



BIPM summer school (9-11 September, 2025)

Automated realization of UTC(IT) at INRiM

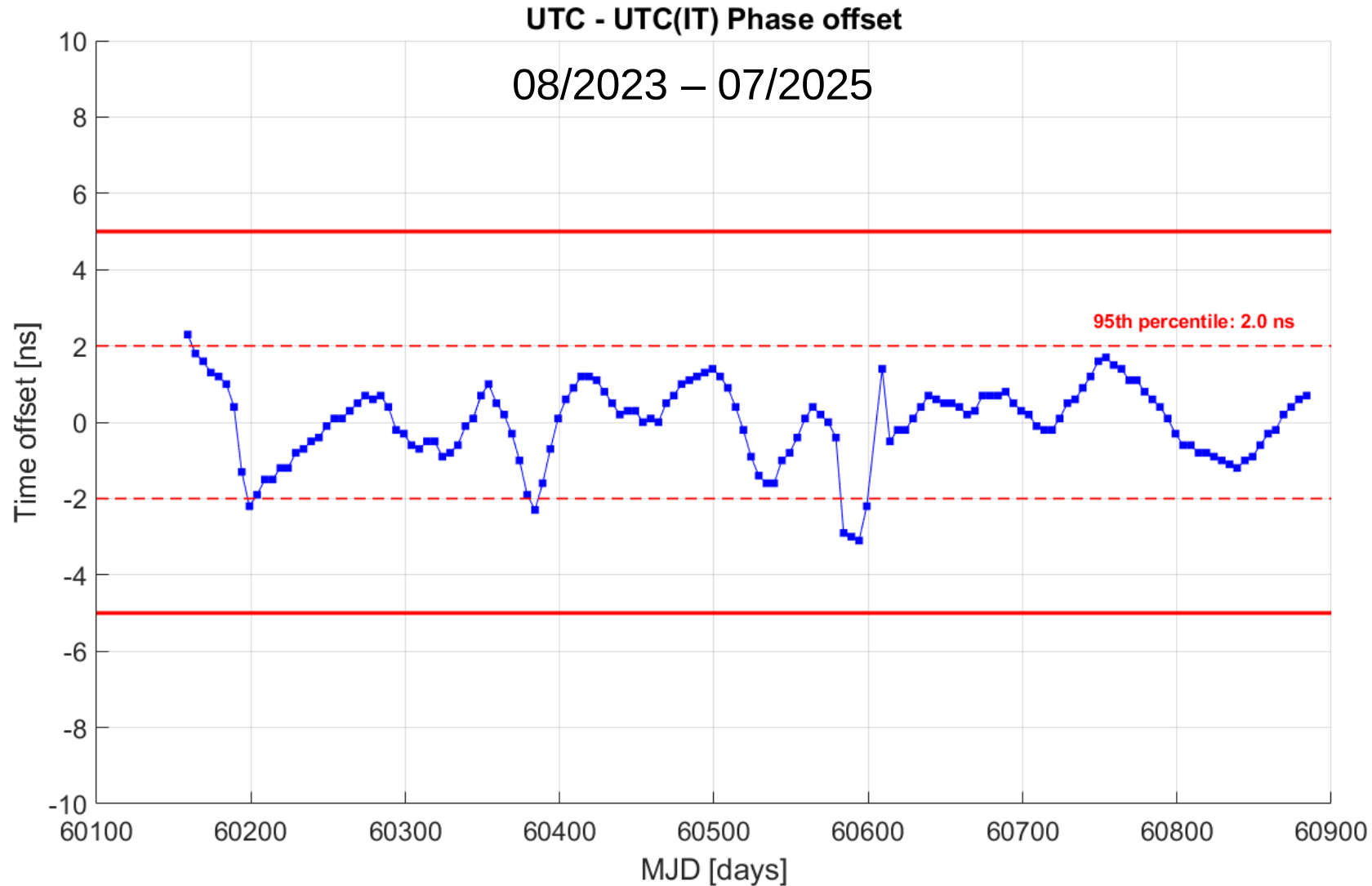
Ilaria Sesia

Italian National time scale UTC(IT)



