

SATELLITE TIMING · HOLDOVER · CRITICAL NETWORK CONTINUITY

GNSS Timing & Resilient PNT

Precise GNSS-derived time and frequency with protected reception and local oscillator holdover.

RF Integrity + Source Qualification + Local Timescale + Critical Outputs

GNSS Timing Receivers

GNSSDO

PTP Grandmasters

Time Servers

Critical Networks

Holdover

Application Review

FCom begins by identifying the required system role: protected GNSS RF front end, timing-receiver reference, DPLL / GNSSDO oscillator, autonomous holdover source, network-interface clock or always-on RTC.

System-Level Design

Resilient PNT depends on the combined behavior of RF filtering, source validation, clock learning, temperature response, aging, phase noise, distribution latency and recovery logic.

L1 / L2 / L5

Representative multi-band GNSS RF paths.

10 MHz

Common disciplined reference and holdover frequency.

±5 ppb

Selected FCom OCXO stability options.

50 fs

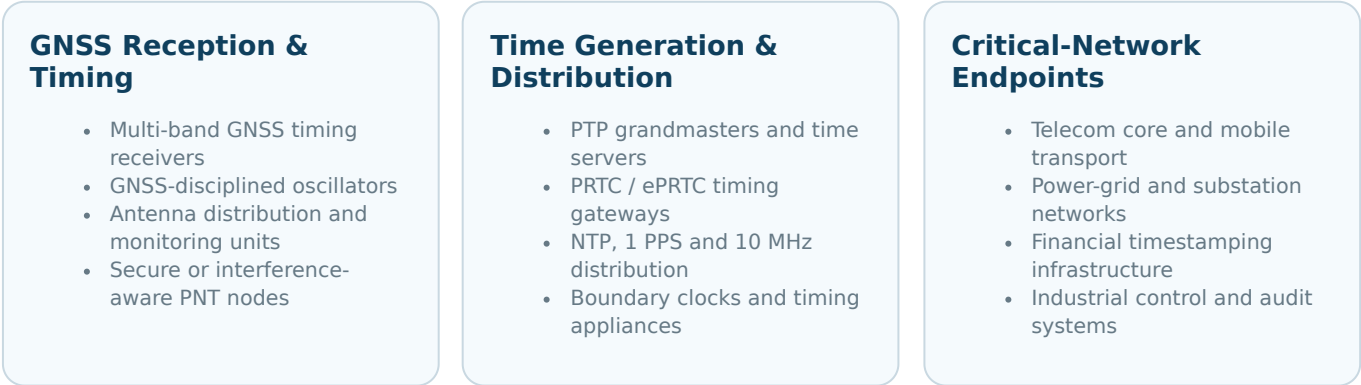
Selected FCom differential XO typical RMS jitter.

01

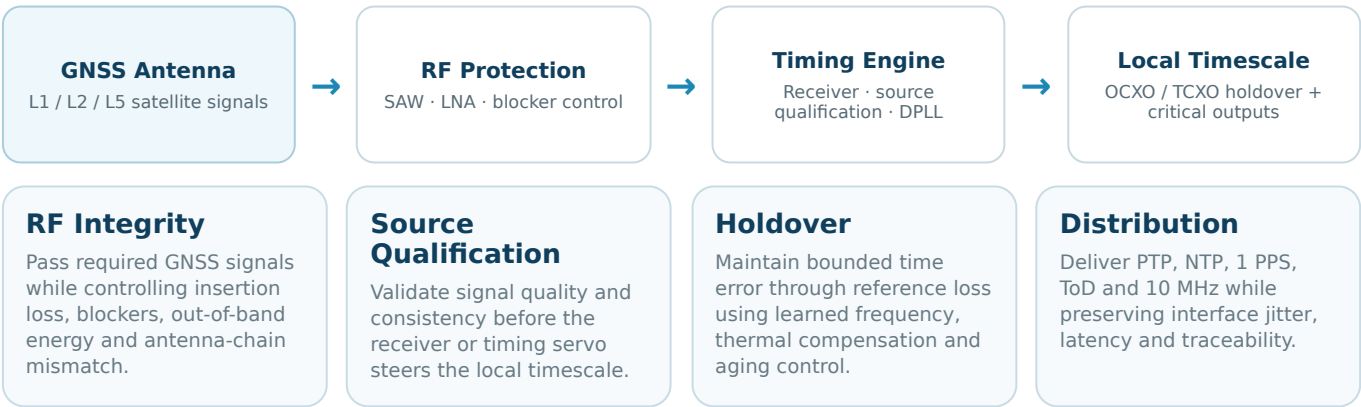
Application Scope & System Architecture

GNSS Timing & Resilient PNT addresses systems that derive precise time and frequency from satellite signals and maintain a controlled local timescale during interference, signal loss, antenna faults or network disruption. This guide supports telecom, energy, finance, industrial automation and other critical-infrastructure applications.

