Class A Bridge Latency Calculations

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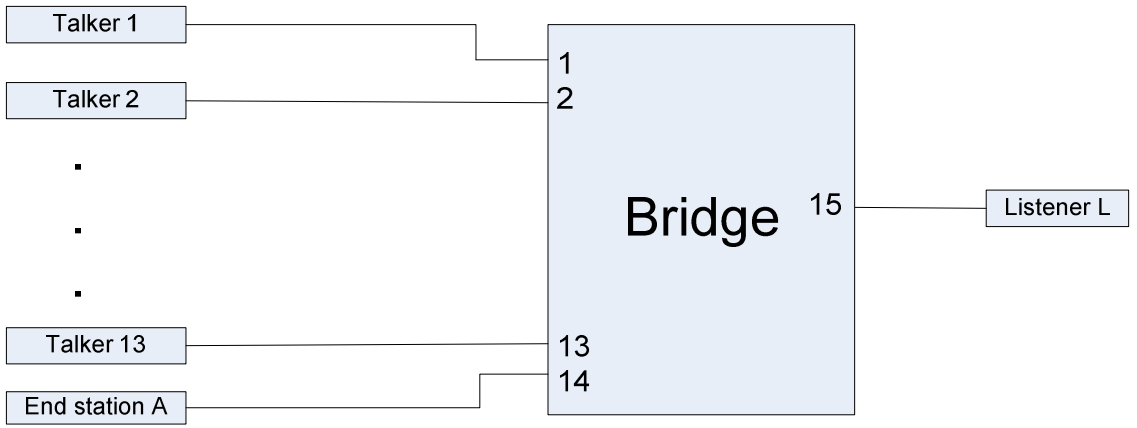
Example

- 15 port FE Bridge
- 13 FE talkers, each is sending one stream
- 1 FE listener L, is receiving all 13 streams
- 1 non AVB FE end station A



Talker Behavior

- One class A stream to listener L with 70 bytes stream size ➔ 90 bytes packet size incl. IFG and preamble (7.2µs @FE)

- 90 bytes * 13 = 1170 bytes class A traffic

- Every talker starts with a max size legacy frame (1542 bytes) to end station A at $t_{0\text{-}1clk}$ (123.36µs @FE)

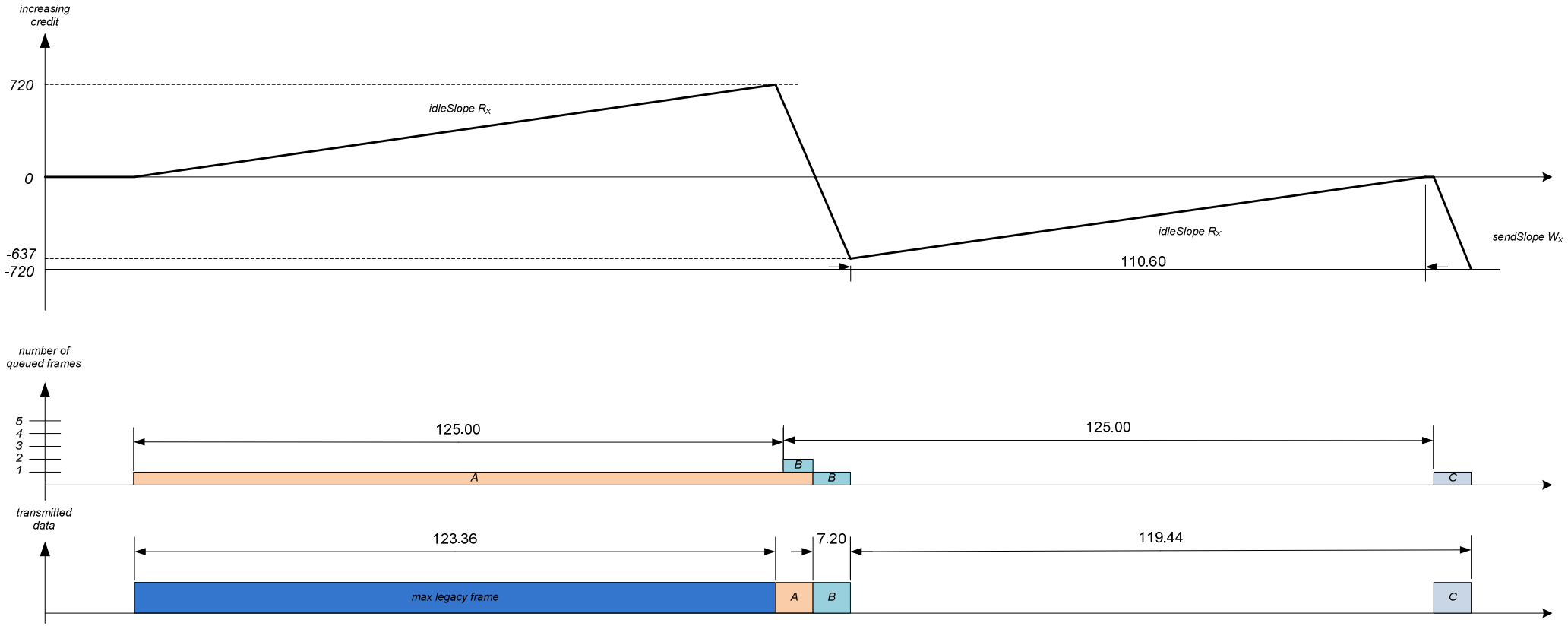
- At t_0 a 90 bytes class A stream packet needs to be transmitted

