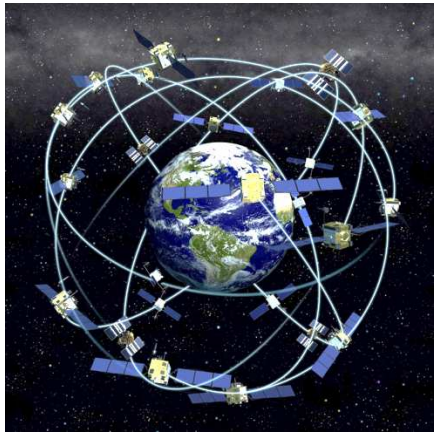
SCOTUM

UNITED NATIONS

Economic and Social Council

CEN Workshop Agreement SCUTUM – WG Telematic



Jean-Philippe MECHIN

Satellite Applications & Telecommunication Task Force

PARIS, 2012, January 16th-18th

Présent pour l'avenir

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

www.cete-sud-ouest.developpement-durable.gouv.fr

Agenda

- Link between WG Telematic & SCUTUM
- Satellite positionning
- Attributes
- Model

Link between WG Telematic & SCUTUM

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

Initial Project Objectives

- **S**e**CU**ring the EU GNSS adop**T**ion in the dangero**U**s **M**aterial 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.

Présent pour l'avenir

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

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

Présent pour l'avenir

How it’s working ?

