the network!
Fault containment not achieved!*

*1: In general the babblor can be a node (= Talker or Bridge).

Next steps (1/2)

- Presentation focused on: "Per-class"
Options: "Per-class" vs. "Per-stream"
- Presentation focused on: "Threshold enforcing Ingress Policing"
Options: "Threshold enforcing IP" vs. "Blocking IP"

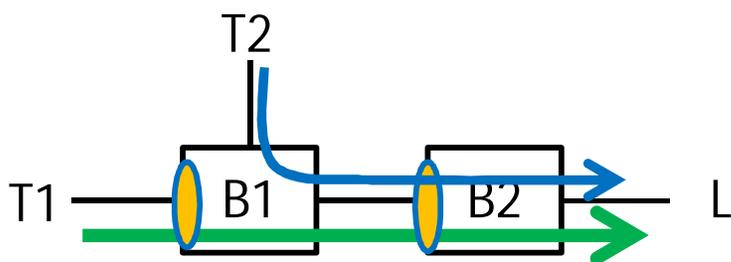


Next steps (2/2)

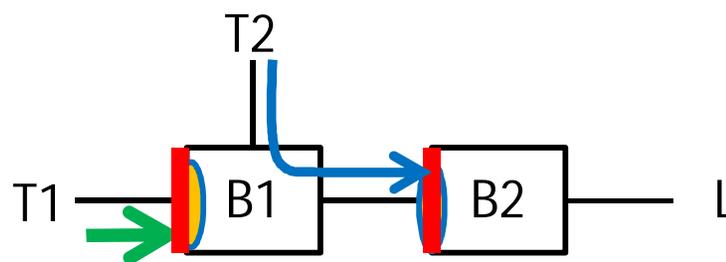
- It is worth to evaluate all 4 combinations:
{Per-Class, Per-Stream} X {Enforcing, Blocking}
Evaluate: Which combination will address which of the three issues?
- We will need time to do this thoroughly, since some “details” can easily be overlooked.
(See backup slide for some examples.)
- Maybe there are additional ideas worth evaluating?
*E.g.: Enable per stream ingress policing for critical streams only.
Frames that sucessfully passed an ingress policing filter will be colored green.
Green frames will never be dropped on egress.*

Backup

- Worth to go through all 4 combinations:
 {Per Class, Per Stream} X {Enforcing, Blocking}
- This needs to be done thoroughly, since some “details” can easily be overlooked. E.g.:
 - Is “Blocking” an independent mechanism that can be triggered by an Ingress Policing mechanism? If so, then what is the behavior during the time between “Threshold violation detected” and “Blocking activated”? Enforcing Threshold? Ignoring problem?
 - Blocking needs to be carefully implemented to avoid unintended “blocking” on more than one ingress port.



1) Both per class ingress policing filters detect threshold violation caused by “green stream” before “Blocking” is activated.



2) Consequently “Blocking” is simultaneously activated on B1 and B2. “Blue Stream” is now blocked for no good reason.