Representative Equipment



Representative Resilient Timing Chain



Architecture guidance: GNSS diversity, SAW filtering and a high-stability oscillator each support resilience, but none provides a complete resilient-PNT solution by itself. A complete design should detect degradation, enter protection or holdover predictably, report the event and recover without an uncontrolled time step.

02

Select by System Node

FCom recommends that the device position be defined before selecting a frequency-control or RF component. This separates antenna-path filtering, receiver-reference, disciplined-loop, holdover and output-interface requirements.

System Node	Typical Function	Representative Frequency	Typical Device Class	Selection Focus
Antenna / RF front end	Pass selected constellations and suppress blockers before the GNSS receiver	1176.45 / 1227.60 / 1268.52 / 1561.098 / 1575.42 MHz	Narrowband, multiband or wideband GNSS SAW selected from the actual receiver passband	Insertion loss, ripple, rejection mask, LNA position, impedance and package
GNSS timing receiver	Acquire satellite time and generate timing pulse / disciplined-frequency measurements	19.2 / 20 / 25 / 26 / 30.72 / 38.4 / 40 MHz	TCXO or CMOS XO selected by receiver accuracy, waveform and power	Total stability, phase noise, startup, supply and receiver clock specification
DPLL / GNSSDO loop	Filter timing-measurement noise and steer the local frequency reference	10-52 MHz; architecture-specific 25 / 100 / 125 MHz	VCXO where the timing IC controls an external oscillator; fixed reference where steering is internal	APR, control voltage, gain, loop bandwidth and phase-noise transfer
Autonomous holdover	Maintain the local timescale through GNSS loss or declared source rejection	10 MHz typical; other frequencies are timing-engine specific	Low-noise OCXO; wide-temperature TCXO only where the time-error budget permits	Temperature trajectory, aging, warm-up, retrace, learning and outage duration
Grandmaster / network I/O	Distribute PTP / NTP / 1 PPS / ToD / 10 MHz and clock Ethernet interfaces	10 MHz; 25 / 100 / 125 / 156.25 / 312.5 MHz	Holdover oscillator plus low-jitter XO for PHY, switch, FPGA or SerDes domains	Output interface, integration band, load, latency, redundancy and failover behavior
Control / RTC / event log	Maintain calendar, alarm chronology and timestamp continuity	32.768 kHz; 24 / 25 / 40 / 50 MHz	Tuning-fork crystal, ultra-low-current kHz XO or compact CMOS XO	Current, ESR, startup, backup supply, temperature and long-term availability

Start with the Outage Scenario

Begin by defining the failed reference, required operating duration and maximum UTC / phase error allowed at the end of the outage.

Separate the Error Budgets

Receiver measurement noise, steering error, oscillator holdover, output latency and network asymmetry are different contributors.

Confirm the RF Passband

A center frequency alone does not define a GNSS SAW. Please specify the constellation, signal, passband edges and rejection points.

Selection guidance: ppm or ppb stability is not a direct holdover-time specification. Convert the allowed time error and outage duration into a system frequency-error allocation, then include thermal, aging, calibration and algorithm residuals.

03

Frequency & Component Placement Matrix

These are recurring design anchors in GNSS timing systems. Their component meaning depends on constellation coverage, receiver architecture, DPLL partition and output-interface requirements.

