Proposal for New Annex
“TrafficSpecification settings for bursty traffic with bounded latency”

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Abstract

- These slides provide a brief explanation of the New Annex proposal for Std 802.1Q.
- The actual pre-draft of the annex can be found at

  https://www.ieee802.org/1/files/public/docs2020/maint-maruhashi-pre-draft-TSpec-Annex-0920-v01.pdf

Outline of the New Annex

- Focuses on bursty traffic by time-sensitive application
  - "bursty" means the traffic comprises "Cluster of frames"
  - "time-sensitive" means the application requires "bounded latency"
- This type of traffic is common in IoT applications.
  - e.g. real-time camera inspection system which is required to report within 500msec.
  - See Nendica Report: FFIoT
- Introduces TSpec settings for such traffic to:
  - avoid disturbing other reserved traffic by temporal high network load
  - avoid overprovisioning of reserved bandwidth

Table of Contents

Z.1.1 Targeted Traffic Characteristic

- Parameters describing characteristic of traffic
  - Size of a ”cluster of frames” in bit/byte (*dataSize*)
  - Delivery time tolerance (upper bound of *deliveryTime*)
  - Minimum time between clusters
    - Note that clusters of frames occur sporadically, implying T1 ≠ T2
    - Assuming (Minimum time between clusters) > (Delivery time tolerance)

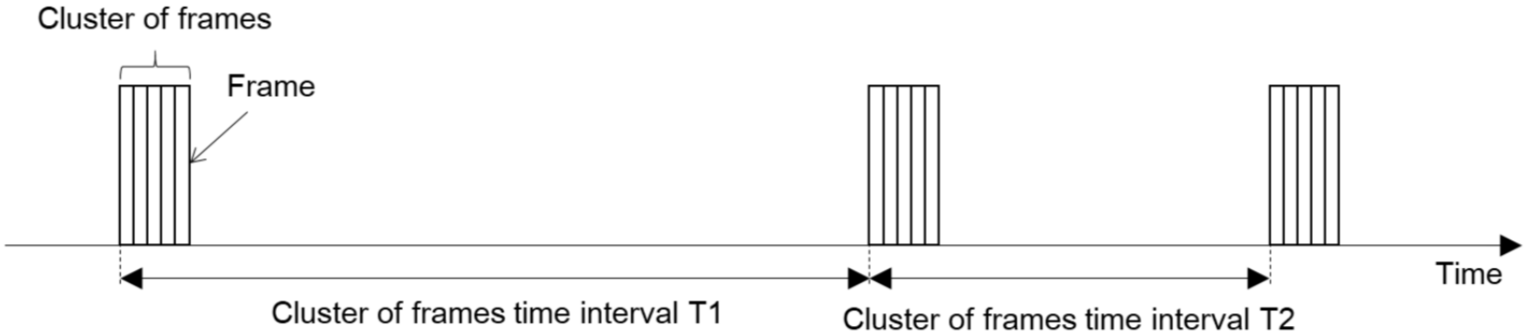


Figure Z-1— Example of bursty traffic pattern

Z.1 Feature of TSN network with Bursty Traffic

Z.1.2 Network Structure

- Talker is assumed to be equipped with
  - transmission selection algorithm
    - credit-based shaper

      and/or
    - ATS
  - enough buffer memory
- Bridges and Listners are assumed to support resource (bandwidth) reservation function.

