TELESPAZIO
a LEONARDO and THALES company


# U-DRAGON
## Unified – DistRibuted Advanced Global Operative Network

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# TELESPAZIO S.p.A.

## U-DRAGON: Unified DistRibuted Advanced Global Operative Network

*Sviluppo tecnologico di una nuova infrastruttura di Ground Segment distribuito dedicato al settore dei micro-satelliti e dei cubesat con capacità multi-missione, multi-satellite e multi-utente*

ASSE 1 - Priorità Investimento 1.b - Azione: 1.1.3

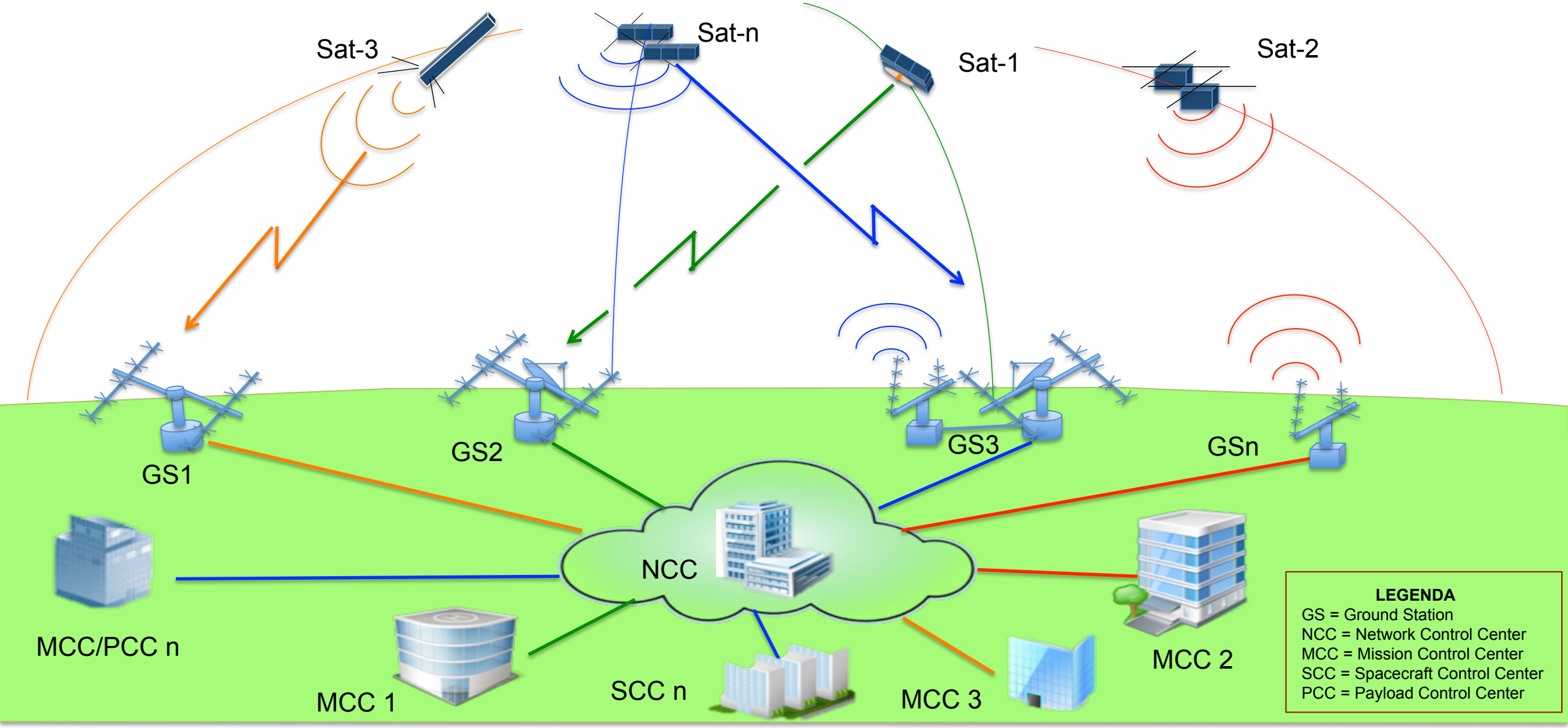
PON IMPRESE E COMPETITIVITÀ 2014>20
Riaccendiamo lo sviluppo