Frequency / Signal	Common Placement	Functional Meaning	Typical Device Class	Engineering Note
32.768 kHz	RTC / event log / always-on domain	Calendar, audit continuity and low-power wake timing	Tuning-fork crystal or ultra-low-current kHz XO	Separate auxiliary clock; not a substitute for 10 MHz holdover or UTC traceability
10 MHz	GNSSDO, PRTC / ePRTC, grandmaster and reference I/O	Disciplined frequency and local holdover anchor	Low-noise OCXO; TCXO only for a defined lower holdover class	Specify phase noise, aging, warm-up, learning interval and time-error target
19.2 / 20 / 25 / 26 / 30.72 / 38.4 / 40 MHz	GNSS receiver, MCU / FPGA, modem or DPLL input	Receiver reference, local logic clock or synthesis input	TCXO, VCXO or CMOS XO selected by loop function	Confirm fixed versus pullable operation, waveform, supply and total stability
1176.45 MHz	GPS L5 / Galileo E5a / QZSS L5 path	Secondary-frequency GNSS reception for timing and integrity measurements	GNSS SAW filter	Align passband edges with the receiver and verify cascaded loss / noise figure
1227.60 / 1268.52 MHz	GPS L2 and BeiDou B3 paths	Independent multi-frequency PNT channels	Frequency-specific GNSS SAW filter	Select the filter from the exact signal frequency and bandwidth; L2 and B3 require different responses
1561.098 / 1575.42 MHz	BeiDou B1I and GPS L1 / Galileo E1 / QZSS L1 paths	Primary GNSS reception around the L1 / E1 region	Narrowband or multiband GNSS SAW	Choose from required constellations and blocker mask, not center frequency alone
1582.4 MHz wideband	Broad multi-constellation front end around upper L-band	One wider RF path supporting multiple nearby signals	Wideband GNSS SAW	Wider coverage can increase blocker exposure; check LNA linearity and receiver selectivity
25 / 100 / 125 / 156.25 / 312.5 MHz	Timing appliance PHY, switch, FPGA and SerDes domains	Network and digital interface references	Low-jitter CMOS or differential XO	Specify output standard and integrated-jitter bandwidth; these clocks do not replace holdover

RF Decision

Select the constellation set, passband and rejection mask before choosing narrowband, multiband or wideband SAW filtering.

Holdover Decision

Translate the outage duration and time-error limit into an oscillator allocation that includes temperature and aging effects.

Interface Decision

State frequency, waveform, load and integration band for every network and digital output-clock node.

04

Representative Platform & Architecture Matrix

Four public platforms illustrate distinct architecture levels: carrier PRTC / ePRTC, a documented GNSSDO control loop, an open data-center time appliance, and a critical-infrastructure resilient timing gateway.

MICROCHIP

TimeProvider 4100 PRTC / ePRTC Grandmaster

01

Carrier timing platform with multiband GNSS, PTP, NTP, SyncE, 1 PPS / ToD and E1/T1 interfaces. Publicly documented configurations include OCXO, super-OCXO and rubidium references, GNSS protection functions and redundant deployment modes.

GNSS / Trusted Core → PRTC + Holdover → PTP / SyncE / 1 PPS

Architecture takeaway: GNSS RF filtering, local holdover and network-interface clocks occupy separate component positions. The internal oscillator frequency remains platform-specific unless defined in the target design.

SPARKPNT

GNSSDO / GNSSDO+ Disciplined 10 MHz Platform

02

Public documentation describes a GNSSDO architecture using a multiband Septentrio mosaic-T receiver, controller-based frequency steering and either a 10 MHz digitally controlled TCXO or double-oven OCXO.

L1 / L2 / L5 GNSS → Clock-Bias Servo → 10 MHz + Aligned 1 PPS

Architecture takeaway: the GNSS antenna path, receiver measurement function, steerable 10 MHz local reference and phase-aligned physical-time output are distinct design functions.

OPEN COMPUTE PROJECT

Time Card + Open Time Server

03

Open PCIe timing architecture with configurable GNSS, 10 MHz, PPS and IRIG interfaces. The Time Card maintains the local PHC / holdover function and transfers time to a server and timestamping NIC.

GNSS / 10 MHz / PPS → Time Card PHC → NIC PPS / PTP / NTP

Architecture takeaway: external references, the local holdover source, PCIe time transfer and NIC / FPGA interface clocks require independent performance budgets.

SAFRAN

SecureSync 2400 Resilient Timing Gateway

04

Modular critical-infrastructure timing system accepting GNSS, IRIG and other references. Internal 10 MHz TCXO, OCXO or rubidium options support holdover, with 1 PPS, 10 MHz and network timing outputs depending on configuration.

GNSS / IRIG → Source Select + 10 MHz → 1 PPS / 10 MHz / Network

Architecture takeaway: published holdover performance varies with oscillator grade; reference diversity still requires an explicit outage-time error budget.

Use of public references: the platforms above are shown as architecture examples. FCom recommendations are based on the customer's target schematic and electrical requirements; platform inclusion does not indicate qualification, adoption, endorsement or drop-in compatibility.

05

Protected GNSS Timing & Holdover Architecture

This reference architecture qualifies the satellite source, disciplines a local oscillator and maintains a controlled timescale through RF interference, antenna failure or declared GNSS rejection.

