



# EPIC Online Technology Meeting Atomic Clocks and Quantum Sensors Spectratime / Orolia Switzerland

*3<sup>rd</sup> of April 2020*

The Global Leader in Resilient PNT

Providing the world's most critical applications real-time, accurate, reliable positioning, navigation, and timing data.

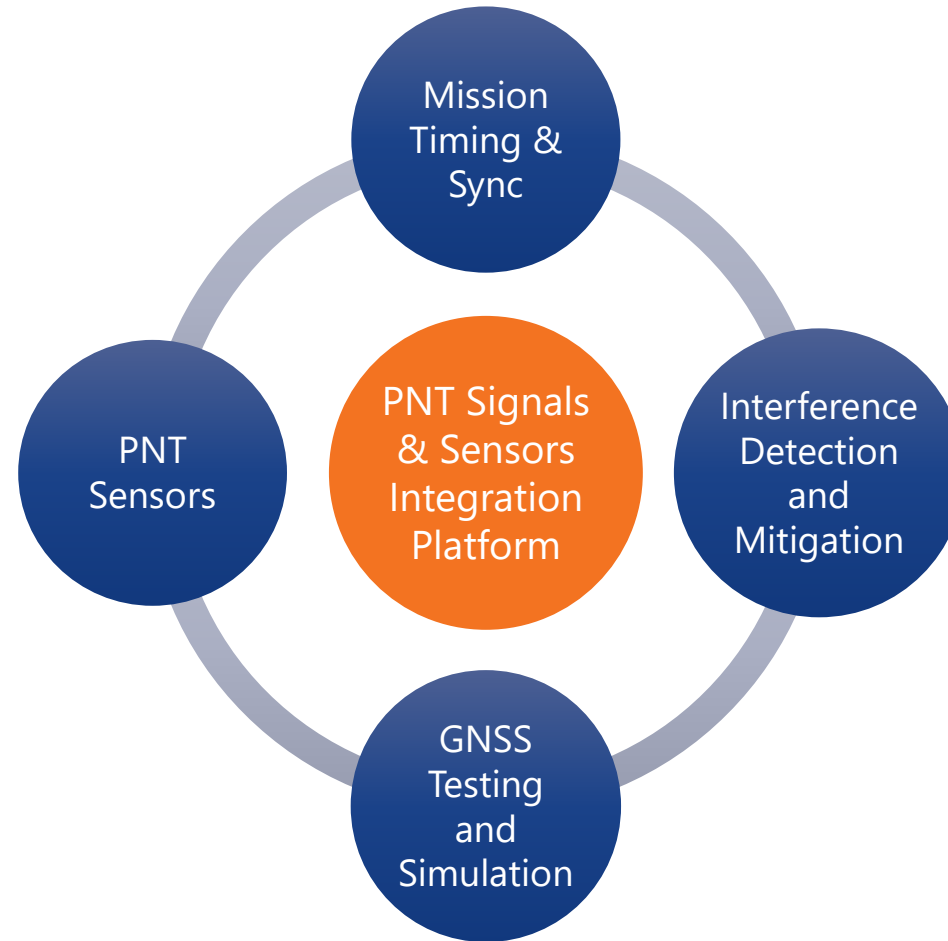
Safety, Security and Reliability



# OROLIA IS THE WORLD LEADER IN RESILIENT PNT

**The only provider of complete Resilient Positioning, Navigation and Timing (PNT) solutions.**

Proven GNSS signal protection & countermeasure technology that is available now



Continuous improvement cycle to adapt to emerging threats over time

Bolt-on, retrofit solutions that are ready to deploy

# OROLIA SOLUTIONS

Orolia delivers Resilient PNT with a broad suite of solutions for every operating environment.



