



Message Types for Offline H-ARAIM and V-ARAIM

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**EU-U.S. Cooperation on Satellite Navigation,
Working Group-C on Next Generation GNSS**

ARAIM Outreach Event

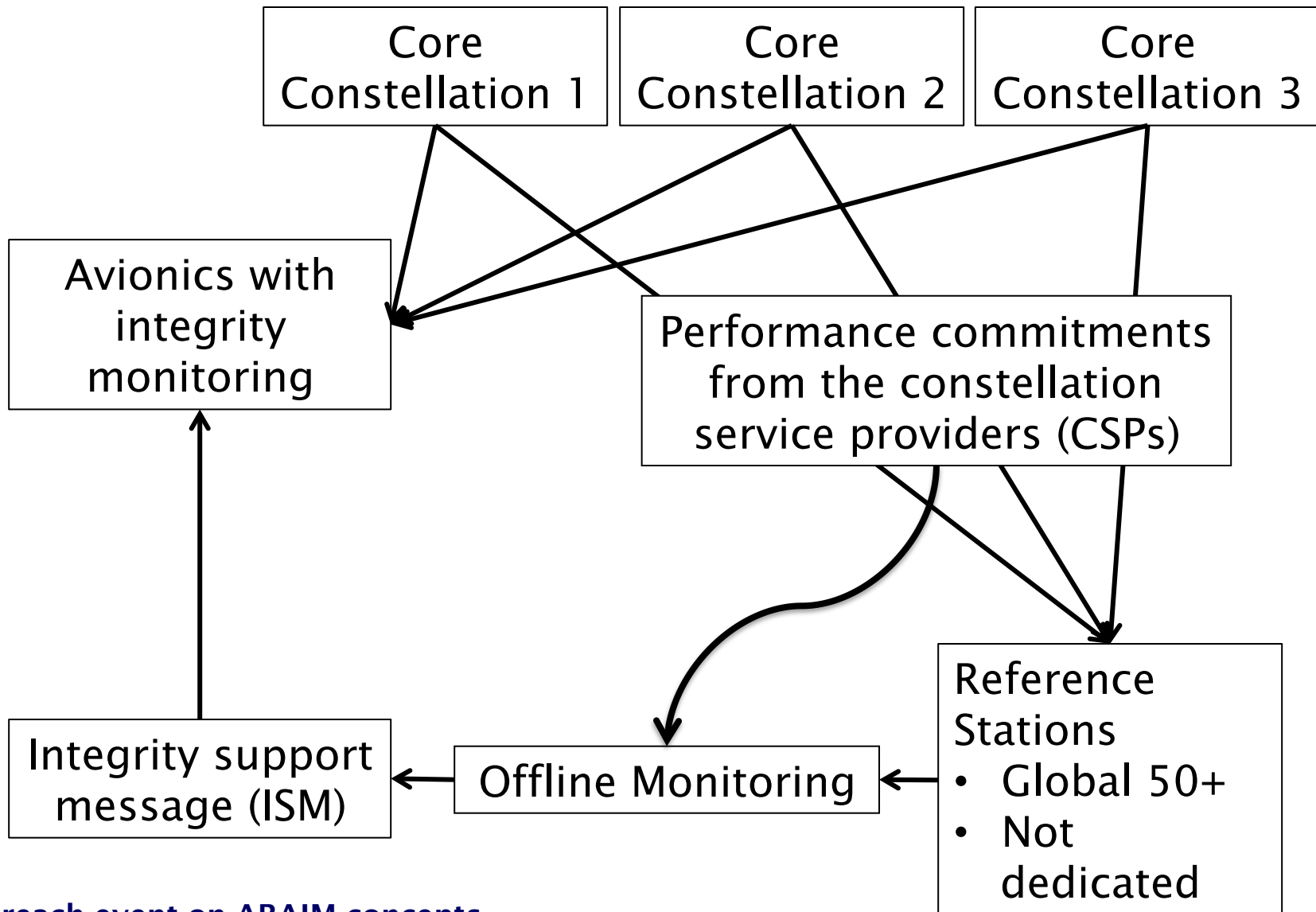
Toulouse

7 April 2017

Outreach event on ARAIM concepts



Offline ARAIM





Integrity Parameters

- To be sent in Integrity Support Message (ISM)
 - P_{sat} : probability that an individual satellite is faulted
 - P_{const} : probability that two or more satellites are faulted within a constellation due to the same root cause
 - URA: 1-sigma SIS ranging confidence parameter for satellite
 - or α_{URA} to scale the broadcast URA value
 - URE: 1-sigma SIS ranging accuracy parameter for satellite
 - or α_{URE} to scale the broadcast URA value
 - b_{nom} : upper bound on the ranging bias for each satellite
- Values to be decided/validated by ANSP
 - Must be suited to operation
 - More stringent operations require greater confidence
 - Values transmitted are upper bounds not max. likelihood
 - Simpler operations may use weaker bounds that are easier to verify and more easily agreed upon