- At t_0 + 125µs a second class A stream packet needs to be transmitted

- At t_0 + 250µs a third class A stream packet needs to be transmitted

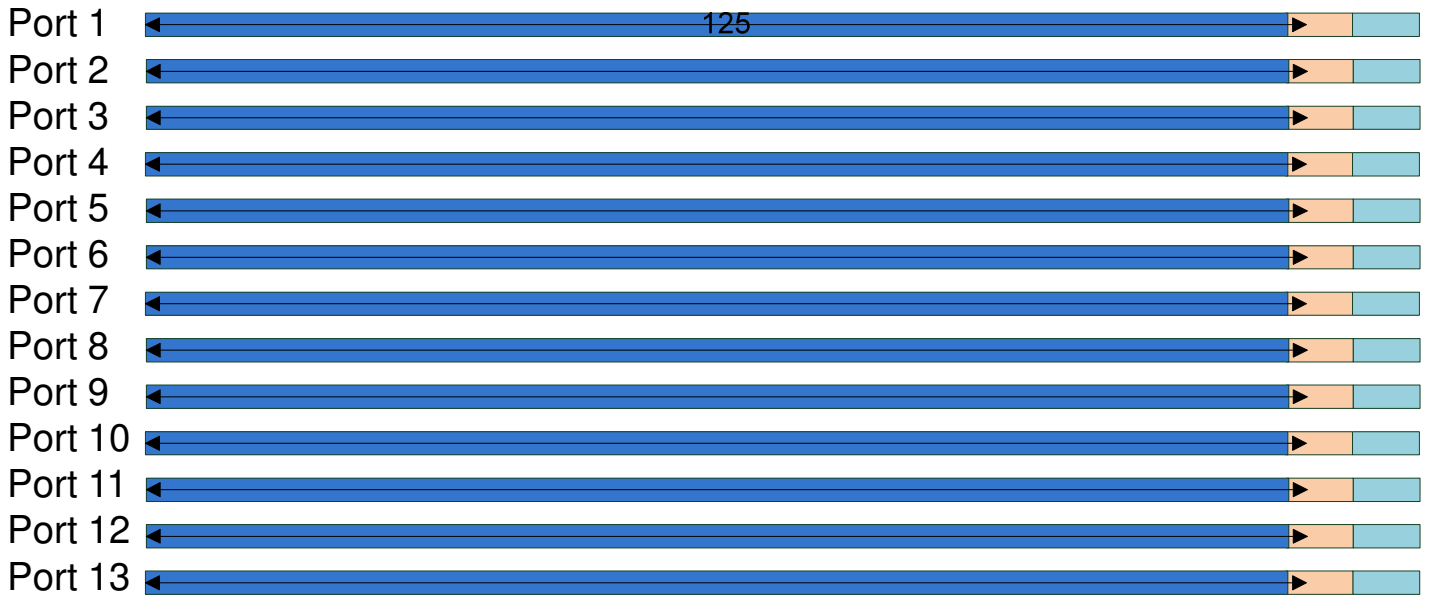
Talker Behavior

Result:



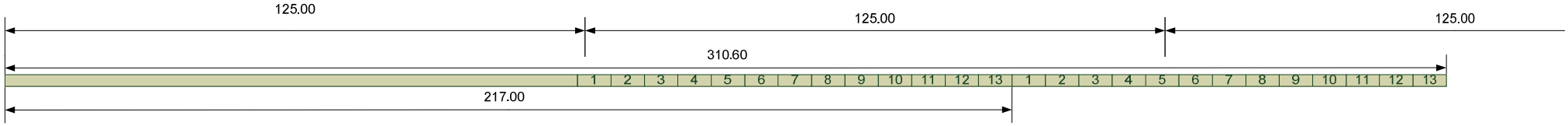
Bridge Ingress

Every talker sends the same traffic pattern.
This results in the following bridge ingress:

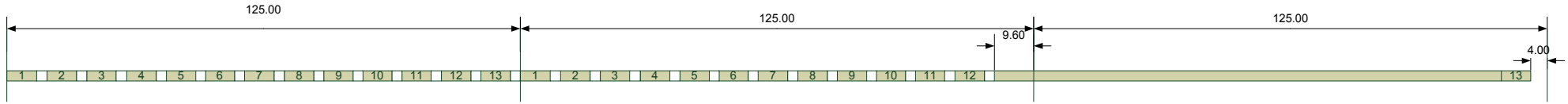


Bridge Egress to Listener

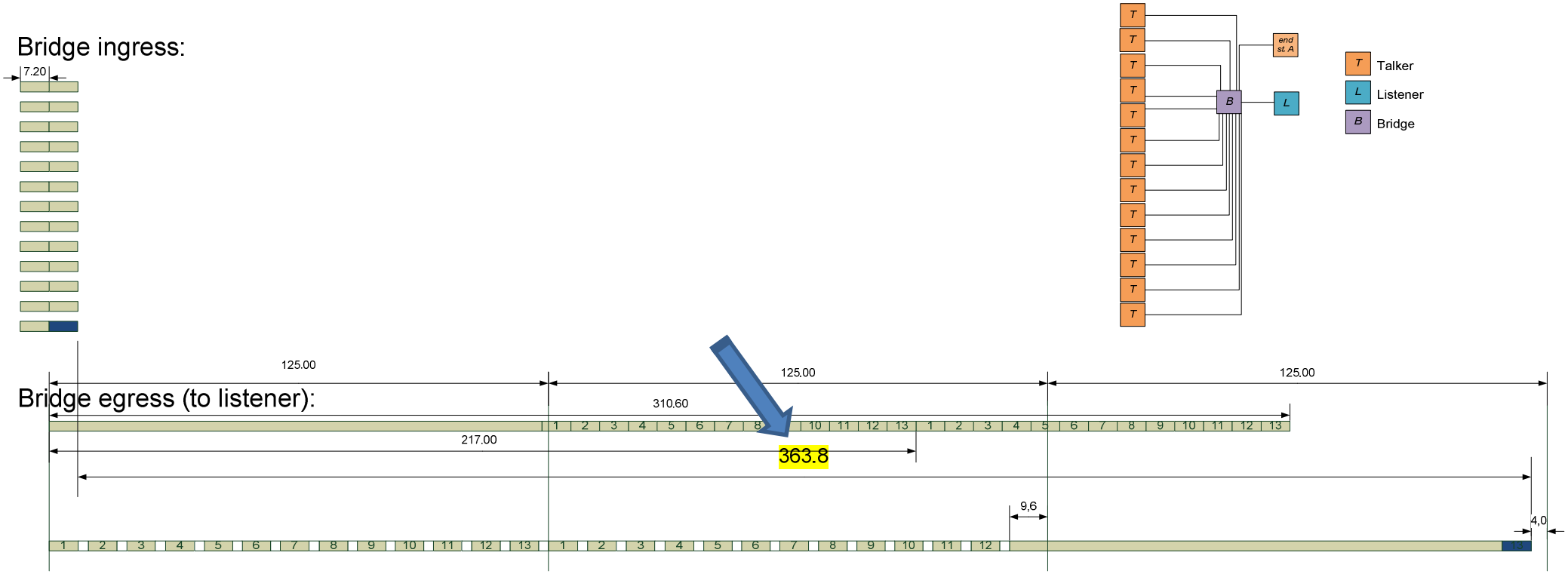
Bridge egress with one max legacy frame from end station A starting at $t_{0\text{-}1clk}$:



Bridge egress with one max legacy late interfering frame from end station A:

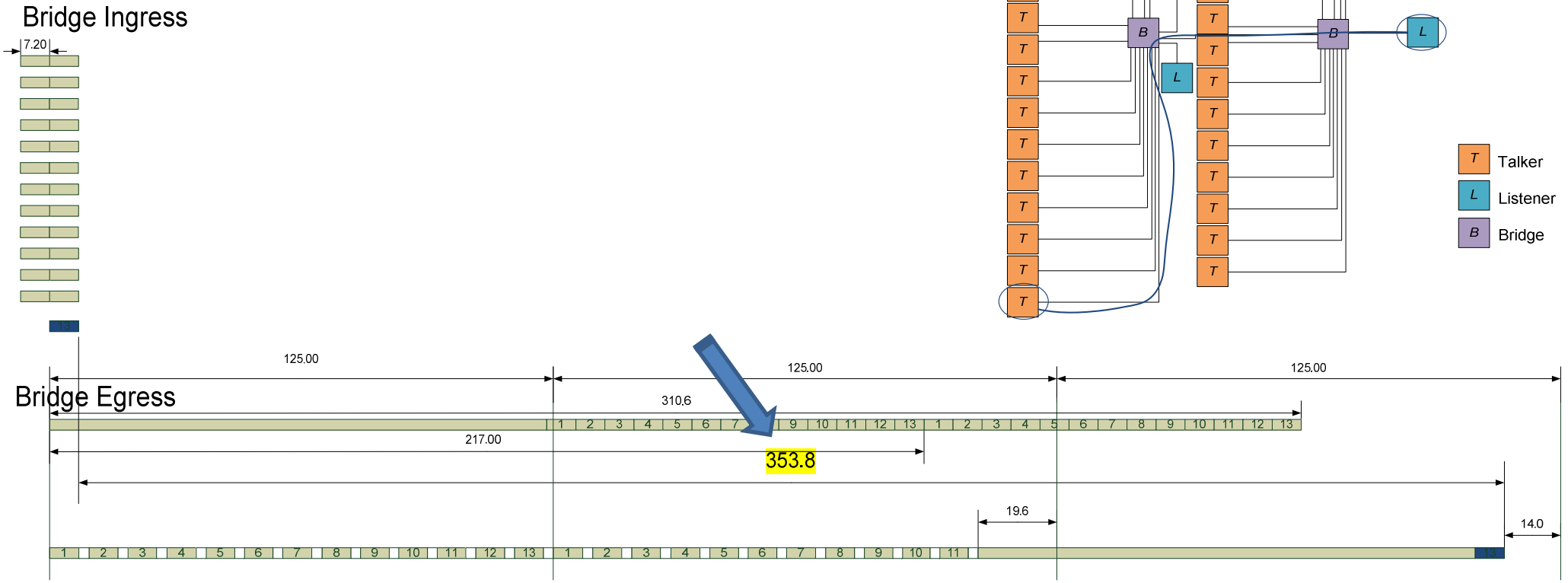


Bridge Latency @FE – Case 1



Bridge Latency @FE – Case 2

- Can this happen every hop?
  - No. But this can happen at every bridge.



FE Case 2 Results

- Bridge latency:
  12 (talker) * 2 (frames) * 7.2µs (90 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 7.2µs (13. talker) – 7.2µs (frame arrival) = 353.76µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 353.76µs (FE bridges) = 2372.2µs

  ➔ >2 ms over 7 hops

[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

FE Case 2 Results (Fan-In = 7)

- Bridge latency:
  6 (talker) * 2 (frames) * 13.36µs (167 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 13.36µs (7. talker) – 13.36µs (frame arrival) = 337.12µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 337.12µs (FE bridges) = 2272.36µs

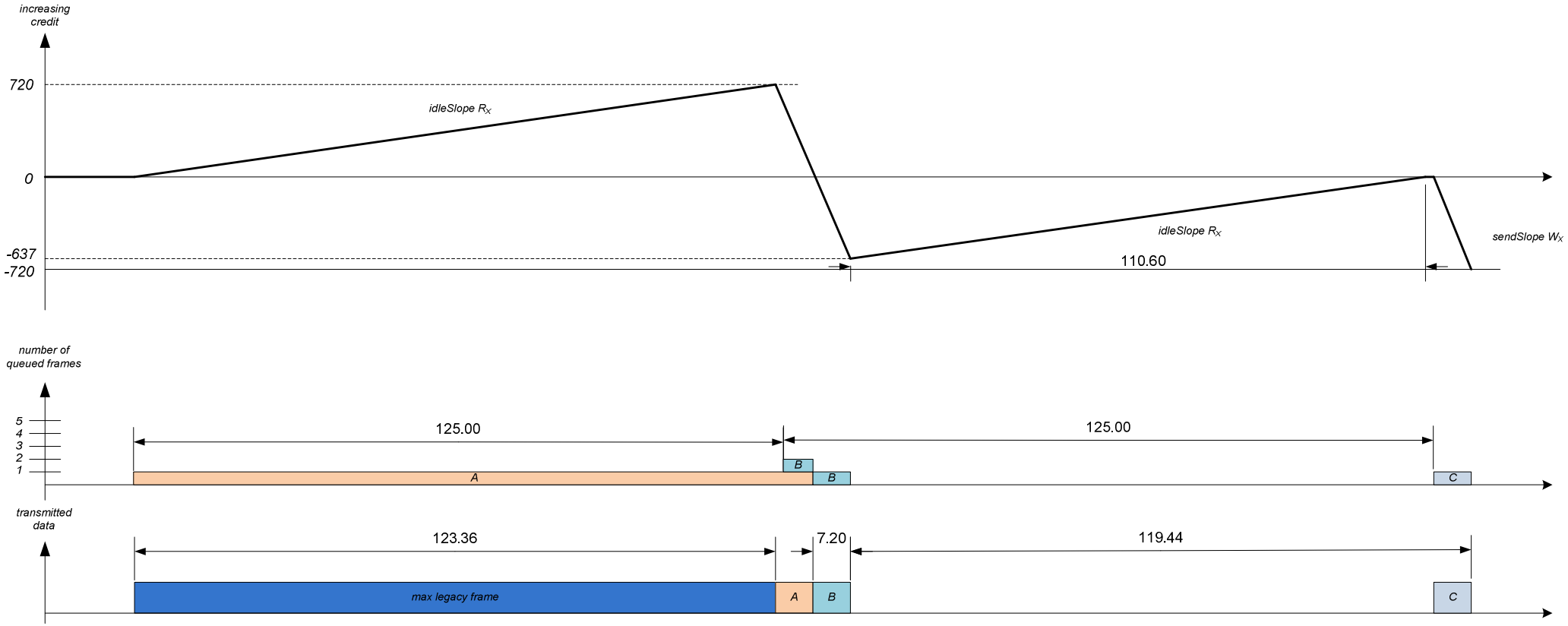
  ➔ >2 ms over 7 hops

- But is this the worst case?
  Is it possible that more than 2 frames of the same stream bunch together?

