CEN Workshop Agreement
SCUTUM – WG Telematic

Jean-Philippe MECHIN

Satellite Applications & Telecommunication Task Force

PARIS, 2012, January 16th-18th

MINISTERE de l’ÉCOLOGIE, du DEVELOPPEMENT DURABLE, des TRANSPORTS et du LOGEMENT

Agenda

• Link between WG Telematic & SCUTUM

• Satellite positioning

• Attributes

• Model
Link between WG Telematic & SCUTUM

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Initial Project Objectives

- **SeCUring** the EU GNSS adoption in the dangerous **Us** Material transport
- SCUTUM is to launch and pursue a concrete path supporting EGNOS services introduction and exploitation in the transport of dangerous goods in Europe.
- The project is conceived to exploit the added value of EGNOS CS/EDAS for providing "guaranteed positioning" services.
SCUTUM approach

is to convey existing commercial initiatives into EGNOS, in order to:

- Ensure large-scale use involving the main stakeholders (institutions, Authorities, goods owners/ producers, transport operators, service/application providers, equipment manufacturers)
- Extensively validate EGNOS CS/EDAS based solution in real commercial operations
- Initiate technical standardisation
- Provide technological and market inputs for EGNOS CS pricing
- Define and validate the commercial viability and market strategy.
Agreement with WG Telematic

• Explore the parameters needed for location
• Propose solutions to express confidence in the position
• Take into account the first result of the matrix

This was agreed after Hamburg meeting in April 2010
EGNOS Service

EGNOS Service provide:

– Differential correction
– Integrity signal
– GPS like ranging

Two ways to provide these services:

– Open Service
– Commercial Service
How it’s working?

**Figure 3** MENTORE service architecture for EDAS-based EGNOS CS-NAV

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Satellite positioning
TRIANGULATION

- It’s the way to locate a point
Distance or Ranging

Signal send by the satellite includes:
- Id from the satellite
- Start Time of the signal

- Orbit is know
- Satellite position is known
- Travel time calculation =
  (Arrival time on receiver – Start time from satellite)
  x Speed of light
• 4 satellites are needed to avoid clock error
Constellation constraints

GPS example

- 24 satellites at least
- 20,200 km Circular orbit
- 6 orbital planes
  4 satellites per plane at least
- 2 rounds / day
- each satellite sends signal permanently

Figure issued from Wikipedia
**SIGNALS**

- **Sinusoidal carrier**
  carries the signal
  **Frequency**: 1 575 420 000 cycle/second (1575.42 MHz)

- **Navigation message** (composed by 0 & 1)
  **transmits** orbit information, satellite clock, ionospheric data...
  **Data flow**: 50 bits/second

- **Code C/A** (composed by 0 & 1)
  **transmits**: satellite id, information for ranging Satellite-Reveiver
  **Data flow**: 1 023 000 bits/second (1023 bits/ms)
Navigation message

Digital message composed by 0 & 1

Extremely high clock precision: 0.000015 second time difference by year

Short terms almanac: Precise Satellite Position for the next 4h

Long term almanacs: Approximate satellite position of the whole constellation for the next 180 days
Code C/A (Coarse Acquisition Code) or PRN (Pseudo Random Noise) is the fixed signal which is broadcast.

By comparison with the same code known by the receiver can be deduced:
- satellite ID
- distance between the receiver and the satellite

Signal in the receiver
Signal sent

Cross Corrélation
**C/A**

**Code C/A (Coarse Acquisition Code)** or PRN (Pseudo Random Noise) is the fixed signal which is broadcast.

By comparison with the same code known by the receiver can be deduced:
- satellite Id
- distance between the receiver and the satellite

**Signal in the receiver**

**Signal sent**

**Cross Corrélation**
MULTIPATH

Distance between Receiver and Satellite is not direct

Errors

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Impact of ranging error

Distance = 20,183,434 km +/- 5 m

Distance = 20,183,452 km +/- 5 m
Geometry

Good
GDOP (Accuracy factor) = 1.1

Bad
GDOP (Accuracy factor) = 2
Global solution

EGNOS corrections for satellite position, clock, ionospheric and tropospheric distortion

