The Consorzio Torino Time scientific and industrial activities

Luigi Bragagnini – Consorzio Torino Time

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Consorzio Torino Time Background

Established in Torino on the 2th of April 2004

CTT shareholders:

- Finpiemonte S.p.A
- Fondazione Torino Wireless
- INRiM (was IEN Galileo Ferraris)
- Politecnico di Torino University
- SEPA S.p.A.
- Alenia SIA Sp.A.
- Thales Alenia Space Italia S.p.A.
- Altec S.p.A.

The Italian Gateway to ISS

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Mission and Motivation

Mission

- Non-profit organization;
- Founded to participate in the Galileo Time Programs and to set up related activities in the Turin area;
- The first achievement has been the IOV Galileo PTF;
- After the successful PTF deployment, CTT will be a candidate for the supply of the Time Services needed for the Galileo System operations;

Motivations

- Galileo is one of the biggest Aerospace European projects;
- Will create new opportunities and job positions;
- GNSS System Providers are making significant investments;
- It is an opportunity for growth of the Piedmont Region, in the field of Aerospace, Timing, ICT at national and international level.

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Synergy between research and industry,

between public and private sectors

CTT values (2/4)

The public **institutional** associates:

Finpiemonte

Fondazione Torino Wireless

- *Strategic role for the support and promotion of CTT initiatives.*

The public **scientific** associates :

INRIM (was IEN Galileo Ferraris):

- *WW recognised in the Time e Frequency Metrology*

Politecnico di Torino:

- *WW recognised in the **Education** and **Research** fields w/specific **excellence** in **GNSS***
- *Joint initiatives w/**ISMB – Istituto Superiore Mario Boella**:*
  - **Galileo Lab**
  - **Master on Navigation and related applications**

CTT values (4/4)

:The private **industrial** associates

Thales Alenia Space Italia (TAS-I):
- *Leading manufacturer in Space Systems and Applications*

Altec:
- *hi-tech services for space missions (e.g. ISS)*

SEPA:
- *HW & SW hi-tech solutions provider for Timing applications*

Alenia SIA:
- *SW Engineering for aerospace applications*

- ***Provide industrial processes based on Space Standards.***
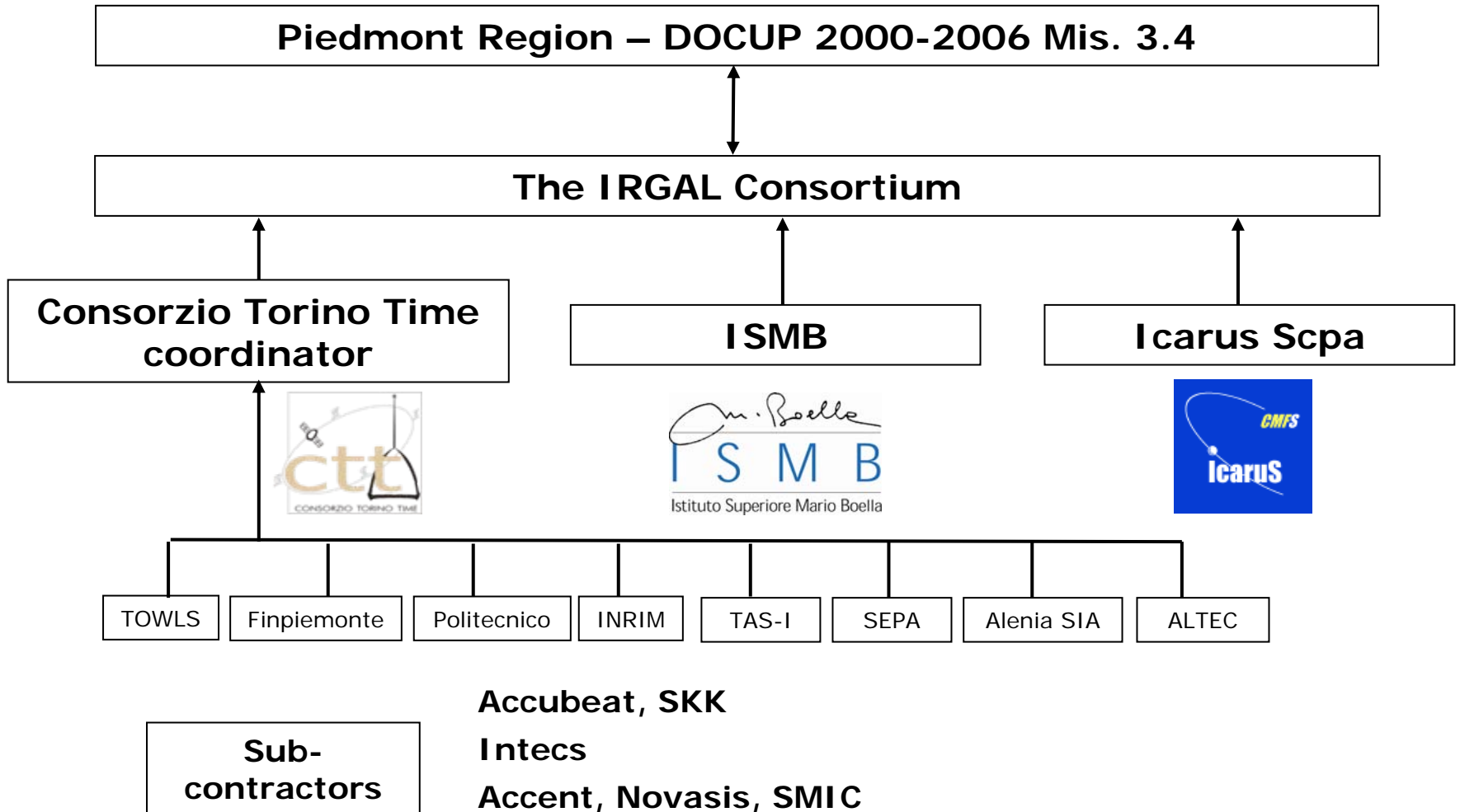
2. CTT Projects activities