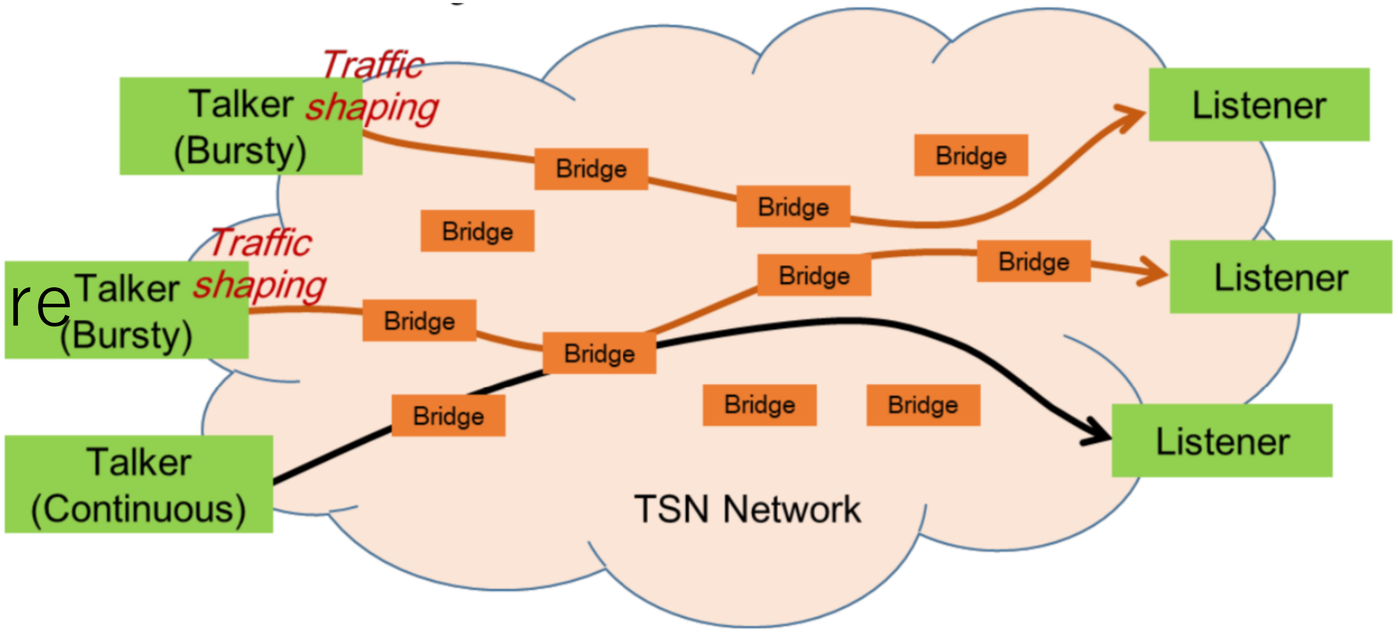


Figure Z-2 — An example of network structure under consideration

Z.2 Overall Frame Transmission Delay

Z.2.1 Delivery Time

- This clause provides definition and calculation of *dataSize* and *deliveryTime*

$$dataSize = \sum_{k=1}^{n} frameLength(k)$$

$$deliveryTime = accumlatedLatency + \frac{\sum_{k=1}^{n-1} frameLength(k)}{shapingRate}$$