[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

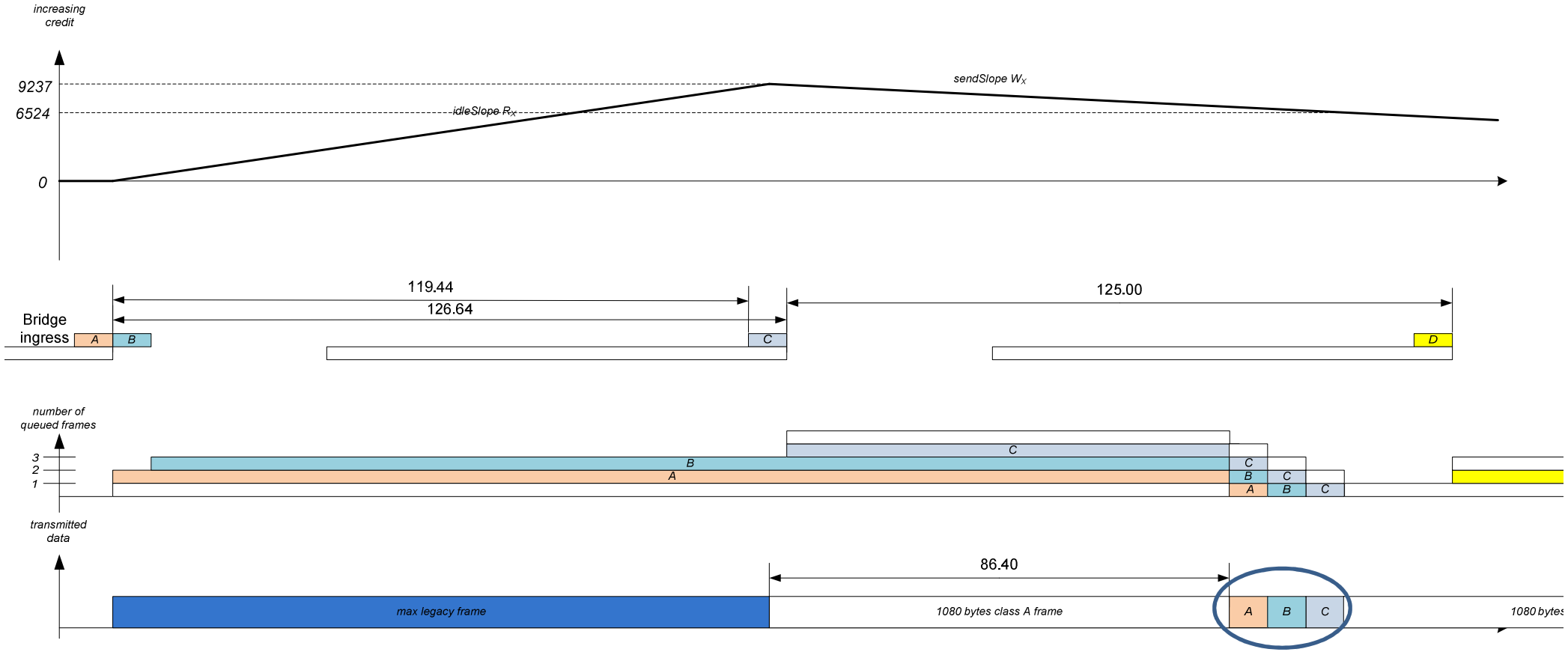
Bridge Latency @FE – Case 3(1)

Talker:



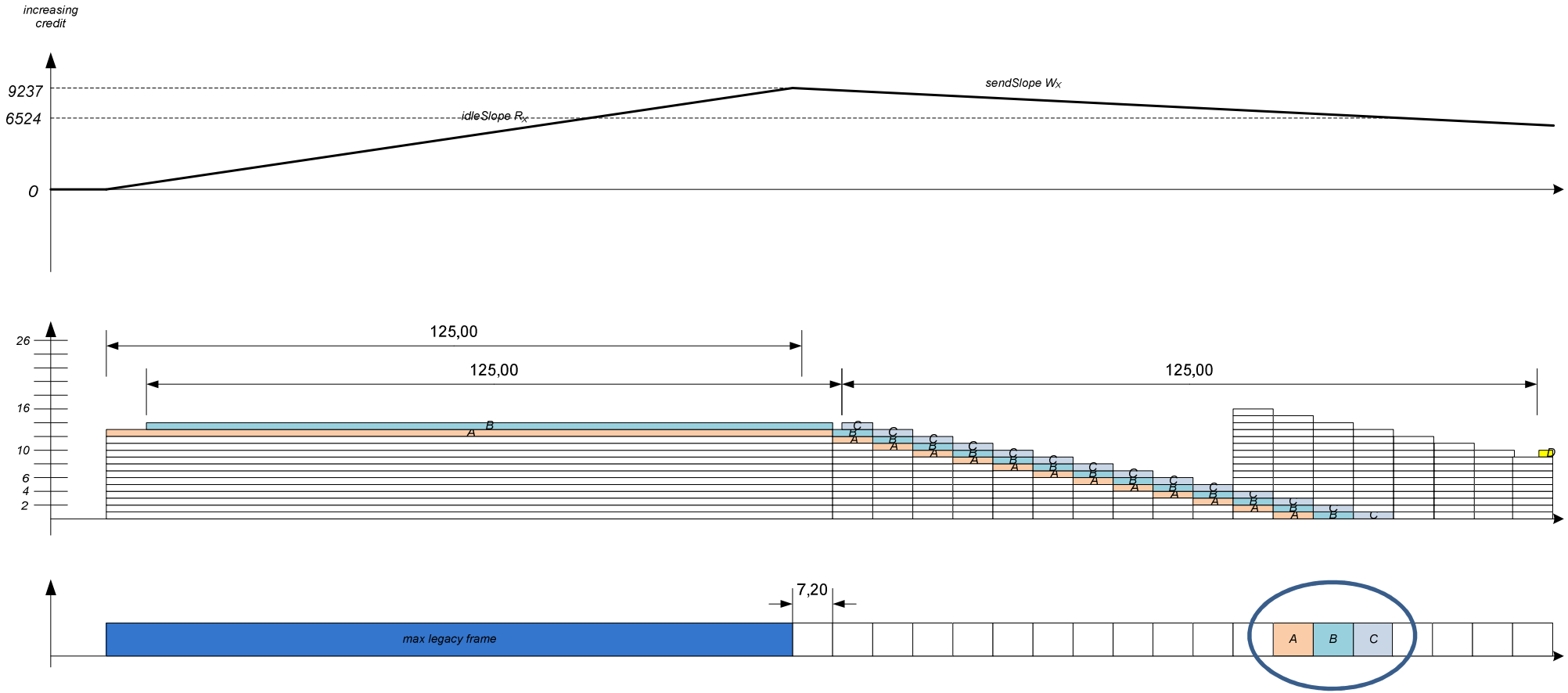
Bridge Latency @FE – Case 3(2)

