



SIEMENS

802.1Qci (Unapproved PAR): Per-Stream Filtering and Policing

Stream Filtering and Policing for Industrial Control Applications

IEEE 802 Plenary Meeting - March 2015, Berlin
Feng Chen, Franz-Josef Goetz
Siemens AG

Contents

1. Recap: Constraints on Industrial Control-Data Streams (CDS)
2. Stream Filtering and Policing for Industrial Control Applications
 - per-stream filtering and policing with a jitter-aware metering algorithm
 - concept of per-class filtering and policing

Recap: Constraints on Industrial Control-Data Streams

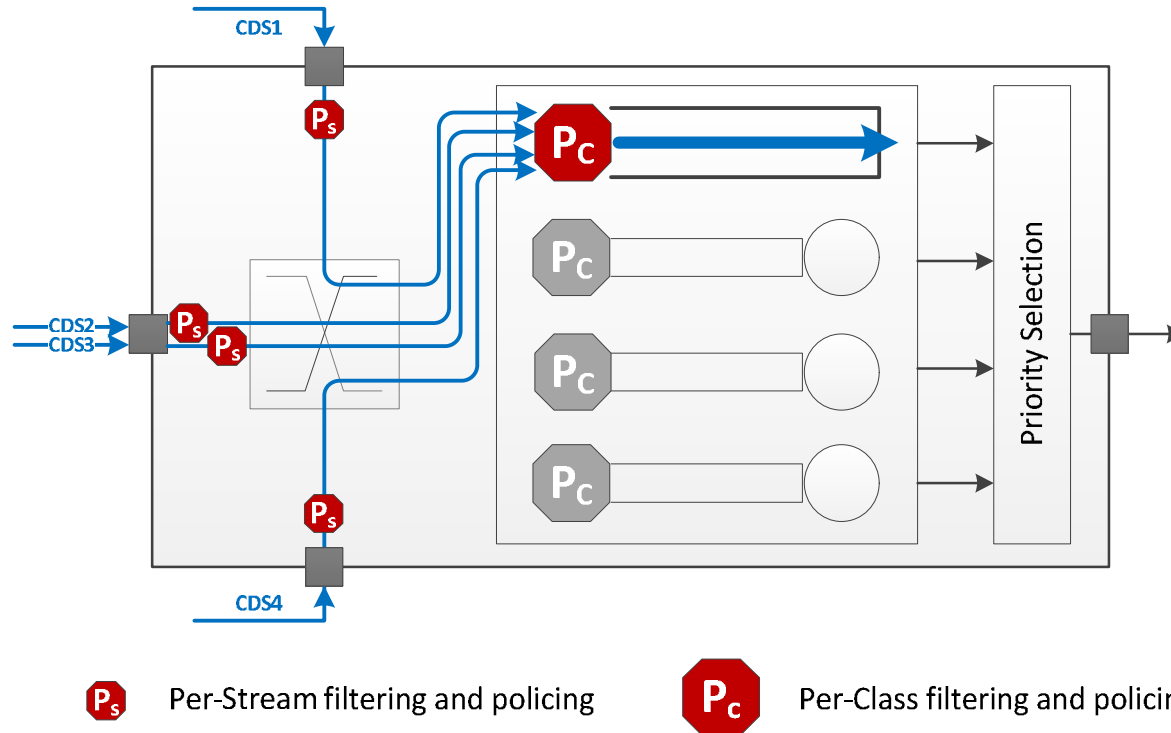
- Preferred Topology
 - daisy chain (a line or a ring)

- End-station (talker)
 - periodic generation and transmission at talkers (like TAS)
 - fixed frame size for a stream
 - one transmission period per class for all talkers
 - fixed transmission order (typically in a burst)
 - may be synchronized and transmission is coordinated with other talkers

- TSN bridges
 - Strict Priority (SP) with highest priority for control-data streams
 - pre-emption for highest priority queue (express traffic class)
 - cut-through for control-data streams
 - **Non time-based policing and forwarding assumed in this presentation**

- Further constraints resulting from control application requirements
 - maximum E-2-E delay must be lower than one transmission period