Ministero dello Sviluppo Economico

# U-DRAGON: the Project

- **The U-DRAGON Project could be considered the Telespazio answer to the emerging micro-satellites market,** able to meet the needs of both private & institutional sectors in commercial & scientific utilization fields.
- **U-DRAGON design is based on a distributed network of mini ground-stations** to be offered on a commercial basis, as a link to be used simple ground segment for the control of micro/nano-satellites and cubesats.
- **U-DRAGON is a communication infrastructure,** allows TT&C services via the direct bidirectional link between the User and his satellite through ground stations assigned temporarily to him.
- **U-DRAGON is able to serve many heterogeneous Satellites** using **many Ground Stations** to be connected to **many User Centers.**
- **The access to U-DRAGON is managed via internet** by using a dedicated **VPN** to ensure secure and controlled data/command exchanges
- **U-DRAGON is a first step to the establishment of a global network distributed ground stations** and a first step towards the development of new commercial services for small satellites
- **U-DRAGON is an example of Ground Segment as a Service (GaaS).**

# U-DRAGON: Scheme of links



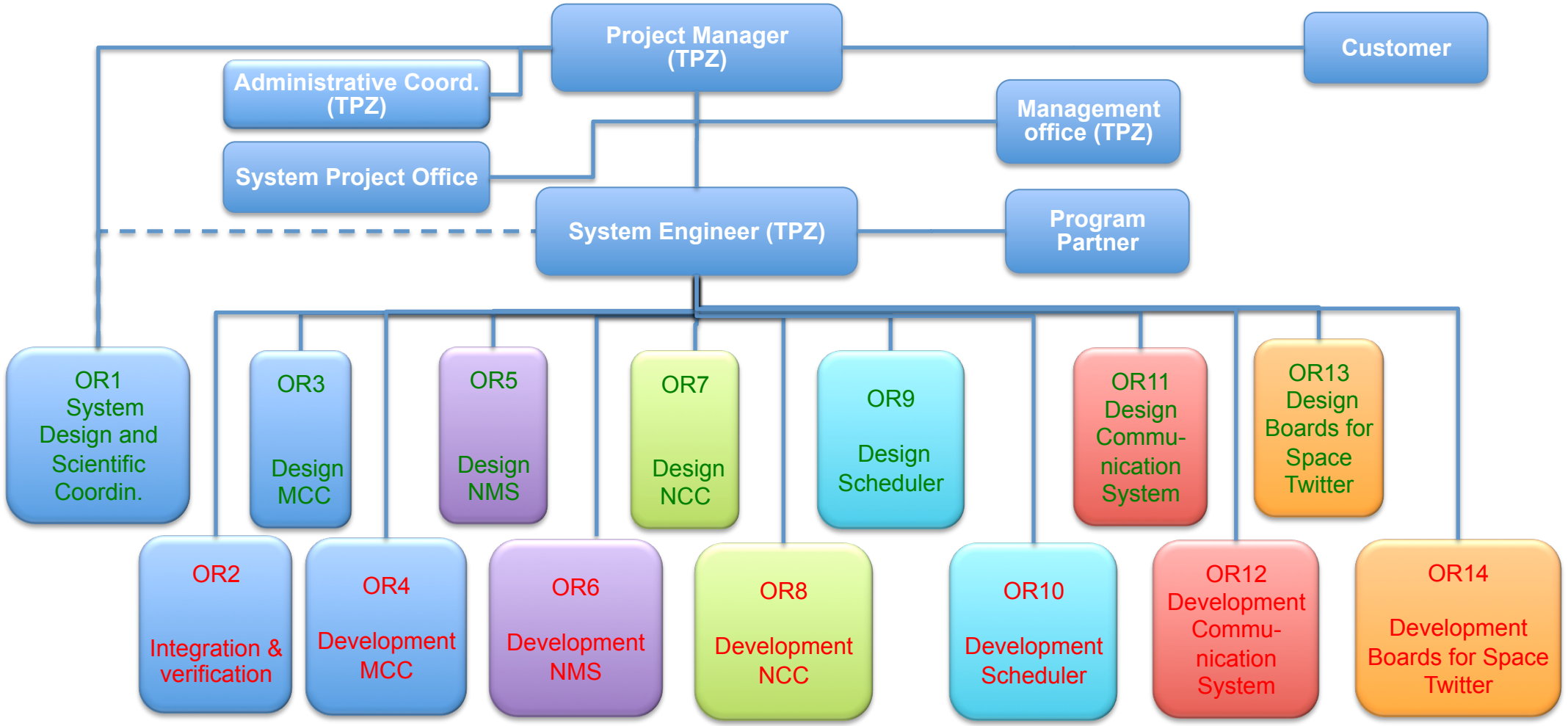
# U-DRAGON: Program in Brief

- **R&D Program** financed by Italian Minister of Economic Development (MISE)
- **Call for Tender:** *Grandi Progetti* (Large Projects) – 2016
- **Kick-Off Program:** May 2018
- **Prime:** Telespazio
- **Partners:**
  - GEM/Sistematica (for “Service Manager” development)
  - Euro.Soft (for “Space Twitter” development)
- **Milestones: KoM (Jun-18)**, Mission Definition Review **MDR** (Mar-19), System Requirements Review **SRR** (Jun-19), System Preliminary Design Review **S-PDR** (Sep-19), **S-PDR CloseOut** (Oct-19), **S-PDR CloseOut Delta** (Oct-19), System Critical Design Review **S-CDR** (Mar-20), **S-CDR CloseOut** (Mar-20), **MCC CDR** (Apr-20), **SRV CDR** (Apr-20), **NMS CDR** (Apr-20), **STW CDR** (Apr-20), **NPM CDR** (22-Apr-20), **UMC CDR** (Apr-2020), **SCH CDR** (Apr-20), **GSF/GST CDR** (Jul-20), Subsystems Acceptance (May/Sept-21), System Incr.1 (Oct-21), System Incr.2 (Mar-22), **End Program (June 2022)**