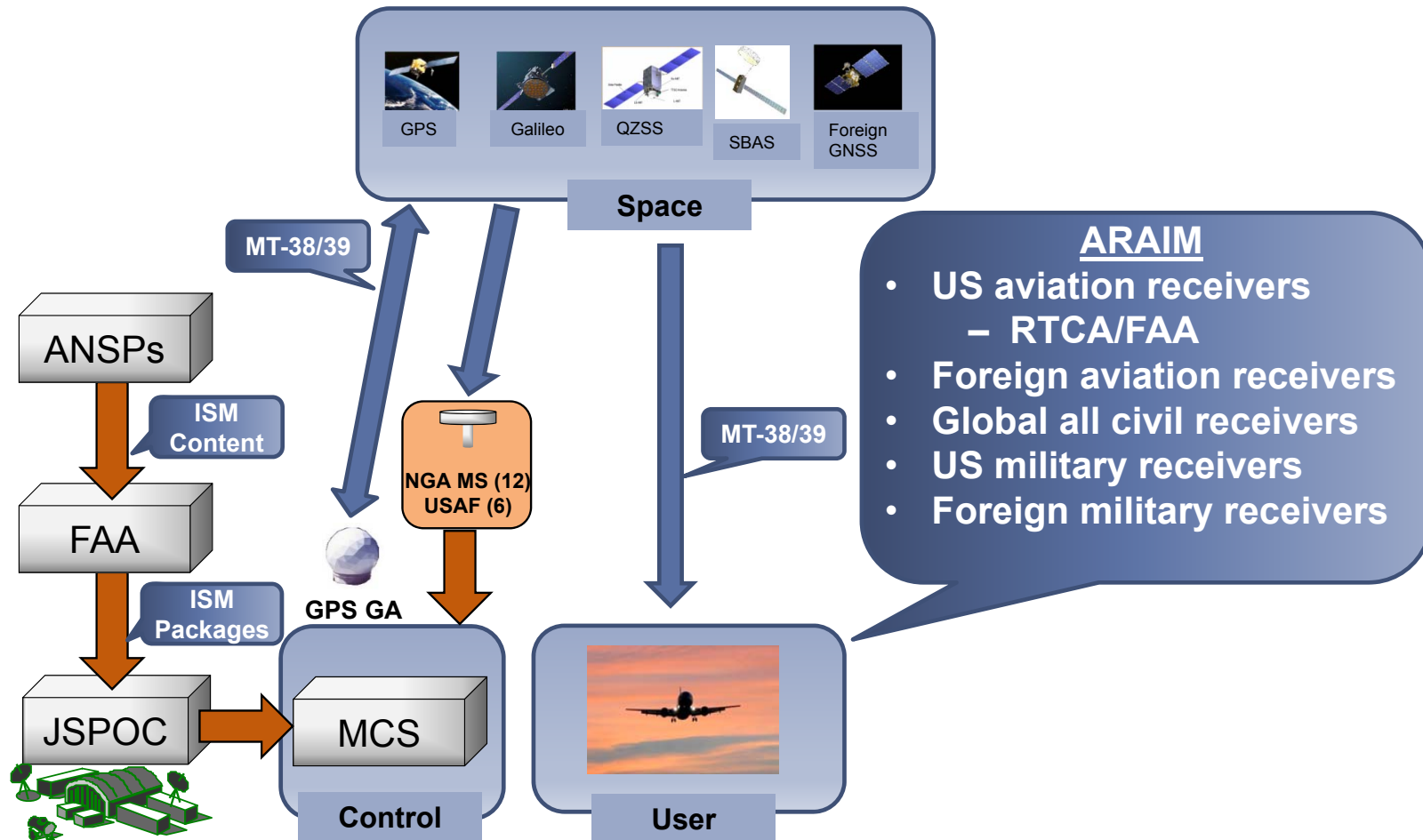
Example Offline Message

	Parameter	Description	Value	Size (bits)
Data Header	ISM_WN	ISM Week Number	[0, 1, ... 1023]	10
	ISM_TOW	ISM Time of Week (hours)	[0, 1, ... 167]	8
	ANSP ID	Service Provider Identification	[0, 1, ... 255]	8
	Criticality	Usable for Precise/Vertical?	[0, 1]	1
Total Header = 27 bits				
Per Constellation Parameters	$Mask_i$	32 bits indicating whether an SV is valid for ARAIM (1) or not (0)	$[m_1, m_2, \dots, m_{32}]$	32
	$P_{const,i}$	Probability of constellation fault at a given time	$[10^{-8}, 10^{-5}, 10^{-4}, 10^{-3}]$	2
	$P_{sat,j}$	Probability of satellite fault at a given time	$[10^{-6}, 10^{-5}, 10^{-4}, 10^{-3}]$	2
	$\alpha_{URA,j}$	Multiplier of the URA for integrity	[1, 1.25, 1.5, 2, 2.5, 3, 5, 10]	3
	$\alpha_{URE,j}$	Multiplier of the URA for continuity & accuracy	[0.25, 0.5, 0.75, 1, 1.25, 1.5, 2, 4]	3