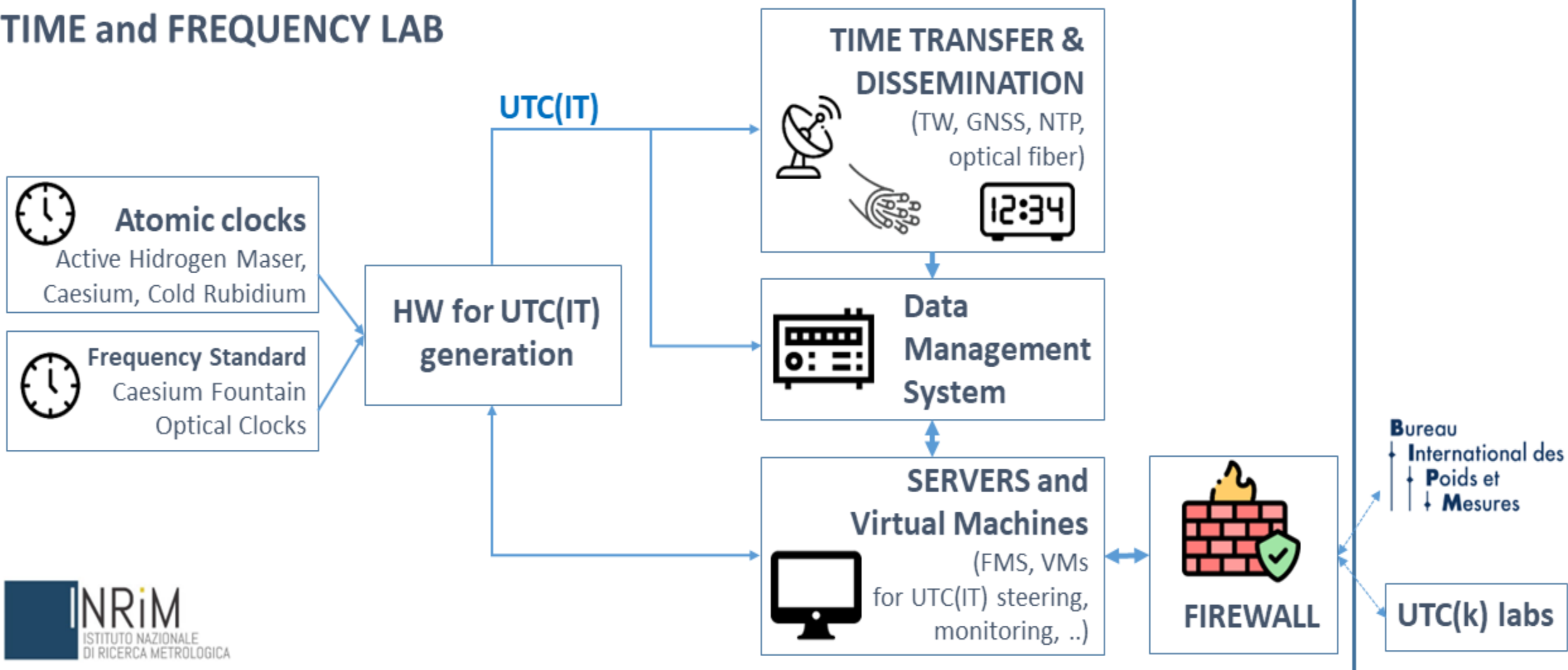
INRIM realizes the Italian national time scale, kept aligned to the international reference time at nanosecond level