Proposed Uses of Stream Filtering and Policing for Industrial Control Data Streams



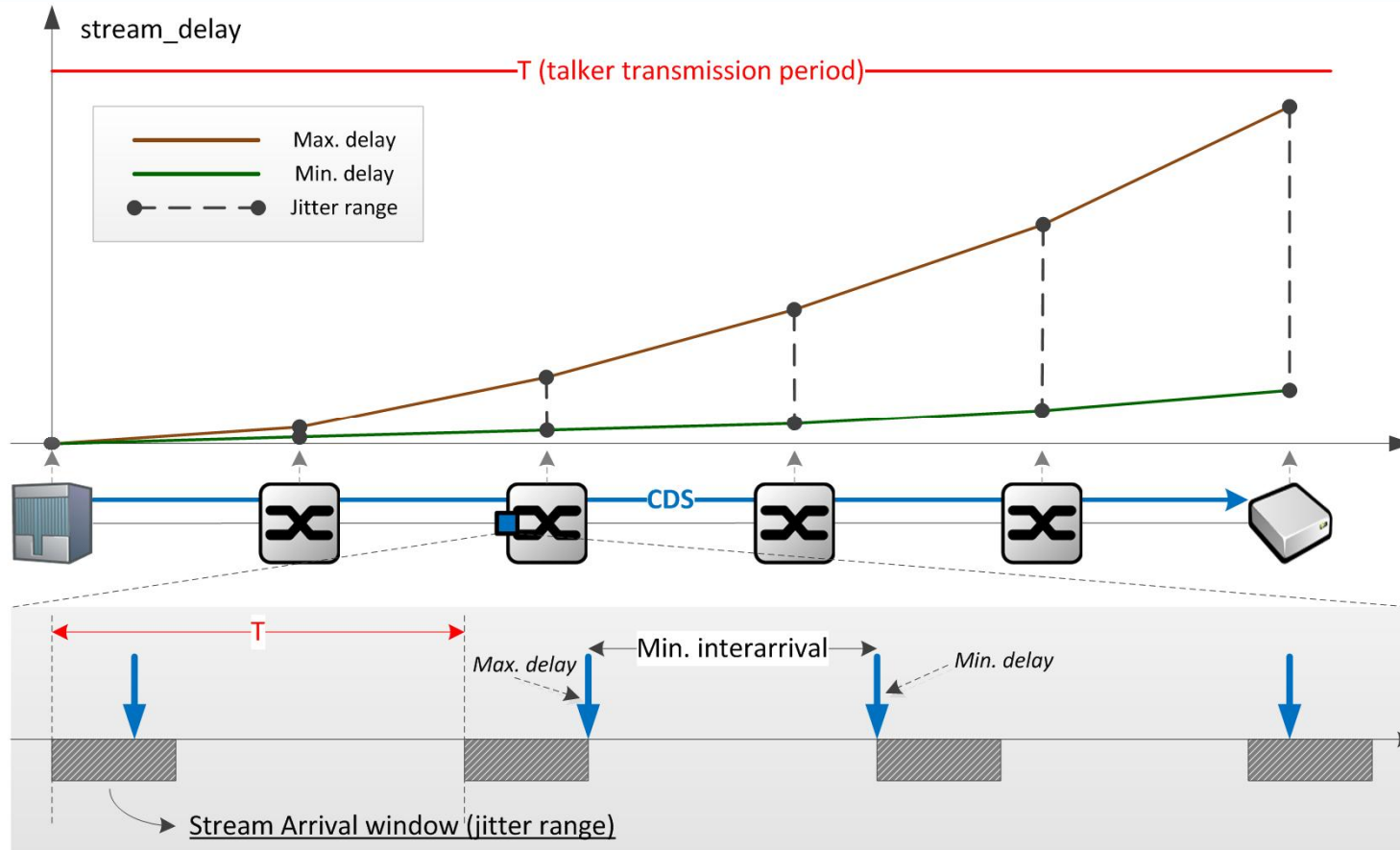
Per-stream filtering and policing

- perform per-stream bandwidth enforcement to ensure conformance with traffic contract
- detect and limit faulty stream to protect transmission of other non-faulty streams on egress
- filter out non-conformant frames, e.g. over-sized frames