Aerospace



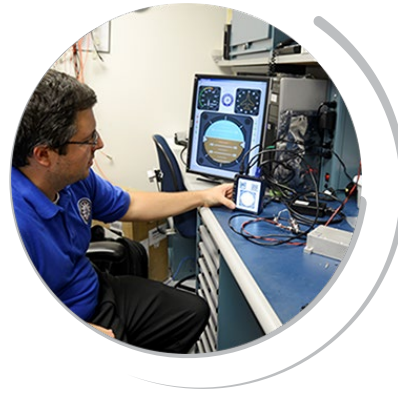
Defense



Critical Infrastructure



Maritime

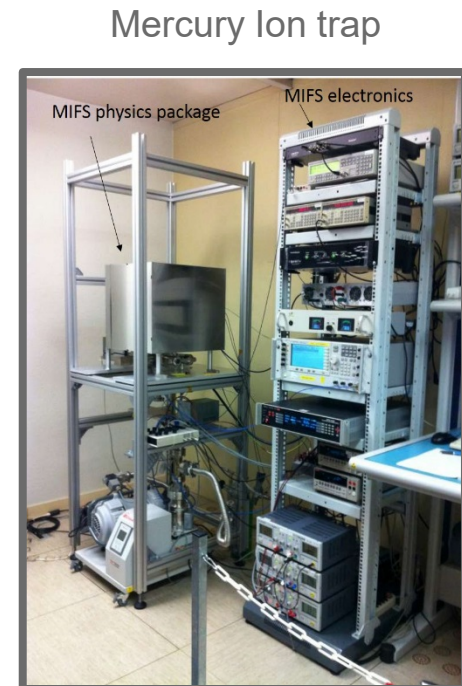
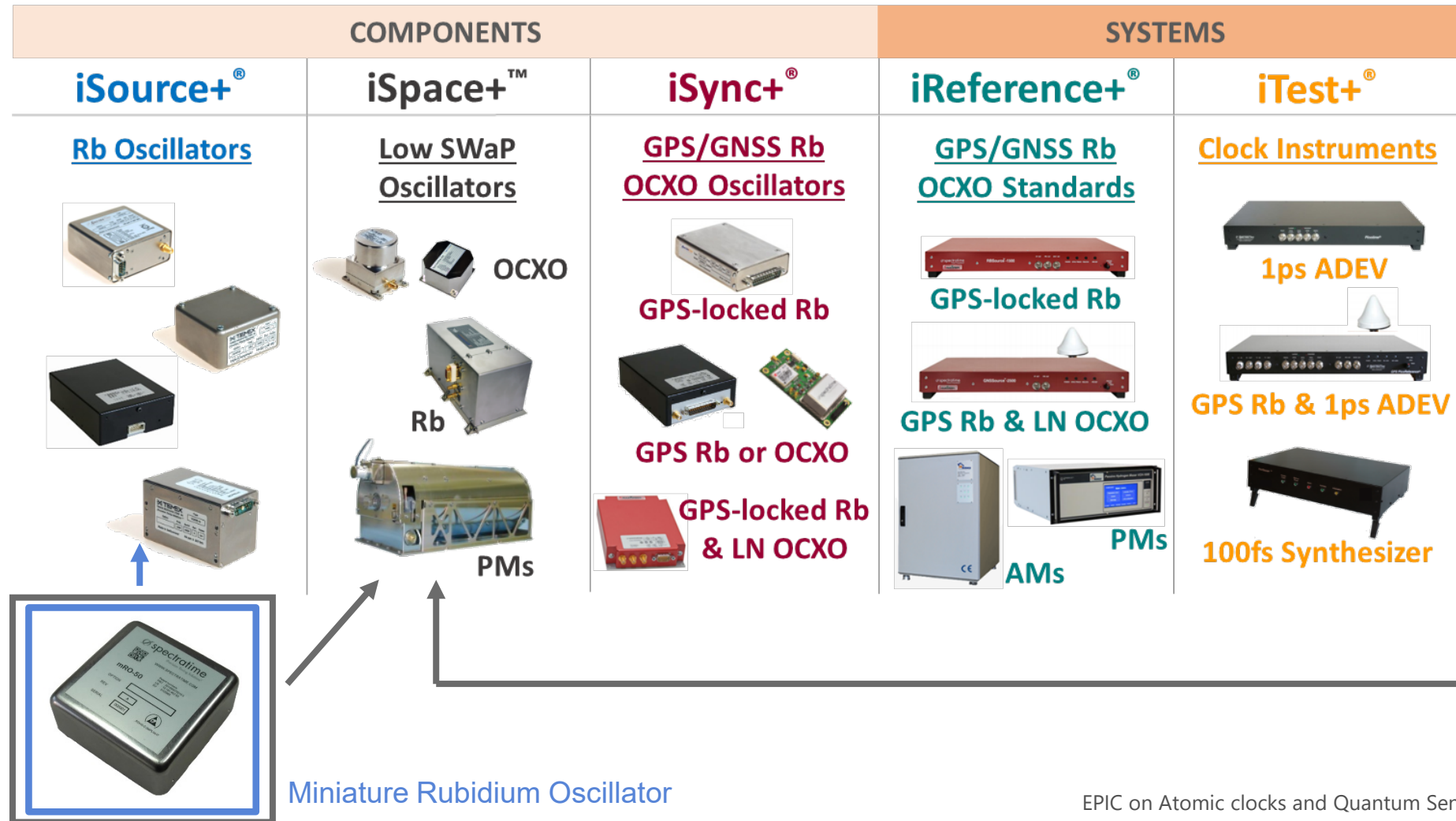


Testing & Simulation



# SPECTRATIME / OROLIA SWITZERLAND

Spectratime celebrates its 25th anniversary in 2020. Spectratime is the world leader of space atomic clock supplying three satellite constellations and also the first supplier of Rubidium clocks for ground application over the world.



