Solving 5G Performance Synchronization Challenges

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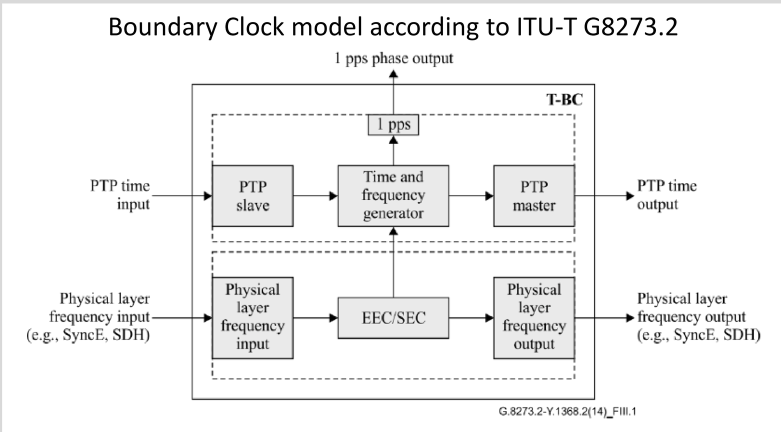
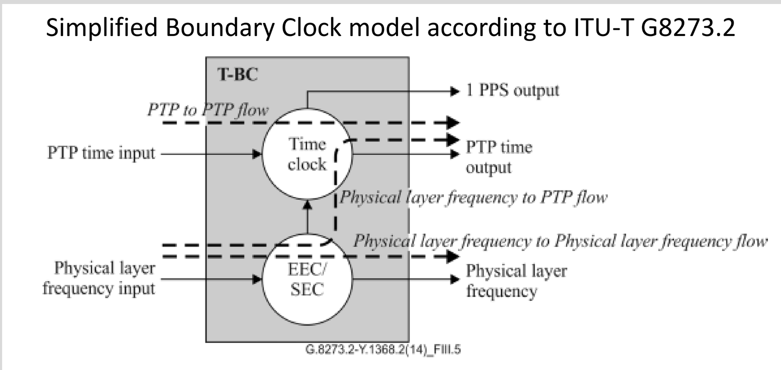
PTP+SyncE (hybrid mode) is most commonly used





Hybrid mode uses SyncE physical layer frequency to assist PTP

Helps to achieve Time Error performance

Provides stable reference clock traceable to PRC as reference to PTP

INTRODUCTION

5G networks impose extremely stringent time synchronization requirements particularly for outdoor equipment such as the remote radio head (RRH). These IEEE 1588/PTP systems depend on the performance of the local precision oscillator for clock recovery and time holdover.

What's driving oscillator requirements?