- **Goals:** Development of a prototype of Ground Segment dedicated to micro-sats and cubesats.

# U-DRAGON: Task Distribution

| COMPANY | | PROJECT TASKS | CONTRACTUAL RELATIONSHIP |
|---|---|---|---|
| TELESPAZIO a LEONARDO and THALES company | Telespazio S.p.A. | 1 Project Management<br>2 Reporting to the MISE<br>3 Definition of system requirements, design and system development<br>4 Definition of requirements, design and development of Ground Network<br>5 MCC design and implementation<br>6 NMS Requirements definition, design and implementation<br>7 Definition of requirements, planning and implementation Scheduler<br>8 Definition of Space Twitter requirements<br>9 Configuration & QA Management<br>10 Risk Management | PRIME<br>*Mandatario di R.T.I.* |
| GEM ICT Research & Development | GEM | 11 Realization of NCC software components<br>12 Functional and performance tests of the NCC infrastructure | SUBCO<br>*Mandante di R.T.I.* |
| Euro.Soft BEYOND INNOVATION | Euro.Soft s.r.l. | 13 Space Twitter Unit Design<br>14 Development of “custom” elements for EGSE<br>15 Procurement of the COTS elements for the prototype of the flight segment<br>16 Realization of the Space Twitter Unit with COTS components. | SUBCO<br>*Mandante di R.T.I.* |

# U-DRAGON: Structure of "Tasks to be accomplished"



# U-Dragon: Description of “Tasks to be Accomplished”

**OR-1 System Project and Scientific Coordination - Telespazio (RI).** General Project Management, drafting of System Specifications, definition of the System Architecture

**OR-2 System Integration and Verification - Telespazio (SS)**. Integration and Validation

**OR-3 Design of the MCC prototype (Mission Control Center) - Telespazio (RI)** Design of a first prototype of MCC to be used for the end-to-end test.

