



GALILEO IOV Position Results

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Navigation solutions powered by Europe

IOV Mission Objectives

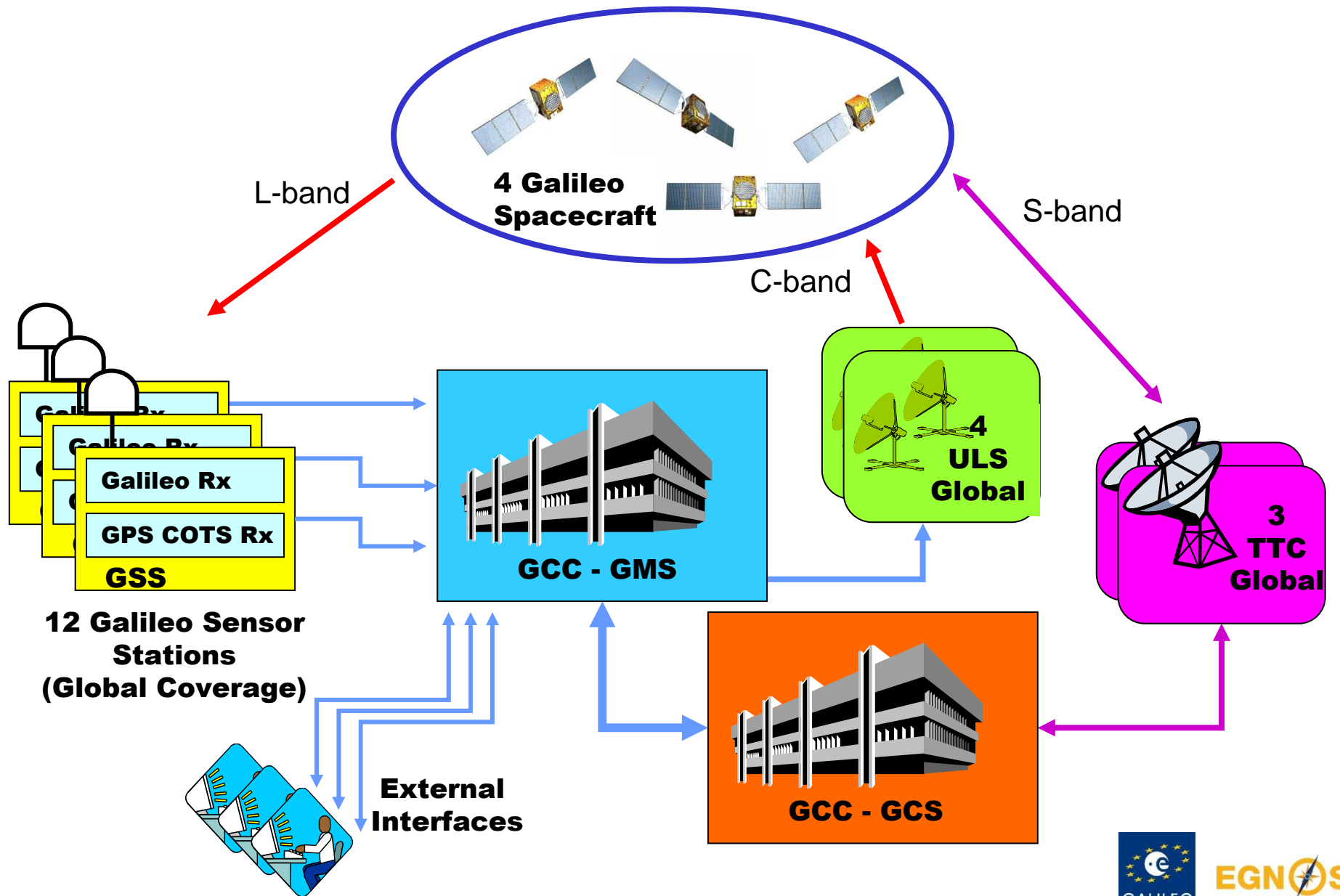
- ★ Verification before full System Deployment:
 - ★ Verification of Space, Ground and User components and Interfaces prior to full system deployment
 - ★ Navigation Processing & Message Dissemination Capabilities