Per-class filtering and policing

- perform per-class bandwidth enforcement for control-data classes on egress port

Jitter Behavior of Industrial Control Data Streams (1)

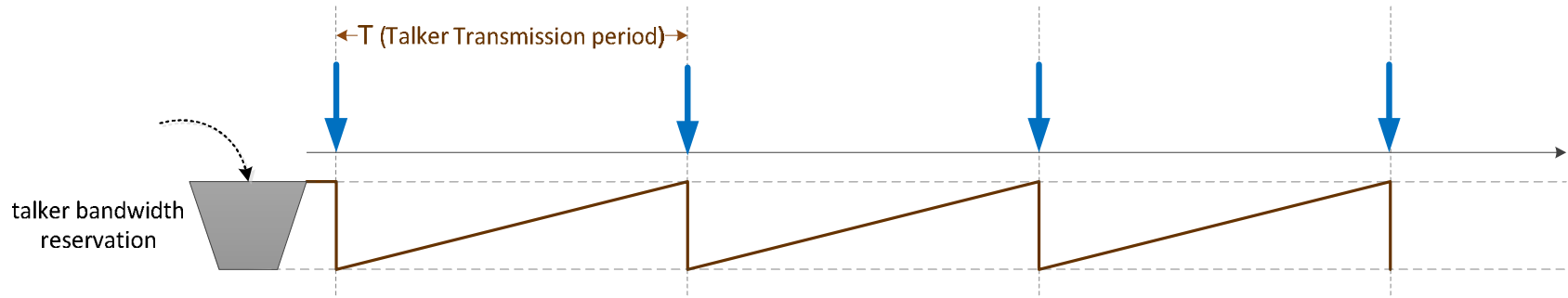


Jitter of stream

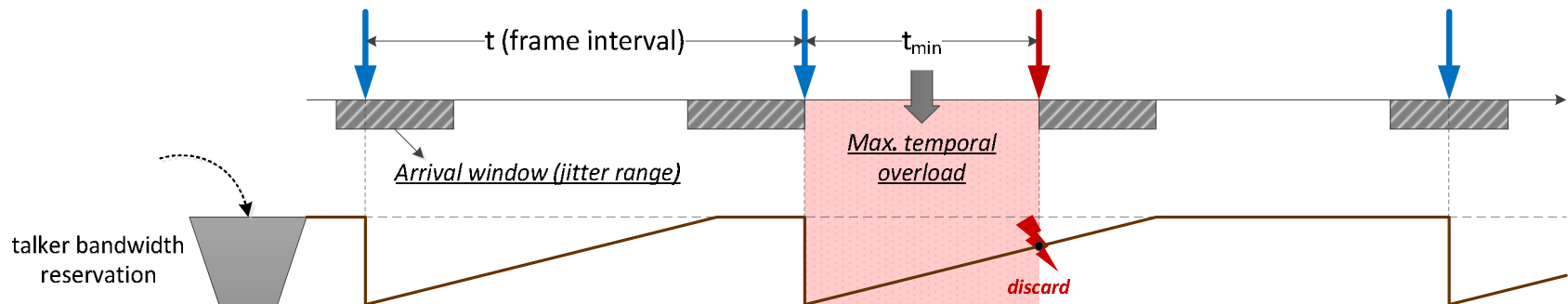
- is defined as the variation in delays of one stream measured on the ingress port of a specific bridge
- is quantified by **Max. Delay – Min. Delay**, with a constraint **stream jitter < T (talker transmission period)**
- accumulates along the stream transmission path as hop count increases (typically minimum on edge ports)

Jitter Behavior of Industrial Control Data Streams (2)

Policing of non-jittered stream (e.g. at talker)



