

# H2020 – EU **SATELLITE** NAVIGATION

## Upstream R&D activities

H2020 Programme Committee • Brussels, 16 January 2020

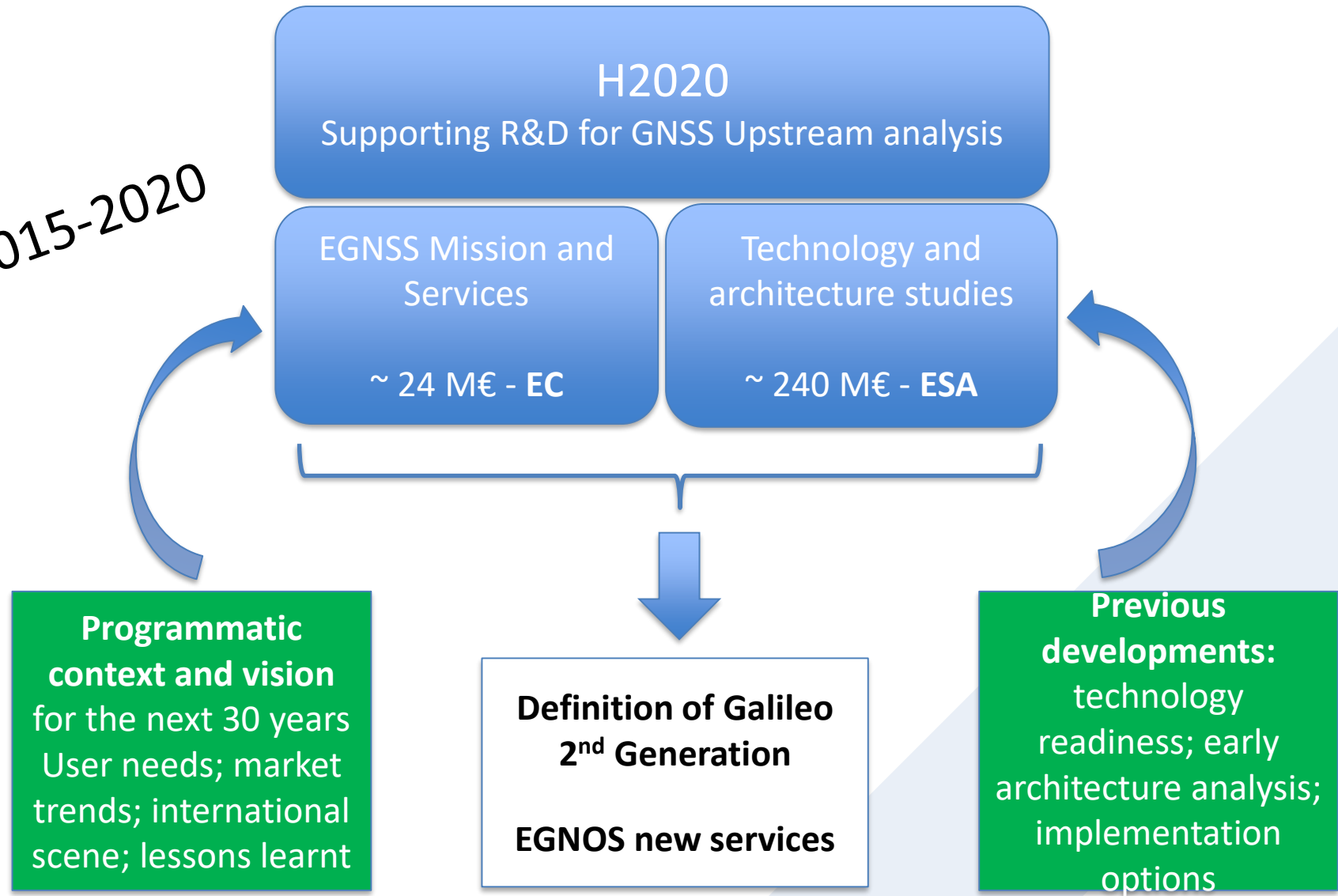
# H2020 EGNSS Upstream R&D

## Overview of achievements

- The study of the **evolution** of EGNSS at **mission** and **system** levels has been supported by a strong R&D programme under the **HORIZON 2020** envelope.
  - Assessment of viability for new mission concepts or new services
    - **direct management by EC**
  - Technology and architecture
    - **budget is delegated to ESA**
  - Specific R&D on applications and receiver technology is also conducted (GSA)