★ Analysis of System Performance with the view to refine the FOC system

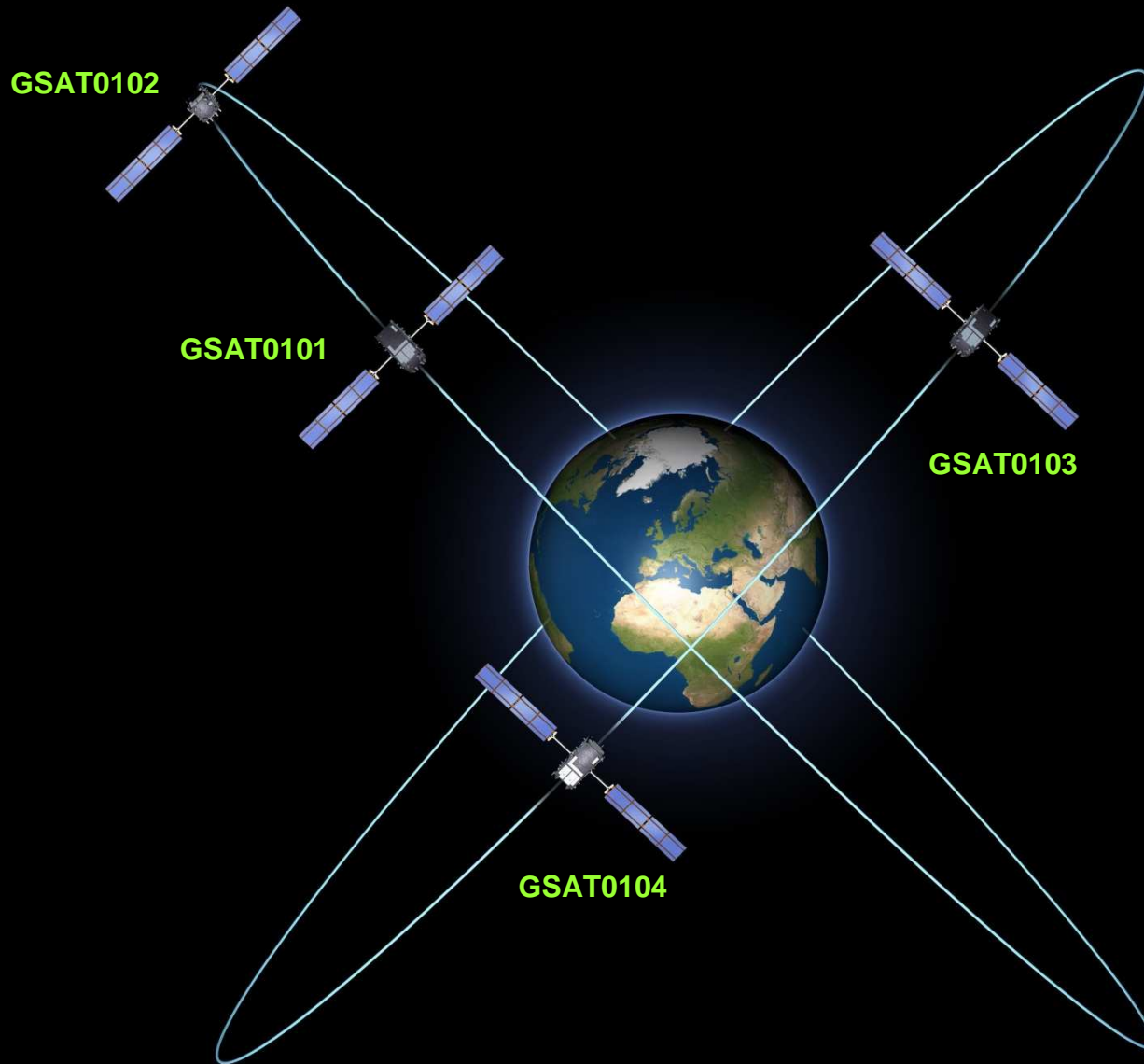
- ★ Signal in Space Ranging Error & User Equivalent Range Error budget
- ★ Verification of Operational Procedures