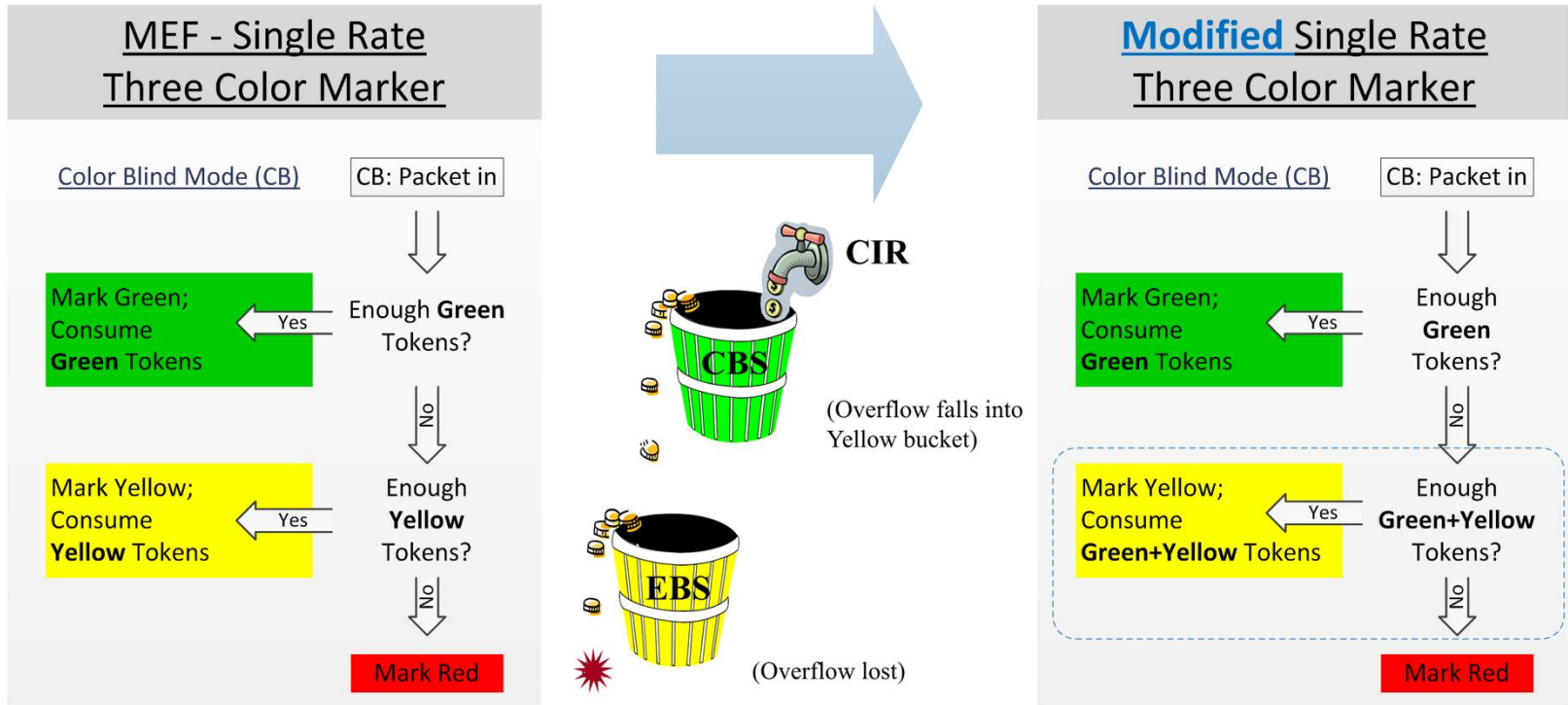
Policing of jittered stream (e.g. on bridges)



Problem: jitter causes variation in the frame interval t , leading to temporal overload at $t < T$. If metered with talker bandwidth reservation, normally jittered frames may be dropped.