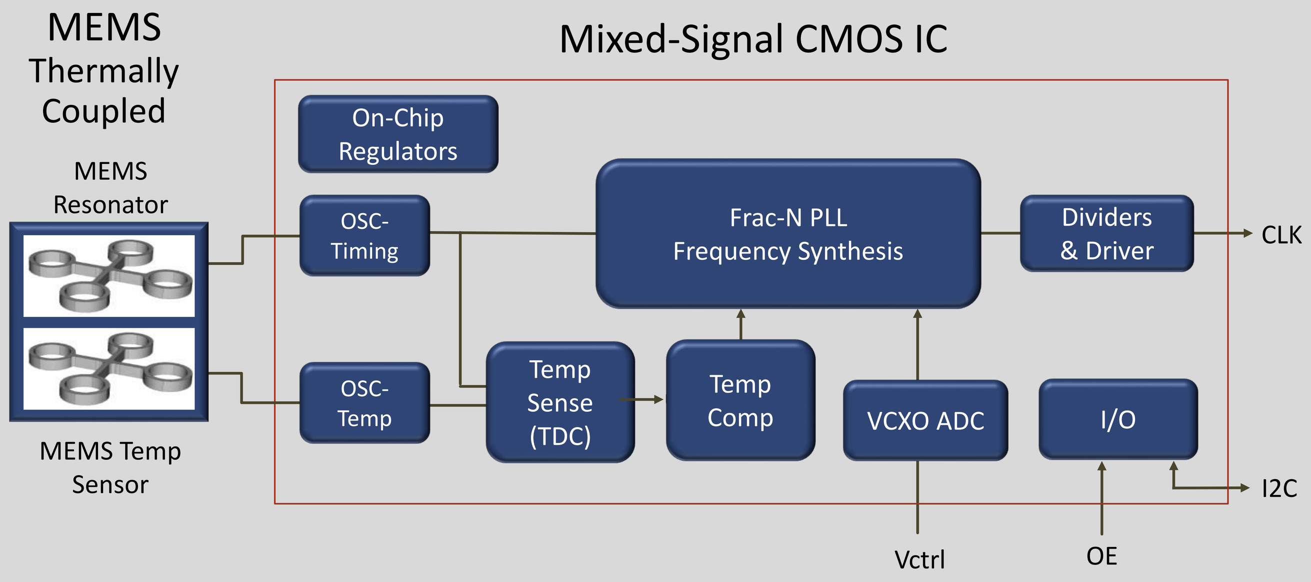
System architecture

- SyncE (MTIE, TDEV G.8262)
- PTP (Time Error)
- PTP + SyncE Hybrid Mode (G.8262, Time Error G.8273.2)
- Holdover requirements

Environment conditions

- Magnitude of temperature variations
- Speed of temperature variations
- Breezy air

MEMS* precision oscillators (TCXO & OCXO) enables best dynamic performance



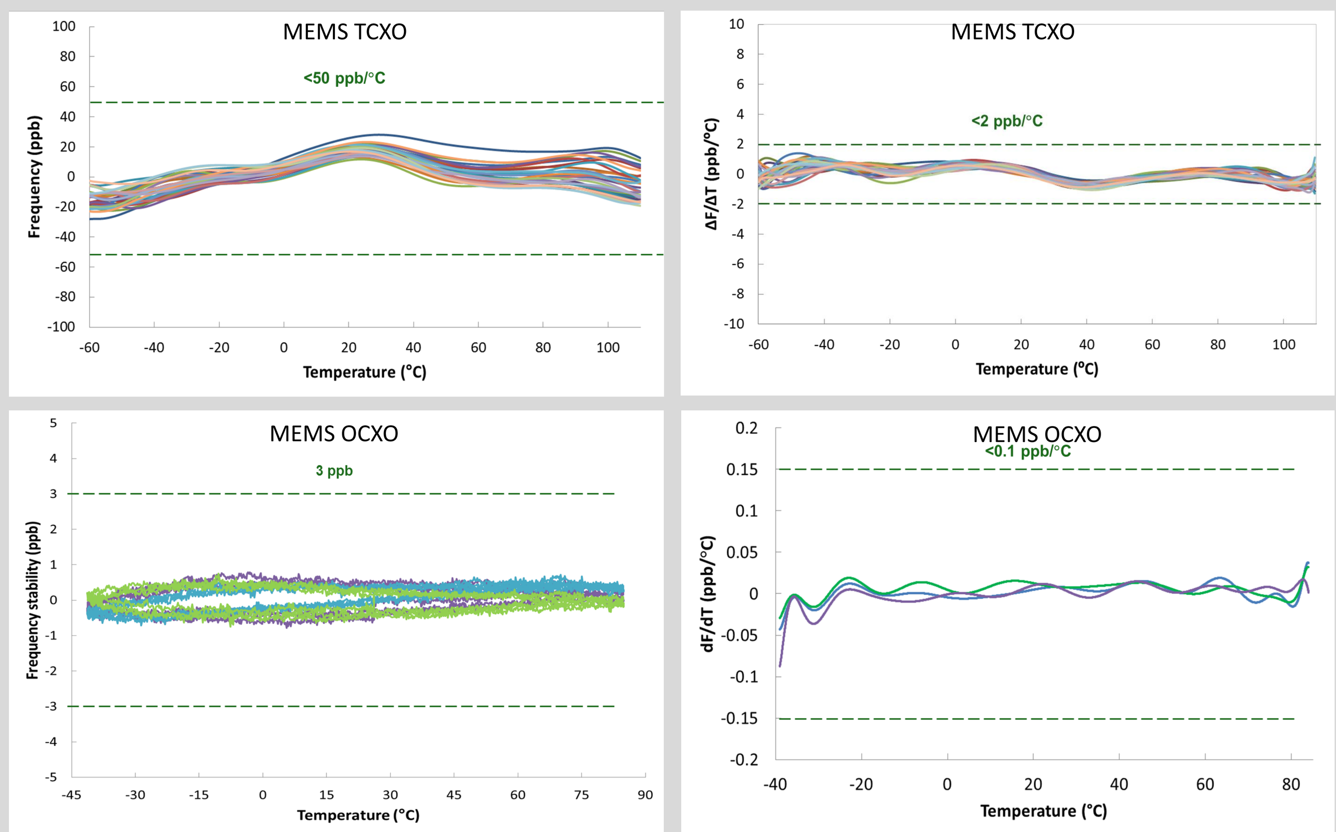
MEMS Resonator

- No aging
- No activity dips
- 30x better vibration immunity

MEMS Temp Sensing - 100% Thermal Coupling

- 30 µK, 10x more accurate
- 350 Hz tracking, 40x faster
- Airflow, temp ramp resistant