# H2020 EGNSS UPSTREAM STRUCTURE

2015-2020



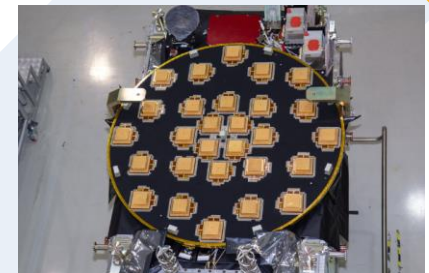
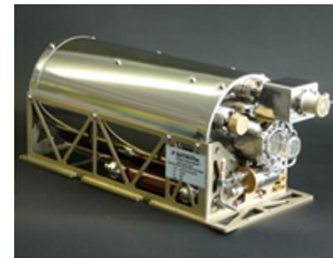
# MAIN EVOLUTIONS (1)

- **Service** evolutions include:
  - Robust **Timing** Services
  - **Space** Service Volume
  - **ARAIM** – coming back to serving SoL communities
  - **Emergency** Warning Services
  - **Search And Rescue** – Innovative service based on the return link
  - **Ionosphere** Prediction Capability
  - **Signals** Evolution – increased performance at user level (TTFF, accuracy, authentication, etc)
  - **EDAS** service evolution
  - **EGNOS** Aviation service evolution
  - **SBAS** authentication
  - **OS NMA/HAS** concept demonstrators



# MAIN EVOLUTIONS (2)

- **Technological** evolutions include:
- **Navigation Payload (Signal Generation Unit)**
  - New signals
  - Flexibility to accommodate rapidly evolving needs
  - Self-compensating capability (thermal variations, config changes)
- **Amplifiers**
  - More efficiency
- **Clocks**
  - More reliable
  - Technology diversity (PHM, Rubidium, Caesium + Clock Ensemble for robustness)
  - Less bulky
- **Antennas**
- As well as **ground stations equipment, ODTs, RFCS, EGNOS technology, EGNOS evolutions system engineering, etc**



- H2020 was used at mission and services and techno and infrastructure level to **bring to maturity the second generation of Galileo, develop technologies, and launch concept studies for EGNOS evolution.**
- Thanks to the efforts spent on H2020, the definition of G2G has come to maturity.
  - The new EU Space Programme regulation includes the new services for Galileo, as studied and consolidated in H2020.
  - G2G Mission is outlined and agreed.
  - Different architectures have been assessed, in Phase A/B types of activities.
  - Dedicated technologies required to meet G2G mission objectives have been studied (TRL).

# H2020 EGNSS Mission and Services

## State of play of individual actions



## Actions launched under 2015 Work Programme

6 Completed, 1 Terminated

H2020 MAS Projects 2015	Participants	Duration	Budget	Status
Timing Services	<b>Netherlands Aerospace Laboratory (NLR)</b> , Finnish Geospatial Research Institute (FGI), Netherlands Metrology Institute (VSL), Finnish Metrology Institute (VTT), NavCert (DE)	18 months	599K €	Completed
Ionosphere Prediction Service	<b>Telespazio (IT)</b> , Nottingham Scientific Limited (NSL), Telespazio Vega, Universita Tor Vergata, Istituto Nazionale di Geofisica e Vulcanologia (IT), Nottingham University (UK)	24 months + 12 months	670K €	Completed
Signals Evolution	<b>Airbus (DE)</b> , ENAC (FR), Istituto Superiore Mario Boella (IT)	24 months	600K €	Completed
EGNOS Authentication	<b>Qascom (IT)</b> , GMV (ES), Universita Padova (IT)	12 months	300K €	Completed
Galileo Regional Service	<b>GMV (ES)</b> , Airbus (DE), Nottingham Scientific Limited (UK), Valdani Vicari & Associati Srl (VVA)(IT)	21 months	690K €	Completed
ARAIM Demonstrator	<b>EGIS Avia (FR)</b> , Airbus (FR), Direction des Services de la Navegation Aerienne (FR), Imperial College of London (UK), Illinois Institute of Technology (USA)	21 months	-	Project Terminated at 54% completion. Continuation JRC
CS Enhancements	<b>GMV (ES)</b> , CGI (UK), Qascom (IT), IFEN (DE)	18+6 months (ext. till Sept-2019)	999K €	Completed