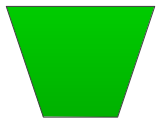
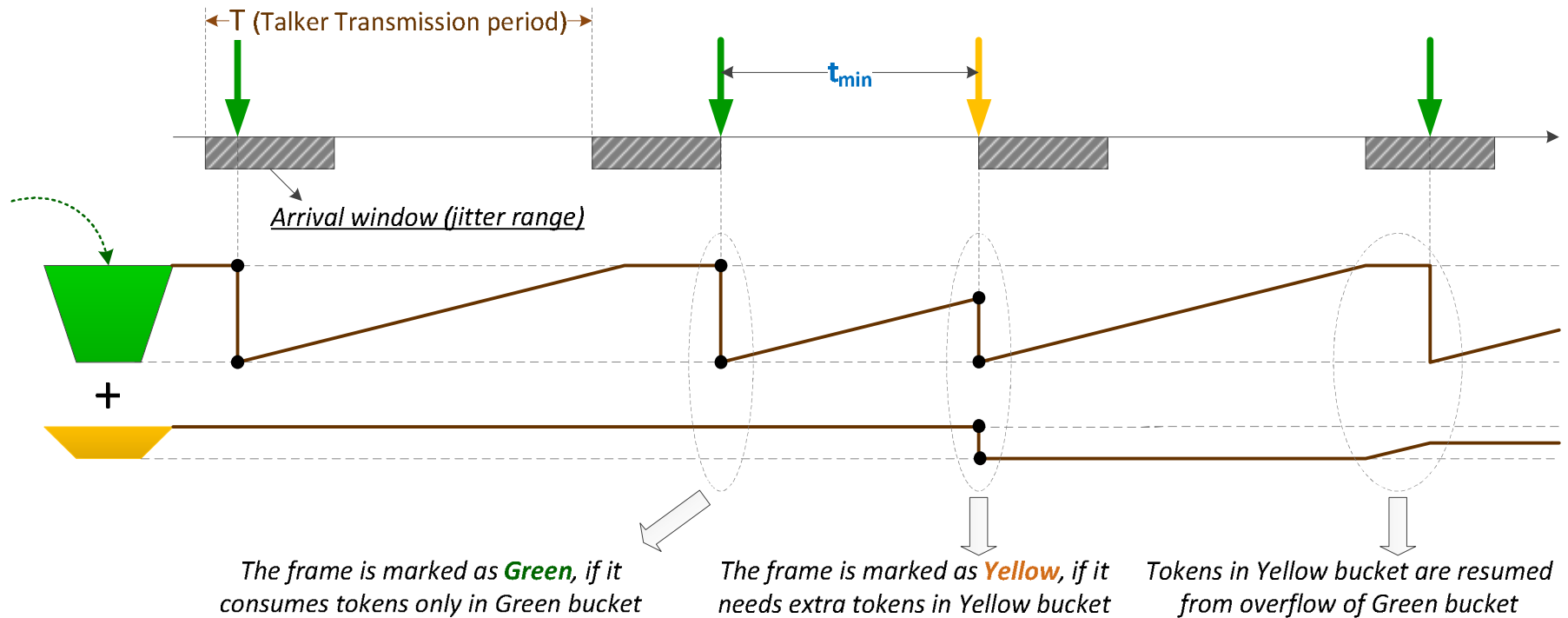
Solution: increase bucket size to allow max. temporal overload caused by jitter, with a value derived from the minimum frame interval $t_{min} = T - (\text{max. delay} - \text{min delay})$

Proposed Per-Stream Policing Algorithm for CDS



MEF SRTCM	Difference	Modified SRTCM
bandwidth for excessive traffic only from Yellow bucket	Meaning of yellow tokens	bandwidth for jitter compensation
at least for a complete frame size	Used tokens of yellow frames	from Green and Yellow buckets
best effort	Range of EBS	allowing smaller than a frame size (required for edge ports)
	Transmission of yellow frames	kept in highest priority

