



TELESPAZIO & the Space Weather

ROLE, ACTIVITIES, EXPERTISE, STRATEGIES

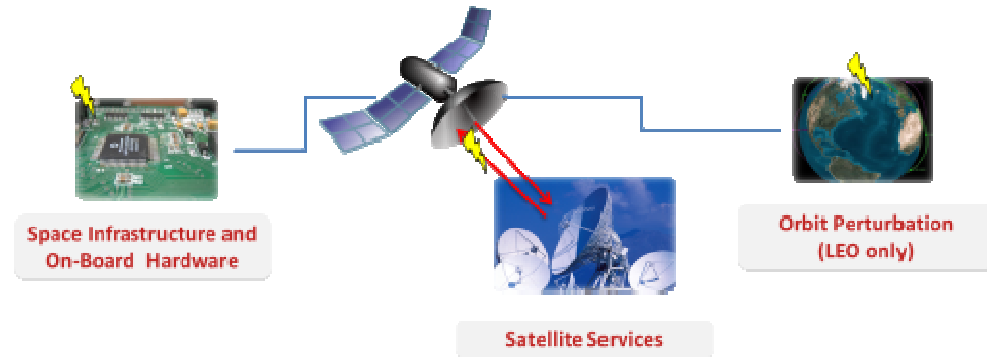
Washington - May 18th, 2017



- SWE impact on Space Infrastructures**
- Extreme Scenario: a Carrington event nowadays**
- Propagated impact of SWE on Ground Critical Infrastructures**
- Telespazio's involvement in SWE**
- Role and Background of Telespazio in SWE**
- Telespazio's Strategy in SWE**

Satellites can be differently exposed to SWE depending on their orbit →

- **LEO:** minor exposition due to Geomagnetic shielding /major exposition to atmospheric drag variation induced by Space Weather
- **MEO & GEO:** more intense exposition to Space Weather

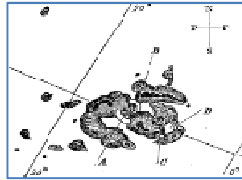
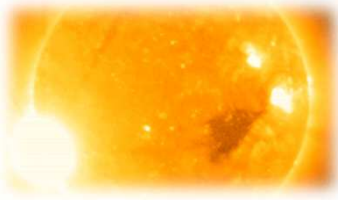


Impact on Satellite services are mainly related to Ionospheric interaction of Space Weather →

- **Impact on TLC:** High-Frequency Telecom systems (both satellites and ground) are very sensitive to Space Weather. A Minor event can cause a fair degradation of service and some occasional loss of radio contact. Severe and Extreme events can cause Telecommunications blackout and heavy loss of radio contact. Effects can last from a few seconds to several hours, according to the Event intensity.
- **Impact on GNSS:** GNSS systems are more robust than communication systems. In fact minor sun activities have no impact on GNSS signal, while severe events can cause minor disruption. An extreme event can cause positioning errors for several hours on the sunlit side of Earth, which may spread into the night side.

Impact of Space Weather on civil aviation activities, in particular concerning polar routes

Carrington event – 1859: September 1st, 1859: Richard Carrington observed a large flare, which caused a major Coronal Mass Ejection (CME) to travel directly toward Earth, reaching it in 17.6 hours.



Sunspots sketched by Richard Carrington
Copyright: Royal Astronomical Society

Carrington nowadays?

