



Outcomes of WG-B Special Meeting on “GNSS User Positioning Integrity”

ICG WG-B

Background



- WG-B called for a special meeting on “GNSS User Positioning Integrity” in line with decision taken at ICG-4
- WG-B convened on March 08, 2010 in Munich
- Good feedback on this initiative received, reflected in number of speakers and participants
 - 10 presentations representing public sector, industry and academia
 - 41 participants from EU, US, Russia and China
- This presentation is to summarize the findings of this special meeting

Agenda



**Special Meeting of ICG WG-B
“GNSS User Positioning Integrity”
08th March 2010, Munich
Room: “Einsäulensaal”
Residenz München**

Agenda

09:30	Registration	
10:00	Welcome and Introduction	R.Lucas, ESA
10:15	Challenges of Providing Integrity in Future GNSS	Igor Mozharov TSNIMASH
10:45	Wishes for interoperable GNSS Integrity Systems from a Users Point of View	H.Trautenberg, EADS Astrium
11:15	Interoperability for Liability Critical Applications	M.Azaola, GMV
11:45	<i>Break</i>	
12:00	Assessment of Combined Integrity Algorithms	C.Stoeber, UFAF
12:30	Multi constellation Regional System (MRS) - A step towards Multi constellation Interoperability	H.Delfour/D.Lekaim, THALES.ALENIASPACE
13:00-14:30	<i>Lunch Break</i>	
14:30-15:00	Multi-Constellation Augmentation Service System (MASS): Primary Results of Wide Area Real-Time Differential GPS Prototype System in China	Ass. Prof. H.Zhang, Wuhan University
15:00-15:30	Current Status and Future Development of Russian System of Differential Corrections and Monitoring	V. Kurshin, Russian Space Systems
15:30-16:00	Aviation Considerations for Dual Frequency and Multi-Constellation SBAS	Leo Eldredge, FAA
16:00-16:15	<i>Break</i>	

16:15-16:30	“Experimental Results of the Baseline Length Definition on Signals: GPS, GLONASS and GPX/GLONASS”	V.Tyubalin, IKOSP
16:30-17:00	“Primary Analysis of Multi-constellation Interoperability”	J. Tang, CNAGA
17:00-17:40	Discussion on Preliminary Conclusions of the Workshop	
17:40-18:00	General Discussion on WG-B Work Plan	
18:00	<i>End of the Workshop</i>	

Summary



- **H.Trautenberg, EADS ASTRIUM on “Wishes for interoperable GNSS integrity systems from a users point of view”**

Navigation

Interoperable GNSS Integrity Systems

- Commit on the quality of the individual signal!
- Commit on the monitoring quality of the individual signal!
- Use an overbounding that works also for
 - asymmetric,
 - biased and
 - multimodal distributions!
- Allow for explicit biases in the overbounding!
- Inform the user on the expected failure rate!
- Be transparent in your safety case!
- Be transparent and specific in your assertions!

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All the space you need

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The logo for EADS ASTRIUM, with 'EADS' in a bold sans-serif font and 'ASTRIUM' in a smaller font below it, with a stylized blue and orange graphic element.

Summary (cont'd)



- M.Azaola, GMV on “Interoperability for Liability Critical Applications (LCA)”

