

# DETAILED CURRICULUM VITAE

Roma, 23/11/2023

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**Name:** *Giovanni Boscagli*

**Nationality:** Italian

**Birth date:** 24/01/1956

**Birth place:** Savona, Italy

**Address**

(Private): Via delle Sette Chiese 94, 00145 ROMA (RM)  
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**Education:** **Degree (Laurea) in Astronautical Engineering** at the "Scuola di Ingegneria Aerospaziale" Università La Sapienza, Rome (24/05/2000).

- *Thesis:*

“Strumentazione per esperimenti di Radio Science con Mercury Orbiter”

*(Instrumentation for radio science experiments with a Mercury Orbiter)*

- *Final mark:*

110 cum laude, the board recommended the publication of the thesis.

Certified **Engineer to the practice of the profession**, following the “Esame di Stato” at the Università degli Studi di Pisa, 1<sup>st</sup> Session 1983.

**Degree (Laurea) in Electronic Engineering** at the Università degli Studi di Pisa (on 14/04/1983) with emphasis in Telecommunications and Digital Signal Processing, after a 5 year curriculum (28 courses):

- *Thesis:*

“Uso dell’agilità in polarizzazione nei sistemi radar”

*(Use of polarisation agility in radar systems)*

- *Final mark:*

108/110

**Present Position:**

**Working as consultant** of Centro Ricerca Aerospaziale Università la Sapienza (CRAS) Roma for the definition of the radio frequency link, the communication subsystem and the performances in the following studies:

- ATLAS: for orbit determination and time synchronization (ODTS) of a lunar radio navigation system as part of the Lunar Radio Navigation Service (LRNS) in the frame of ESA Moonlight initiative.

- ARES: for time transfer and orbit determination for a Martian navigation system based on small satellites; study supported by the Italian Space Agency (contract n. 2021-8-E.0, ARES4SC) and by an agreement between Sapienza, Argotec, and the Italian National Research Council (CNR).

**Retired from ESA-ESTEC in date 01/02/2022.**

## **Experience:**

January 2022- January 2012

Working as **TT&C Principal Engineer** in the section TEC-EST of the RF Payload System Division in the Electrical Engineering Department, Directorate of Technical and Quality Management of ESA-ESTEC.

**Technical Officer** of the following R&D Activities

- Design and Development of the Integrated Deep-Space & Radio-Science Transponder (IDST) – Development of an EM including most of the techniques/functions developed in the above R7D activities
- Flexible and Autonomous TT&C Transponders for Multi Mission Applications implementing: Up-Link TC Autonomous Acquisition with bit rate recognition, Uplink TC LDPC codes, demodulation of very low bit rates, Wide Band Differential One-Way Ranging (WBDOR), On-Board Radio Science (OBRAS), Spread Spectrum (SS) for Multiple Spacecraft per Aperture (MSPA) and Secure Applications, MFSK modulation for EDL and TT&C Contingency.
- Advanced Manufacturing and Integration Techniques for TT&C Transponders/Transceivers: development of the BB of the Integrated Deep-Space & Radio-Science Transponder (IDST)
- Miniaturisation of the Deep Space Transponder: architectural and technological study with development of critical sections (RF HYBRIDS).
- CDMA Implementation for TT&C and Precision Navigation: focused on SBI implementation
- High Performance Time and Frequency Link – Microwave: for Time and Frequency Transfer

**RF Communication and TT&C Responsible** for the following ESA missions/projects:

- JUICE
  - X/Ka Deep Space Transponder
  - KaT
  - Link Performances and RF S/S analysis
- EXOMARS
  - X-Band TT&C
  - UHF Proximity Link
  - Link Performances and RF S/S analysis
- MSR-ERO (Mars Sample Return – Earth Return Orbiter)
  - X-Band TT&C
  - Link Performances and RF S/S analysis

- MSR- SFR (Mars Sample Return - Sample Fetch Rover)
  - UHF Proximity Link
  - Link Performances and RF S/S analysis
- GALILEO EVOLUTION for the S-band TT&C Transponder (including TRANSEC for secure link application), C-Band Mission Receiver, Search And Rescue Transponder (SART),
- BepiColombo System Testing Activities
  - X/Ka Deep Space Transponder
  - KaT
  - Link Performances and RF S/S analysis