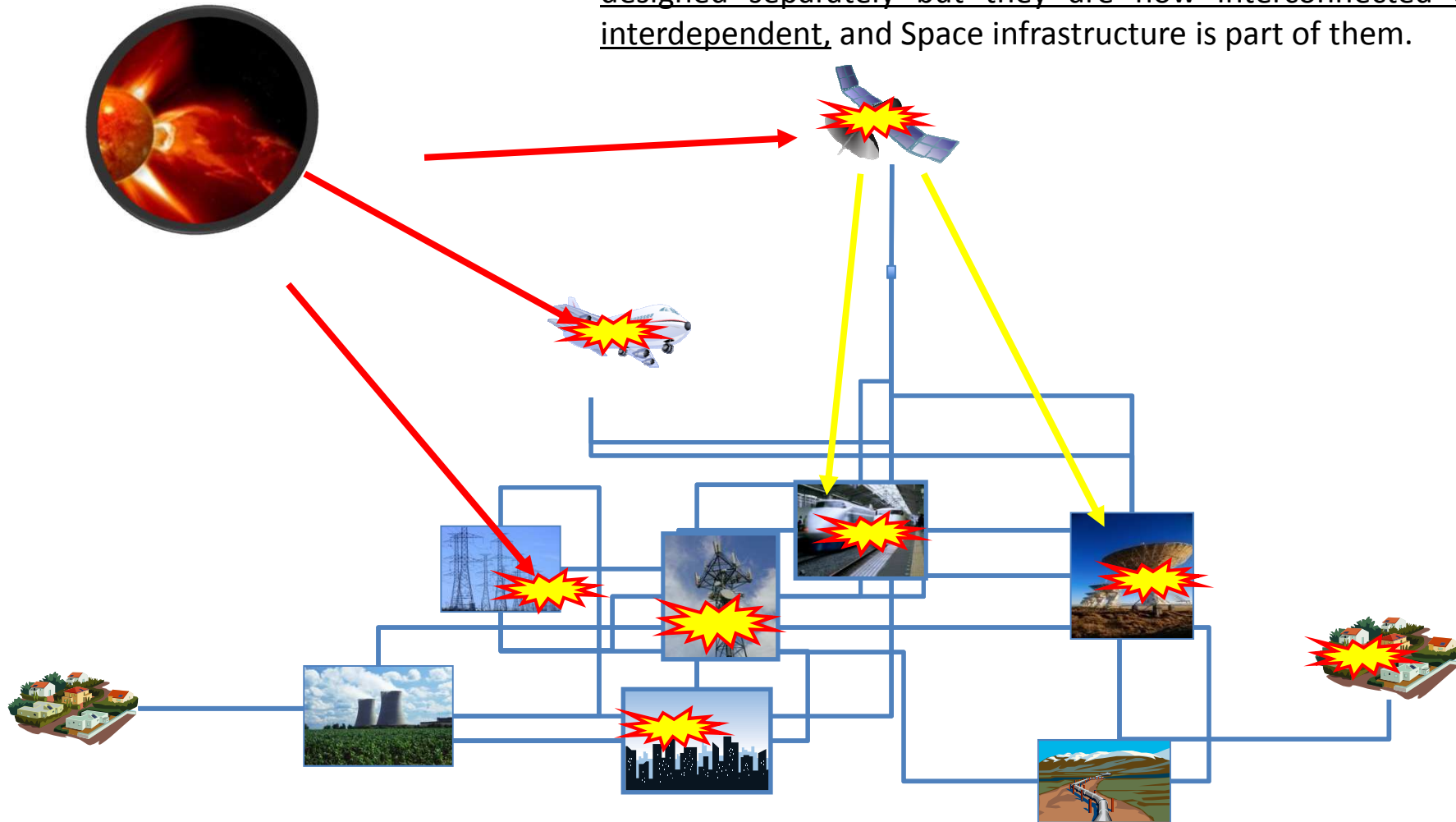
- 80 satellites (LEO, MEO, GEO) could be disabled as a consequence of a superstorm event.
- Possible failure of many of the GPS/GLONASS/Galileo satellite systems in MEO.
- Shorten de-orbit period of about 100 LEO satellites, from decades to about nine years, due to the temporarily increased atmospheric drag.

Potential economic loss

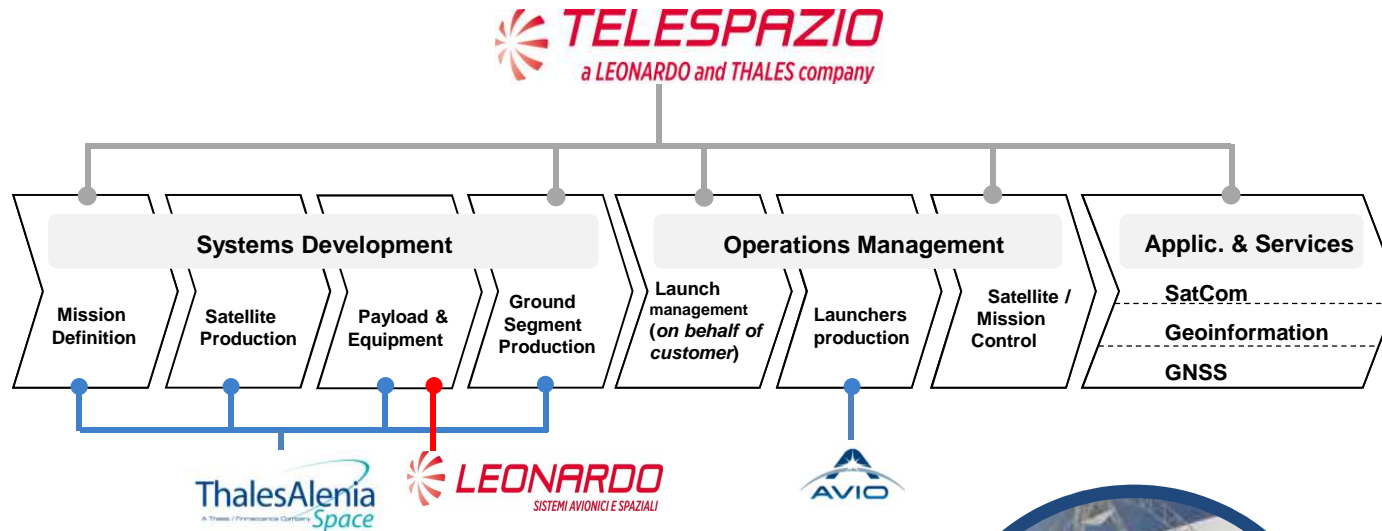
- **Total loss ~ \$70 billion**
 - lost revenues (~\$45 billion) and satellite replacement for GEO satellites (~\$25 billion)