## Actions launched under 2016 Work Programme

5 Completed, 1 Terminated

H2020 MAS Projects 2016	Project Participants	Duration	Budget	Status
EGNOS Maritime Safety Service (SEASOLAS)	<b>GMV (ES)</b> , Valdani Vicari & Associati Srl (VVA), Kongsberg (NO), ESSP, General Lighthouse Authority (UK)	18 months	311K €	Completed
EGNOS EDAS Service Evolution	<b>VVA (IT)</b> , Deimos (ES)	9 months	170K €	Completed
PRS Service Evolution	<b>FDC(FR)</b> , Qinetiq (UK)	12 months	-	Terminated
Emergency Warning Service definition	<b>Thales (FR)</b> , Telespazio (FR), IES Solutions (IT), STMicroelectronics (IT)	22 months	950K €	Completed
Galileo Space Service Volume	<b>Thales (IT)</b> , Thales (FR), SpaceTec (DE)	18 months	747K €	Completed
Search and Rescue Service Evolution	<b>Thales (FR)</b> , ELTA (FR)	18 months	399 K €	Completed

## Actions launched under 2017 Work Programme

3 Completed, 3 on-going

H2020 MAS Projects 2017	Project Participants	Duration	Budget	Status
EGNOS High Accuracy Service	<b>GMV (ES)</b> , Alfa Consulting (IT)	18 months	322K €	Completed
Multipath model for Aviation	<b>DLR (DE)</b> , ADS (DE), Airbus SAS (FR), Rockwell Collins (UK), Thales Avionics (FR)	20 months	1.607K €	on-going
Evolution of SBAS Services for Aviation Safety	<b>Egis Avia (FR)</b> , Thales (FR), Helios (UK)	12 months	250K €	Completed
SBAS Authentication (follow on EGNOS Authentication)	<b>Qascom (IT)</b> , GMV (ES), Honeywell (UK), Stanford University (US)	15 months	483K €	on-going
Timing Services Extension and Consolidation (follow on Timing Services)	<b>GMV (ES)</b> , VVA(IT), ORB (BE), PTB (BE)	12 months	328K €	Completed
Signals Evolutions (follow on FUNTIMES)	Airbus (DE), ENAC (FR), IstitutoSuperiore Mario Boella(IT), UAB (ES), UniBW(DE)	24 months	600K €	on-going

## Actions launched under 2019 Work Programme

3 procurements published  
(+3 more under preparation)

H2020 MAS Projects 2019	Project Participants	Duration	Budget	Status
R&D on EGNOS Service for Payment/Liability Critical Applications on Road sector				Deadline submission 31/01
R&D on EGNSS Services for U-Space (drones)				Contract signed
EGNSS-Based Rail Safety Services				Deadline submission 28/02

## Actions launched under 2020 Work Programme

A budget of 2M€ has been earmarked for service evolution type of activities on EGNOS and Galileo

# H2020 HSNAV

## State of play of individual actions

# H2020 – HSNAV status (1)

## Actions launched under 2015 Work Programme (1/3)

H2020 ID	Activity subject	Status	Prime	Country	Initial Budget
<b>H2020-ESA-001</b>	Enhanced Passive Hydrogen Maser (PHM)	On Going	Leonardo/Gillam	IT/BE	5 M€
<b>H2020-ESA-002</b>	Robust RAFS and On-Board Clock Ensemble (RRAFS/ONCLE)	On Going	Orolia	CH	4 M€
<b>H2020-ESA-003</b>	Self-Compensating Device	On Going	RUAG	SE	2 M€
<b>H2020-ESA-004</b>	S-Band Advanced Transponder	On Going	TAS-E/TESAT	ES/DE	2,5 M€
<b>H2020-ESA-005</b>	C-Band Advanced Transponder	Action cancelled			
<b>H2020-ESA-006</b>	Attitude Control Sensors	On Going	Leonardo	IT	1 M€
<b>H2020-ESA-007</b>	Multipactor Prediction Techniques for GNSS Signals	On Going	VAL Space	ES	1 M€