***IRGAL** (**I**nnovation and **R**esearch on **GAL**ileo)*
Funding: (Eu-Piedmont Region)

- *enabling technologies on GNSS Timing and Receivers*

The IRGAL Consortium

Piedmont Region – DOCUP 2000-2006 Mis. 3.4

The IRGAL Consortium

| Consorzio Torino Time coordinator | ISMB | Icarus Scpa |

| TOWLS | Finpiemonte | Politecnico | INRIM | TAS-I | SEPA | Alenia SIA | ALTEC |

Sub-contractors

Accubeat, SKK

Intecs

Accent, Novasis, SMIC

IRGAL Major Objectives

The project is divided in two major WPs, with different scientific objectives

WP- Timing

Strengthen Torino Research and Industrial community in GNSS Time field

-Development of an innovative CPT based atomic Caesium clock prototype;

-Integration of an additional H-Maser clock at INRiM premises to enhance the UTC time scale performance;

-Design and realization of a Fiber Optic link for the Time & Frequency transfer between remote sites;

-Development of a Time Measurement Analysis software for the implementation of a Test Station for timing systems.

WP - Receivers

Development of GNSS Receivers

-Design and development of GNSS receiver in Software Radio Technology
- **Fully software receiver**
- **Receiver on hybrid FPGA+ARM board;**

-Design and development of a RF multifrequency GNSS front end:
- **Lab prototype with discrete components;**
- **Galileo/GPS front end in 0.13µm RFCMOS;**

-Definition of the architectural block diagram of the "Galileo receiver" on chip

Galileo Precise Timing Facility (PTF) for IOV: Customer: ESA, Thales Alenia Space France

- *A key element of the Ground Galileo Mission Segment.*

The PTF generates the physical time scale of Galileo with two main purposes:

- **Navigation Timekeeping** : Time stability is a critical issue for Satellite Navigation System