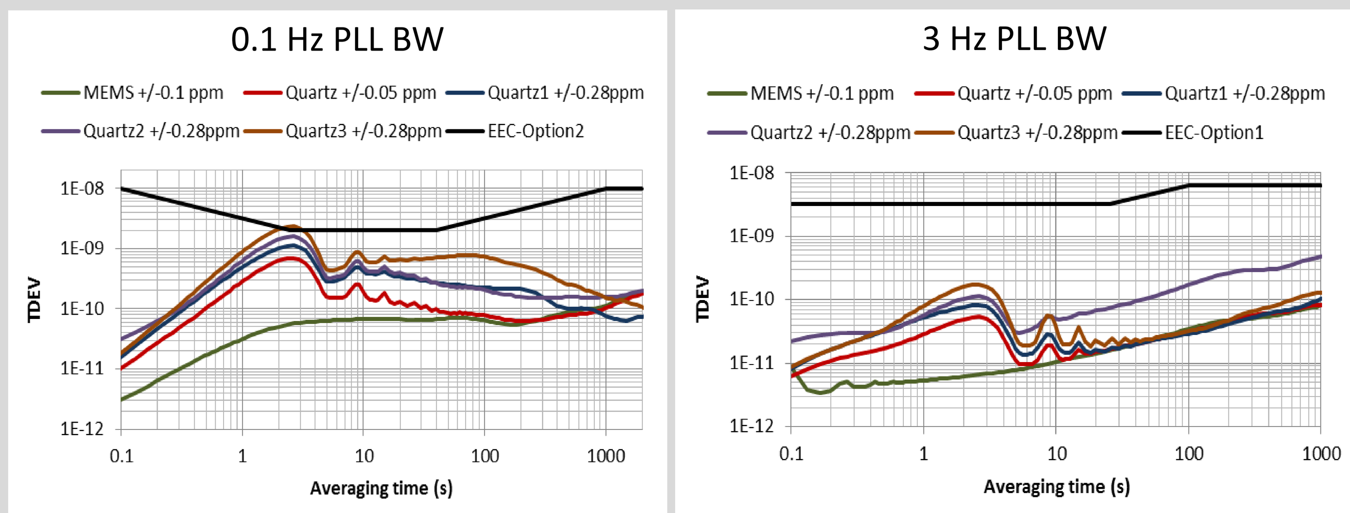
MEMS precision oscillator achieves best ΔF/ΔT - ±1 ppb/°C for TCXO, ± 0.1 ppb/°C for OCXO



SyncE performance in breezy air

Airflow fluctuations are modulating frequency of the local oscillator

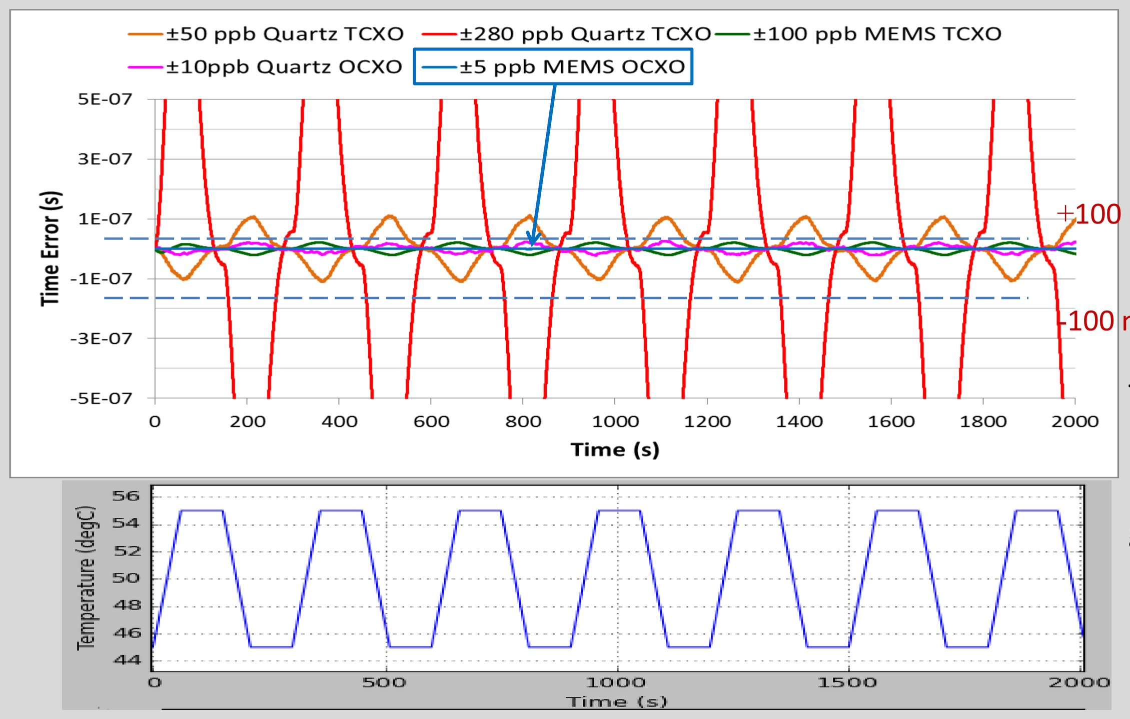
MEMS TCXOs can track fast airflow changes (breezy air)