accumulatedLatency needs to be calculated in advance

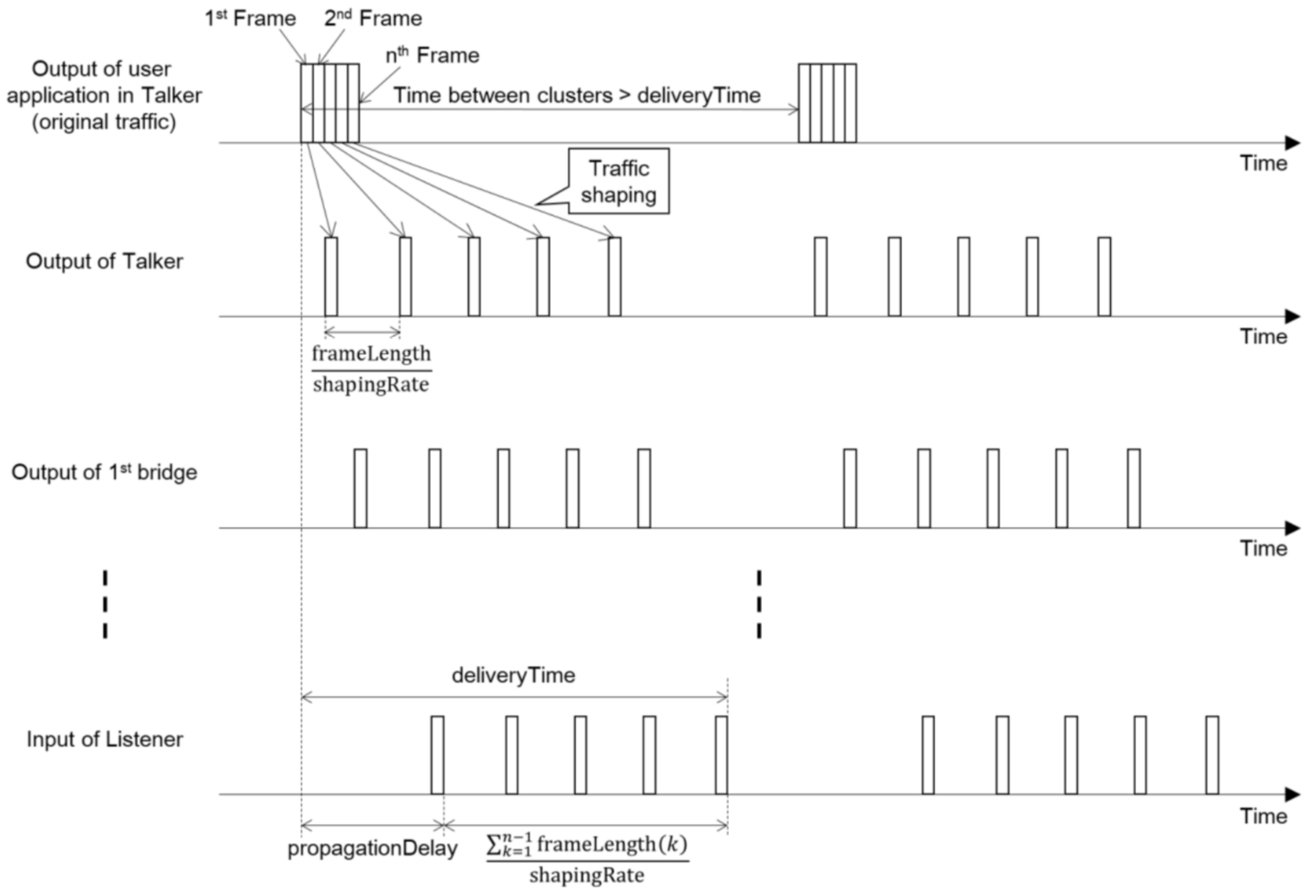


Figure Z-3— Frame propagation from Talker to Listener

Z.2.2 Accumulated Latency acquisition

Z.2.2.1 Fully distributed model

- Currently UNI does not have functionality to obtain the value of *accumulatedLatency* in advance of reservation.
  - *accumulatedLatency* is obtained from AccumulatedLatency group in Status group as a result of successful reservation (IEEE Std 802.1Qcc-2018, Clause 46.2.5.2)
    - "the word element refers to a single item of information used for TSN configuration. The word group refers to a collection of related elements. Groups are organized hierarchically," (IEEE Std 802.1Qcc-2018, Clause 46.2)
  - Therefore, two steps are required at least to:
    1. Make a reservation with tentative higher accumulatedLatency
    2. Redo the reservation with more suitable accumulatedLatency
       - Note that the second reservation can be failed.

Z.2.2.2 Fully centralized model and centralized network/distributed user model

- CNC obtains all information from the network directly.
- Therefore CNC can compute *accumulatedLatency* by itself.

  - For example, the CNC reads the bridge delay (12.32.1) and propagation delay (12.32.2) from each bridge in order to compute *accumulatedLatency* (-see Annex U, Clause U2, step 5, IEEE Std 802.1Qcc-2018).

Z.3 Recommended TSpec Settings

- *requiredMinimumShapingRate* is intended to
  - shaping the bursty traffic with bounded latency
  - ensuring the requirement for the delivery time is met
  - minimizing over-provisioning of bandwidth reservation

$$requiredMinimumShapingRate = \frac{\sum_{k=1}^{n-1} frameLength(k)}{targetLatency}$$