**Participation in activities related to ESOC Ground Station (G/S) new developments as:**

- Multiple Frequency-Shift Keying Modem for Very Low Data Rates - As TEB Deputy Chairperson.
- Multiple Spacecraft per Aperture with Code Division Multiple Access modulation and linearizer – As TEB Chairperson and technical expert in the course of the activity.
- Reliable TT&C during superior solar conjunctions – As TEB Chairperson
- Tracking, Telemetry & Command (TT&C) Processor (TTCP) Development, Production and Deployment – As TEB Expert
- X-Band Sampling Technology Demonstration – As TEB Chairperson
- S-Band Advanced Ground Modem (SBAM) and Digital Tracking Receiver (DTR) for Galileo Evolution (including TRANSEC or secure link applications) – As TEB Chairperson and technical expert in the course of the activity.

**Member of the Technical Committee for the organization of the ESA TT&C Workshops**\_(in 2013, 2016 and 2019) and **Panel Chairman** for “Modulation & DSP” panel and “Ranging, Tracking Techniques and Radio Science” panel.

January 2012

Reintegrated in the Electrical Engineering Department of ESA-ESTEC (TEC-EST) from the Space Segment Procurement of the Galileo Project (NAV-NSO, Directorate of Galileo Programme and Navigation Related Activities)

2011- 2009

Working as **Integrated Support** to the Space Segment Procurement in the Galileo Project (NAV-NSO, Directorate of Galileo Programme and Navigation Related Activities).

Technical Responsible in the Galileo Project, both for IOV and FOC phase, for the development, procurement and testing up to satellite level for the following units/subsystems:

- S-band TT&C based on the **Dual Mode S-band Transponder (DMST)** making use of Standard and Spread Spectrum (SS) modulation.
- C-band **Mission Receiver (MISREC)**; unit based on new Digital Signal Processing (ASIC) for CDMA techniques applications.
- UHF-band **Search and Rescue Transponder (SART)**

Supporting as expert the Galileo satellite system activities related to the space/ground interface for the S, C and UHF band.

Involved in the S-band and C-band protected link design including the development of the FOC Common Security Unit (CSU).

Other activities:

- TEB chairman for the ARTES 3-4 activity for development and qualification of an “*UHF transponder*” (MIER proposal)
- TEB chairman for the following ESOC activity: “*Interdisciplinary study on enhancement of end-to-end accuracy for spacecraft tracking techniques*”
- Member of the Technical Committee for the organization of the ESA TT&C Workshops (September 2010) and Panel Chairman for “*Ranging, Tracking Techniques and Radio Science*” and for “*On-board TTC Technology*”.

February 2009

Assigned as **Integrated Support** from Electrical Engineering Department of ESA-ESTEC to the Space Segment Procurement in the Galileo Project (NAV-NSO, Directorate of Galileo Programme and Navigation Related Activities)

2009-2001

Working in the Electrical Engineering Department of ESA-ESTEC as:

**Technical Officer** for the development/procurement of:

- The Engineering **Qualification Model (EQM)** and the **Flight Models (FM)** of the DMST for the Galileo IOV phase.
- The C-band MISion RECeiver (MISREC) for the Galileo IOV phase (EM/EQM/FMs);
- The EQM/FM models of the X/X/Ka **Deep Space Transponder (DST)** for the BepiColombo mission to Mercury.
- The **Engineering Model (EM)** of the DMST: Predevelopment Phase of the transponder for Galileo constellation; unit based on new Digital Signal Processing (ASIC) and RF (MMICs) circuits.
- The EM of the X/X/Ka DST: Predevelopment Phase of the transponder for BepiColombo mission; unit based on new Digital Signal Processing (FPGA/ASIC) and RF circuits (Hybrids, MMICs).
- The elegant **Breadboard (BB)** of SCOUT transponder for commercial application following the new ETSI standard based on frequency modulation and SS techniques and using new Digital Signal Processing (implemented in FPGA).
- The EM of the **Integrated S-band Transponder (ISBT)** for Earth Observation missions with Alcatel Espacio (GSTP-3 activity) based on new Digital Signal Processing (ASIC) and RF (Hybrid) circuits.
- The BB of the Flexible Frequency Synthesiser for the future TT&C applications (TRP Activity).
- The BB of the Digital Modem (based on FPGA) with Alenia Spazio for on-board TT&C applications (TRP activity).
- The BB of the Digital Modem (based on FPGA) with Alcatel Espacio for on board TT&C applications (TRP activity).
- The “*RF-optical system trade-off study for interplanetary missions*” (AURORA) with the target of investigating the performances of an

integrated on-board RF-Optical terminal taking the Mars Sample Return (MSR) mission as a reference mission