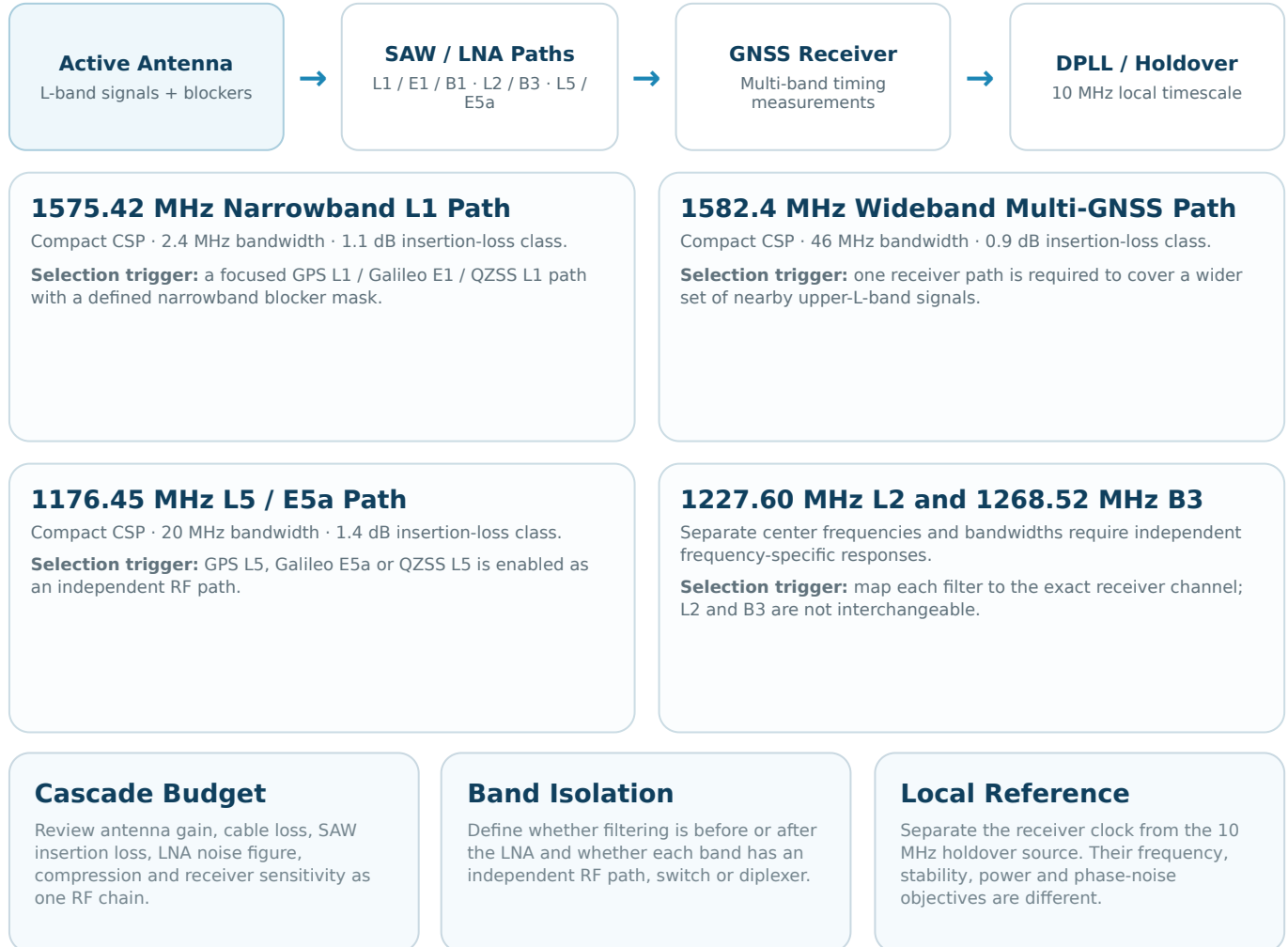
LAYER 1 GNSS RF Input	Antenna + LNA Gain, noise figure and blocker exposure	Band Selection L1 / L2 / L5 constellation paths	Primary FCom RF Node Frequency-specific SAW filtering supports receiver sensitivity and blocker tolerance. GNSS SAW · constellation · passband · rejection mask · LNA position
LAYER 2 Source Qualification	GNSS Receiver Time pulse and frequency estimates	Integrity Logic Cross-check, alarm and source rejection	Receiver Reference Class A compact TCXO or XO supports receiver acquisition and measurement continuity; exact stability and waveform follow the receiver specification. TCXO / XO · receiver-defined frequency · waveform · supply · startup
LAYER 3 DPLL & Timescale	Discipline Loop Estimate, steer and learn	Holdover State Thermal model + aging control	Primary FCom Holdover Node 10-40 MHz low-noise or compact OCXO options with frequency stability to ±5 ppb. OCXO · 10 MHz typical · phase noise · aging · warm-up · power
LAYER 4 Critical Outputs	Physical Timing 10 MHz · 1 PPS · ToD	Network Timing PTP · NTP · SyncE	Network Interface Clock Low-jitter differential XO for PHY, switch, FPGA or SerDes reference domains. Differential XO · 125 / 156.25 MHz typical · output · integration band
LAYER 5 Control & Audit	RTC / Event Log Calendar and alarm continuity	Management Health, alarms and recovery record	Auxiliary Timing Node 32.768 kHz crystal or ultra-low-current XO for persistent management functions. 32.768 kHz · only where the management architecture requires it