$$= \frac{dataSize - frameLength(n)}{targetLatency}$$

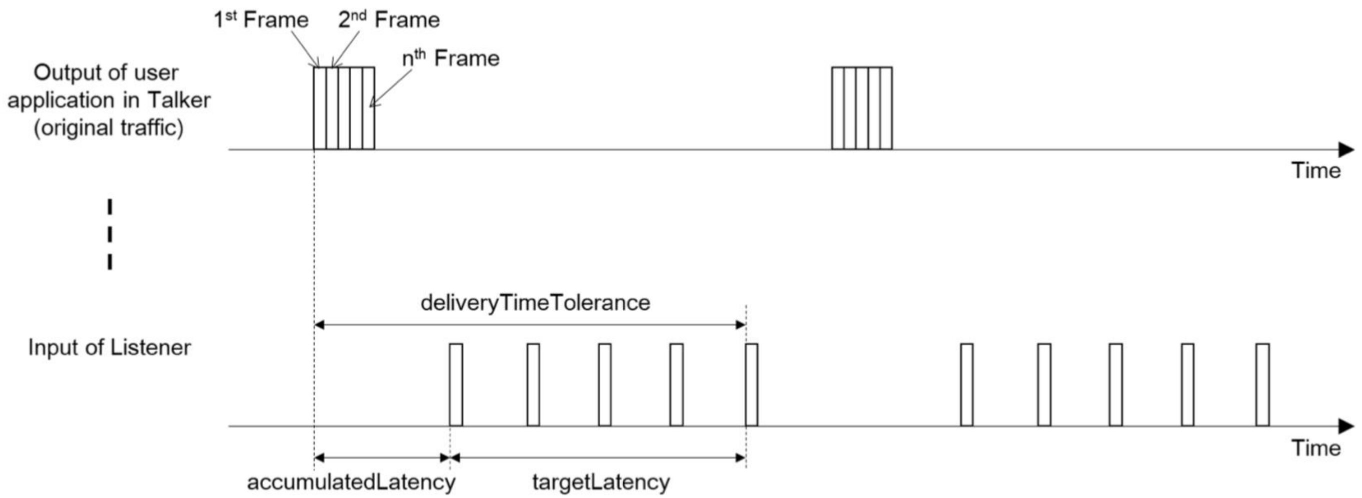


Figure Z-4— Frame propagation within delivery time tolerance while minimizing over-provision of bandwidth reservation

Z.3.1 Settings for MSRP TSpec

According to IEEE Std 802.1Q-2018

$$MaxFrameSize = \min\left(\mathrm{floor}\left(\frac{dataSize}{targetLatency} \times classMeasurementInterval\right), Maximum\ SDU\ Size\right) \quad (Z-5)$$

$$MaxIntervalFrames = \mathrm{ceil}\left(\frac{1}{MaxFrameSize} \times \frac{dataSize}{targetLatency} \times classMeasurementInterval\right) \quad (Z-6)$$

According to IEEE Std 802.1Qcc-2018

$$MaxFrameSize = \min\left(\mathrm{floor}\left(\frac{dataSize}{targetLatency} \times Interval\right), Maximum\ SDU\ Size\right) \quad (Z-7)$$

$$MaxFramesPerInterval = \mathrm{ceil}\left(\frac{1}{MaxFrameSize} \times \frac{dataSize}{targetLatency} \times Interval\right) \quad (Z-8)$$

Z.3.2 Settings for Token Bucket TSpec

- According to P802.1Qcr, parameters for ATS are
  - *CommittedBurstSize*
    - shoud be *CommittedBurstSize* ≧ (any frame sizes in the cluster)
  - *CommittedInformationRate*