UTC(IT) performances over the last 2 years



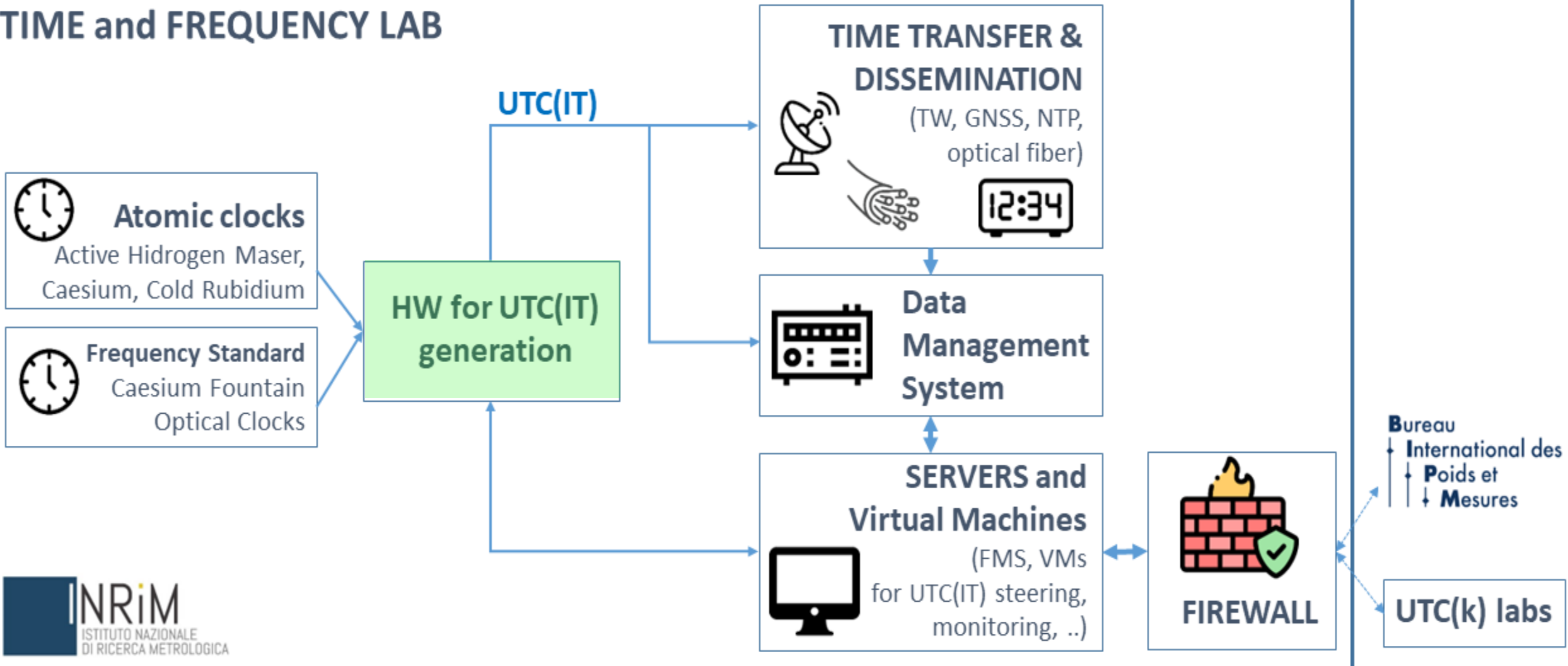
Overview of INRiM Time and Frequency Lab