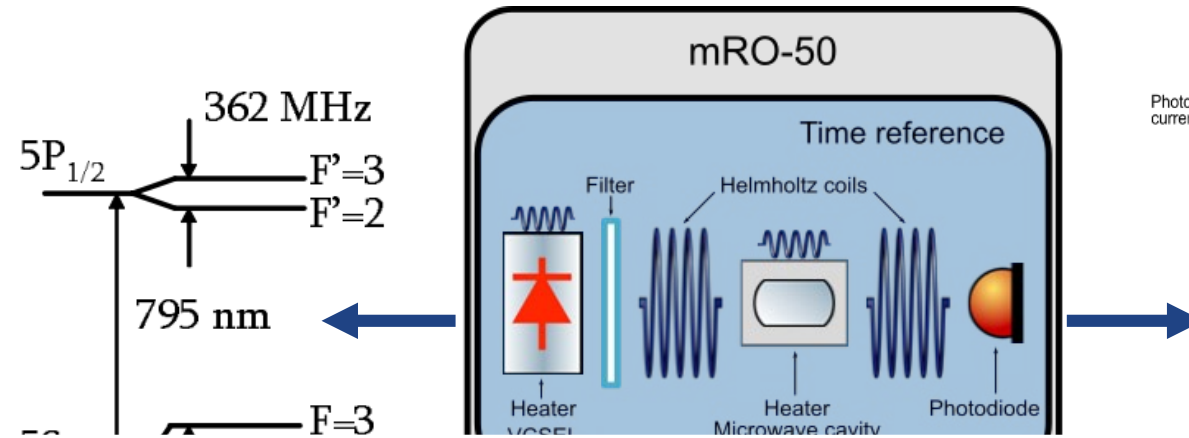
# miniature Rubidium Oscillator (mRO-50) principle



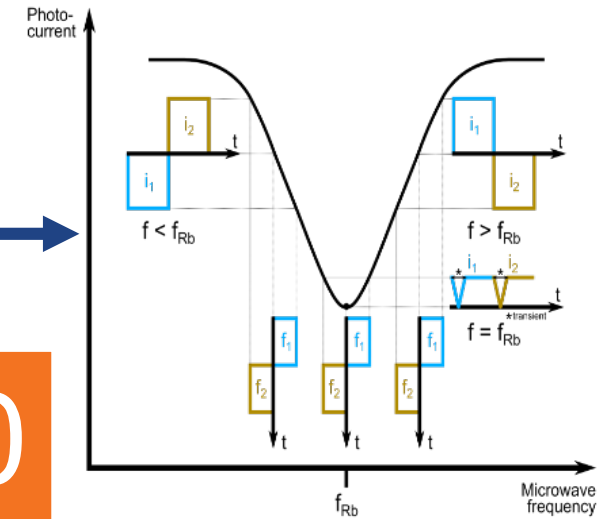
mRO-50 (50.8 x 50.8 x 19.5mm)

Miniature Rubidium Oscillator (mRO-50) is an oscillator based on the Rubidium oscillator architecture produced by Spectratime since 1995. It has been adapted for low power (from 7W to 0.4W) and size (from 182cc to 50cc).

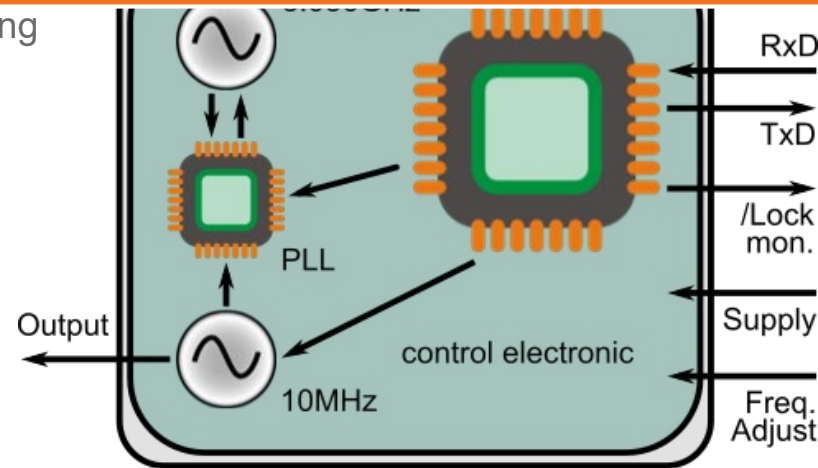
Funding by ESA, Europe and self-funding



Rb85 optical pumping  
(D1 line)

