

SCr 100, SCr 200, SCe 300 and SCe 400 SoftClocks

NTP, PTP and GPS Software Solutions for Residential and Enterprise Small Cells

Key Features

- Timing solution tailored to wireless small cells at the network edge
- Packet timing engine for NTP and PTP synchronization protocols
- High sensitivity indoor softGPS
- Operates with leading processor and middleware platforms
- Supports macro sniff implementations

Key Benefits

- Software solution using existing processor and oscillator resources
- Integrates tightly with product design for cost effectiveness
- Reliable synchronization at low packet rates

The Symmetricom® packet-based timing solutions are software products optimized for small cell applications.

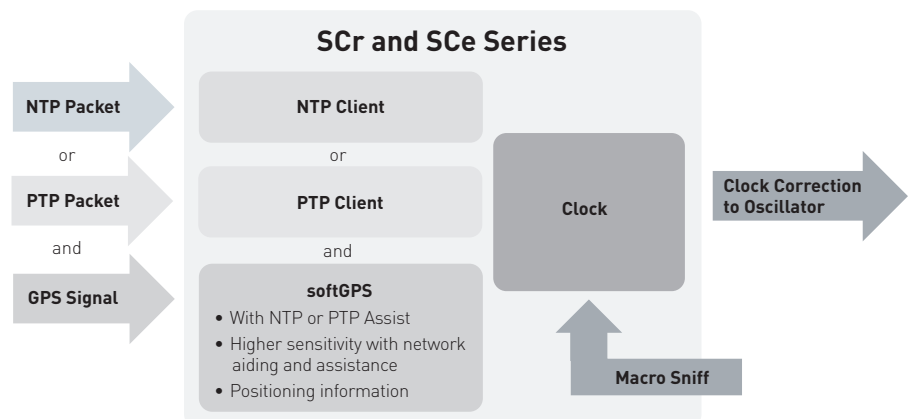
The product portfolio includes residential or enterprise broadband, local area networks (LANs) and softGPS solutions.

The software provides a configuration option for NTP or PTP (IEEE 1588v2) protocols. Resilient algorithms achieve compliance with regulatory frequency control requirements (e.g. to 3GPP standards) with high confidence, even in contended broadband access networks with variable delays, packet loss and re-routing. On LANs, synchronization is maintained within microseconds with network time domain variations filtered by the holdover characteristics of a qualified TCXO or OCXO.

A synchronization application delivered with the packet timing engine provides integration with the platform and consolidates other sources of time and frequency (e.g. from a macro sniff receiver) with packet time to provide overall control of synchronization. The synchronization application makes intelligent use of information on the Temperature Compensated Crystal Oscillator (TCXO) or Oven Controlled Crystal Oscillator (OCXO) characteristics, available from configuration data, to provide rapid start-up and filtering of synchronization adjustments. The product performs best with ultra-stable Voltage Controlled Temperature Compensated Crystal Oscillators (VCTCXO) and OCXO.

The timing solution is portable to any embedded processor and benefits from low latency hardware time stamping.

SoftClock for Small Cells



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Oscillator

Selected oscillators should provide frequency control to within the required limits autonomously for durations between one day and several months. Beyond this time, when the product is unused or when first installed, the defined characteristics of the oscillator are used to allow the disciplining software to make the most effective use of network time measurements. A simple and quick manufacturing test allows storage of initial parameters that can be sufficiently accurate for immediate operation in some cases, even on first use.

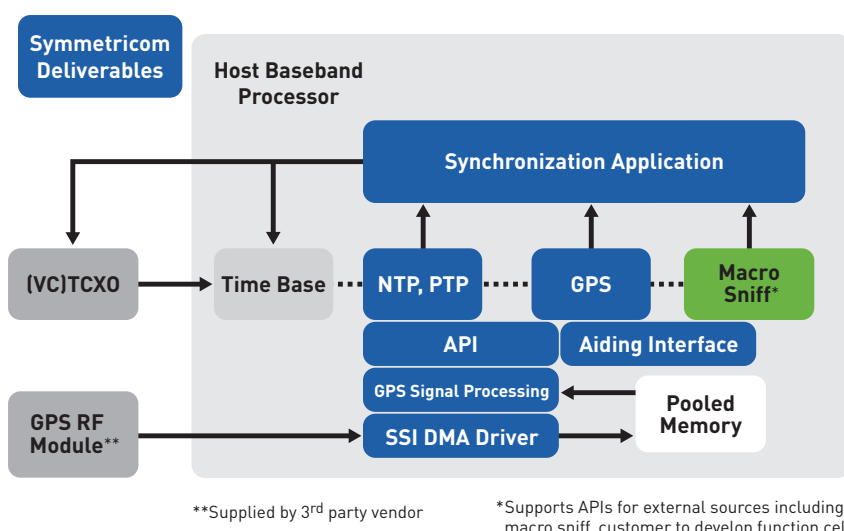
Oscillator Disciplining Algorithm

SoftClock oscillator disciplining software makes use of network time measurements, the characteristics of the oscillator and historical information from previous frequency adjustments to adjust the oscillator to its nominal frequency. The frequency-control processes are optimized for the challenging characteristics of typical residential broadband access networks. An API delivers information on frequency uncertainty allowing an application to make best use of any flexibility within regulatory frequency limits. On networks with stable delay characteristics the algorithm and oscillator work together to provide synchronization within microseconds to support TDD air interfaces and synchronous broadcast services.