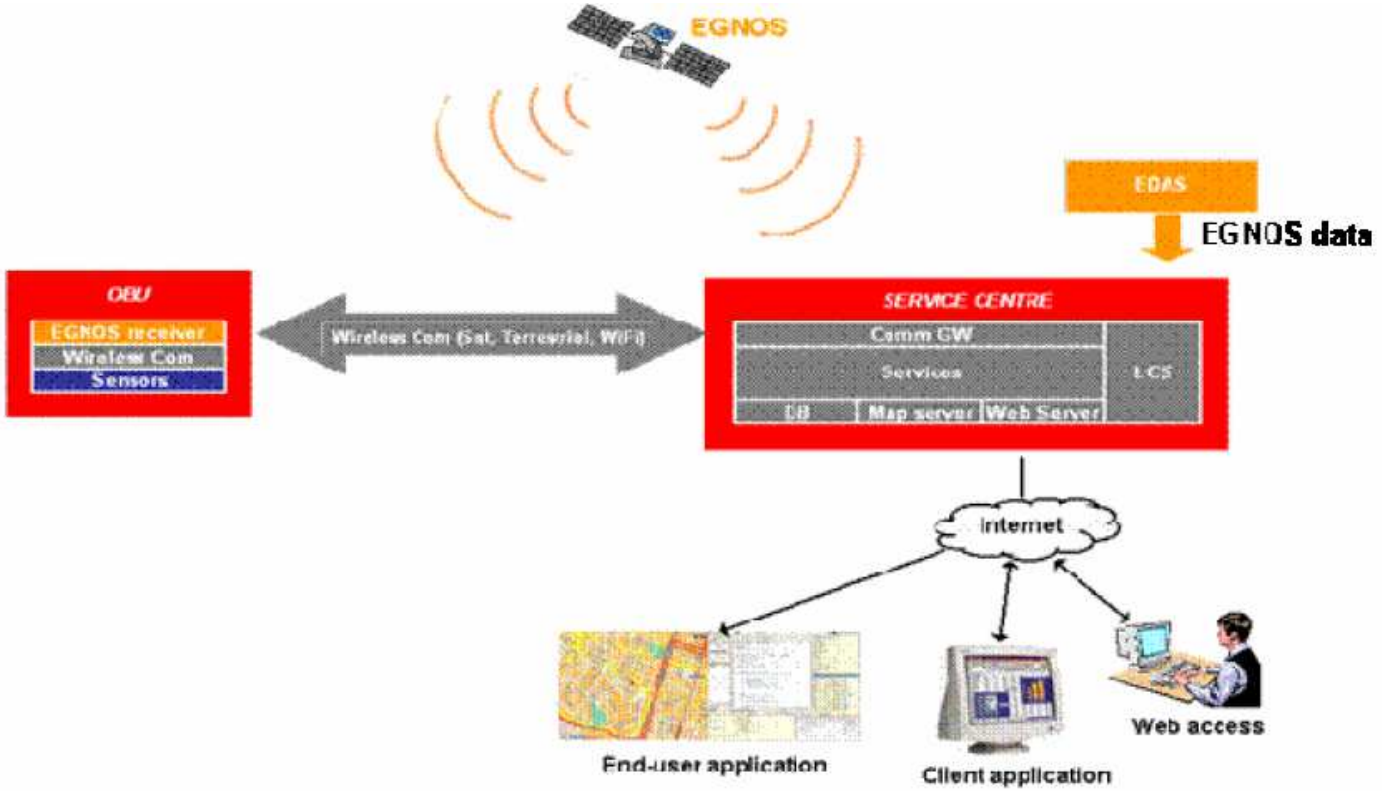


Figure 3 MENTORE service architecture for EDAS-based EGNOS CS-NAV

Présent pour l’avenir

Work packages