Policing of Jittered Stream with Modified SRTCM

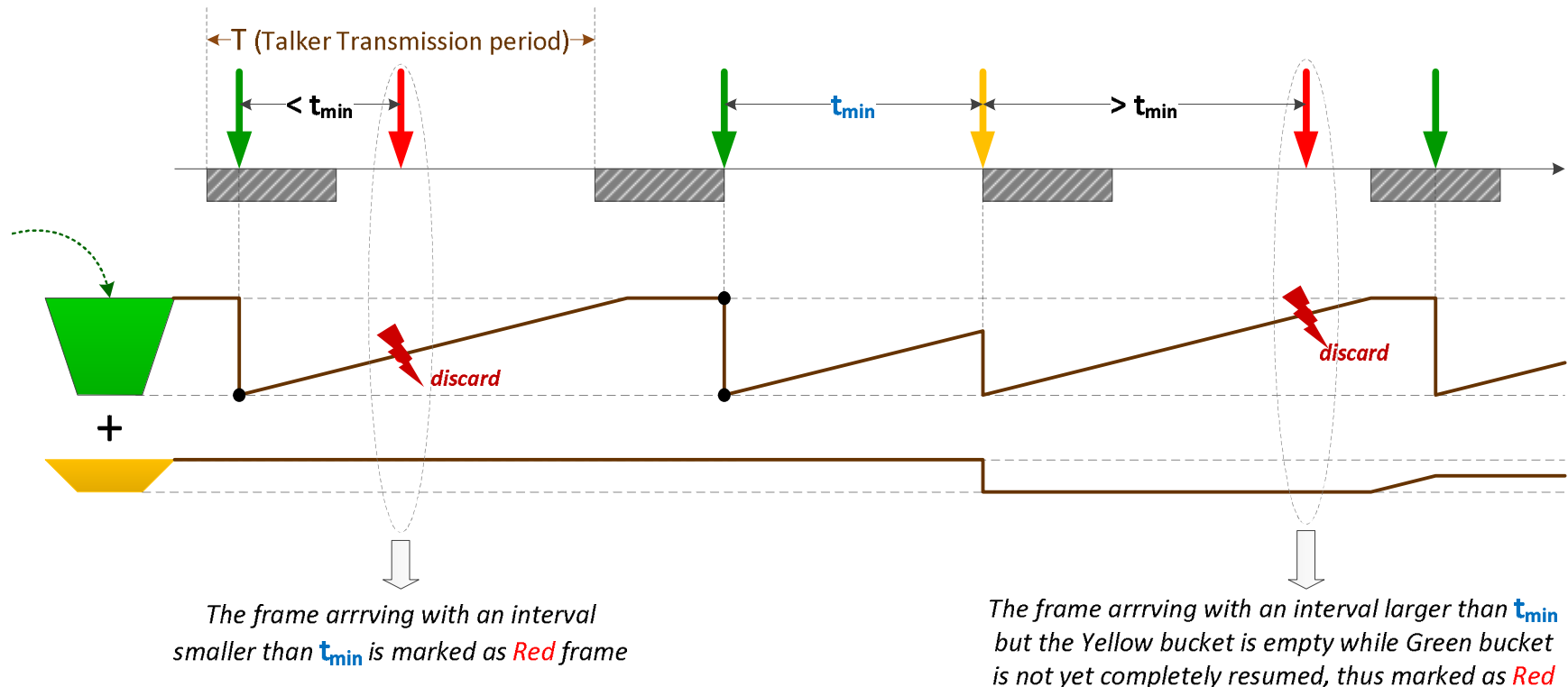


Configuration according to traffic contract made by the stream talker



Jitter buffer: bucket size can be derived from minimum frame interval caused by jitter t_{min}

Policing of Faulty Stream with Modified SRTCM



The modified SRTCM

- ensures that normally jittered frames (arriving within jitter range) will never be discarded.
 - guarantees that within any observation interval t , the amount of conformant frames (incl. Green and Yellow frames) will not exceed information rate times t plus the bucket size (Green+Yellow buckets)
- => determine the capability of detecting faulty streams with excessive traffic**