Application review: FCom evaluates holdover as accumulated time error over a defined outage and temperature trajectory. Oscillator stability, learning interval, aging, retrace, DPLL state and recovery policy are therefore reviewed as one system.

06

Multi-Band GNSS RF & Local Reference Architecture

In this reference architecture, RF paths are partitioned by the required constellation and signal, then qualified measurements are combined with a stable local reference for disciplining and holdover.



RF selection: product mapping for these RF paths is provided in the FCom Selection Guidance on page 8. Final selection requires confirmation of the receiver passband, rejection mask, source / load impedance, matching network, blocker environment, package and temperature range.

07

FCom Selection Guidance

The four decision points below translate the defined RF path, holdover objective and interface-clock requirements into practical FCom selection directions.

Decision 1 · L1 Narrowband or Wideband RF Path

FSF1411-1575M42-2M4-1.1-40 or **FSF1109-1582M4-46M-0.9-40**

Narrowband direction: focused 1575.42 MHz signal coverage.
Wideband direction: broader coverage of nearby upper-L-band GNSS signals.

Narrowband: 1575.42 MHz · 2.4 MHz BW · 1.1 dB IL · CSP1411
Wideband: 1582.4 MHz · 46 MHz BW · 0.9 dB IL · CSP1109
Selection inputs: Signals · passband · blocker mask · LNA position

Decision 2 · Secondary GNSS Band

FSF1109-1176M45-20M-1.4-40 / **FSF3030-1227M6-2M4-2.5-40** / **FSF3030-1268M52-20M46-0.7-40**

Select the frequency-specific path from the receiver signal plan. L5 / E5a, GPS L2 and BeiDou B3 require different center frequencies and bandwidths.

L5 / E5a: 1176.45 MHz · 20 MHz BW · 1.4 dB IL
L2 / B3: 1227.6 MHz narrowband · 1268.52 MHz / 20.46 MHz BW
Selection inputs: Receiver channel · cascade loss · rejection points

Decision 3 · Holdover Performance Class FOC-5S-LN or FOC-7S

Low-noise direction: consider this direction when close-in phase noise is a primary design limit. **Compact direction:** consider this direction when board area is constrained and the same nominal stability class meets the validated requirement.

Low-noise OCXO: 10-40 MHz · ± 5 ppb · -162 dBc/Hz @ 10 kHz
Compact OCXO: 10-40 MHz · 9×7 mm · ± 5 ppb
TCXO condition: The defined short-outage time-error budget permits

Decision 4 · DPLL or Network Interface Clock

FVC-3X / **FCO-3L-UJ**

These series address two distinct clock nodes and are not alternatives for the same electrical function.

DPLL VCXO: 2-66 MHz · 2.8 / 3.3 V · CMOS · ± 50 to ± 150 ppm
Network XO: 100-220 MHz · LVPECL / LVDS / HCSSL · 50 fs RMS jitter*
Outside range: FCom application review required

1 · Confirm RF / Clock Function

SAW filter, receiver reference, pullable loop source, holdover oscillator and output clock are different component functions.

2 · Confirm the Architecture

Please provide the RF block diagram and clock tree so passband, steering and frequency-generation roles are unambiguous.

3 · Apply the Error Budget

Complete the selection using the RF rejection, time-error, stability, phase-noise, jitter, temperature and interface limits.