4 pseudoranges at least

Location, Speed, Time

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Accuracy: GPS Example

- tropospheric
- Orbit et Clock synchronisation
- ionospheric
- Interference at receiver level
- Multipath
- Geometry x 1,2
- 5 m in 95%
- Measured position
- Position

Accuracy:
- Measured position
- Orbits et Clock synchronisation
- Ionospheric
- Interference at receiver level
- Multipath
- Geometry x 1,2
- 5 m in 95%
- Position

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EGNOS ad-value

One example with GPS only and GPS+EGNOS
Attributes
<table>
<thead>
<tr>
<th>No</th>
<th>INFORMATION</th>
<th>WHO IS IT FOR?</th>
<th>WHAT IS IT FOR?</th>
<th>WHEN IS IT NEEDED?</th>
<th>HOW IS IT PROVIDED?</th>
<th>AVAILABILITY</th>
<th>USE OF TELEMATICS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Driver/Crew</td>
<td>Public authorities</td>
<td>All information in the transport document under A is necessary before and throughout the journey. This column only indicates particular circumstances where this information needs to be available.</td>
<td>Fire detector</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diver/Crew</td>
<td>Enforcement bodies</td>
<td></td>
<td></td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Diver/Crew</td>
<td>Emergency response</td>
<td></td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver/Crew</td>
<td>Infrastructure managers</td>
<td></td>
<td></td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Driver/Crew</td>
<td>Security bodies</td>
<td></td>
<td></td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>New information</td>
<td>Various</td>
<td>Knowing the position</td>
<td>Knowing the position in relation with alerts. Throughout journey.</td>
<td>Location Reference based OBU providing GNSS information (Use of EGNOS correction and Integrity) (it has to refer to the transmitter or the transport unit and not to the package inside the container or the transport unit)</td>
<td>E</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Positioning information (Coordinates, speed, direction, ...)</td>
<td>Various</td>
<td>Knowing the position</td>
<td>Knowing the position in relation with alerts. Throughout journey.</td>
<td>Location Reference based OBU providing GNSS information (Use of EGNOS correction and Integrity) (it has to refer to the container or the transport unit and not to the package inside the container or the transport unit)</td>
<td>E</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Tunnel Safety and Access Control Information</td>
<td>Various</td>
<td>Monitoring of vehicles approaching and traversing the tunnel to avoid potential dangerous vehicle to access the tunnel</td>
<td>Monitoring of vehicles approaching and traversing the tunnel to avoid potential dangerous vehicle to access the tunnel</td>
<td>Link between vehicle with infrastructure management systems</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
SCUTUM CEN Workshop Agreement

- Define a minimum set of data to
  - Get from receiver raw data to apply Egno EDAS corrections
  - Transmit result of computation

- Highlight with 3 examples:
  - Service architecture for commercial services
  - LBS using 3GPP standard
  - Datex II extension
<table>
<thead>
<tr>
<th>Field</th>
<th>Length / Data Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Message Type</td>
<td>1 byte / Unsigned Integer</td>
<td>At present only message type 1 (current message) is implemented. Other values are reserved for future use.</td>
</tr>
<tr>
<td>Fleet ID</td>
<td>2 bytes / Unsigned Integer</td>
<td>= 0 in case not used, &lt;&gt; 0 in case of fleet or Company ID</td>
</tr>
<tr>
<td>Number of messages</td>
<td>1 byte / Unsigned Integer</td>
<td></td>
</tr>
<tr>
<td><strong>Following fields are repeated for each mobile terminal message.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terminal ID</td>
<td>2 bytes / Unsigned Integer</td>
<td>= 0 in case of service architecture with SL,&lt;&gt; 0 in case of service architecture with SL0/1</td>
</tr>
<tr>
<td>GPS time of week</td>
<td>4 bytes / Unsigned Integer</td>
<td>Milliseconds</td>
</tr>
<tr>
<td>Extended GPS week number</td>
<td>2 bytes / Unsigned Integer</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>1 byte / Bit mask</td>
<td>Bit 0: GPS / SBAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = GPS only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = SBAS-corrected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other bits: Reserved for future use.</td>
</tr>
<tr>
<td>X</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Y</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Z</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Number of Satellites in view</td>
<td>1 byte / Unsigned Integer</td>
<td></td>
</tr>
<tr>
<td><strong>Following fields are repeated for each satellite in view.</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satellite ID</td>
<td>1 byte / Unsigned Integer</td>
<td>PRN[1]</td>
</tr>
<tr>
<td>Signal Strength (C/N0)</td>
<td>1 byte / Unsigned Integer</td>
<td>dB-Hz</td>
</tr>
<tr>
<td>Pseudo Range</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Phase</td>
<td>8 bytes / Double Precision</td>
<td>Meters (optional), in case not used = NaN</td>
</tr>
<tr>
<td>Doppler</td>
<td>8 bytes / Double Precision</td>
<td>Hertz (optional), in case not used = NaN</td>
</tr>
<tr>
<td>Optional Data Length</td>
<td>1 byte / Unsigned Integer</td>
<td>Length of following optional data section</td>
</tr>
</tbody>
</table>
Minimum set of data after calculation