TIME and FREQUENCY LAB

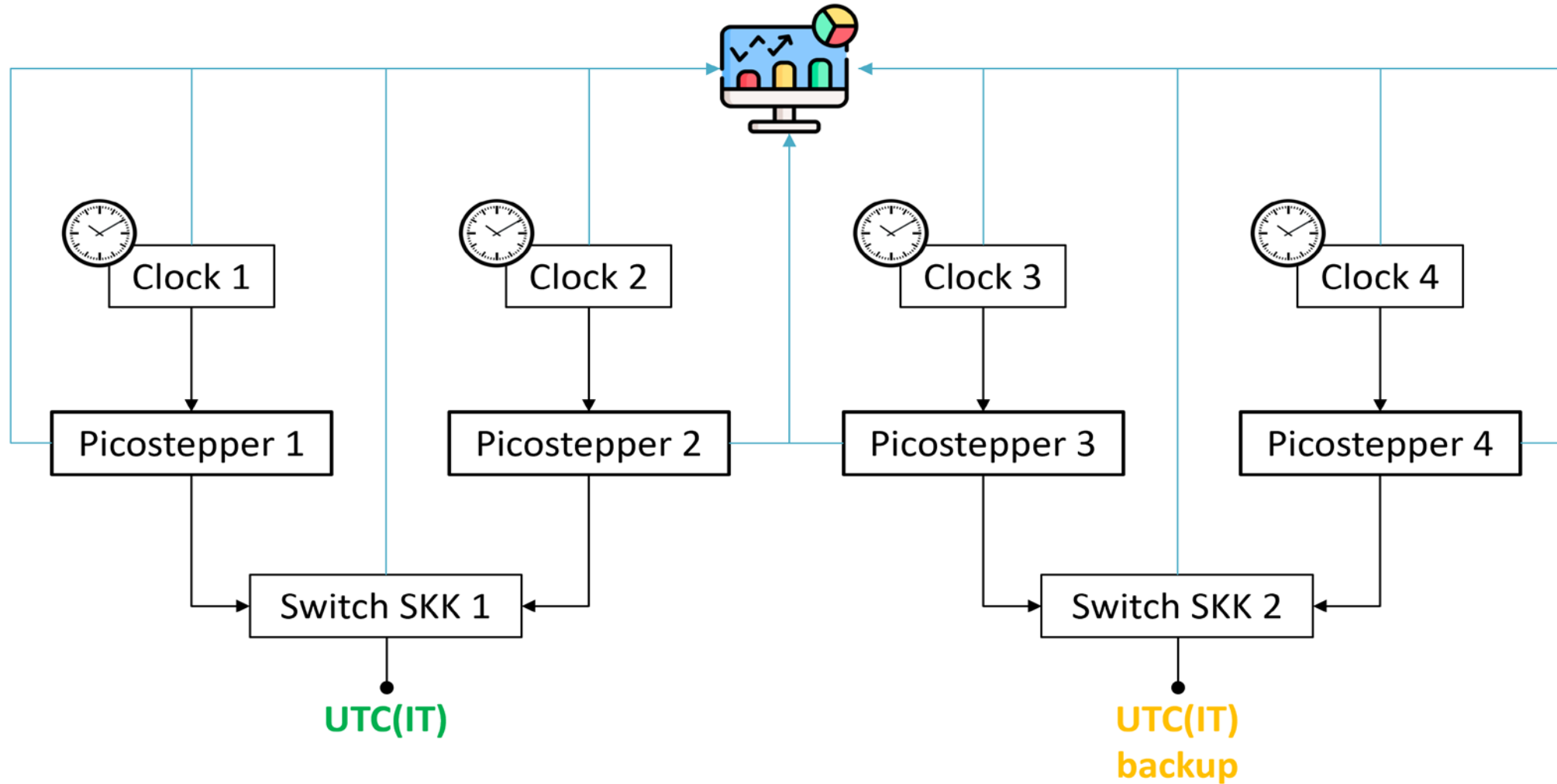


Hardware for UTC(IT) generation

TIME and FREQUENCY LAB

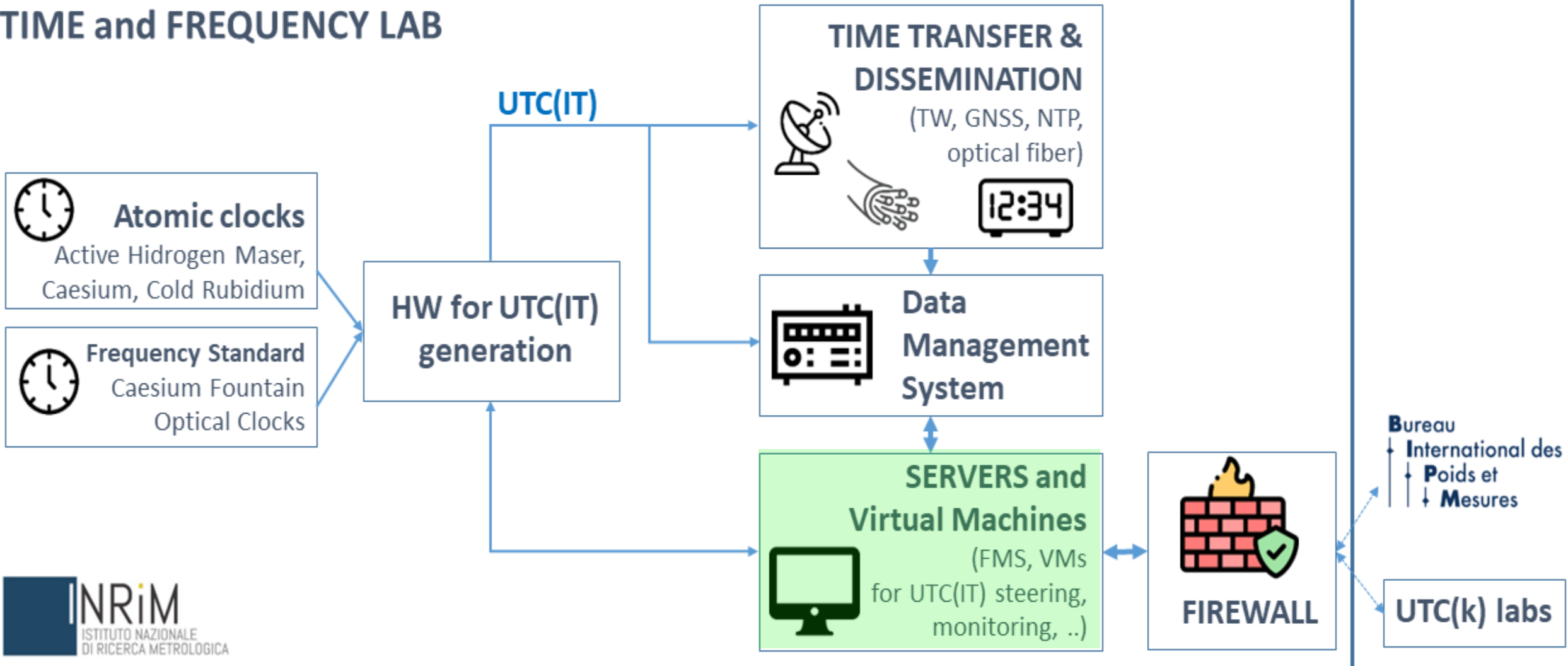


Hardware for UTC(IT) generation



T&F Lab Servers & Virtual Machines

TIME and FREQUENCY LAB

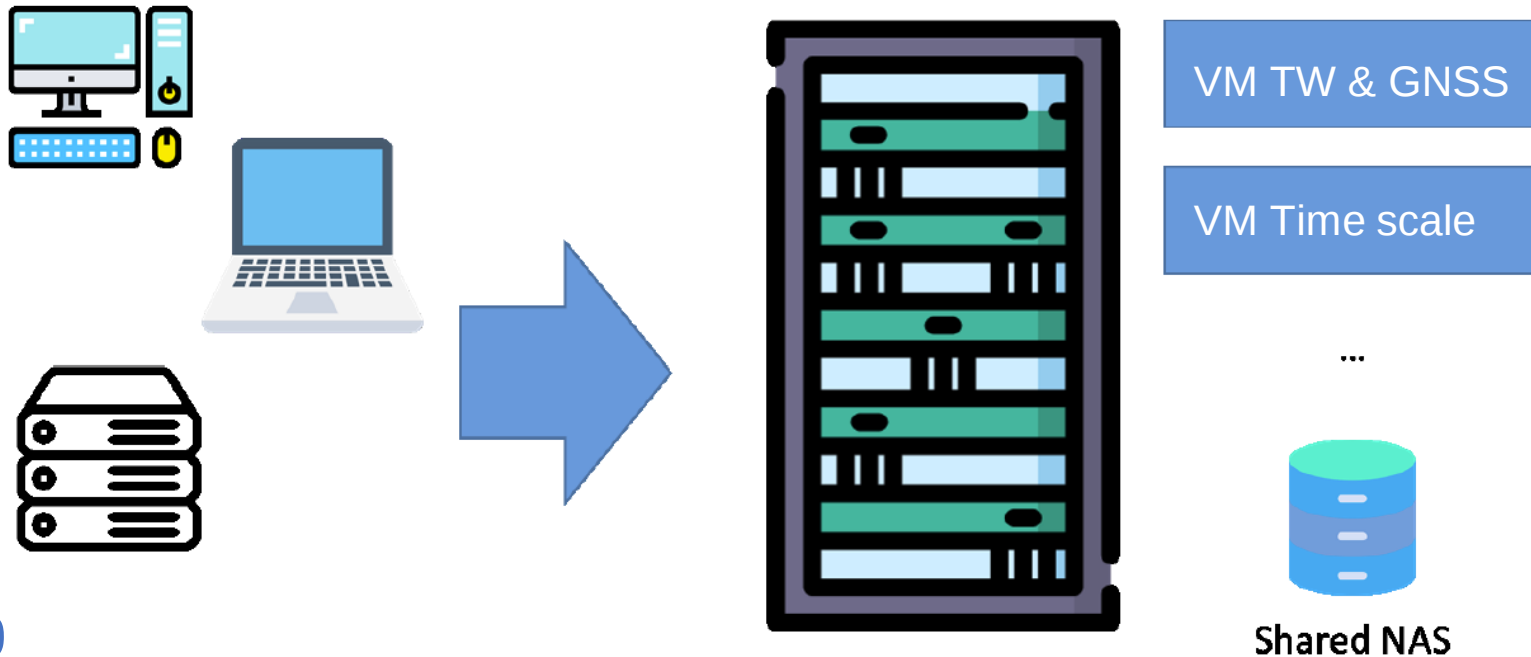


Virtual machines for UTC(IT) generation and data storage

Before 2020

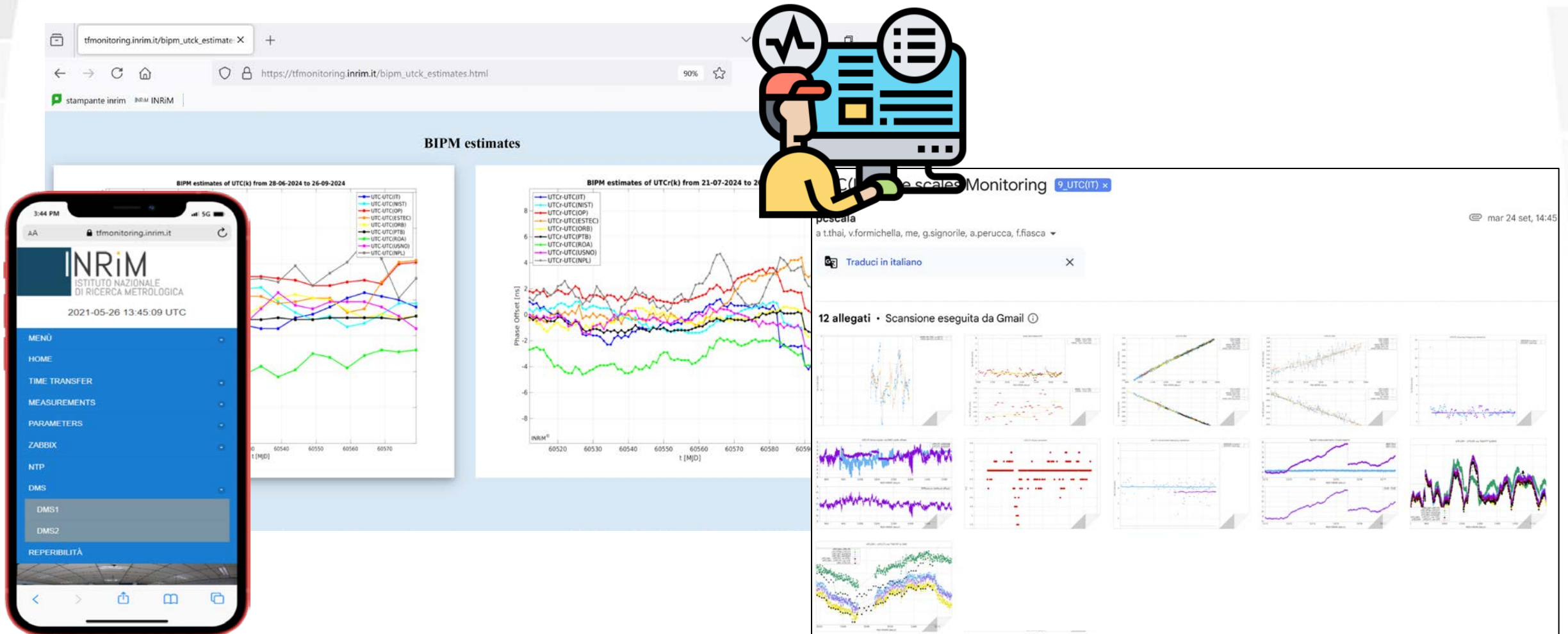


After 2020



Virtual Machine for UTC(IT) Monitoring