Ordering-code note: complete SAW part numbers are shown where the passband directly determines selection. Oscillator products are shown at series level; FCom confirms frequency-specific ordering codes and the stated performance conditions after reviewing the complete requirements. *Use the applicable product specification to confirm the jitter integration band.

08

Engineering Validation & Application Inputs

To support an accurate FCom recommendation, please provide one requirement set for each RF or clock node. A GNSS SAW, receiver TCXO, DPLL VCXO, holdover OCXO and Ethernet reference are evaluated against different acceptance criteria.

GNSS Signals & RF Topology

- Constellations, bands and receiver channels
- Antenna, cable, surge protection, LNA and SAW order
- Single-path, switched, diplexed or independent-band topology
- Source / load impedance and matching-network constraints

SAW Passband & Rejection

- Center frequency and passband edges
- Maximum insertion loss and in-band ripple
- Rejection mask, blocker frequencies and blocker power
- Package, temperature, matching and annual volume

Holdover & Time Error

- UTC / phase-error limit and outage duration
- Operating temperature trajectory and airflow
- Aging, warm-up, retrace and learning interval
- Normal, protection, holdover and recovery modes

Oscillator Electrical Interface

- Exact frequency, supply and output waveform
- Load, termination, amplitude and enable behavior
- Package, height, warm-up power and steady-state power
- Startup, calibration and control-function requirements

Phase Noise, Jitter & DPLL

- Phase-noise mask at exact offset frequencies
- RMS jitter limit and integration bandwidth
- VCXO APR, control range, gain and polarity
- DPLL bandwidth, source switching and recovery behavior

Qualification & Program Inputs

- Temperature, reflow, vibration and screening needs
- Prototype quantity and EVT / DVT / PVT schedule
- Annual volume, service life and change control
- Required reports, traceability and qualification status

Component Validation

Measure SAW loss / rejection or oscillator frequency, phase noise, jitter, pull response, warm-up, aging and thermal behavior.

Timing-Chain Validation

Verify acquisition, source qualification, reference switching, holdover accumulation, alarm generation and monotonic recovery.

System Integrity Validation

Test antenna faults, blocker conditions, interference, spoof indicators, network impairment and audit-log continuity.

Share the GNSS / RF block diagram, clock tree and one requirement set per node. FCom Engineering can then recommend an applicable part number or configurable product series for review.

Technical Review →

09

Engineering FAQ & Application Review

Does multi-constellation GNSS equal resilient PNT?

Not by itself. It reduces dependence on one constellation but does not replace RF integrity monitoring, independent checks, controlled holdover, alarms, recovery logic and alternative references.

Does every GNSS timing receiver require an OCXO?

Not necessarily. A TCXO may be sufficient for continuous lock and a short outage budget. An OCXO is considered when longer holdover, lower phase noise or tighter time-error limits justify its power and warm-up.

Can ± 5 ppb be converted directly into 24-hour error?

Not by itself. Initial calibration, temperature trajectory, aging, retrace, oscillator learning and the timing servo contribute to the actual accumulated time error.

Is a wideband GNSS SAW always preferable?

Not necessarily. Wideband filtering can support more nearby signals but admits more out-of-band energy. Narrowband filtering can improve selectivity but may exclude required constellations or channels.

Is 1575.42 MHz enough information for SAW selection?

No. Selection also requires the signal set, passband edges, insertion-loss limit, ripple, rejection points, antenna / LNA order, impedance, matching, package and temperature range.

Can an FCom device directly replace a part in a public platform?

No direct replacement is implied. Any substitution requires confirmation of the complete electrical specification, package, pinout, qualification, test method and frequency-specific ordering code.

Public Architecture References

1. Microchip TimeProvider 4100 and vPRTC architecture: product page · vPRTC overview
2. SparkPNT GNSSDO / GNSSDO+ control loop and hardware: working principle · hardware documentation
3. Open Compute Project Time Card and Open Time Server: Time Card repository · server architecture
4. Safran SecureSync 2400 architecture and holdover behavior: platform introduction · holdover documentation

FCom product information: product data in this guide reflects the FCom product matrix available on 21 August 2026. Final specifications, performance conditions, availability and ordering codes are confirmed in the applicable product specification and FCom application review.

Discuss Your Resilient PNT Timing Architecture

To begin an application review, please share the GNSS bands, RF block diagram, receiver or timing-IC model, local reference frequency, holdover time-error target, output interfaces, temperature, package and prototype / annual volume.

[General Inquiry](#)
[Technical Support](#)