<table>
<thead>
<tr>
<th>Field</th>
<th>Length / Data Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal ID</td>
<td>2 bytes / Unsigned Integer</td>
<td>= 0 in case of service architecture with SL ?, =/ 0 in case of service architecture with SL0/1</td>
</tr>
<tr>
<td>Result</td>
<td>1 byte / Bit mask</td>
<td>Bits 2,1,0: Error Codes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,0,0 = No error</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,0,1 = CRC32 Check Unsuccessful</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,1,0 = Message Size Mismatch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,1,1 = Timeout Expired</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,0,0 = Unable to Compute Correction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bits 4,3: Corrections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,0 = Corrections Not Applied</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0,1 = Corrections Applied by Terminal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,0 = Corrections Applied by Service Centre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other bits: Reserved for future use.</td>
</tr>
<tr>
<td>Lat</td>
<td>8 bytes / Double Precision</td>
<td>Degree. Corrected position resulting from Processing Algorithm calculations</td>
</tr>
<tr>
<td>Lon</td>
<td>8 bytes / Double Precision</td>
<td>Degree. Corrected position resulting from Processing Algorithm calculations</td>
</tr>
<tr>
<td>Height</td>
<td>8 bytes / Double Precision</td>
<td>In meters. Corrected position resulting from Processing Algorithm calculations</td>
</tr>
<tr>
<td>HPL</td>
<td>4 bytes / Single Precision</td>
<td>In meters</td>
</tr>
<tr>
<td>VPL</td>
<td>4 bytes / Single Precision</td>
<td>In meters (optional)</td>
</tr>
</tbody>
</table>

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## Minimum set of data for low level service

<table>
<thead>
<tr>
<th>Field</th>
<th>Length / Data Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminal ID</td>
<td>2 bytes / Unsigned Integer</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>2 bytes / Bit mask</td>
<td>Bit 0: GPS / SBAS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 = GPS only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = SBAS-corrected</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Other bits: Reserved for future use</td>
</tr>
<tr>
<td>Extended GPS Week</td>
<td>2 bytes / Unsigned Integer</td>
<td></td>
</tr>
<tr>
<td>GPS time of week</td>
<td>4 bytes / Unsigned Integer</td>
<td>Milliseconds</td>
</tr>
<tr>
<td>X</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Y</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Z</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
</tbody>
</table>

*The following fields are repeated for each satellite in view*

<table>
<thead>
<tr>
<th>Field</th>
<th>Length / Data Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite ID</td>
<td>1 byte / Unsigned Integer</td>
<td>PRN[^1]</td>
</tr>
<tr>
<td>Pseudo Range</td>
<td>8 bytes / Double Precision</td>
<td>Meters</td>
</tr>
<tr>
<td>Signal Strength (C/N0)</td>
<td>1 byte / Unsigned Integer</td>
<td>dB-Hz (optional)</td>
</tr>
</tbody>
</table>

[^1]: Valid for GPS / Galileo
Model
Datex II extension

• For exchange of raw data issued from GNSS receiver
  – Level C Extension within the model for DG Transport provided by Germany

• For exchange of result of calculation
  – Level B Extension for other purpose
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Thank you for your attention

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