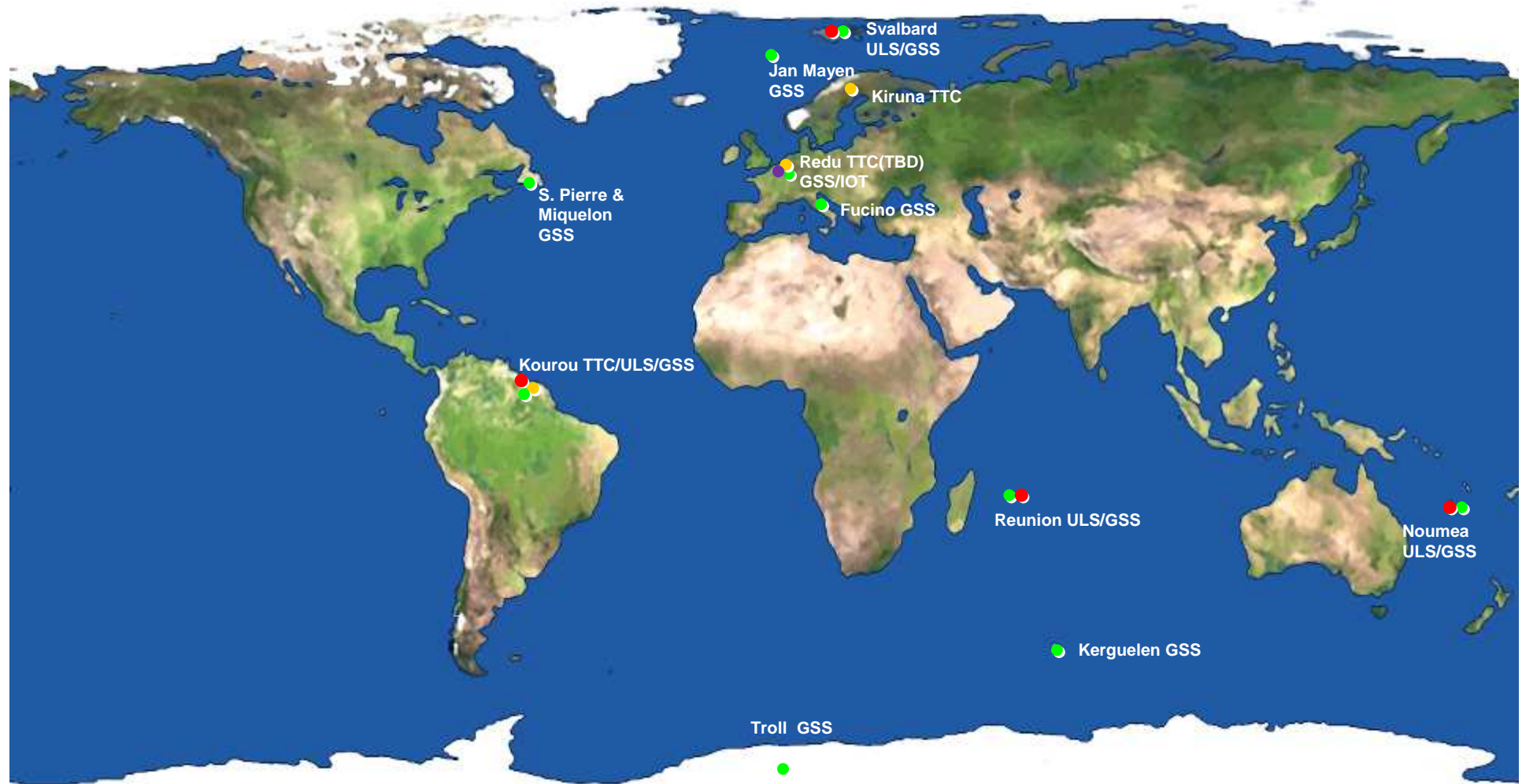
System Status: IOV Configuration



Galileo Space Segment for IOV



Galileo Ground Segment for IOV



- 12 GSS
- 4 ULS
- 3 TT&C
- 1 IOT



Galileo Ground Segment for IOV



**Fucino
GCC-I & GSS**



Kerguelen GSS



**Kourou
Launch Site**

ESCC ESOC



**Noumea
GSS/ULS/TTC**



Kiruna TTC

ESCC CNES



**Kourou
TTC-ULS**

**Oberpfaffenhofen
GCC-D**



SAT MANUFACTURER

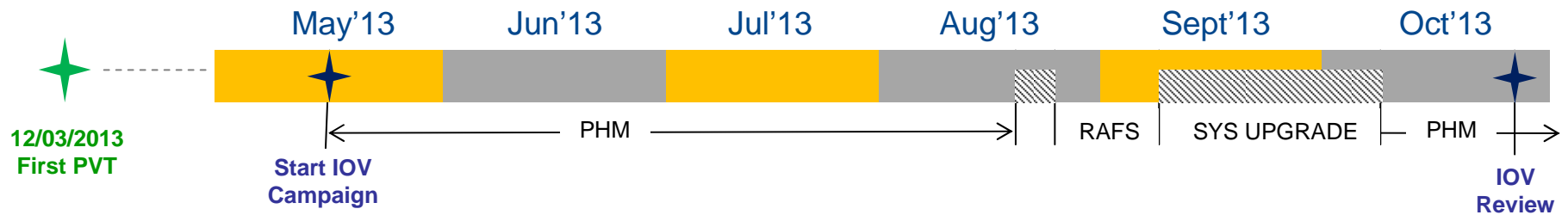


Redu IOT



IOV SCHEDULE

 PLANNED OUTAGE



Satellite	Availability* SIS (%)	Availability* Navigation Message (%)
GSAT0101	100	100
GSAT0102	100	100
GSAT0103	100	100
GSAT0104	86.3**	78.8**