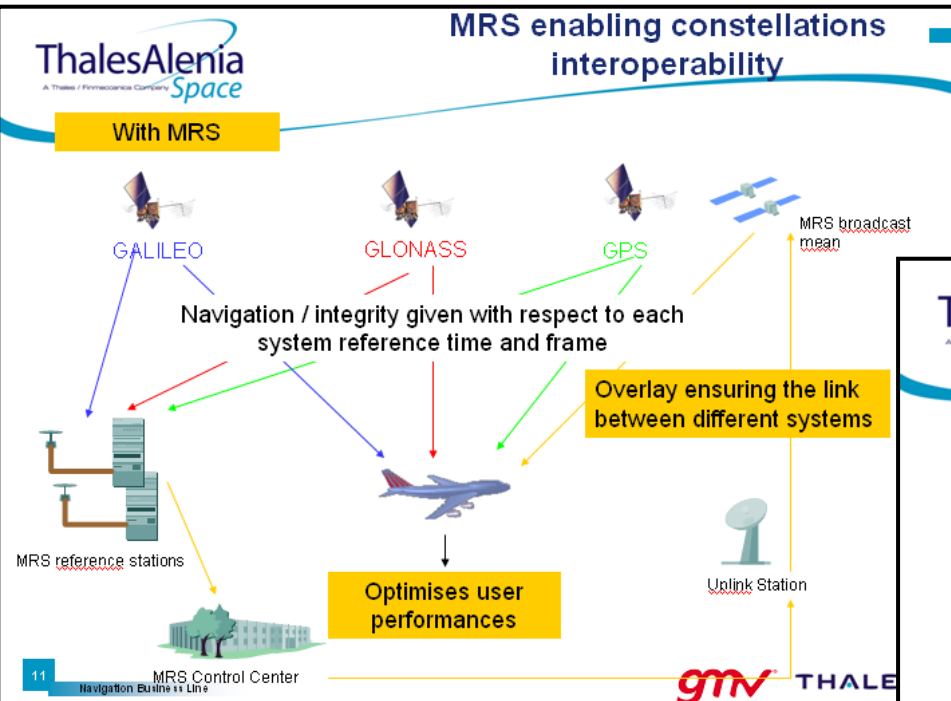
MAIN CONCLUSIONS

- LCA needs integrity
- Integrity in road applications faces challenges that in civil aviation can be disregarded (local effects)
- Mission segment-provided integrity is not enough due to local effects
- Hence, mission segment support to LCA cannot be oriented to error monitoring
- Different strategies analysed (MRA, ECA)
- The benefits of multiple constellations became clear in both cases

Summary (cont'd)



- H.Delfour, THALESALENIASPACE on “Multi constellation Regional System (MRS) concept as an evolution of the current SBAS concept”



Worldwide interoperability

ThalesAlenia Space

First stage (MRS system step 1, 2 & 3), based on existing SBAS “backbone”

- MRS concept (European SBAS) is regional but many SBAS exists around the world, that would allow provision of nearly worldwide service (see article ION ITM session B2 by Todd Walter), taking benefits of :
 - Bi-frequency
 - Addition of reference stations in the southern hemisphere
 - Multi-constellation
 - Multi-broadcast (e.g. allowing high latitudes coverage)
- User standards to evolve
- Uses existing satellite blocks in open service and taking benefit of growing constellations

Second stage, based on advanced integrity concepts like those studied in GEAS and existing ground infrastructure (e.g. MRS)

- Integrity burden to be re-allocated between User (RAIM), Space (e.g. on-board integrity monitoring) and Ground segments
- New User standards to be developed
- Could take benefit of future satellite blocks with integrity service (GPS III, ...)

17 Navigation Business Line

gmv THALES

Summary (cont'd)

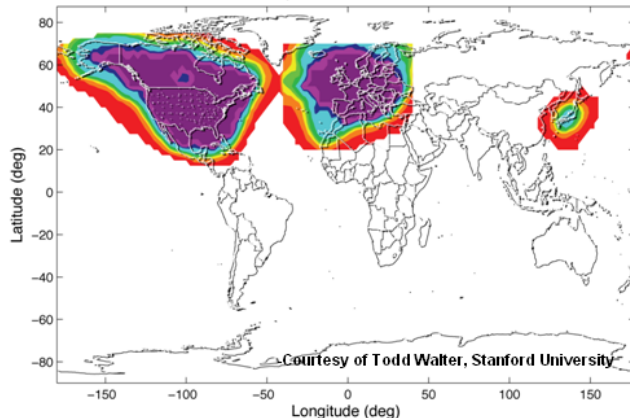


- L. Eldredge, FAA on “Aviation Considerations for Dual Frequency and Multi-Constellation SBAS”

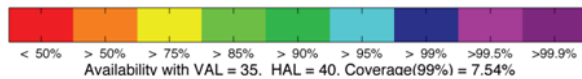
LPV-200 Coverage Estimated (Single Frequency GPS)