- **Metrological Timekeeping**: to link the Galileo System Time to the UTC time reference. This is done in cooperation with Time Service Provider (TSP), UTC(k) Labs and BIPM
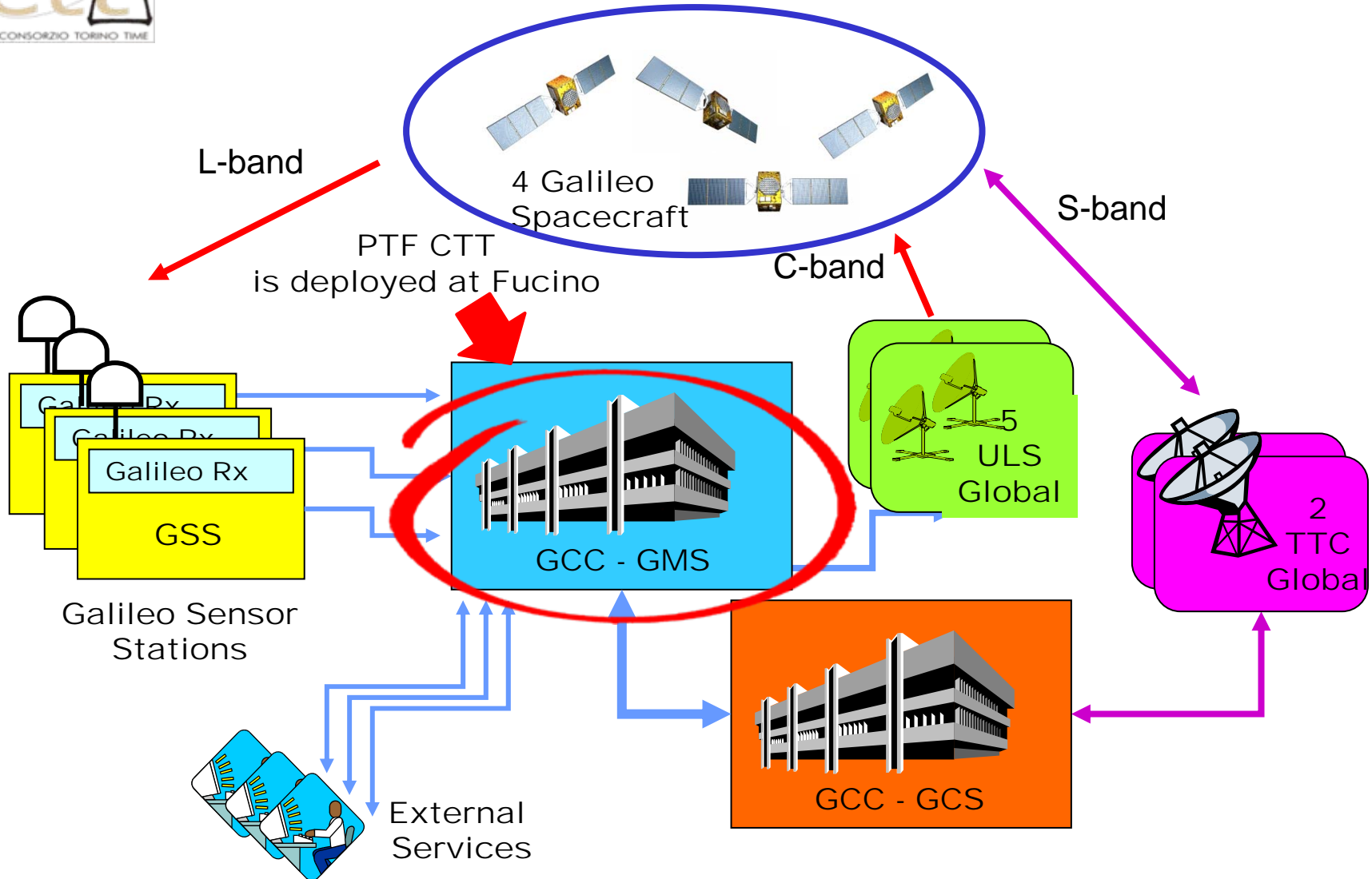
PTF, the Time of Galileo (1/2)

The key PTF Requirements are:

- Generation of the Galileo System Time with state-of-the-art performances

- Support to the **interoperability** with GPS by evaluating the GPS-Galileo Time Offset

- Unmanned operations

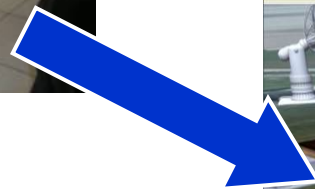- Design for Reliability, Maintainability, Safety and Galileo SW Standards

The PTF CTT in the Galileo IOV scenario

L-band

4 Galileo Spacecraft

S-band

C-band

PTF CTT is deployed at Fucino

Galileo Rx

Galileo Rx

Galileo Rx

GSS

Galileo Sensor Stations

GCC - GMS

5 ULS Global

2 TTC Global

External Services

GCC - GCS

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From the PTF Integration room in Altec Torino....

...to the Fucino Galileo Control Centre

HARRISON
Funding: Galileo Supervisory Authority

- *Galileo Time & Synchronisation Applications*

Project purpose is to study the benefits on society of Time and Synchronization opportunities offered by GNSS and Galileo

A wide potential user community has participated to the project
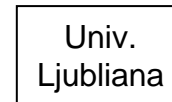
The project is arranged in three phases:

- the User Community Analysis
- the development of pilot demonstrators
- the field trials of the demonstrators

Harrison project activities (1/2)

User Community analysis:

- Scientific and Time Applications
  1) Astronomy and astrophysical applications
  2) Quantum Cryptography

- Industrial and Transport Applications
  1) Application on Electrical and Power Industry,
  2) Sync in Data Networks with Quality of Service (QoS) guarantee
  3) Mobile and cellular Networks: synch of base stations
  4) Railways applications

- Economics Financial/Banking Applications
  1) Banking application, anti money laundering
  2) Cryptography, security protocols for time stamping.