	$b_{nom,j}$	Nominal bias term in meters	[0.0, 0.25, 0.5, 0.75, 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5, 3, 4, 5, 7.5, 10]	4
Total Core = 46 bits x 4 Constellations = 184 bits				



GPS CNAV MT-38/39

GPS MT-38/39 “Big Picture”





Proposed GPS CNAV MT-38

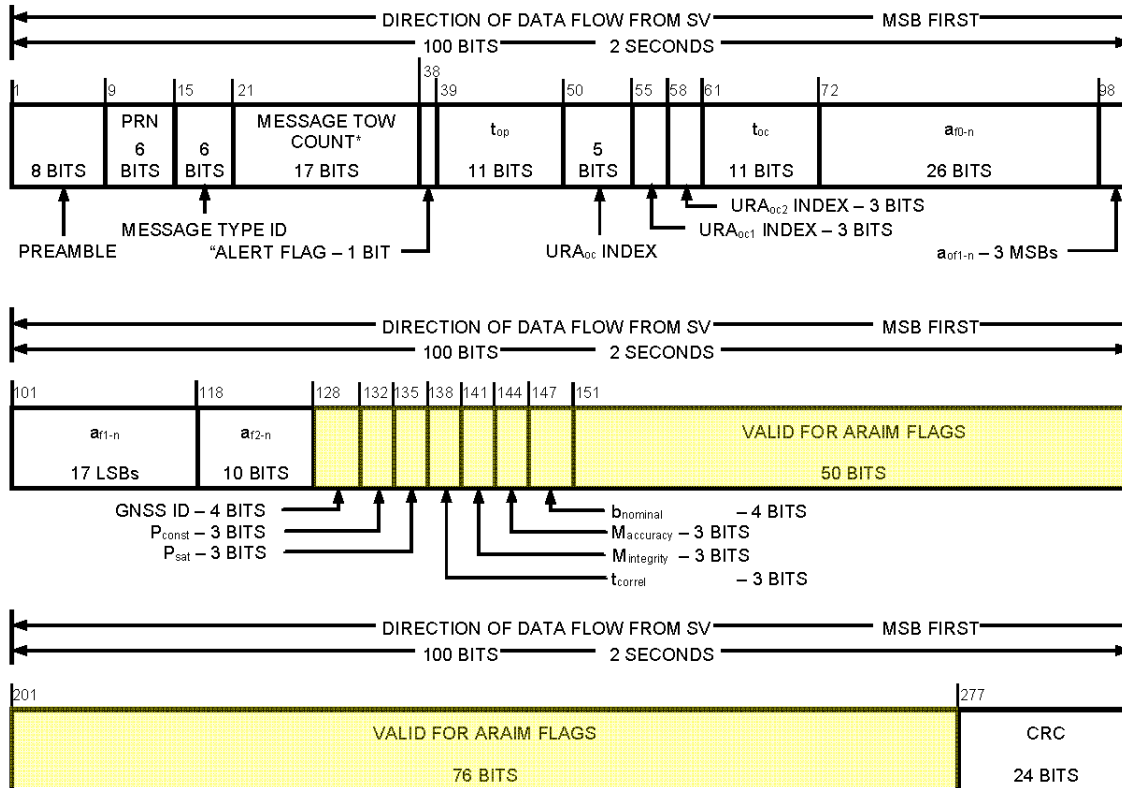


Table 20-XII. ISMP

Parameter		No. of Bits**
GNSS ID	GNSS Constellation ID	4
P_{const}	Probability of constellation integrity fault	3
P_{sat}	Probability of satellite integrity fault	3
t_{correl}	Correlation time constant	3
$M_{integrity}$	URA multiplier for integrity	3
$M_{accuracy}$	URA multiplier for accuracy	3
$b_{nominal}$	Nominal pseudorange bias	4
Flags	Valid for ARAIM flags	63 x (2)



Proposed GPS CNAV MT-39

Parameter		No. of Bits**
WN_{IVM}	Week No.	13
DN_{IVM}	Day No.	3
ANSP	Air Navigation Service Provider identifier	7
Validation Pattern	Validation pattern for the contemporaneous ISM	126