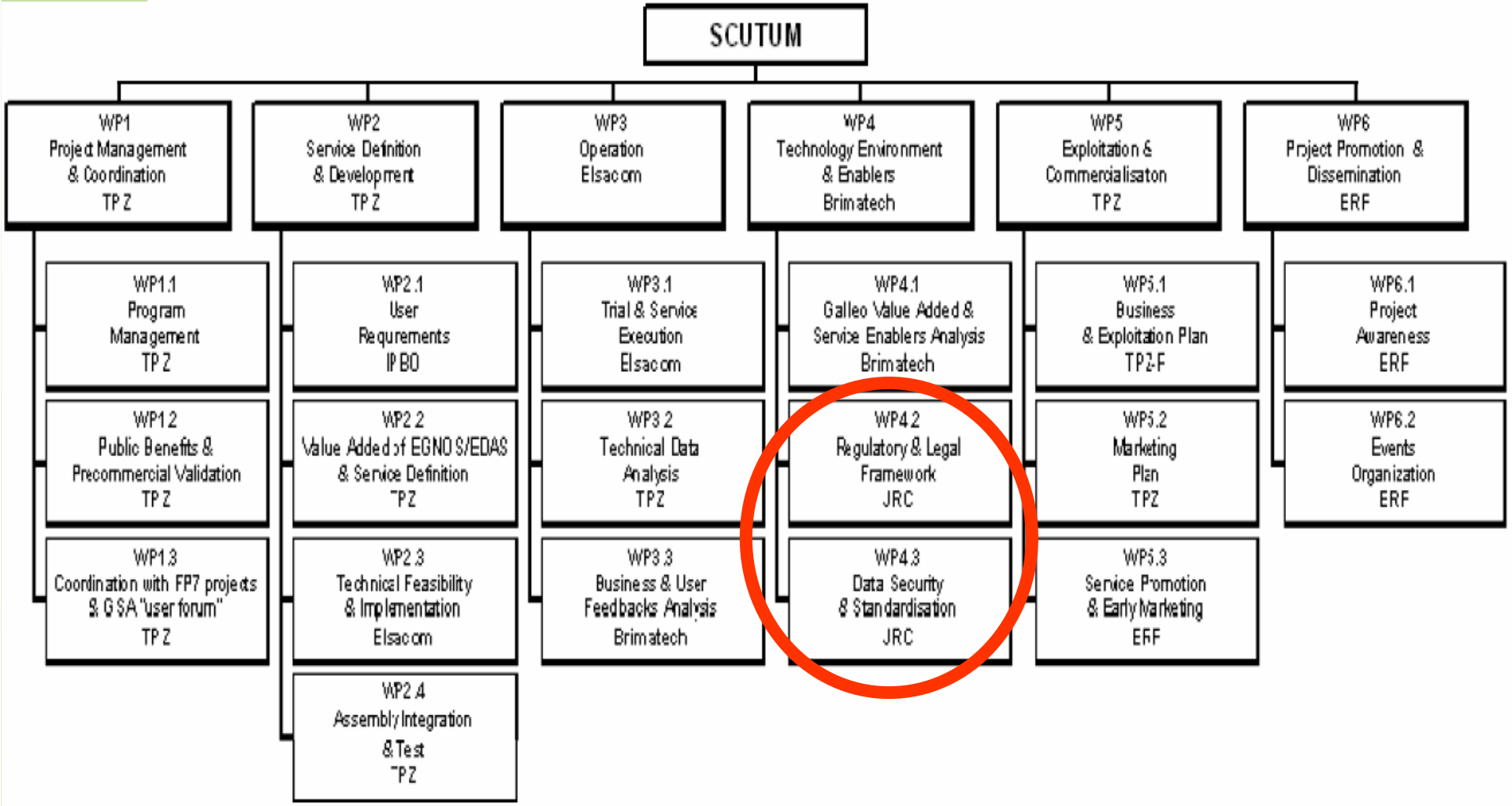


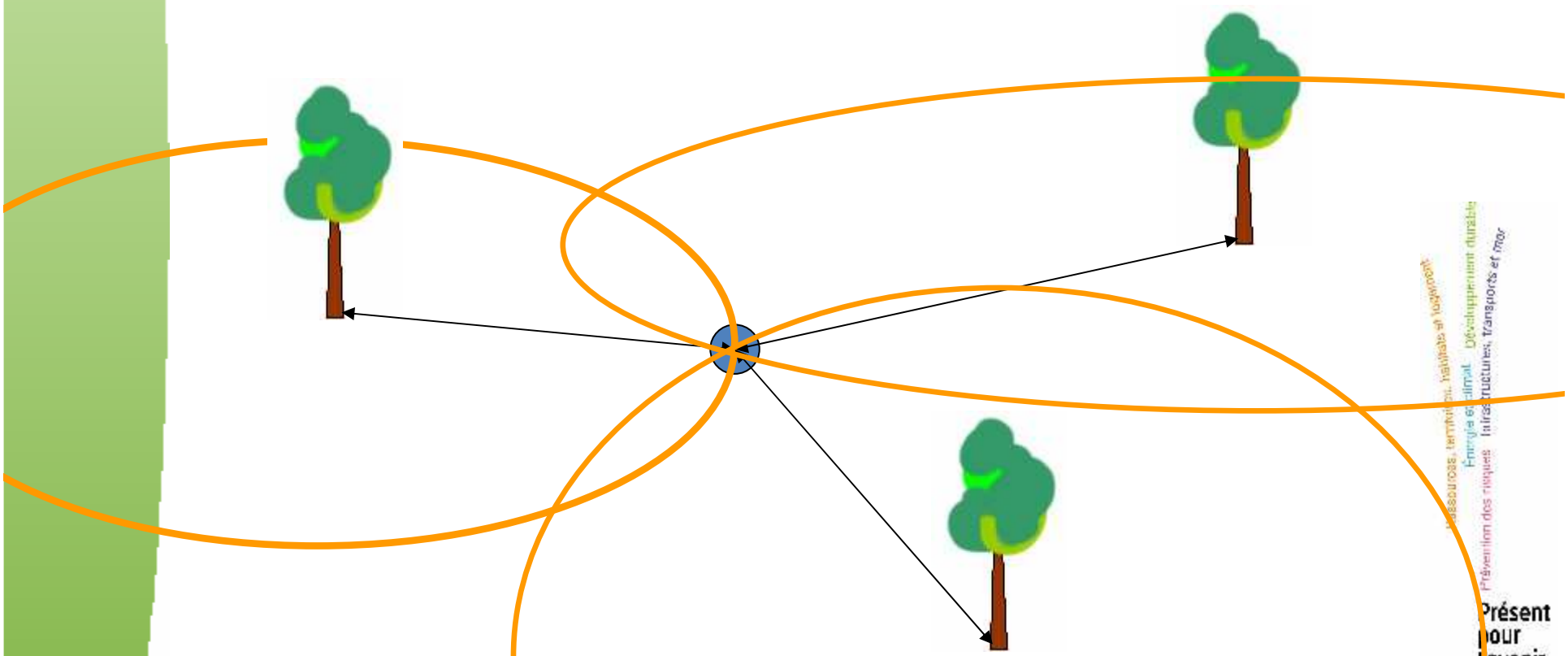
Figure 8 SCUTUM WBS

Satellite positionning