First bridge (after talker):



Bridge Latency @FE – Case 3(3)

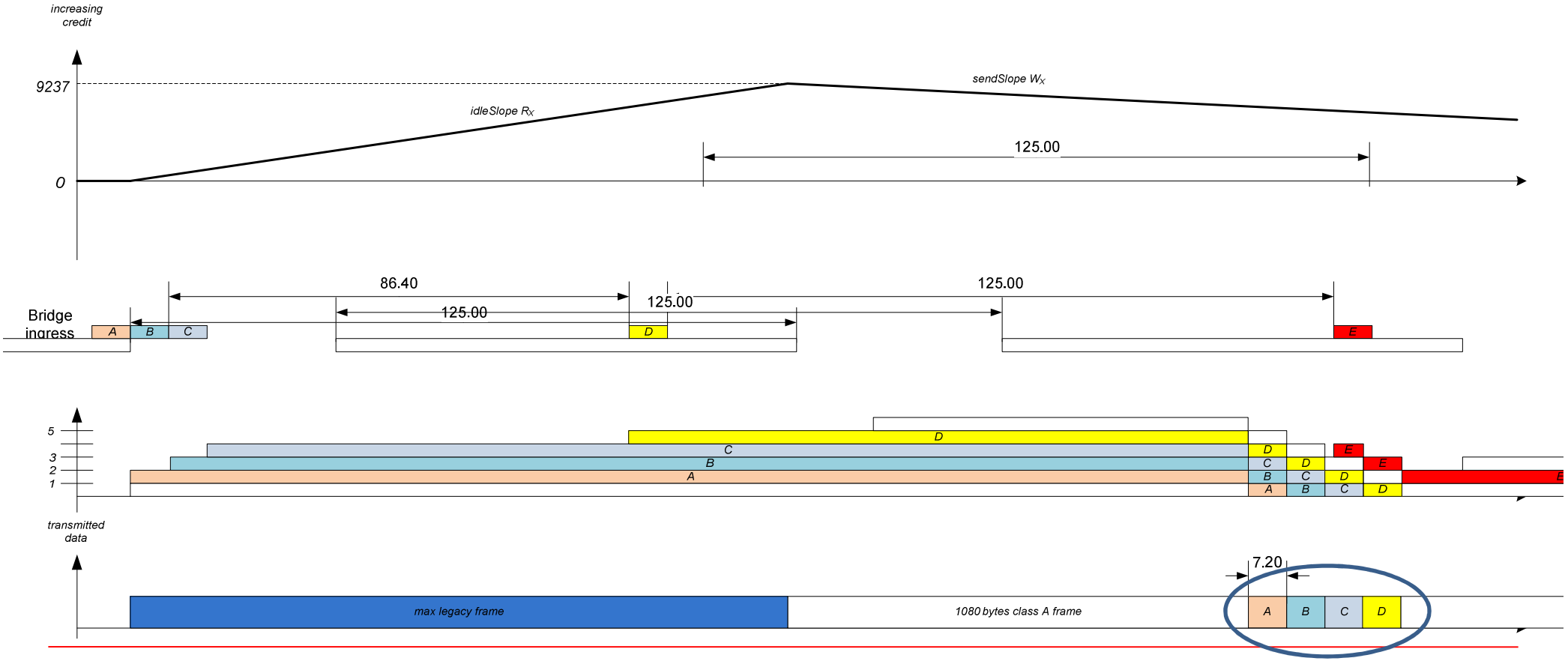
First bridge (after talker):



Bridge Latency @FE – Case 3(4)

Second bridge (after talker):

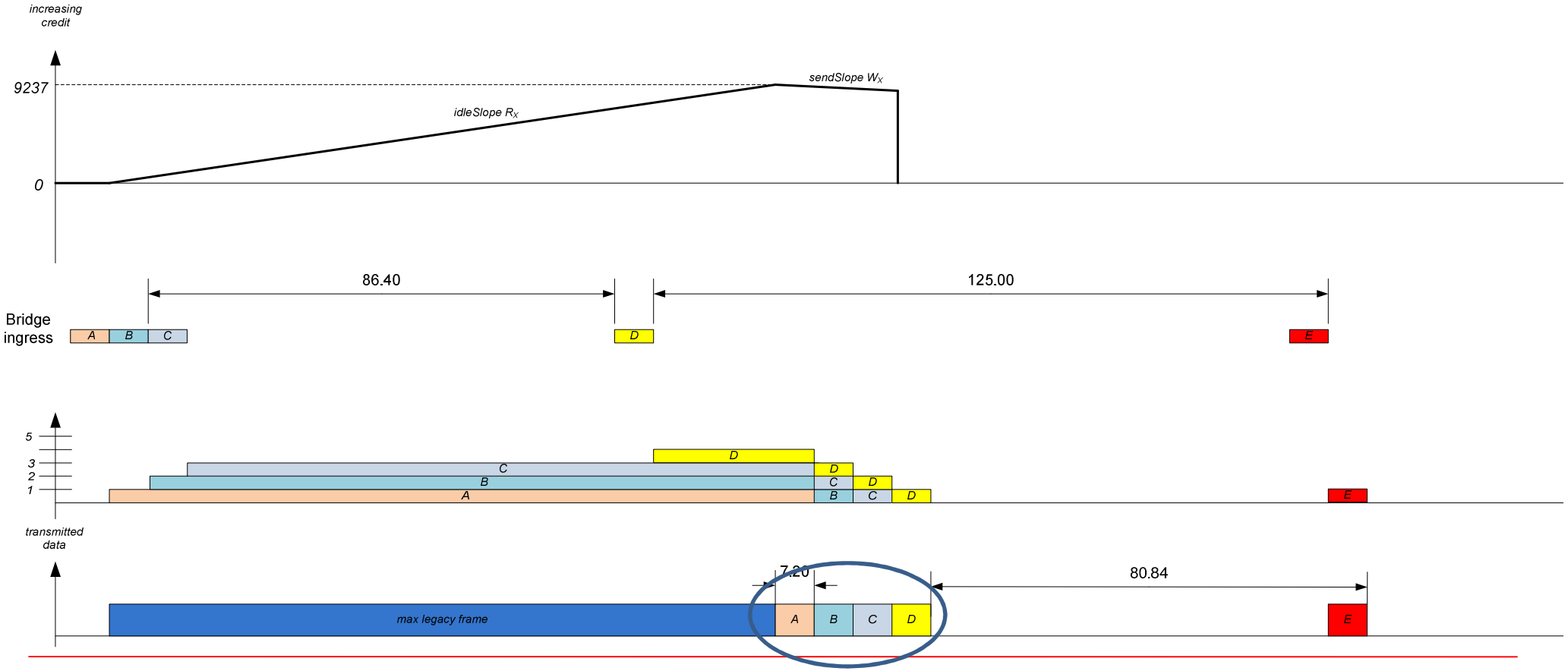
Interfering class A talker (1080 bytes)