* Period: 14/05/2013 to 31/07/2013

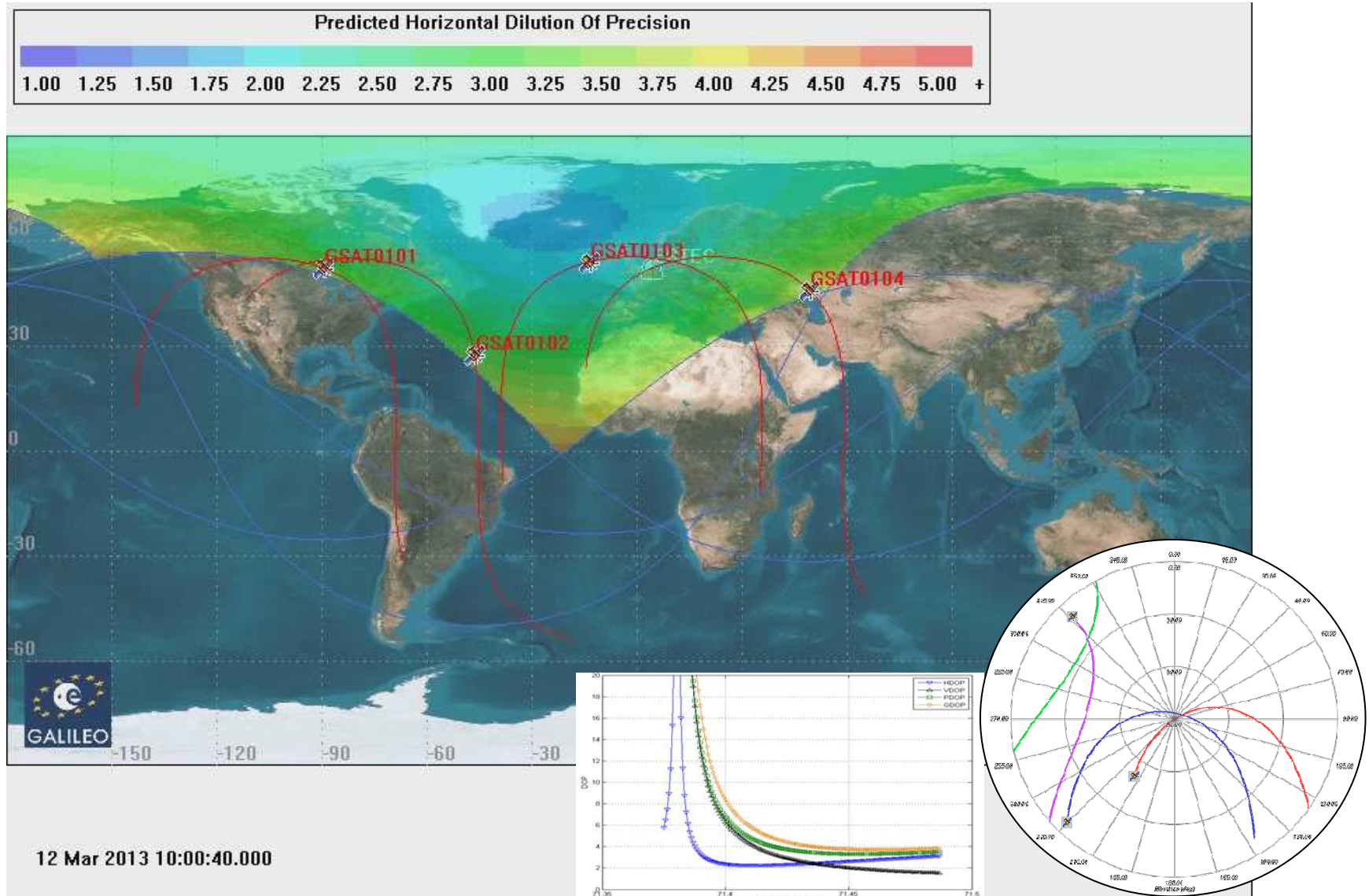
** Outage on 14/06/13. Resumed signal broadcast 26/06/2013, navigation message on 01/07/13