## Actions launched under 2015 Work Programme (2/3)

H2020 ID	Activity Subject	Status	Prime	Country	Initial Budget
<b>H2020-ESA-008</b>	G2G Test User Receiver Technologies	On Going	GMV TASI	ES IT	7 M€
<b>H2020-ESA-009</b>	High Power Amplifiers Technology	On Going	TTI	ES	2 M€
<b>H2020-ESA-010</b>	High Power RF Passive Technology Framework	On Going	WO1:Sener Tryo WO2:TESAT	ESP/DE	250 M€ 450 M€
<b>H2020-ESA-011</b>	Flexible Payload and Signal Generation Technology Framework	On Going	TAS-I	IT	3 M€
<b>H2020-ESA-012</b>	Navigation Antenna Technology (partial and new)	Action cancelled			
<b>H2020-ESA-013</b>	Inter-Satellite Links Technology	On Going	TAS-E/ADS	ES/DE	2,1 M€
<b>H2020-ESA-014</b>	Electric Propulsion EPS Qualification for G2G	Action cancelled			
<b>H2020-ESA-015</b>	GNSS Ground Reference Station Transversal Technologies Framework	On Going	Indra	ES	0,4 M€

## Actions launched under 2015 Work Programme (3/3)

H2020 ID	Activity	Status	Prime	Country	Initial Budget
<b>H2020-ESA-016</b>	EGNOS Test User Receiver Technologies	On Going	TAS-I	IT	1,85 M€
<b>H2020-ESA-017</b>	On Board Cesium Clock Technology	Action cancelled			
<b>H2020-ESA-018</b>	GNSS ODTS Algorithm Technology	On Going	Deimos and GMV	ES	0,75 M€
<b>H2020-ESA-019</b>	EGNOS signal distortion technology	On Going	ADS	DE	0,5 M€
<b>H2020-ESA-039</b>	Advanced CMCU EQM	On Going	ADS/ TAS-E	DE/ES	5 M€
<b>H2020-ESA-040</b>	G2G Test User Receiver Breadboard	On Going procurement	-	-	4,5 M€



## Actions launched under 2016 Work Programme

H2020 ID	Activity subject	Status	Prime	Country	Initial Budget
<b>H2020-ESA-020</b>	GNSS Evolutions System Phase B1 Framework	On Going	ADS TAS-I TCS	DE IT FR	14,7 M€
<b>H2020-ESA-021</b>	GNSS Evolutions Space Segment Phase B1	On Going	ADS TAS-I OHF	DE IT DE	2,7 M€
<b>H2020-ESA-022</b>	GNSS Evolutions Ground Segment Phase B1	On Going	TASF ADS CGI GMV	FR DE UK ES	15 M€
<b>H2020-ESA-023</b>	GNSS Evolutions Phase B System Tools Framework	Action cancelled			

## Actions launched under 2017 Work Programme (1/2)

H2020 ID	Activity subject	Status	Prime	Country	Initial Budget
<b>H2020-ESA-024</b>	S-Band Advanced Transponder EQM	On Going procurement (CCN to 004)	TAS-E/TESAT	ES/DE	2,8 M€
<b>H2020-ESA-025</b>	High Power Amplifiers	Action cancelled			
<b>H2020-ESA-011</b>	Flexible Payload and Signal Generation Technology Framework	Action cancelled			
<b>H2020-ESA-012</b>	Navigation Antenna Technology Framework	Action cancelled			
<b>H2020-ESA-026</b>	Inter-Satellite Link EQM	On Going Procurement	-		5,67M€ <sup>18</sup>
<b>H2020-ESA-027</b>	C-Band Advanced Receiver EM	On-hold (Activity may be taken over by Transition Programme)	-		1,5 M€
<b>H2020-ESA-028</b>	S-Band Advanced Ground Modem	On Going	INDRA		1,499M€
<b>H2020-ESA-029</b>	G2G Satellite and Payload Test Bed	On Going Procurement	-		7,46 M€
<b>H2020-ESA-030</b>	G2G End to End System Modelling Tool & Experimentation	On Going Procurement	-		1 M€

