High Precision, Low investment
EGNOS for aviation

- EGNOS for aviation: what, how?
- EGNOS and Galileo status in Europe
• Avg NPA in USA: 450ft; LPV: 200ft

• Benefits:
  – Reduction in DDC of 48%\(^1\)
  – Reduction of CFIT of 75%\(^2\)

  – Reduction in ground infrastructure cost

• Costs
  – Cost of a procedure = yearly ILS maintenance
  – Cost of receiver

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1. Eurocontrol estimate; DDC – Delays, diversions and cancellations; 2. Airlines/ANSP estimate; CFIT – Controlled flight into terrain
...close to €2,4 billion

1. L.E.K. cost benefit analysis, 2009
**EGNOS: comparable to ILS cat1**

even more than BaroVNAV¹

<table>
<thead>
<tr>
<th>Approach Type</th>
<th>CAT A</th>
<th>CAT B</th>
<th>CAT C</th>
<th>CAT D</th>
</tr>
</thead>
<tbody>
<tr>
<td>ILS CAT I</td>
<td>223</td>
<td>233</td>
<td>243</td>
<td>253</td>
</tr>
<tr>
<td>SBAS APVI</td>
<td>263</td>
<td>273</td>
<td>282</td>
<td>292</td>
</tr>
<tr>
<td>SBAS APVII</td>
<td>240</td>
<td>250</td>
<td>259</td>
<td>269</td>
</tr>
<tr>
<td>APV BaroVNAV</td>
<td></td>
<td></td>
<td>407</td>
<td></td>
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<tr>
<td>LNAV</td>
<td></td>
<td></td>
<td></td>
<td>437</td>
</tr>
</tbody>
</table>

1. RNAV Approach benefits analysis, Eurocontrol, 2009
APV SBAS = LPV = EGNOS = mandated by ICAO

The International Civil Aviation organisation (ICAO) calls for APV to be implemented on all instrument runways, by 2016 with intermediate milestones: 30 per cent by 2010, 70 per cent by 2014.

April 2009 industry declaration calling upon:
“All leaders of the civil aviation community, to fully support implementation of Performance Based Navigation (PBN) into the air navigation system according to the ICAO provisions and established timetable.”

French ANSP declares:
• SBAS APV on all IFR runways by 2016
• ILS Cat I proposed to be progressively replaced by APVs from 2015 on DSNA managed airfields, phased out by 2020

UK ANSP declares:
• Today 133 NPA supported by VORs

Italian ANSP declares:
• EGNOS suitable for 70% of runways
A "Follow Me" vehicle is tracked using EGNOS during a demonstration at Casablanca’s airport. © Ahmed ElAmin

Speakers at the METIS event at Casablanca’s airport watch a demonstration of EGNOS in action. © Ahmed ElAmin

The more efficient green GPS guided procedure compared to the conventional red track currently used most often at Sydney.

Courtesy of Waypoints, ICAO PBN publication, Q1 2010
SatNav: soon in all aircraft

1998: RNAV 5

2010: CPDLC (approved)

2015:
- 2015: CPDLC (approved)
- 2016: ADS-B (to be approved in 2010)
- 2017/18: PBN (A-RNP and APV?) (to be approved in 2012?)

2020: 3 de-facto GNSS mandates (IRs) with different requirements on GNSS positioning and time

A “CNS pack” approach in the regulatory roadmap would reduce installation/certification costs

GPS/RAIM or GPS/SBAS receivers

EGNOS

EU

GSA
GPS augmentation system: EGNOS

‘It’s there, use it’
European Commission Vice-President Tajani,

Oct 1, 2009, declaration of Open service availability:

“Both the Open Service and the Safety-of-Life Service are provided free of charge, and the European Union is committed to supporting EGNOS for the long term, even after Galileo has become operational. This includes extending its geographical scope within the coverage of the three satellites involved.”
# EGNOS in Europe – services

<table>
<thead>
<tr>
<th>Service</th>
<th>Accuracy</th>
<th>Service Status</th>
<th>Expected Lifetime</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Open Service</strong></td>
<td>Typical vertical and horizontal positioning accuracy in the centre of Europe around 1m (spec: 3m horizontal, 4m vertical)</td>
<td>Service available since October 2009</td>
<td>20+ years</td>
</tr>
<tr>
<td><strong>Safety of Life Service</strong></td>
<td>Same accuracy as Open Service. SoL service levels compliant to ICAO SARPS definition for APV1</td>
<td>Service to be made available by end 2010</td>
<td>20+ years</td>
</tr>
<tr>
<td><strong>Commercial Service (EDAS)</strong></td>
<td>Corrections provided by terrestrial network allow for sub-meter accuracy locally or regionally through additional processing</td>
<td>Experimental service available; Official service to be made available in 2011</td>
<td>20+ years</td>
</tr>
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</table>
EGNOS in Europe – coverage
Fully independent Satnav: Galileo

Navigation solutions powered by Europe
Galileo Implementation Plan

In order for Galileo to be recognized by the downstream market as the second satellite navigation system of choice it is key to deliver early services as soon as 2014/2015.
Galileo will be offering five services.

<table>
<thead>
<tr>
<th>Service</th>
<th>Description</th>
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<tbody>
<tr>
<td>Open Service</td>
<td>Free to air, mass market, simple positioning</td>
</tr>
<tr>
<td>Commercial Service</td>
<td>Encrypted, high accuracy, added-value service</td>
</tr>
<tr>
<td>Safety of Life Service</td>
<td>Adds integrity to Open Service</td>
</tr>
<tr>
<td>Public Regulated Service</td>
<td>Encrypted, robust, continuous availability</td>
</tr>
<tr>
<td>Search and Rescue Service</td>
<td>Near real-time, precise, return link</td>
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</table>
The two Galileo test satellites have secured the frequencies and tested critical technology in space.

- Giove-A
  - Launched on 28 December 2005
  - Securing of Galileo frequencies
  - In-orbit technology test bed

- Giove-B
  - Launched on 27 April 2008
  - First Passive Hydrogen Maser atomic clock ever flown in space
  - Implementation of CBOC signal
The public benefits to the 27 EU Member States from satellite-based navigation are estimated to be over €800 billion during the period 2010-2027. This value does not include some of the major potential benefits, such as employment growth and saved lives, which were estimated on a non-monetary basis.

Meanwhile, the public benefits derived from Galileo are forecast at €58 billion in the 2010-2027 period. The benefits include reduced travel time and fuel consumption, and public expenditures savings due to a reduction in road accidents and injuries, for example.

These public benefits are expected to grow rapidly. The road segment has the potential to reap the largest public benefits from Galileo, accounting for more than 70% of the estimated total. The benefits derive mainly from a reduction in travel time (a result of better navigation), the availability of more devices, better congestion management and the development of intelligent services.

In agriculture, the use of more accurate positioning technologies enabled by Galileo will allow rationalisation and increased efficiency in the use of fertilisers and pesticides. In aviation, the integrity information provided by Galileo and EGNOS will increase flight safety and reduce fuel consumption.
Thank you...