**OR-4 Realization of the MCC - Telespazio (SS)** Development of a first prototype of MCC

**OR-5 Design of the NMS (Network Management System) - Telespazio (RI)** Design of the development of the FCAPS framework, systems and tools for network management + T-DGSN integration with TPZ networks

**OR-6 Realization of the NMS (Network Management System) - Telespazio (SS)** Development of the NMS, of the tools for traffic analysis, asset configuration, security, etc.

**OR-7 Design of the NCC of the T-DGSN - GEM (RI)** for the design of the Network Control Center, star center of the T-DGSN

**OR-8 Realization of the NCC (Network Control Center) of the T-DGSN - GEM (SS)** for the realization of the Network Control Center that connects with all the nodes of the network.

**OR-9 Planning / Scheduling system design - Telespazio (RI)** Design of the planning system for the passage of satellites on the stations and scheduling of the assignment of ground stations to satellites

**OR-10 Realization of the Planning / Scheduling system (Scheduler) of T-DGSN - Telespazio (SS)** Realization of the planning and scheduling system for assigning ground stations to satellites

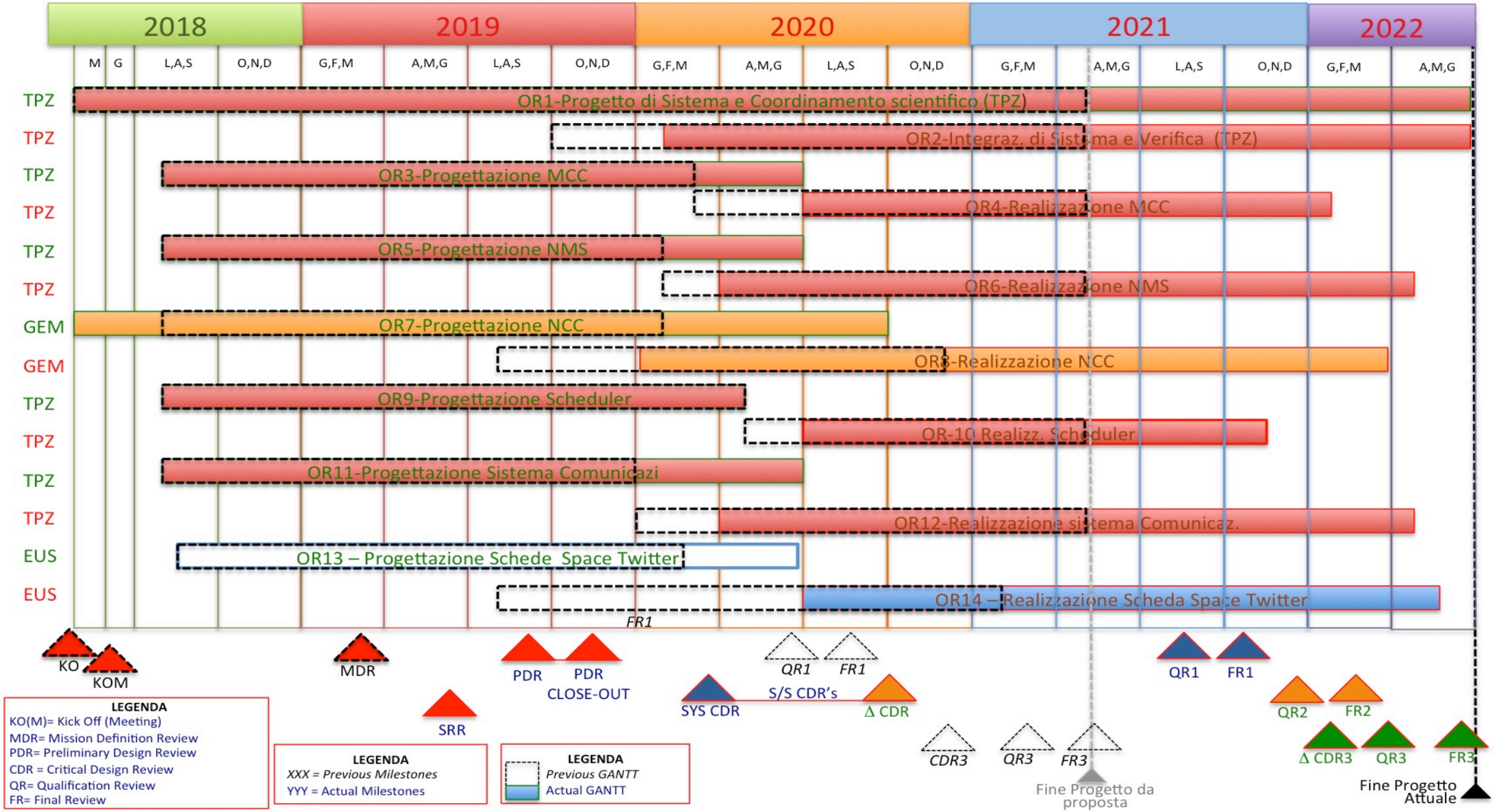
**OR-11 Communication layer design T-DGSN - Telespazio (RI)** Communication layer design (satellite stations, antennas, RF part, wiring, pointing, transceiver, S / S and I / F control for the DGSN network in collaboration with Univ . of Naples through NITEL)