## Actions launched under 2017 Work Programme (2/2)

H2020 ID	Activity subject	Status	Prime	Country	Budget
<b>H2020-ESA-031</b>	Advanced ODTS Algorithms Test Platform & Experimentation	On Going Procurement	-		1,42 M€
<b>H2020-ESA-032</b>	G2G Constellation Mission Analysis Tool (G2-CMAT)	In preparation	-		1,14 M€
<b>H2020-ESA-033</b>	G2G RF Constellation Simulator (RFCS)	On Going Procurement	-		4,5 M€
<b>H2020-ESA-034</b>	GNSS Evolutions System Exploratory Capabilitie	Action cancelled			
<b>H2020-ESA-035</b>	Assessment of system improvements aligned to new EGNOS Mission needs	On Going Procurement	-		1 M€
<b>H2020-ESA-036</b>	Feasibility analysis of ARAIM ISM generation by EGNOS	On Going Procurement	-		1,42 M€
<b>H2020-ESA-037</b>	Evil Waveform and Ionospheric Characterization Monitoring Network	On Going	DLR		1,2 M€
<b>H2020-ESA-038</b>	GNSS Evolutions Science Activities and Experimental Payloads –Call for Ideas	On Going Procurement	-		3 M€

## Actions launched under 2018 Work Programme

H2020 ID	Activity subject	Status	Prime	Country	Budget
<b>H2020-ESA-020</b>	GNSS Evolutions System Engineering Phase B - contracts extension	On Going	ADS TAS-I TCS		11,277 M€
<b>H2020-ESA-022</b>	GNSS Evolutions Ground Segment System Engineering Phase B activities	On Going	TAS F ADS CGI GMV		11,88 M€

## Actions launched under 2019 Work Programme

H2020 ID	Activity subject	Status	Prime	Country	Budget
H2020-ESA-020	GNSS Evolutions System Phase Bo/B1 Framework	Not Started	-		6,88 M€
H2020-ESA-041	Multi-purpose on-board digital generative processor including SAR evolution	Not Started	-		1,42 M€
H2020-ESA-042	GNSS Satellite Laser Ranging Station	Not Started	-		2,36 M€
H2020-ESA-015	GNSS Ground Reference Station Transversal Technologies Framework	Not Started	-		1,42 M€
H2020-ESA-043	ULS advanced station	Not Started	-		1,7 M€
H2020-ESA-044	EGNOS Evolutions System Engineering Phase 0	Not Started	-		4,5 M€
H2020-ESA-045	EGNOS technology -NLES	Not Started	-		1,42 M€

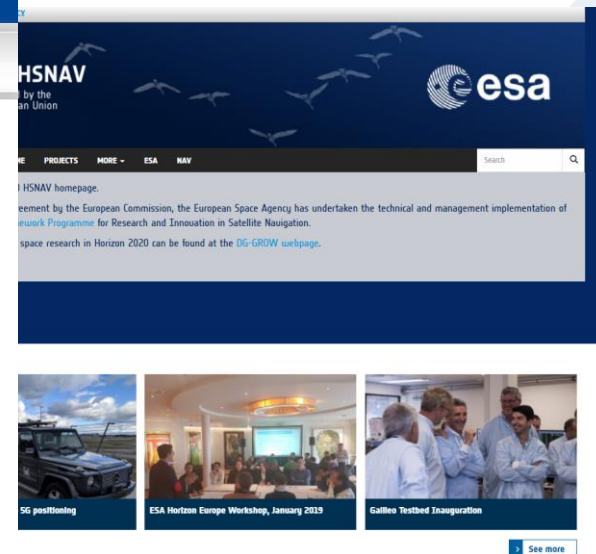
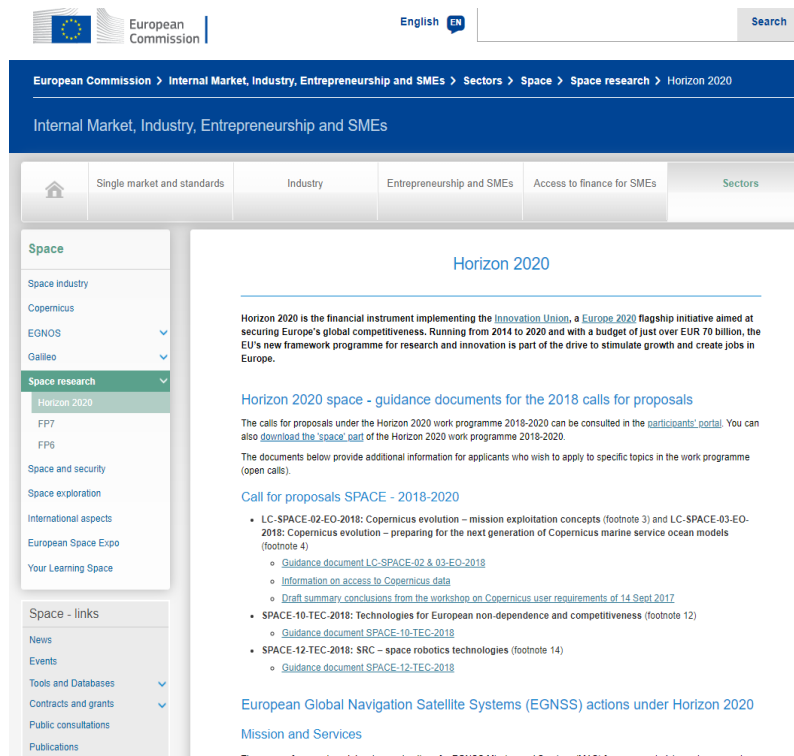
## Actions launched under 2020 Work Programme