(Sten F. Odenwald and James L. Green, Space Weather (2007) 5: 1-16.)

All Critical Infrastructures, backbones of modern society, were designed separately but they are now interconnected and interdependent, and Space infrastructure is part of them.



Space Weather can impact on the whole super-system, not only for first level impacts but also for propagated impacts, triggering a dangerous **domino effect**.



TELESPAZIO
a LEONARDO and THALES company

- ✈ 67% Leonardo
- ✈ 33% Thales
- ✈ 2500 Employees
- ✈ Over 600 M€ revenues in 2016
- ✈ Geographical Footprint: Italy, France, Germany, Spain, UK, Brazil, Argentina, Rumania
- ✈ 4 Spaceports in Italy:
 - ✈ Fucino
 - ✈ Matera
 - ✈ Lario
 - ✈ Scanzano
- ✈ Spaceports in Rumania, Brazil, Argentina



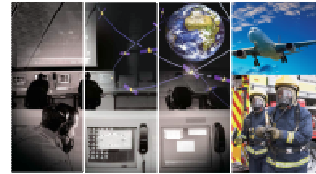
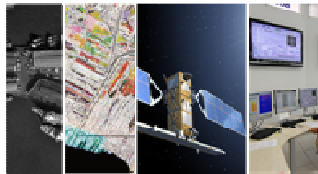
Thanks to its portfolio of assets, solutions and skills, Telespazio plays a key role in the main spatial programs, both national and international:

- Cosmo-SkyMed
- Optsat
- Copernicus

- Sicral
- MilSatcom
- GovSatCom

- Galileo
- EGNOS

- Exomars
- SSA



- TPZ manages large communication networks integrating both satellite and terrestrial solutions for commercial and military customers
- TPZ provides at global level geospatial services and applicative solutions
- TPZ performs leap and in orbit control activities for large third parties satellite constellations



Stakeholder, actor in space business, owning assets and operating space activities



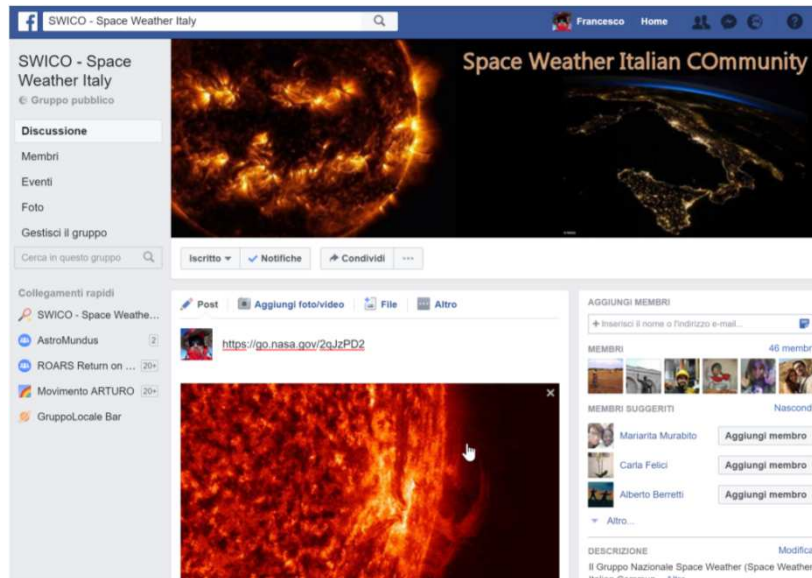
System designer, integrator and **services/solutions provider**

Telespazio is Industrial Partner for the Italian Space Weather Community (SWICo)

SWICo = Space Weather Italian Community

SWICo (www.swico.it) has over **110 members** from 15 different institutions (i.e.: CNR, INAF, INFN, INGV, Universities, Industries).