POSITIONING PERFORMANCE

1st Position Fix

12/03/2013 10:00 -11:00 UTC



Accuracy of 1st Position Fix at ESTEC

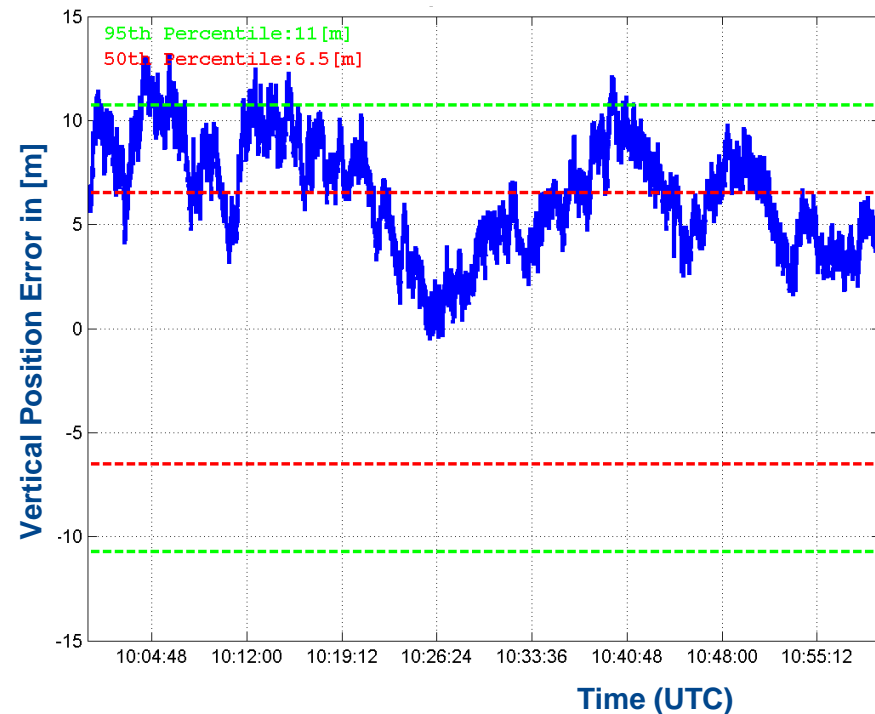
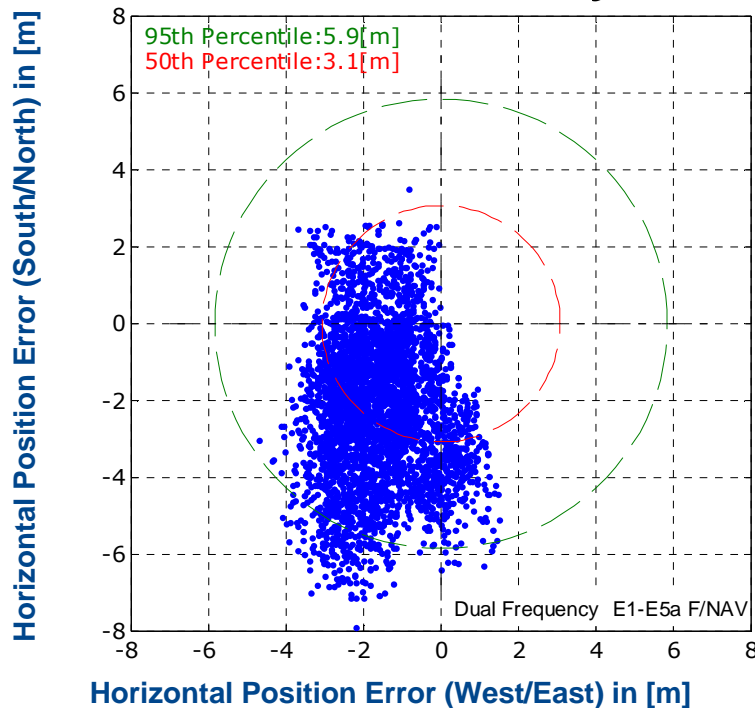
Standalone Galileo Position Solution

E1/E5a Dual Frequency Receiver