Packet rates are flexible, providing economical use of server resources for internet applications or rapid and accurate synchronization on LANs.

Packet Engine

The packet exchange engine is compatible with standards compliant NTP or PTP servers. Both engines offer simple client capability. Where the platform supports



Complete SoftClock Solution

it, hardware time stamping can be used for both inbound and outbound packets; inbound hardware time stamping can also be used on encrypted links. The PTP engine uses Announce, Sync and Delay messages. Message rates can be configured to match back-haul and server capabilities.

softGPS

The SCr 200 and SCe 400 SoftClock models include high sensitivity, indoor GPS capability that can improve overall performance. The software includes functions to consolidate frequency control measurements from all sources (NTP/PTP, macro-sniff) and apply optimum corrections to the reference oscillator. Along with the correction, the software continually provides an estimate of current uncertainty even at power-on and during holdover. softGPS is assisted at startup by a secondary timing source such as NTP or PTP. softGPS enables best possible performance optimized for a BOM sensitive design with minimal CPU usage. Implementation is tightly integrated with a RF front-end sub-assembly module supplied separately.

Interfaces

The packet-based timing software presents interfaces for:

- Configuration and initialization
- Non-volatile storage
- Frequency and time offset information from auxiliary sources
- Reporting frequency and time error and uncertainty, exceptions
- 'Sockets' network interface
- Time stamp driver interface
- VCTCXO control voltage adjustment (where applicable)

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Performance Summary*

Typical small cell configuration using NTP/PTP with low-cost TCXO

Parameter	Comment	Minimum	Typical	Maximum	Units
F₂₄ 24 hr holdover	Autonomous frequency hold-over (while server is unavailable)			±250	ppb
F_L Locked frequency	Locked frequency error with respect to server reference		±50		ppb
PD Round-trip packet delay	Acceptable network round-trip delay to time-server			500	ms
PL Packet loss	Acceptable network packet-loss			15	%
PDV Packet delay variation	Acceptable RMS packet delay variation within at least one 2 hr window per 24 hrs			±5	ms
T_{acq} Acquisition time	On first installation, to ±100ppb		30	120	min
T_{acq} Acquisition time	After 1 week un-powered, to ±100ppb		30	120	min
R_{PKT} Packet rate	Packet rate	2	16	48	per min
	Load (sum of uplink and downlink)	18	140	420	Mbyte per month

Typical LAN synchronization configuration using NTP/PTP

Parameter	Comment	Minimum	Typical	Maximum	Units
F_L Locked frequency	Locked frequency error with respect to server reference		±15		ppb
PD Round-trip packet delay	Acceptable network round-trip delay to time-server			500	ms
PL Packet loss	Acceptable network packet-loss			15	%
PDV Packet delay variation	Acceptable RMS packet delay variation			±150	µs
T_{acq} Acquisition time	On first installation, to ±20ppb		20		min
R_{PKT} Packet rate	Packet rate (downstream from server)	0.5	4	12	per min

* Performance in outdoor deployments is dependent on customer hardware design, for example: oscillator temperature range and type of backhaul used.

PTP performance over internet connections expected to have lower performance for timing measurements when compared to LAN.

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Macro Sniff Support

Symmetricom's SoftClock solutions support APIs for external sources such as macro sniff. Using a customer developed function call, macro sniff works with the small cell radio resources to listen to the network and operate in conjunction with neighboring macro cells.

Auxiliary Frequency Offset Interface

The software can take into account alternative sources of frequency error information (for example from macro sniff or network listen receivers) in making adjustments to the oscillator. The interface allows a number of such sources to indicate measured frequency error along with information on bounds of accuracy and time of measurement. Corrections presented at this interface with error bounds less than currently achieved by the packet-timing software will be applied immediately.

Reporting

Throughout normal operation, the software will make available on demand:

- The current estimate of frequency and time accuracy
- The state of each source of time and frequency (e.g. each NTP server and additional interface)
- The current network quality (in lock, acquiring, uncertain, unusable, no response)

Software Models

Symmetricom's SoftClock solutions are available in four models.

	SCr 100	SCr 200	SCe 300	SCe 400
	Residential 250 ppb sync	Residential 250 ppb sync	Enterprise 100 ppb sync	Enterprise 100 ppb sync
Application				
NTP	•	•	•	•
PTP	•	•	•	•
GPS	–	•	–	•

Packet and Time Stamp Interfaces

Timing packets are sent and received on OS Sockets interfaces. The software supports proprietary interfaces to time-stamp functions in hardware or the kernel where available. Latency variation should be controlled for incoming packets.

VCTCXO Control Voltage

A driver interface is supported for making adjustments to the VCTCXO control voltage via a DAC.