Multiple disciplinary approaches are essential in Space Weather science since the Sun-Space-Earth system is quite complex.



ESA Unclassified – For official use only

ESA/PB-SSA(2009)7 rev.4
Paris, 17 April 2015
(Original: English)

EUROPEAN SPACE AGENCY

SPACE SITUATIONAL AWARENESS PROGRAMME BOARD

List of national assets potentially available to the European SSA programme

Information Document

Summary

The following table lists national assets potentially available for the European SSA programme, as provided by participating Member States.

This issue reflects the status as of March 2015. It incorporates– revisions or new information provided by: Austria, Denmark, Finland, Germany, Italy and Romania.

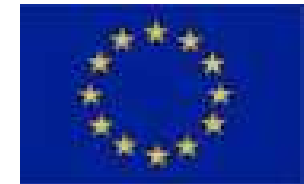
It also includes a list of the ESA-owned assets that could be used in the framework of the SSA Programme.

This list will be updated annually.

SWICo updated the list of Italian assets in 2015. Around 80 assets are listed, including:

- Models
- Neutron Monitor/SEP
- Solar telescopes
- Database and archives
- Laboratories
- Ionospheric instruments
- Magnetospheric network
- Radars
- Etc.

- **SPARC - Space Awareness for Critical Infrastructures.** EC-CIPS (Critical Infrastructures Protection and Security) project - completed in 2014 - Telespazio Prime (~ 0,6 M€)
 - ✓ Analyze space phenomena, like **Space Weather**, Space Debris and Near Earth Object, as threats for Critical Infrastructures and identify, classify and quantify possible space hazards.
 - ✓ Analyze their **impact directly** on Space Infrastructures, and indirectly, through satellite **failures propagating** at ground level.
 - ✓ Share good practice to prevent or mitigate failures incoming from space threats and possible **guidelines** to improve these practices, contributing to build a **network of experts** from different fields for Critical Infrastructures Protection and Security.
 - ✓ Make hidden stakeholders aware of Space Threats and define Guidelines and Concepts for New Prevention and Mitigation Services
- **IPS - Ionospheric Prediction Service:** EC project – currently in progress - Telespazio Prime (~ 0,7 M€)
 - ✓ Design and develop a **platform (prototype)** able to translate the prediction and forecast of the ionosphere into a worldwide service customized for specific GNSS user communities.
 - ✓ Set up a **Ionospheric Prediction Service (IPS) prototype** to be eventually integrated with the European GNSS Service Center (GSC).
 - ✓ Propose schemes for **early warning** provision and **alert** dissemination (e.g. like NAGUs), reports, forecasts and modelling results through dedicated web interfaces and services to specific end user groups



Data are relevant and can be obtained from different kinds of **sources** (i.e. space or ground based sensors, forecasting models, reuse of existing sources). After their acquisition, data shall be handled, compared, processed and stored, in order produce information for alert systems and decision makers (**data fusion and analytics**).

A Data Collecting and Processing Centre (DCPC) is fundamental to properly obtain and route information according to the different end-user needs. Data processing, based on scientific **models and tools**, shall drive to **nowcasting and forecasting services**, in order to be prepared to face space weather events.

Therefore, in cooperation with Scientific Community and industrial partnership, **Telespazio's strategy** aims:

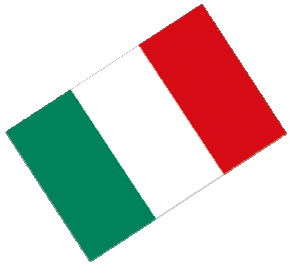
- To **build synergies** aiming to use the different national assets (ref. ESA/PB-SSA(2009)7 rev.4, 17 April 2015) involved in the field of the Space Weather, in order **"to do more with less"**
- To **develop user oriented Space Weather services**, able to represent the available assets and expertise and provide a concrete demonstration of their readiness level;
- To **trace a roadmap** for the programmatic and technological development and implementation of a future **Service Centre for Space Weather**, answering the operative needs.