**OR-12 Realization of the T-DGSN Communication layer - Telespazio (SS)** Realization of the test layer for the T-DGSN in collaboration with the University of Naples through NITEL)

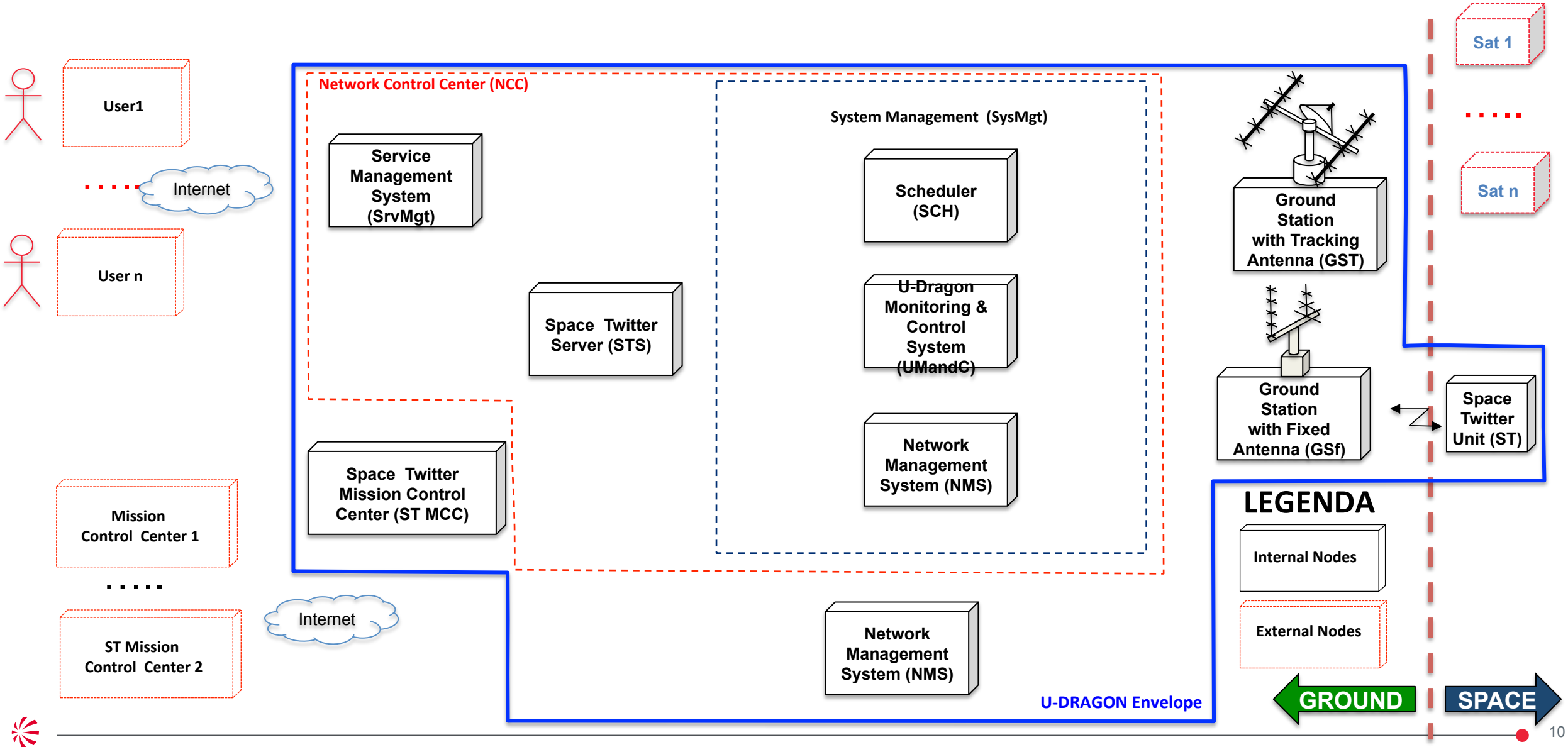
**OR-13 Flight component design (Space Twitter) - Euro.Soft (RI)** Space Twitter (ST) on-board unit design for a Cubesat to be used as a demonstrator