Monitoring web-page and automatic emails allow operators to check clocks, UTC(IT) and steering corrections behavior



14:15 (2 hours ago) ☆ ↩ ⋮



Found the following was
[2022-06-09 11:50:06]-[
=====

Found the following was
[2022-06-09 11:50:15]-[

REP-001: MASTER/BACKUP SWITCH SUL COMMUTATORE DOPO UL MASTER H-MASER

P-001	Task name
	Master/backsup switch in seguito a failure sul Master H-Maser
Date	Reason
28/02/2020	Effettuare lo switch di scala al verificarsi di una failure sul Master H-maser
Duration	Frequency
??	in reperibilità
Equipment	Man Power
	1

Informations

H-maser failure

H-maser funziona nominalmente

REQUIRE la procedura fra le 11:45 UTC e le 12:15 UTC

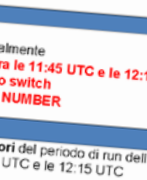
CERE CH MASTER sullo switch

CERE AOG BACKUP ID NUMBER

Procedura

RICARE di essere **al di fuori** del periodo di run dell'algoritmo di steering a tutti i giorni fra le 11:45 UTC e le 12:15 UTC

RICUTARE il canale dello switch da **AUTO** sul **LED SPENTO** al fine di **passare** MASTER la scala di backup