Telespazio interests and expertise

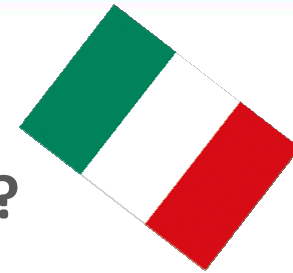
- Customers / End Users Requirement analysis
- System Requirement analysis
- Survey of existing assets
- System Architecture
- Networking
- Data Integration and Exploitation
- Service Center Design and development
- System management & Operations

Contribution from the scientific community

- Sensors
- Data
- Phenomenon Physical Modelling
- Models for Forecasting and Early Warning
- Potential Impact assessment
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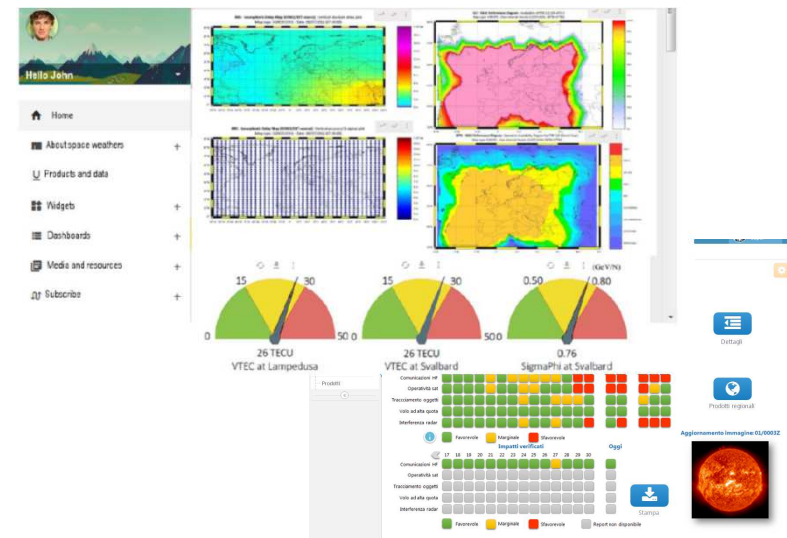
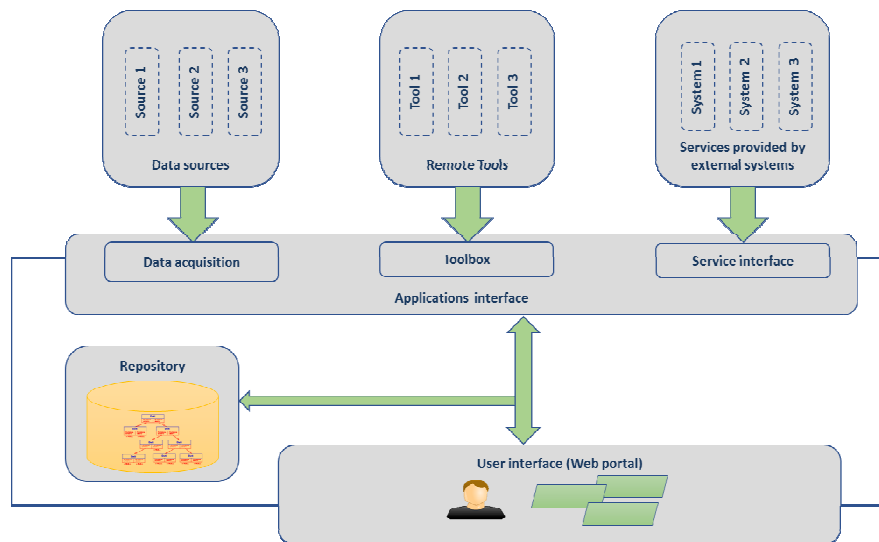


Therefore, what is Telespazio doing at national level ..?



Proposing its own concept of **architectural solution** for a **national service platform** collecting and integrating all the Italian Space Weather available assets (database, models, tools, existing services, etc., including IPS)

Contributing, in partnership with scientific community and SMEs, to the definition and development of **new space weather services** for both **civil** and **military needs** (i.e. observation and forecast bulletins for Space Weather)





... and what at European level ?



Telespazio, in partnership with scientific community and SMEs, is going to answer EU/ESA calls as additional way to reach the following targets:

- definition, development and validation of **SWE services**, also as service provider;
- design, development and validation of **systems for SWE data collection and exploitation**
- support the process of **SWE networking** also for the enhancement of SWE systems functionalities, applications and integration
- mission and architecture SWE systems **design**, including space and ground **sensors**.

THANK **YOU** FOR YOUR ATTENTION