**OR-14 Realization of flight component (Space Twitter) - Euro.Soft (SS)** Realization of on-board unit ST

# U-DRAGON : Original and Final GANTT



# U-DRAGON: How it works - The Elements, or Nodes.



# How it works (2): Simplified Description of U-DRAGON Nodes (1/2)

| | |
|---|---|
| The "Shop Window"<br>**Service Mng System** | The **Service Management System represents the access portal for U-DRAGON Users.** Through its Web interfaces, the user enters the information necessary for access and use of the system by providing satellite data, communication, level of service requested and manages the User Requests |
| The "Brain"<br>**Scheduler** | The **Scheduler** based on **optimization algorithms**, called **"Classist & Democratic",** processes the temporary assignment of the Ground Stations (G-S) to the satellites preparing **the Contact Lists** (list of possible passages), the **Preliminary & Final Assignment Plan** with the assignment of G-S to the satellite |
| The "Executor"<br>**U-DRAGON Monitor. & Control** | The **U-DRAGON Monitoring & Control executes the Assignment Plan** configuring Ground Stations, the Network Protocol Manager and the Network Management System. The UMandC is also performing the function of monitoring the nodes with the related subsystems. |
| The "Orchestrator"<br>**Network Manag. System** | The **Network Management System** is used **to manage the connections between all the various nodes by creating secure connections** for the exchange of data and monitoring the traffic between them for verification and accounting. |
| "Our Workhorse"<br>**Network Protocol Manager** | The **Network Protocol Manager transfers the Telemetry from each Ground Station to its Mission Control Centers (MCC)**, while the **Commands are transferred in the opposite direction,** providing protocol conversion in real time if requested |

# How it works (2): Simplified Description of U-DRAGON Nodes (2/2)

| | |
|---|---|
| The U-Dragon "Cockpit"<br>**Mission Control Center (MCC)** | The **Mission Control Center is the Telemetry and Commanding S/W Suit**. It is used to Control the satellite it is possible to viewing, controlling and recording telemetry and generating commands. The COSMOS suite has been identified and customized to the specifications required by the various systems and satellites. |
| The "Small Gateway"<br>**Ground Station Fixed (SGF)** | **Fixed antenna Ground Stations will offer uplink and downlink capability on UHF-VHF bands**. They can serve standard receive-transmission services with microSat and cubesat. The fixed stations are equipped to offer the automatic communication service called Space Twitter |
| The "Large Gateway"<br>**Ground Station Tracking (GST)** | **Tracking Ground Stations managed through an Antenna Controller will offer uplink and downlink capability on UHF-VHF-S bands** and are equipped with S/W orbital propagation and antenna rotor which, through the reception of the TLE updated, ensure satellite tracking during the passage. |
| "Our Distinguished Guest"<br>**Space Twitter (ST)** | **Space Twitter is the on-board communication unit** able to independently establish a connection with ST GSF stations at low data rates. Some possible services have been identified that could be insured by this system. U-DRAGON plans to develop a flight unit made with COST components available for cubesat. |
| The "Butler"<br>**Space Twitter Server (STS)** | **Space Twitter Server is the Unit in charge to manage the Space Tweet (Short Message).** It is organized to receive the tweet, to open the message only to identify the user, to store the message in a shared area and to alert the User a message has been received and stored ready for collection or dispatched to him |