Availability as a function of user location

WAAS
EGNOS
MSAS



Courtesy of Todd Walter, Stanford University



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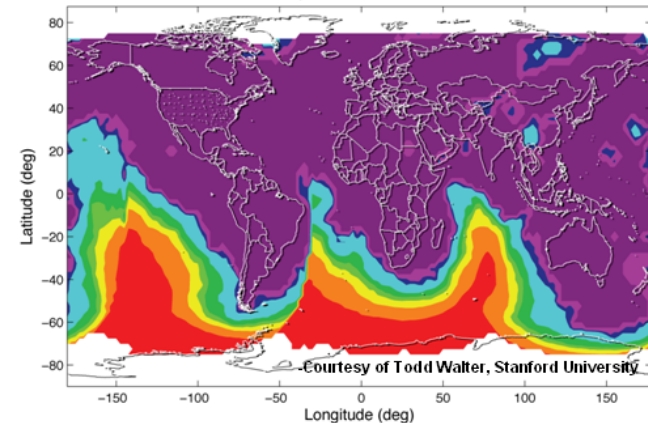


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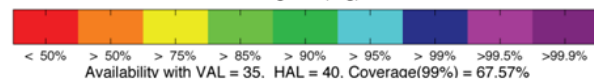
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WAAS, MSAS, EGNOS, GAGAN & SDCM (Dual Frequency GPS + Expanded Networks)

Availability as a function of user location



Courtesy of Todd Walter, Stanford University



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Summary (cont'd)

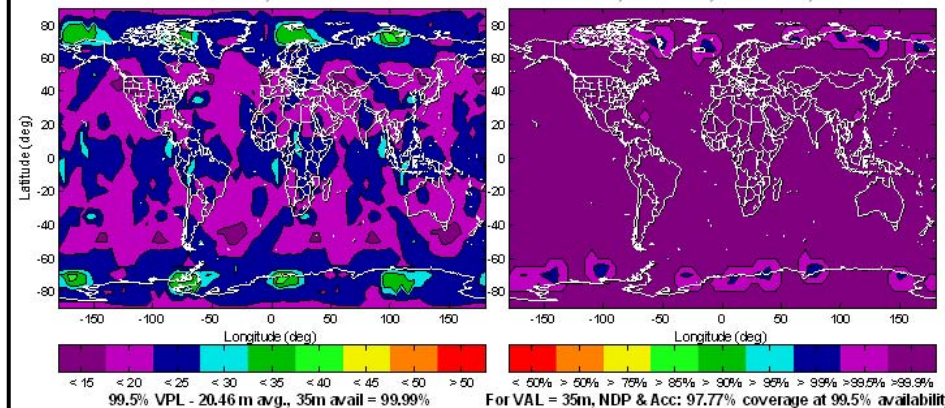


- L. Eldredge, FAA on “Aviation Considerations for Dual Frequency and Multi-Constellation SBAS”

ARAIM Results for 30 SVs & URA = .5 m

URA = 0.5m, Bias = 0.5m

URA = 0.5m, Bias = 0.5m, URE = 0.25m, rBias = 0.1m



ARAIM currently predicated upon a user update rate of ~1hour

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Conclusions

- Single frequency coverage is good within the countries fielding SBAS
- Dual frequency extends LPV coverage outside reference networks
- Expanding networks into southern hemisphere could allow global coverage of land masses
- ARAIM Potential for Multi-Constellation GNSS

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Conclusions of WG-B Special Meeting



- Worldwide Interoperability of PNT Integrity using combined constellations is one of the most important and urgent topics to be solved both on the technical as well as on the standardization side. GNSS interoperability will lead to higher availability, lower alarm limits and improved robustness of PNT integrity solutions.
- The solution should take into account the different user requirements and their particular environmental conditions (aviation, land, maritime).
- More discussions are needed in the different standardization bodies in order to achieve early user acceptance of proposed solutions.
- R&D efforts are necessary to develop integrity solutions for combined constellations as well as for the user side (Advanced RAIM, etc.) in order to consolidate the various roles of multi-regional SBAS, global GNSS integrity, and (A)RAIM.
- Transparency at service provider level is an important issue to reach optimum performance levels.

Way Forward



- Summary of special meeting of WG-B on “GNSS User Positioning Integrity” has been provided to all WG-B members for comments on 31 March 2010 by ICG Secretariat
- No comments received
- It is proposed to reflect conclusions of WG-B special Meeting in WG-B workplan as recommendations