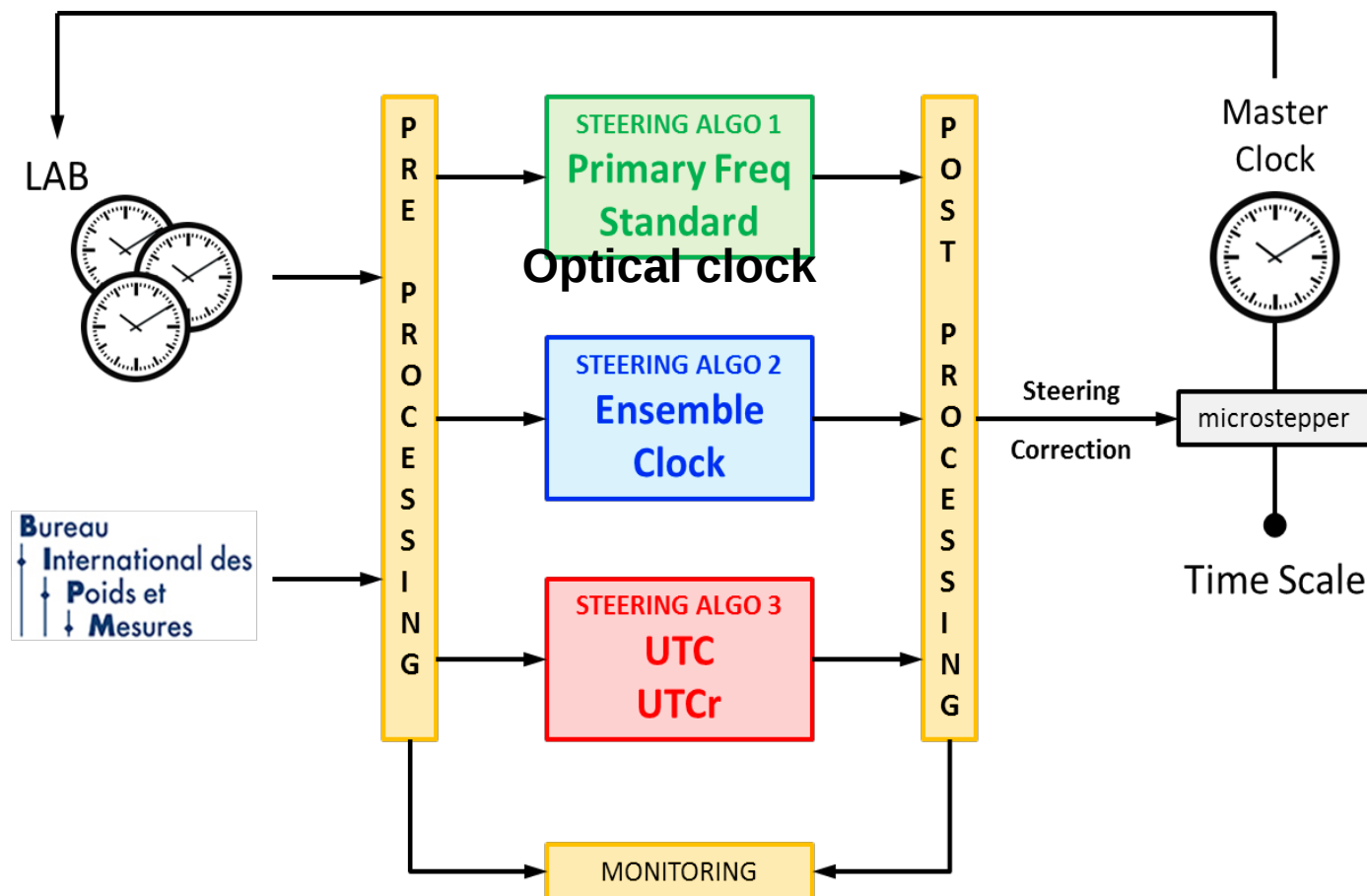


Il caso in figura si dovrebbe girare la manopola da **AUTO** a **2)**



**KEEP
CALM
AND
REBOOT
EVERYTHING**

Virtual Machine hosting UTC(IT) Algorithms



Three main stages:

- ✓ Input data pre-processing
- ✓ A steering algorithm for each of the available steering references
- ✓ Post-processing for the final steering correction computation

Steering Algorithms' Common Principles

The total frequency correction applied to the master clock is:

$$\Delta f = \Delta f_0 + \Delta f_1 + \Delta f_2$$

where:

$\Delta f_0 \rightarrow$ corrects the frequency offset of the master clock vs REF

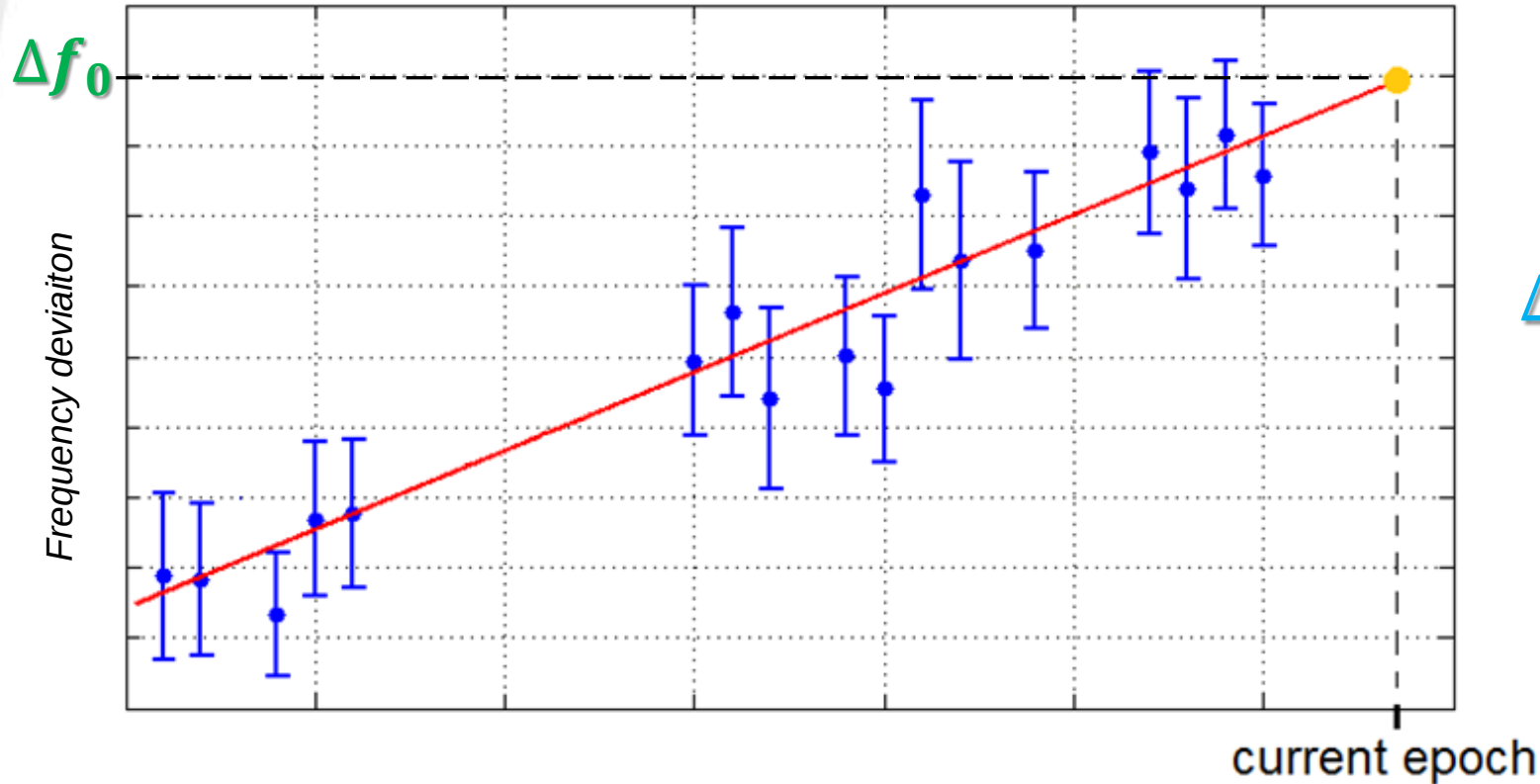
$\Delta f_1 \rightarrow$ corrects the residual frequency offset vs UTC/UTCr

$\Delta f_2 \rightarrow$ corrects the time offset vs UTC/UTCr, for time accuracy

Steering correction computation

Optimized for missing clock data

H-maser vs REF



$$\Delta f_2 = \frac{\text{Residual time offset vs UTC}}{\text{Nacc days}}$$

$$\Delta f = \Delta f_0 + \Delta f_2$$

UTC(IT) team



Thank you for listening!

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INRIM

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