# U-DRAGON Status …..

- U-Dragon program has been concluded, passed the tests and it is operative

- Utilization of U-DRAGON has already been included in two “Demo” Missions:
  - 1) CORAL: ESA Program including a 2U cubesat for IoT ISL for TT&C Services
  - 2) RODIO: ASI Program including 4x cubesats cluster for bi-static SAR EO services

# ….Next Steps…..

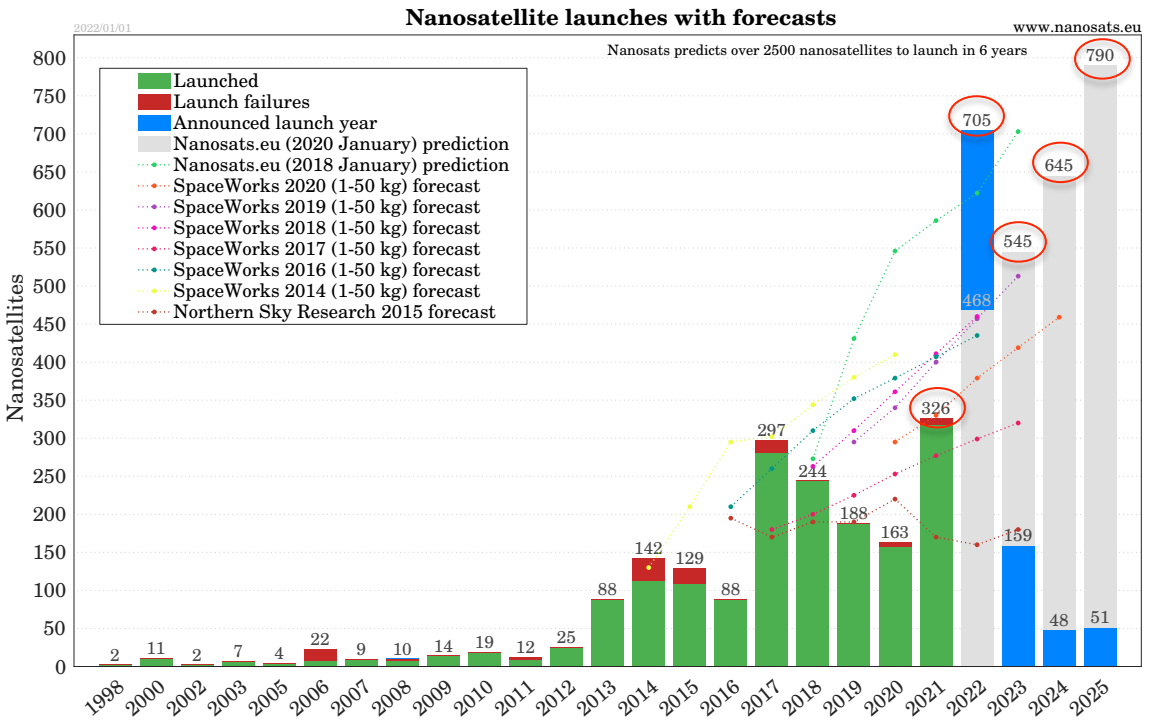
- Solicit inclusion of U-DRAGON in future other TPZ programs
- Re-location of Ground Stations to other TPZ sites
- Possible federation of other existing Ground Stations to U-DRAGON

# …. and Beyond

- The launches forecast for the next years for cubesats, micro-sats and nanosats is quite interesting