12th March 2013 10:00 – 11:00 UTC

Horizontal Accuracy: 5.9 m (95th Percentile)

Vertical Accuracy: 11 m (95th Percentile)



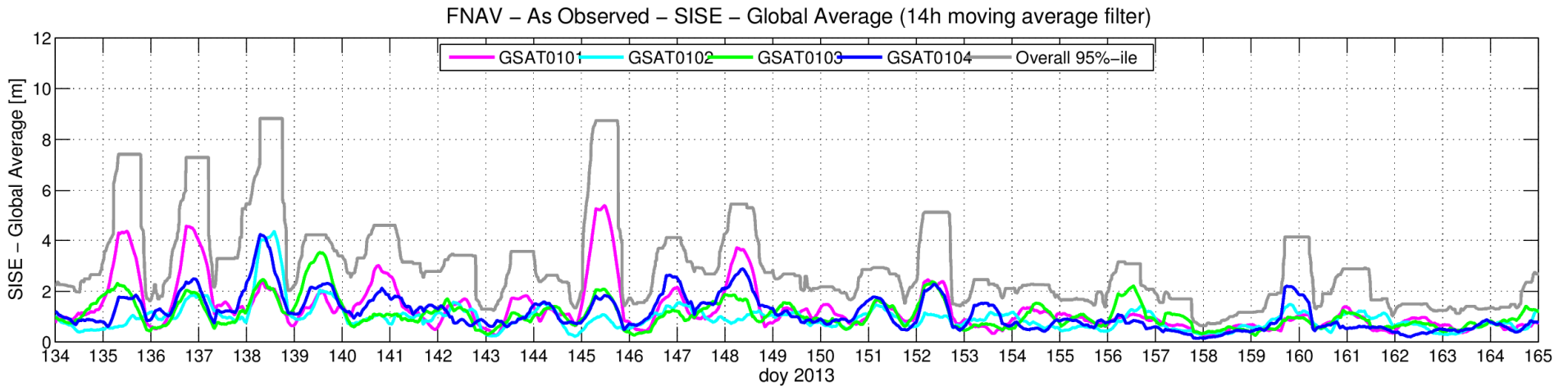
Position Fix established with Test User Receivers in real-time
and with TGVF Reference Receivers off-line.