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TÜV SÜD

ThalesAlenia Space

Rail

EXODUS
e.SOLUTIONS

PFI

I S M B
Istituto Superiore Mario Boella

NSL

Harrison project activities (2/2)

- Service definition and standardization

  ThalesAlenia Space — TELESPAZIO (A Finmeccanica / Thales Company)

- Market analysis

  BAIN & COMPANY

- ACTS (Authenticated and Certified Time Solution) Demonstrator Development

  ThalesAlenia Space — SEPA

- Field Trials
  - ✓ Power and Energy   CESI RICERCA
  - ✓ Transient propagation on power lines
  - ✓ Astronomy and Quantum Cryptography
  - ✓ Cryptography   NSL

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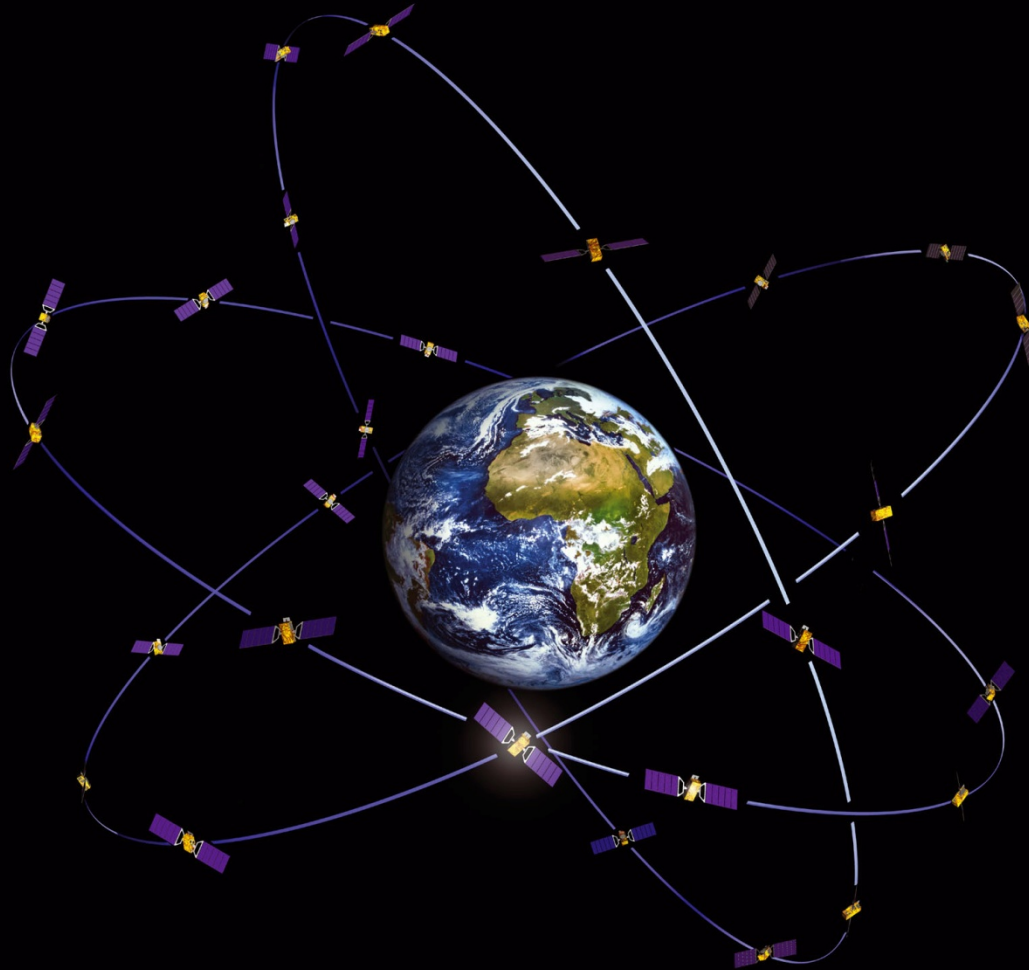
- Project Coordination

  ctt CONSORZIO TORINO TIME — ThalesAlenia Space

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Conclusion

- CTT model: sinergy between research and industry, between public and private sectors.

- CTT projects covered layers:

  - scientific and technology layers;

  - industrial layer;

  - applications and services layer.

  - PTF support Galileo-GPS **interoperability** by evaluating the GPS-Galileo Time Offset.

Thank you!