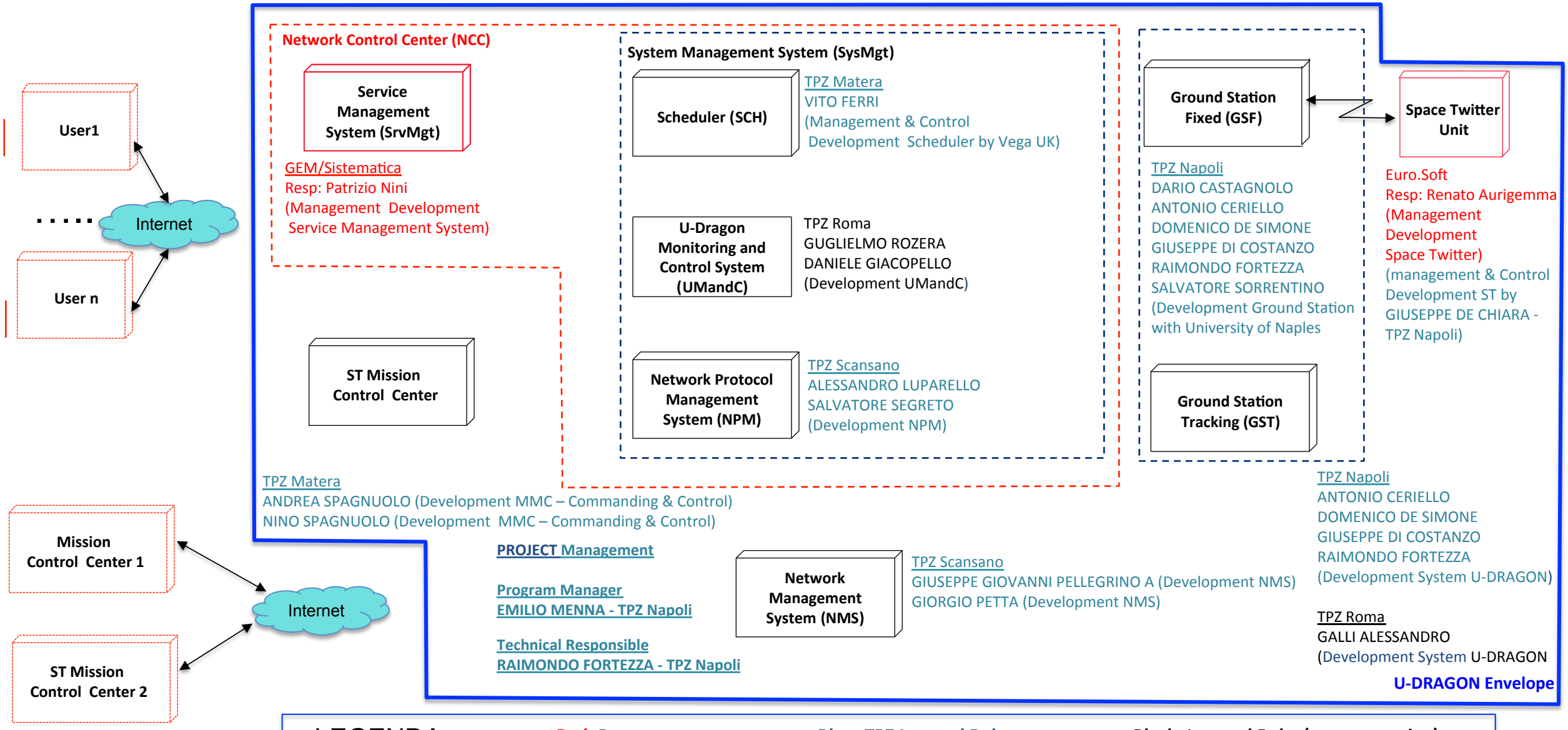
- Even though we expect to capture “1 digit” percent of these numbers, the number of customers served should be “2 digits” per year!!

- Once demonstrated U-Dragon is working as expe-cted with the planned Demo missions we could plan to extend U-Dragon to more mature development meaning:




- ✓ Add more Ground Stations (to reach, at least, a wide distribution at European level)
- ✓ Increase the performances of S/S
- ✓ Enhance the security aspects

# U-DRAGON: Team and Roles




LEGENDA — **Red:** Partners — Blue: TPZ Internal Role — Black: Internal Role (not accounting)