Most of the remaining budget will focus on the completion of the on-going projects; potential for industrial action.

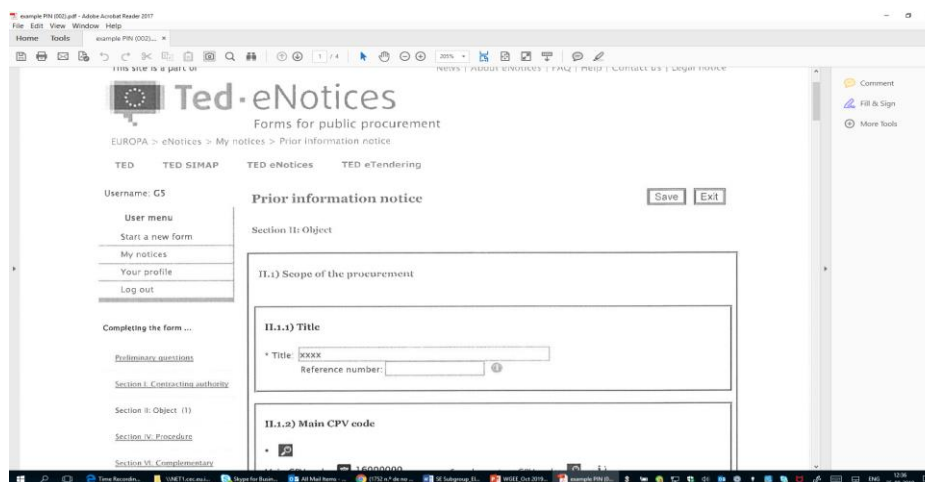
# Access to information

# H2020 – DISSEMINATION OF RESULTS

- Dedicated MAS workshop in 2018, featuring all closed projects.
- Dedicated HSNAP workshop in 2019 at ESTEC, showing achievements
- Continuous update of the H2020 Area under the DG GROW Webpage:
  - [http://ec.europa.eu/growth/sectors/space/research/horizon-2020\\_en](http://ec.europa.eu/growth/sectors/space/research/horizon-2020_en)
- Area under the ESA portal links to projects outcomes and achievements
  - <https://h2020nav.esa.int/>



- **For EC projects:** Publication on TED
  - Advance notice for publication
  - Specific request by MS to be informed upfront
  - Existing procedure: Prior Information Notice (PIN), up to 2 months in advance of publication in the Official Journal.



The screenshot shows the 'Ted-eNotices' web application interface. The header includes the European Union flag and the text 'Ted-eNotices Forms for public procurement'. The breadcrumb trail is 'EUROPA > eNotices > My notices > Prior information notice'. The left sidebar contains a 'User menu' with options: 'Start a new form', 'My notices', 'Your profile', and 'Log out'. Below this is a 'Completing the form...' section with links for 'Preliminary questions', 'Section I: Contracting authority', 'Section II: Object (1)', 'Section IV: Procedures', and 'Section VI: Complementary'. The main content area is titled 'Prior information notice' and has 'Save' and 'Exit' buttons. It contains two sections: 'II.1) Scope of the procurement' and 'II.1.1) Title'. The 'II.1.1) Title' section has a 'Title' field with the placeholder 'xxxx' and a 'Reference number' field. Below this is 'II.1.2) Main CPV code' with a dropdown menu.

- **For projects delegated to ESA:** usual publication on EMITS
  - abstract published 2 weeks in advance of ITT publication



# THANK YOU

<http://ec.europa.eu/galileo>