- The study (TRP) on the “*Assessment of the Feasibility of an Optical Link for Deep Space Mission*”

**TT&C responsible/expert for on-board system activities** including system study / definition, H/W implementation / integration / testing, launch campaigns and participation in project reviews with significant support to the following projects/areas:

- BepiColombo Mercury Planetary Orbiter (MPO), including support on S/C Navigation aspects (based on PN regenerative ranging and Delta-DOR) and Radio Science Experiment (support to PI for KaT unit as member of the MORE Team).
- Solar-Orbiter (SOLO).
- ExoMars (including both Deep Space and Proximity Link aspects).
- Galileo IOV.
- GaIn GSTBV2 (Galileo), supporting Launch Campaign, S/C testing, Panel Reviews (PDR, CDR, QAR) and following transponder procurement.
- SSTL GSTBV2 (Galileo), participating to S/C Panel Reviews (PDR, CDR).
- Earth Observation Missions:
  - Chairing the ESA internal 26 GHz Working Group including support (as TEB Panel Chairman) to the study for “Data Downlink Systems for Earth Observation Satellites operating in the 26 GHz Band”.
  - Co-ordination for ESA Internal study on Sentinel-1 high rate telemetry.
  - Support to MeteoSat 3<sup>rd</sup> Generation System Architectural Study Review.
- Cassini/Huygens Delta Flight Acceptance Review (FAR).
- Rosetta FAR.
- ATV Proximity Link: System Review.

**Expert with active participation to the standardisation activities in the frame of CCSDS and European ECSS** (on Ranging and Radio Frequency & Modulation). Particular emphasis provided for the Novel PN Ranging Techniques promoting internal/external R&D activities (with development of internal analysis/simulation tools) and coordinating external study with Universities and H/W development with industry. Author of several CCSDS papers on this subject with active participation in the issue of the CCSDS Blue and Green Books.

**Expert in activities related to ESOC Ground Station (G/S) new developments** as:

- TEB chairman for the “Study on the Architecture for the Next Generation of ESA TT&C Processor”

- TEB chairman for the “Study and Breadboarding of a Sapphire Oscillator for Ultra High Short Term Stability”

**Member of the Technical Committee for the organization of the ESA TT&C Workshops** (in 2004 and 2007) and Panel Chairman for “Ranging, Tracking Techniques and Radio Science”.

- July 2001 Employed in **ESA-ESTEC** in the Electrical Engineering Department (TEC-ETT) as Radio Communication System Engineer and TT&C Expert.
- 2001-1987 Working in **Alenia Spazio** for the design and development of a new generation spread spectrum transponders with particular emphasis on algorithm definition and digital signal processing design.
- 2000-1998 Technical Manager of the Deep Space Transponder for the "Rosetta" and “Mars Express” mission of the European Space Agency (unit based on Digital Signal Processing implemented in ASIC technology).  
Responsible for the proposal of the transponder of the ESA First/Planck missions.  
Technical Manager of the MARESS transceiver (proximity link) for the “Mars Express” mission under contract from Italian Space Agency (ASI).
- 1998 Technical Manager of the Spread Spectrum Transponder for Italian Army Satellite (SICRAL) under contract from the Italian Defence Ministry.
- 1997 Responsible of an internal study on a commercial network for personal mobile communication using the CDMA technique.  
System engineer in the architectural definition of the Spread Spectrum transponder for the SICRAL satellite.
- 1996 System engineer for the integration and testing activity of the S-Band transponder for the Polar Platform Mission, ENVISAT programme of the European Space Agency (ESA).
- 1995-1994 System engineer for the study and definition of the S-Band transponder for the ESA Polar Platform Mission.
- 1993 Manager of the study for a Fully Digital Demodulator for On-Board FM/FSK-FM/BPSK demodulation (implemented in FPGA).  
System engineer of the Ka-band Translator associated to the gravitational wave experiment in the Cassini mission.  
Technical manager of the study and design of a Spread Spectrum Hybrid (Frequency Hopping / Direct Sequence) receiver for secure communications.
- 1992 Technical Manager of the study and design of the PSA Receiver for the Huygens/Cassini mission for the European Space Agency (ESA).  
System engineer for the integration and testing activity of the Dual Standard Transponder (DST, Standard and Spread Spectrum) under contract with the European Space Agency (ESA).