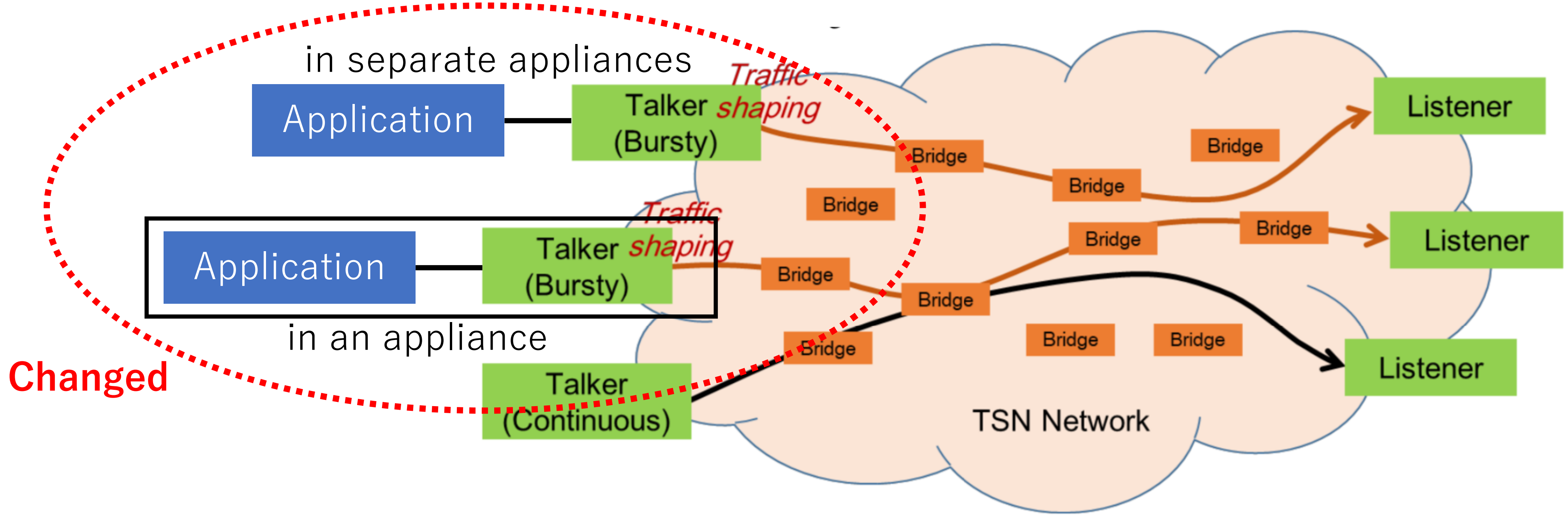
$$CommittedBurstSize = Maximum\ SDU\ Size \qquad (Z-9)$$

$$CommittedInformationRate = \frac{dataSize}{targetLatency} \qquad (Z-10)$$

Suggested updates of the draft

Z.1.2 Network Structure (suggested)

- Distinguish in the figure:
  - application generating clusters of frames
  - Talker as an element of 802.1 network



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Z.1 Feature of TSN network with Bursty Traffic

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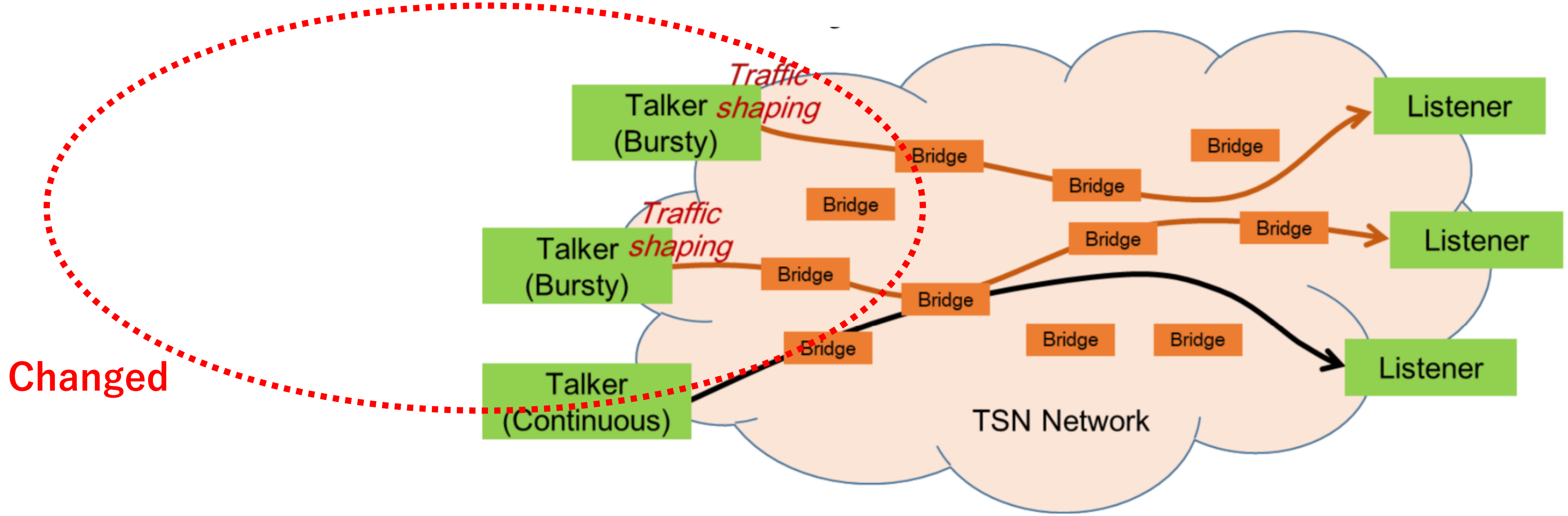