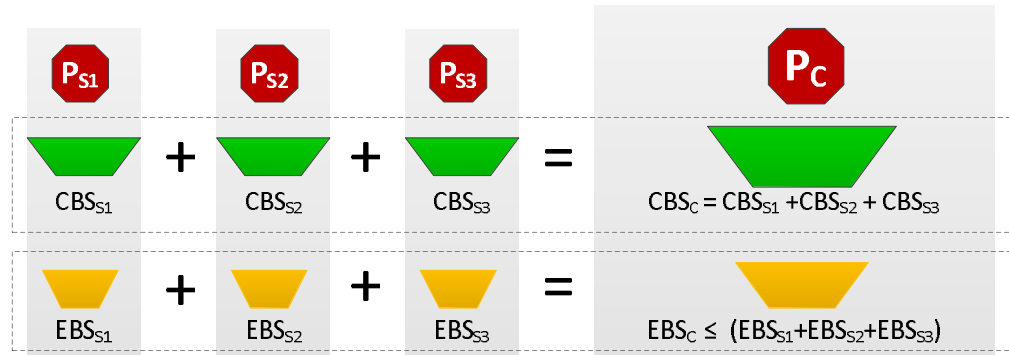
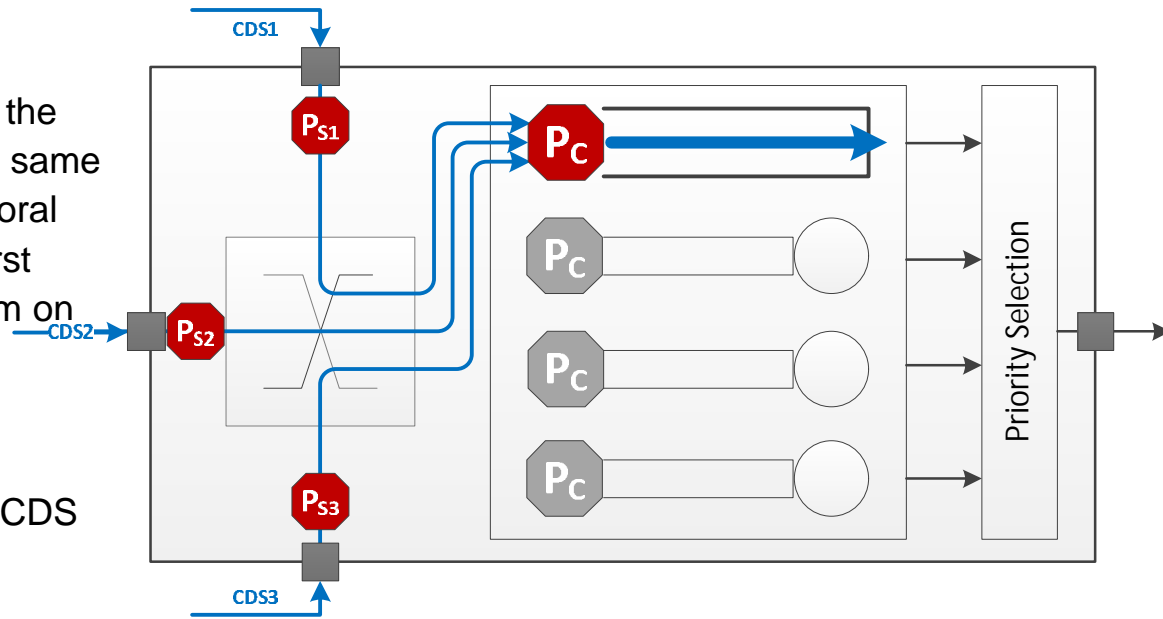
Concept of Per-Class Policing for CDS

Problems on egress port

- multiple jittered streams merging on the same egress port and feeding in the same queue may cause unexpected temporal overload, e.g. an excessive long burst
- need a bandwidth control mechanism on egress port for CDS

Per-Class policing

- Perform bandwidth enforcement for CDS on a per-class base
- Run a policing algorithm in color-aware mode to handle Green and Yellow frames declared by preceding per-stream policer
- Per-class bandwidth allocation could be derived from those for per-stream policing that merge into the same egress queue



CBS: Committed Bucket Size, EBS: Excessive Bucket Size

Thank you for your attention!



Feng Chen

PD TI ATS TM5 1

Gleiwitzer Str. 555

90475 Nürnberg

Phone: +49 (911) 895-4955

Fax: +49 (911) 895-3762

E-Mail: chen.feng@siemens.com

siemens.com/answers