- 1991-1990            System engineer (responsible for the unit architecture and the digital signal processing implemented in ASIC) in the design and development of:
- a new generation Dual Standard Transponder for TT&C subsystem under ESA (European Space Agency) and ASI (Italian Space Agency) contracts
  - a spread spectrum transponder for the Italian Army Satellite.
- 1989-1987            System engineer (responsible for the unit architecture and the digital signal processing) in the study, design and development of:
- a spread spectrum transponder (ESA contract)
  - a Long Range Sensor for rendezvous and docking (ESA contract).
- 1987                    Hired by **Alenia Spazio** in the System Division.
- 1986-1984            Working in **Elettronica S.p.A.** as a System engineer for the study and design of electronic warfare receivers with particular emphasis in the digital Signal Processing for:
- Short Range Anti Radiation Missile
  - Direction finding in ELINT (ELectronic INTelligence) receivers.
- 1984                    Hired by **Elettronica S.p.A.** in the Analysis and Simulations Division.

## Papers:

L.Iess, M.Di Benedetto, G.Boscagli, et al., “*High Performance Orbit Determination and Time Synchronization for Lunar Radio Navigation Systems*”, ION GNSS CONFERENCE, Sept.2023, DENVER.

S.Molli, L.Iess, M.Di Benedetto, G.Boscagli, et al, “Design and Performance of a Martian Autonomous Navigation System based on a Smallsat Constellation”, *Acta Astronautica*, Volume 203, February 2023, Pages 112-124

S.Molli, L.Iess, M.Di Benedetto, G.Boscagli, et al., “*Time transfer and orbit determination for a Martian navigation system based on smallsats*”, 9th IEEE-ESA International Workshop on Tracking, Telemetry and Command Systems for Space Applications, 28 November - 1 December 2022, ESA/ESTEC, Noordwijk, The Netherlands

M.Maffei, L.Simone, G.Boscagli, “On-Board PN Ranging Acquisition based on Threshold Comparison with Soft Quantized Correlators”, under publication in *IEEE Transactions on Aerospace and Electronic Systems*.

L.Simone, M.Maffei, D.Gelfusa, G.Boscagli, “On-Board DSP Techniques for Radio-Science Applications”, *10th International Workshop on Signal Processing for Space Communications*, 6/8 October 2008, Rhodes Island, Greece.

G.Boscagli, P.Holsters, E.Vassallo, “Pseudo-Noise Ranging for Future Transparent and Regenerative Channels”, *AIAA Space Ops 2008*.

G.Boscagli, P.Holsters, L.Simone, E.Vassallo, M.Visintin, “Regenerative Pseudo-Noise Ranging: Overview of current ESA’s Standardisation Activities”, *4<sup>th</sup> ESA Workshop on Tracking, Telemetry and Command Systems for Space Applications*, ESA/ESOC Darmstadt, 11-15 September 2007.

G.Boscagli, P.Holsters, E.Vassallo, M.Visintin, “A Novel Ranging Technique and its Compatibility with Telecommand and Telemetry Signals”, *IEEE: Special Issue on Deep Space*, Nov 2007.

J. L. Massey, G. Boscagli, E.Vassallo, “Regenerative Pseudo-Noise (PN) Ranging Sequences for Deep-Space Missions,” *Int. J. Sat. Comm.*, Vol-25, Issue3 May/June 2007.

