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Why cumulativeScaledRateOffset is important - also for TC like operation

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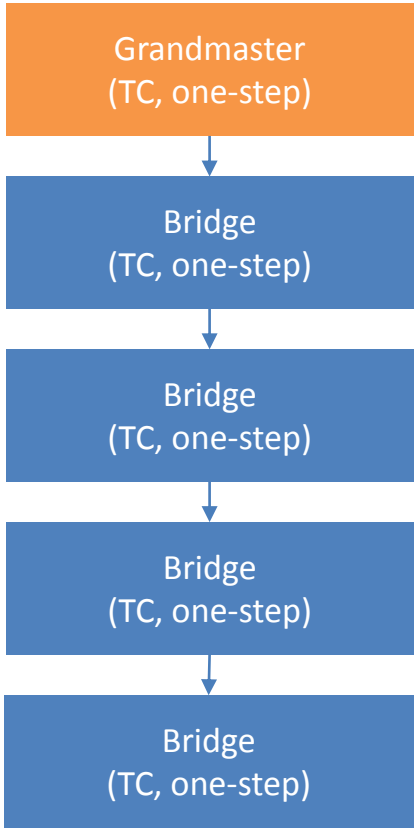
Background

- The current proposal to add a TC like one-step capability assumes that the cumulativeScaledRateOffset field is not updated.
- It is stated that this might have a negligible effect on TC operation (as „the residence time is so short, this should not be significant“).
- As pointed out in a previous call and an email on the reflector, this assumption is not true in the general case.

- The following two slides show two examples (not worst case scenarios) and the resulting time synchronization error due to wrong cumulativeScaledRateOffset values caused by the proposed TC operation:
    - Example 1: TC-only network
    - Example 2: Mixed network (TC and two-step)

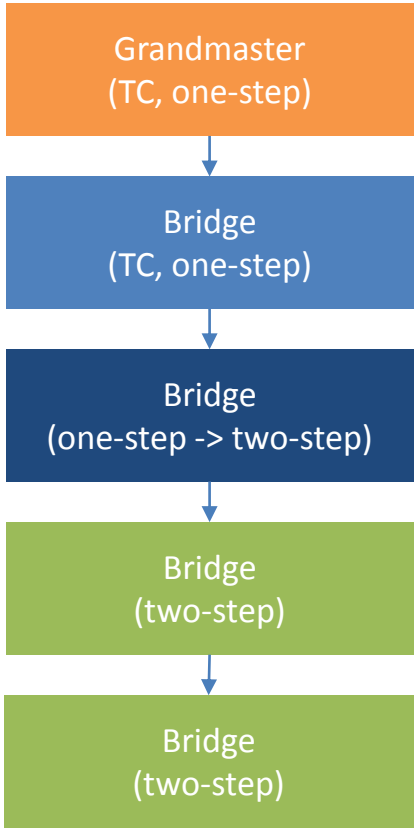
Example 1



Neighbor Rate Ratio	Rate Ratio relative to GM	cumulativeScaledRateOffset	Residence Time	Accumulated Error*
N/A	N/A	0 ppm	N/A	N/A
+100 ppm	+100 ppm	0 ppm	400 µs	40 ns
0 ppm	+100 ppm	0 ppm	400 µs	80 ns
0 ppm	+100 ppm	0 ppm	400 µs	120 ns
0 ppm	+100 ppm	0 ppm	400 µs	160 ns

* accumulated time synchronization error due to wrong cumulativeScaledRateOffset

Example 2



Neighbor Rate Ratio	Rate Ratio relative to GM	cumulativeScaledRateOffset	Residence Time	Accumulated Error*
N/A	N/A	0 ppm	N/A	N/A
+100 ppm	+100 ppm	0 ppm	400 µs	40 ns
-100 ppm	0 ppm	- 100 ppm	10 ms	960 ns
0 ppm	0 ppm	- 100 ppm	10 ms	1960 ns
+100 ppm	+100 ppm	0 ppm	10 ms	2960 ns

* accumulated time synchronization error due to wrong cumulativeScaledRateOffset

Summary

- In TC only networks the error due to not updating cumulativeScaledRateOffset is “small” but not negligible especially in large networks or networks with higher residence times e.g. 100 Mbit/s networks (errors >> 100 ns are possible)
- In mix networks (TC, one-step, two-step) the resulting time synchronization error is huge (errors >> 10 µs are possible)

➔ A correct cumulativeScaledRateOffset is essential to provide accurate time synchronization

➔ The time synchronization errors due to incorrect cumulativeScaledRateOffset information are not acceptable

➔ Even in a TC-like one-step AS mode, the cumulativeScaledRateOffset needs to be updated

Thank You