Bridge Latency @FE – Case 3(5)

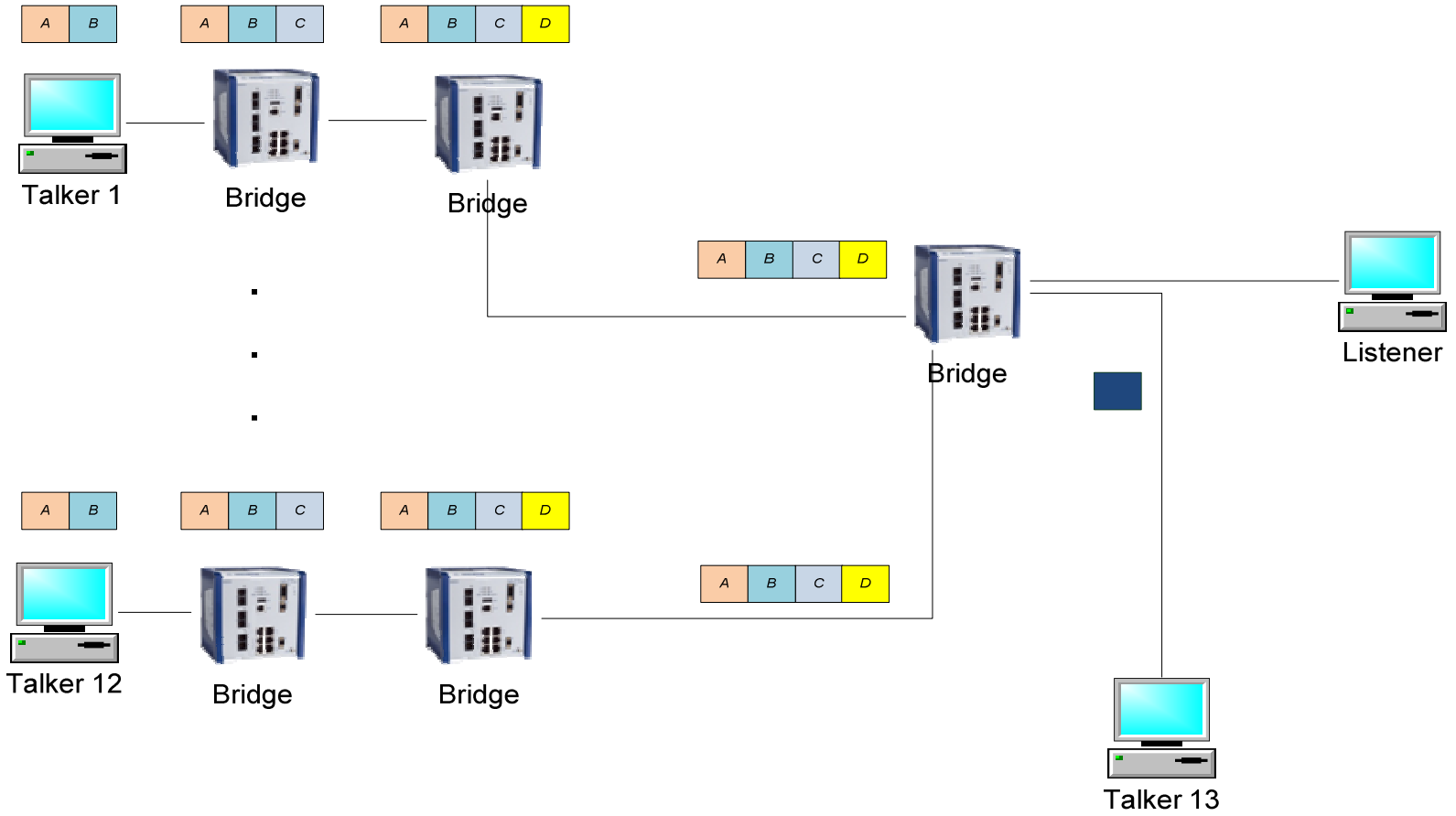
Second bridge (after talker):

No interfering frame (75% of bandwidth allocated but not used)



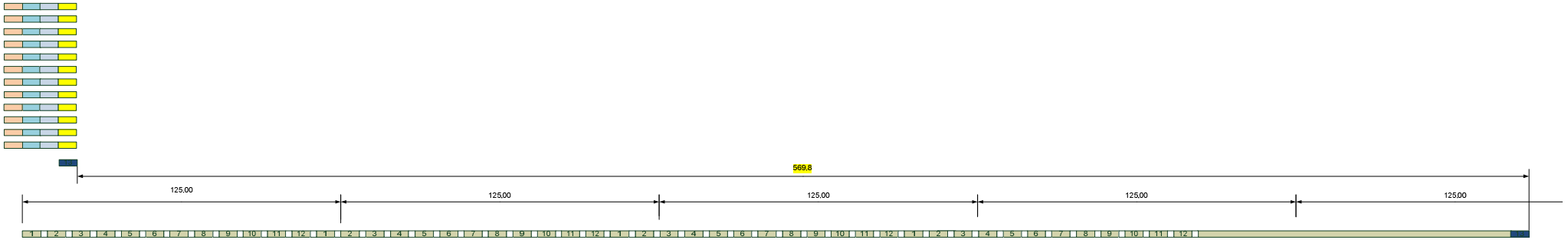
Bridge Latency @FE – Case 3(4)

Bridge ingress:

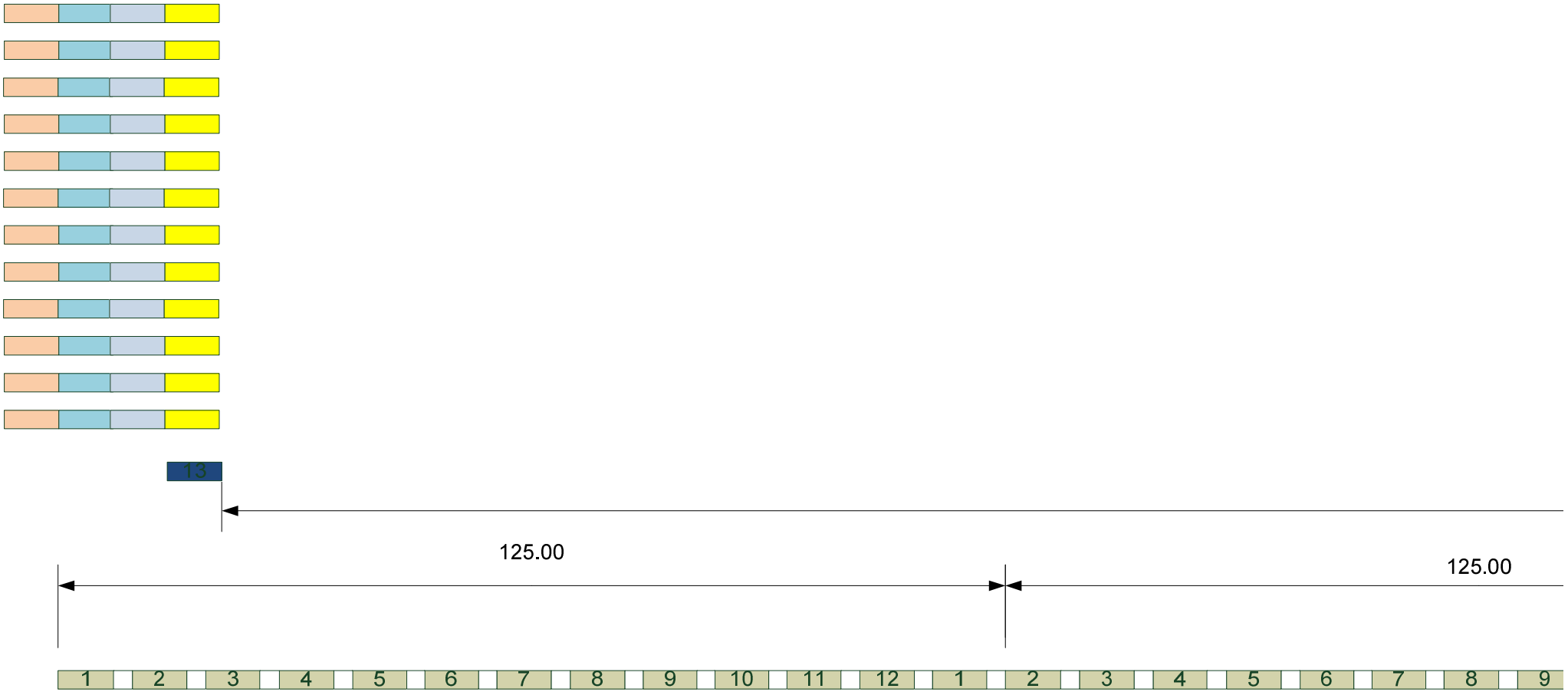


Bridge Latency @FE – Case 3(5)

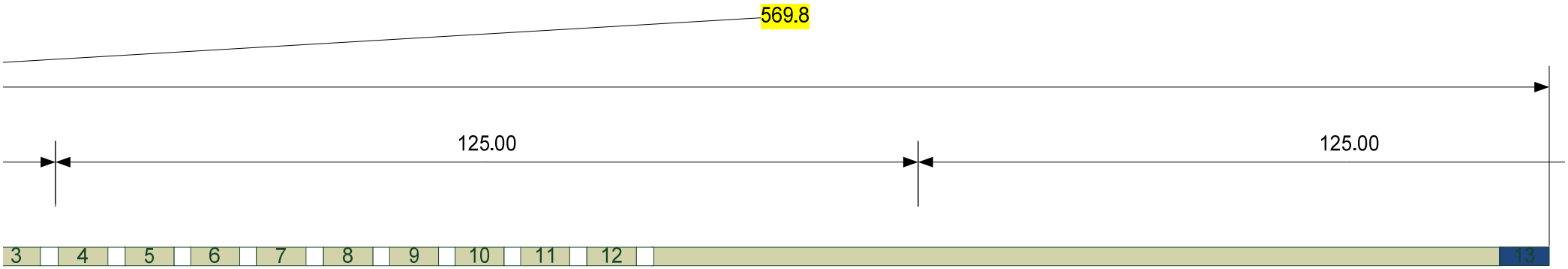
Possible latency:



Bridge Latency @FE – Case 3(6)



Bridge Latency @FE – Case 3(7)



FE Case 3 Results

- Bridge latency:
  12 (talker) * 4 (frames) * 7.2µs (90 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 7.2µs (13. talker) – 3 * 7.2µs (frame arrival) = 569.76µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 569.76µs (FE bridges) = 3668.2µs

  ➔ >>2 ms over 7 hops

[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

FE Case 3 Results (Fan-In = 7)

- Bridge latency:
  6 (talker) * 4 (frames) * 13.36µs (167 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 13.36µs (7. talker) – 3 * 13.36µs (frame arrival) = 524.15µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 524.15µs (FE bridges) = 3394.54µs