J. L. Massey, G. Boscagli, E.Vassallo, “Regenerative Pseudo-Noise-Like (PNL) Ranging Sequences for Deep-Space Missions,” *Int. J. Sat. Comm.*, Vol-25, Issue3 May/June 2007.

E.Vassallo, G.Boscagli, D.Lee, W.L.Martin, Delta-DOR and Regenerative Systems: The New CCSDS Frontier in Spacecraft Ranging, *AIAA Space Ops 2006*.

A.Gesmundo, E.Vassallo, K.Kewin, G.Boscagli, L.Simone, “Digital transponder frequency stability for BepiColombo Radio Science Experiment”, *3<sup>rd</sup> ESA Workshop on Tracking, Telemetry and Command Systems for Space Applications*, ESA/ESOC Darmstadt, 7-9 September 2004.

G.Boscagli, T.Dreischer, P.Holsters, K.Kudielka, R.Timm, M.Wittig "An Integrated RF-Optical TT&C Subsystem for a Mission to Mars", 3rd *ESA Workshop on Tracking, Telemetry and Command Systems for Space Applications*, ESA/ESOC Darmstadt, 7-9 September 2004.

G.Bagnasco, L.Giulicchi, P.Pablos, S.Airey, G. Boscagli, S. Mancuso, D. Nicolini, P. Plancke, P. Rueda-Boldo, M. Schautz, D. Nicolini "The Contribution of the Science Technology Programme to Low-Cost Planetary Missions", IAA September 2003.

G. Boscagli, L. Simone, M.C. Comparini, F.Marchetti, M. D'Attilia, S. Cocchi, M. Deletion, A. Delfino, G. Basile, F. De Tiberis, "Spacecraft Transponder for Deep Space Application: Design and Performance", Volume 3, 2002 Page(s):3-1337 - 3-1347 vol.3, Digital Object Identifier 10.1109/AERO.2002.1035266, Aerospace Conference Proceedings, 2002 IEEE.

G.Boscagli, L.Iess 'Radio Science Experiment for the Mission BepiColombo to Mercury', 2<sup>nd</sup> *ESA Workshop on Tracking, Telemetry and Command Systems*, ESTEC Noordwijk (NL), 29-31 October 2001.

G.Boscagli, M.C.Comparini, L.Simone, 'Deep Space Digital Transponder for Rosetta and Mars Express Missions', 2nd *ESA Workshop on Tracking, Telemetry and Command Systems*, ESTEC Noordwijk (NL), 29-31 October 2001.

G.Boscagli, M.C.Comparini, L.Simone, A.Santoni 'Digital Receiver for Wide-Band FM Based on Delay-Line Detector', 2<sup>nd</sup> *ESA Workshop on Tracking, Telemetry and Command Systems*, ESTEC Noordwijk (NL), 29-31 October 2001.

G.Boscagli, G.Cardarilli, C.M.Comparini, A.Del RE, D.Gelfusa, L.Simone, 'Direct Digital Frequency Synthesis techniques in the View of Implementation on FPGA', 2<sup>nd</sup> *ESA Workshop on Tracking, Telemetry and Command Systems*, ESTEC Noordwijk (NL), 29-31 October 2001.

L.Iess, G.Boscagli "Advanced Radio Science Instrumentation for the Mission BepiColombo to Mercury", *Planetary and Space Science*. Volume 49 Number 14 – Dec 2001.

G.Boscagli, M.C.Comparini, "System Analysis and Transponder Architecture for Future Deep Space Missions", 1<sup>st</sup> *ESA Workshop on Tracking, Telemetry and Command Systems*, ESTEC Noordwijk (NL), 26-26 June 1998.

G.Boscagli, M.C.Comparini, F.Iacomacci, V.Piloni, "DSP Based Aided Acquisition Methods for Signal Reception in Deep Space Fully Digital Receivers", *Fourth International Workshop on Digital Signal Processing Techniques Applied to Space Communications*, King's College London, England, 26-28 September 1994.

G.Boscagli, M.C.Comparini, R.Giordani, M.Martone, "On Board Signal Acquisition Strategies for Deep Space Transponders", *24th European Microwave Conference*, Cannes, France, 5 - 8 September 1994.