Visibility of Satellites to Support PVT

	Number Satellites	Availability of 1 satellite visible worldwide (expected)	Availability of 1 satellite visible worldwide (measured)	Availability of PDOP < 5 (Expected)	No. PVT windows over 10 days	Average window duration (min)	Maximum window duration (min)
IOV	4	67 %	65.3 %	5.5 %	9	88.3	152.1
	6	96%	-	9.6%	18	77	152.1
	8	100%	-	15.5%	32	67.6	152.3
	10	100%	-	32.2%	53	87.5	324.1
	14	100%	-	72.3%	90	115.7	383.3
	26	100%	-	100%	1	14400	14400

SIS Ranging Error (Period 14/05/13 – 14/06/13)



Parameter	Case	Unit	IOV Value	FOC1 Target
ODTS E1-E5a	GSAT0101 (67%)	m	1.26	< 0.65
BGD Accuracy E1-E5a	All satellites (95%)	m	0.32	< 0.5
Maximum Age of Broadcast Message	GSAT0101 (Average)	min	35.1	< 100
Ionospheric Error Correction Performance (single frequency users)	Average all stations	%	98.19	> 68



PVT Performance



Parameter	Case	Unit	IOV Value	FOC1 Target
Availability of PDOP < 5	Average	%	4.56	> 99.5
	Worst	%	1.27	> 99.5
HDOP (when PDOP <=5)	Average	-	3.65	<= 1.35
	Worst	-	4.46	<= 1.54
VDOP (when PDOP <=5)	Average	-	3.65	<= 2.31
	Worst	-	4.64	<= 2.6
E1 Horizontal accuracy (95% confidence level, PDOP <=5)	Average	m	19.4	< 16
	Worst	m	45	< 16
E1 Vertical accuracy (95% confidence level, PDOP <=5)	Average	m	22.0	< 38
	Worst	m	34.2	< 38
E5 Horizontal accuracy (95% confidence level, PDOP <=5)	Average	m	32.9	< 30
	Worst	m	77.5	< 30
E5 Horizontal accuracy (95% confidence level, PDOP <=5)	Average	m	37.4	< 55
	Worst	m	58.4	< 55
Dual Frequency Horizontal accuracy (95% confidence level, PDOP <=5)	Average	m	8.5	< 4
	Worst	m	18.4	< 4
Dual frequency Vertical accuracy (95% confidence level, PDOP <=5)	Average	m	9.7	< 8
	Worst	m	14.2	< 8

Conclusions

- ★ The first position fix with Galileo was obtained on the 12 March 2013.
- ★ The in-Orbit Validation Campaign of Galileo was initiated in May 2013 and will be completed in October 2014
- ★ Almost 1 window of about 2 hours each day during which PVT calculation based on Galileo-only is possible
- ★ IOV results are very satisfactory:
 - ★ Ranging error < 3 m
 - ★ Horizontal, Vertical positioning error < 10 m
- ★ Availability and performance will increase as space and ground segment are completed
- ★ The preparation for Early Services has started