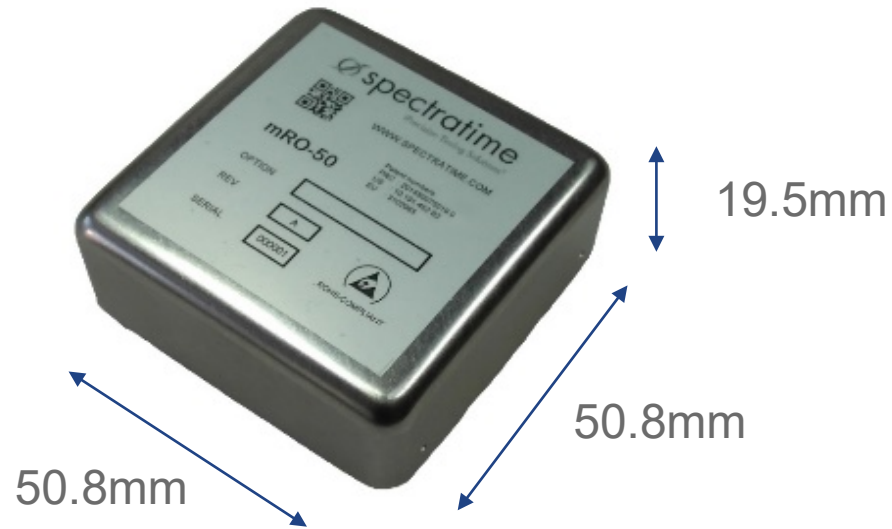


Atomic resonance  
detection



mRO-50 double resonance principle

# mRO-50 features



## Key features:

- $ADEV \leq 5E-11@1s$  with  $\sqrt{\tau}$  law (S option)
- $< 0.45W @ 5V$  or  $< 0.36W @ 3.3V$
- $< 5E-12/day$  (A option)
- 50cc

Full datasheet and manual available soon on [www.orolia.com](http://www.orolia.com)

## ELECTRICAL:

Type	mRO-50	
	Standard version	Options
Frequency	10 MHz	
Frequency change within operating temperature range	$\leq 4 \times 10^{-10}$ over $-10^{\circ}C$ to $+60^{\circ}C$	(option code E) $\leq 4 \times 10^{-10}$ over $-10^{\circ}C$ to $+65^{\circ}C$
Aging After 3 months operations :	$< 1 \times 10^{-11}$ / day	(option code A) $< 5 \times 10^{-12}$ / day
Short term stability	1sec $\leq 1 \times 10^{-10}$ 10sec $\leq 3 \times 10^{-11}$ 100sec $\leq 1 \times 10^{-11}$	(option code S) $\leq 5 \times 10^{-11}$ $\leq 1.5 \times 10^{-11}$ $\leq 5 \times 10^{-12}$
Phase noise (10 MHz) in dBc	1Hz $\leq -60$ 10Hz $\leq -85$ 100Hz $\leq -110$ 1000Hz $\leq -135$ 10000Hz $\leq -140$	(option code S) $\leq -70$ $\leq -90$ $\leq -110$ $\leq -135$ $\leq -140$
Frequency retrace (in stable temperature, gravity, pressure and magnetic field conditions)	$< 1 \times 10^{-10}$ within 1 h after 24 h off	
Warm-up time	Lock $< 2$ minutes at $+25^{\circ}C$	
Analog frequency adjustment. For stable operation, an external voltage shall be applied (cf. the manual of the mRO-50 for electrical scheme)	$1 \times 10^{-8} \pm 20\%$ (3.3V) $1 \times 10^{-8} \pm 20\%$ (5V)	
Digital frequency adjustment range with serial RS-232 port.	Fine: $\pm 7 \times 10^{-9}$ (resolution: $3 \times 10^{-12}$ ) Coarse: $\pm 1 \times 10^{-7}$ (resolution: $1.6 \times 10^{-9}$ )	
Output level	Square wave 3.3V	
Spurious $f_0 \pm 100kHz$	$< -80dBc$	
Supply voltage	5V	3.3V (option code 3.3 V)
Max Power Supply Ripple	$< 50$ mV peak to peak (from 1Hz to 1 MHz frequency band)	$< 5$ mV peak to peak (from 1Hz to 1 MHz frequency band)
Input power @ $25^{\circ}C$	0.45W steady state 1.5W start-up	
Lock Indicator	Unlocked Locked	$> 3$ V $< 0.4$ V