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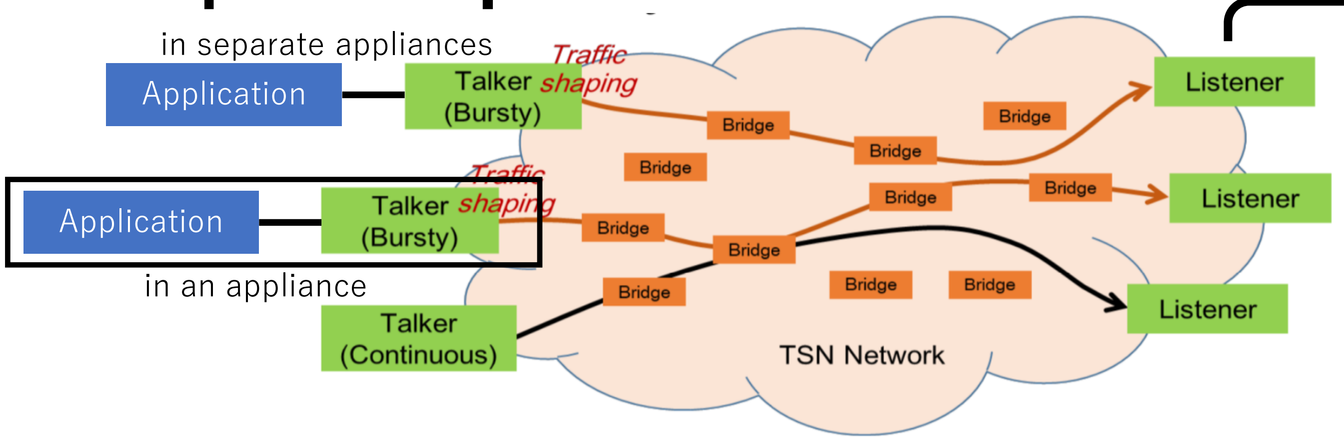
Z.1.2 Network Structure (suggested)

Mapped between elements in Figure Z-2 and Z-3



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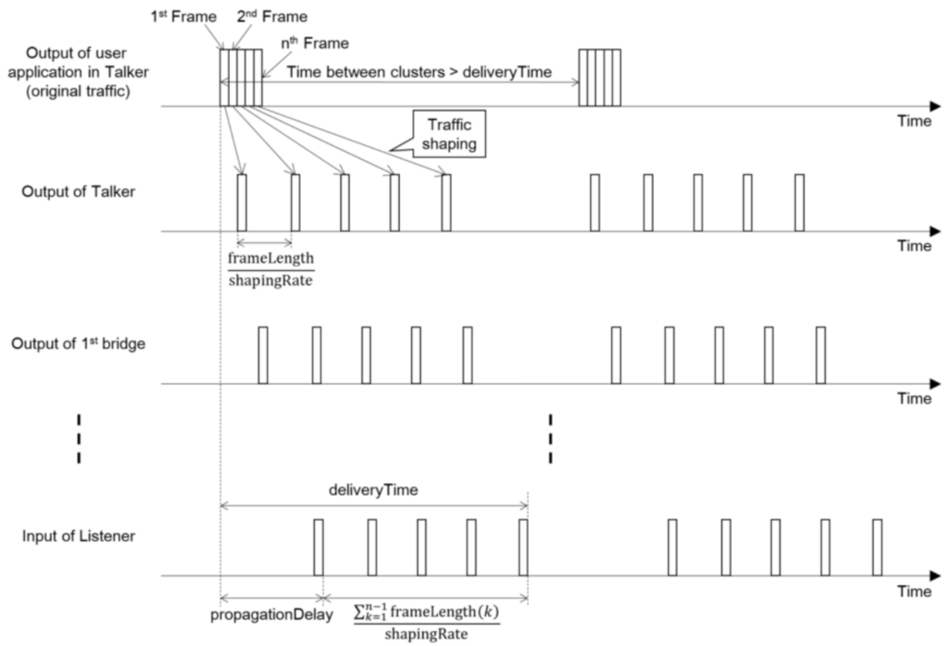