G.Boscagli, R.Giordani, M.Micaloni "A Coherent Ka Band Transponder for Doppler Detection of Gravitational Waves", *24th European Microwave Conference*, Cannes, France, 5 - 8 September 1994. Conference Proceedings: Volume 2, Page 1016.

G.Boscagli, M.C.Comparini, M.Martone, "An All Digital Architecture for On-Board Detection of FM/FSK-FM/BPSK TT&C Signal", *AIAA 15th International Communication Satellite System Conference*, San Diego, 27 February - 3 March 1994.

G.Boscagli, M.C.Comparini, M.Martone, "Fully Digital Receiver for On-Board FM/FSK-FM/BPSK Demodulation", *Fifth NASA Symposium on VLSI Design*, University of New Mexico, 4-6 November 1993

G.Boscagli, M.C.Comparini, "Deep Space Receiver for Cassini-Huygens Radio Links", *22nd European Microwave Conference*, Finland, August 1992.

G.Boscagli, M.C.Comparini, "Fully Digital Receiver for On-Board Application", *Third International Workshop on Digital Signal Processing Techniques Applied to Space Communications*, Noordwijk, The Netherlands, September 1992.

#### **Given Lectures/Seminars:**

- Three lectures given at ALMASpace S.r.l. & University of Bologna on **Tracking Telemetry & Commanding (TT&C) for Earth Observation (EO) Missions** (September 2013, February 2014 and September 2014) for ESEO (European Student Earth Orbiter) Program.
- Seminar on **"PN Regenerative Ranging"**, 8 May 2008, University of Rome (La Sapienza).
- Seminar on **"TT&C for Spacecraft Navigation and Radio Science Experiment"**, 4-8 June 2007, University of Rome (La Sapienza).

#### **Attended Training Programmes/Courses at ESA:**

- "Cryptography and Network Security", November 2010 (5 days course), Prof. Bart Preneel, Katholieke Universiteit Leuven,
- "Space Systems Engineering Course"; 31<sup>st</sup> March 4<sup>th</sup> April 2008, Aeronautics & Astronautics School of Engineering Sciences University of Southampton.
- "Satellite Communications Systems", January 2006 (5 days course), G.Maral and M.Bousquet,
- "Turbo Codes at ESA-ESTEC" in date May 18-20, 2005, University. of Bretagne
- "Synchronisation in Digital Communications" at ESA-ESTEC, Dec. 2004, M. Luise (Univ. of Pisa)
- "Advanced Signal Synchronisation for Wireless Transmission Systems" at ESA-ESTEC, Nov. 2004, M.Moeneclay, H.Steendam (Univ. of Ghent)
- "GPS Operation for Engineers" at ESA-ESTEC in date February 2-6, 2004

#### **Courses attended at the "Scuola di Ingegneria Aerospaziale" Università La Sapienza, Rome (Degree in Astronautical Engineering):**

"Propulsione Aerospaziale"	( <i>Aerospace Propulsion</i> )	(30/30),
"Elettronica Aerospaziale"	( <i>Aerospace Electronics</i> )	(30cum laude),
"Materiali Aerospaziali"	( <i>Aerospace Materials</i> )	(28/30),
"Telemisure Aerospaziali"	( <i>Aerospace Radiometric Systems</i> )	(30 cum laude),

“Impianti di Bordo” (*Onboard Systems*) (30 cum laude),  
“Astrodinamica Applicata” (*Applied Astrodynamics*) (30/30),  
“Meccanica del Volo Spaziale” (*Space Flight Mechanics*) (30 cum laude),  
“Meccanica e Stabilità delle Aerodine”  
(*Flight Mechanics and Stability*) (30/30),  
“Ingegneria dei Sistemi Aerospaziali”  
(*Aerospace System Engineering, Remote Sensing*) (30 cum laude),  
“Tecnica Aerospaziale” (*Aerospace Techniques*) (28/30),  
“Sistemi Aerospaziali” (*Aerospace Systems*) (30 cum laude),  
“Sperimentazione Aerospaziale” (*Aerospace Systems Test*) (30 cum laude),  
“Servosistemi Aeromissilistici” (*Servosystems*) (30 cum laude),  
“Strumenti di Bordo” (*Onboard Instrumentation*) (30 cum laude).