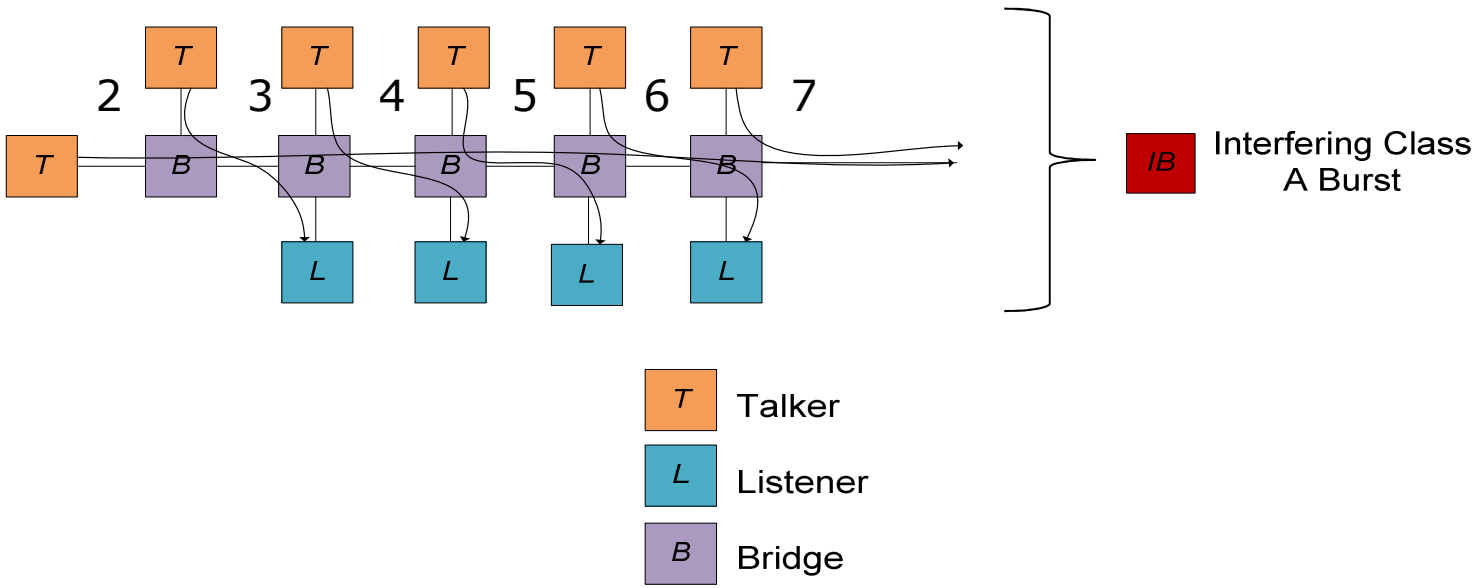
- ➔ >>2 ms over 7 hops

- What is the worst case?
  - I think at every talker/switch one frame can join the interfering class A burst

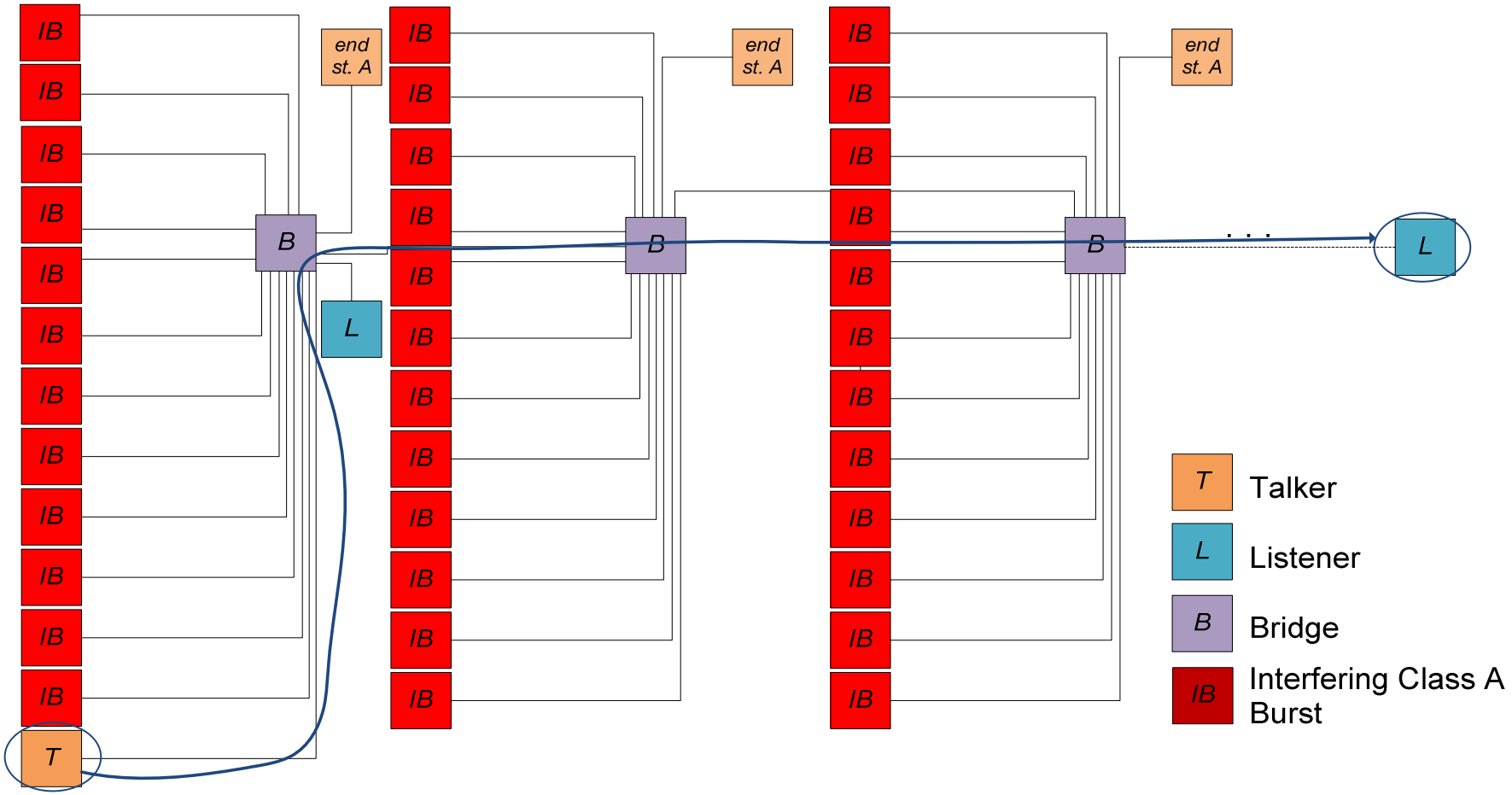
[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

Bridge Latency @FE – Case 4(1)

With a limit of 7 hops for the interfering class A burst (is there a limit?) the following topology should be the worst case for the interfering burst:



Bridge Latency @FE – Case 4(2)



FE Case 4 Results

- Bridge latency:
  12 (talker) * 7 (frames) * 7.2µs (90 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 7.2µs (13. talker) – 6 * 7.2µs (frame arrival) = 893.76µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 893.76µs (FE bridges) = 5612.2µs

  ➔ >>2 ms over 7 hops

[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

FE Case 4 Results (Fan-In = 7)

- Bridge latency:
  6 (talker) * 7 (frames) * 13.36µs (167 bytes) * 1.3333 (pacing 100/75) + 123.36µs (1542 bytes legacy frame) + 13.36µs (7. talker) – 6 * 13.36µs (frame arrival) = 804.72µs

- Over 7 hops the example could end up with a latency of:
  249.64µs (FE talker[1]) + 6 * 804.72µs (FE bridges) = 5077.96µs

  ➔ >>2 ms over 7 hops

[1] http://www.ieee802.org/1/files/public/docs2010/ba-pannell-latency-math-0910-v4.pdf

Thank You