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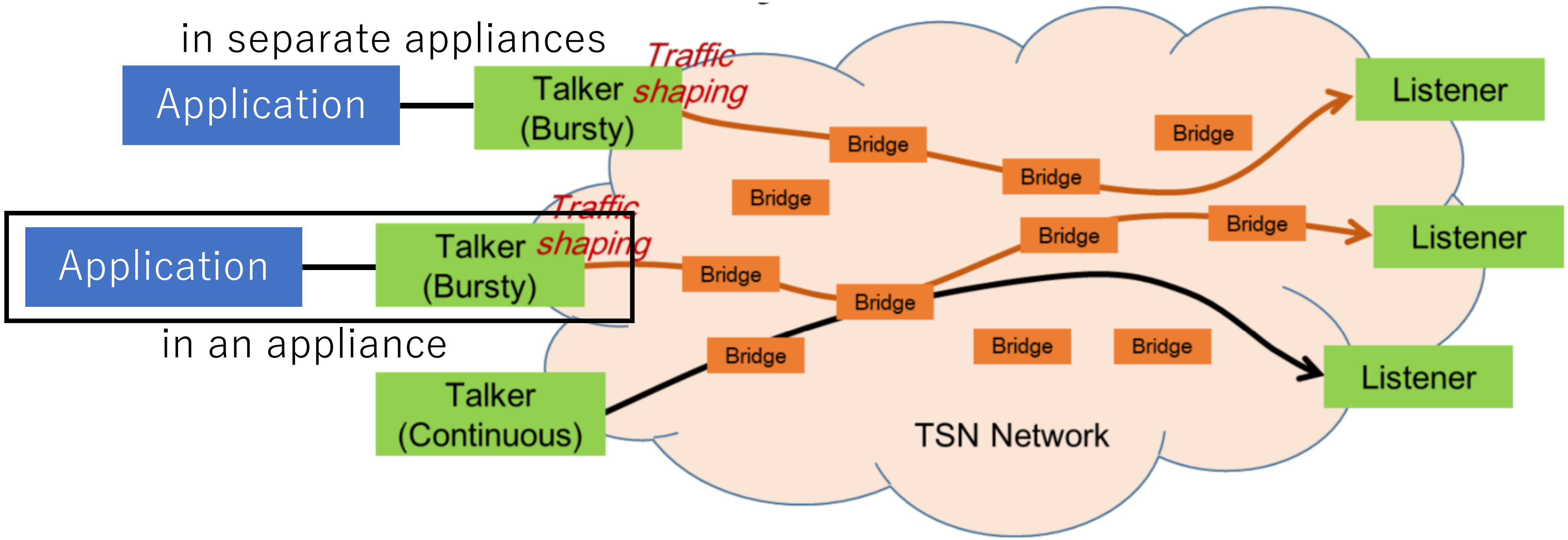

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Added

- TSpec settings for such traffic depend on latency information:
  - allowable worst-case latency the application accept (=bounded latency)
  - latency the network provides (=accumulated latency)
- Introduce TSpec settings for such traffic
  - avoiding disturbing other reserved traffic by temporal high network load
  - avoiding overprovisioning of reserved bandwidth

References

- White paper
  - https://www.ieee802.org/1/files/public/docs2020/new-Maruhashi-Zein-Mapping-method-of-QoS-requirements-to-TSpec-for-bursty-traffic-shaping-0320-v00.pdf
- IEEE 802 Nendica Report: Flexible Factory IoT
  - https://mentor.ieee.org/802.1/dcn/20/1-20-0026-00-ICne-ieee-802-nendica-report-flexible-factory-iot-use-cases-and-communication-requirements-for-wired-and-wireless-bridged-networks.pdf