*MEMS = micro-electro-mechanical systems

PTP time error (without SyncE)

Sync loop time constant = 20s; Temperature change rate = 10°C/min



T-BC requires 100 ns or 70 ns max time error generation

PTP+SyncE PERFORMANCE

SyncE assists PTP by providing a frequency reference traceable to PRC

The bandwidth of the SyncE loop is faster than PTP and can vary from 0.1Hz to 10Hz

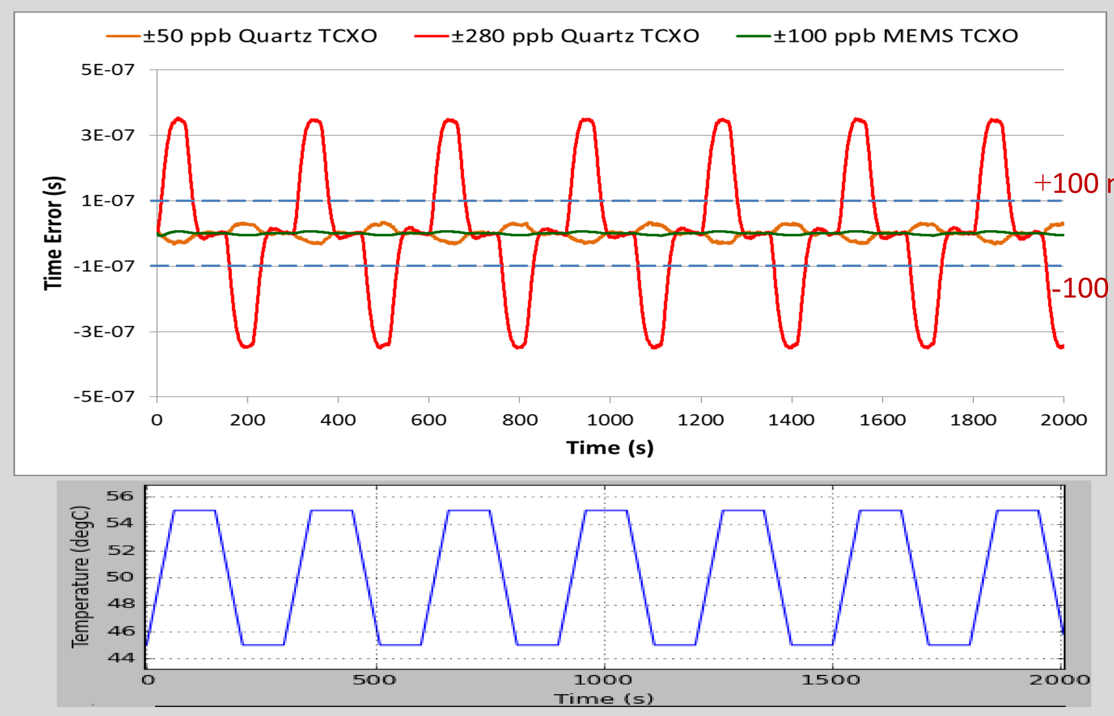
The local oscillator is synchronized to PRC with 0.1Hz to 10Hz BW, equivalent to having a more stable local oscillator

The temperature sensitivity of the local oscillator is filtered by the SyncE loop which maintains performance

Using a poor stability TCXO may violate MTIE/TDEV wander generation requirements, especially under environmental stressors!

PTP+SyncE reduces TE generation

SyncE BW = 0.1 Hz; Temperature change rate = 10°C/min



T-BC requires 100 ns or 70 ns max time error generation