# mRO-50 applications

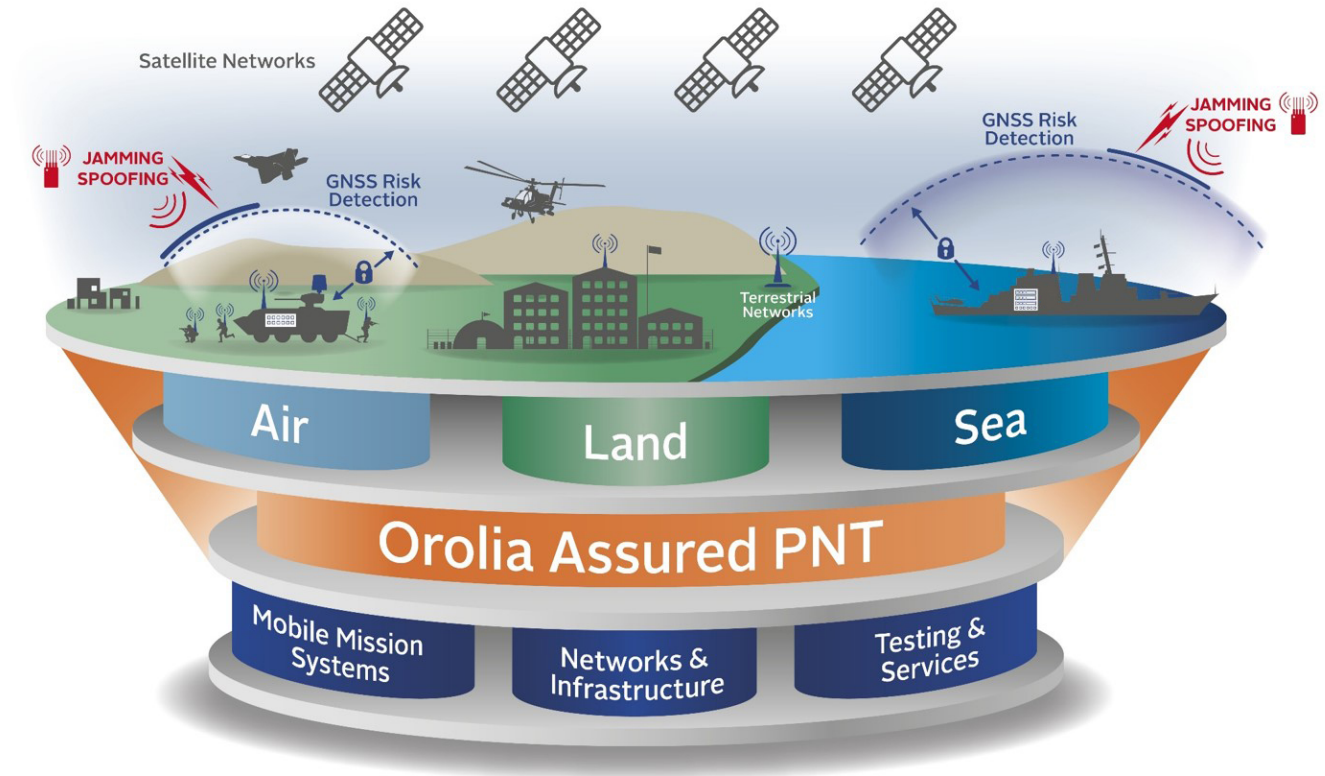
Several studies have demonstrated the many advantages of miniature, very low power timing sources based on atomic clock technology. Such sources allow fast acquisition and long coherent integration.

## Space applications:

- GNSS operation in interference
- Low Earth Orbit satellite missions
- ...

## Ground applications:

- Secured telecom
- Petrol research
- Sub-marine geological research
- Autonomous car
- Avionic
- ...



# WHAT WE OFFER / WHAT WE ARE LOOKING FOR

What we offer:

- A complete portfolio of atomic clocks and expertise for ground and space applications
- Instrumentation and GNSS/GPS receivers
- Custom precision electronics for ground and space applications
- Resilient-PNT portfolio and expertise
- Collaboration in our expertise domain

What we are looking for:

- Collaboration for space qualification of VCSEL via european fundings
- Vacuum encapsulation of DIL-14 or ceramic package ( $<1\text{E-2}$  mBar for 10 years life span)
- ASIC development (low power S band (3GHz) and Q band (40GHz) PLL, PPS...)
- Space qualified optical coating (UV – 200nm)
- Photo-Multiplier Tube (PMT) (UV – 200nm)

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