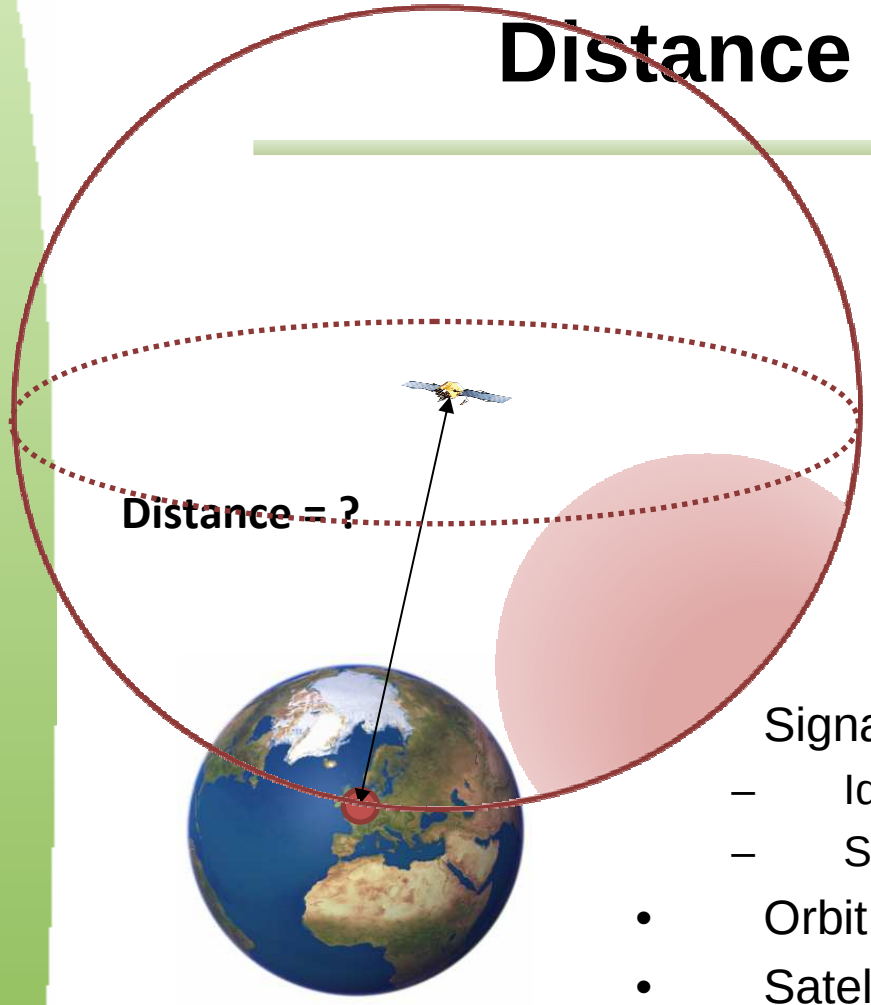
J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

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

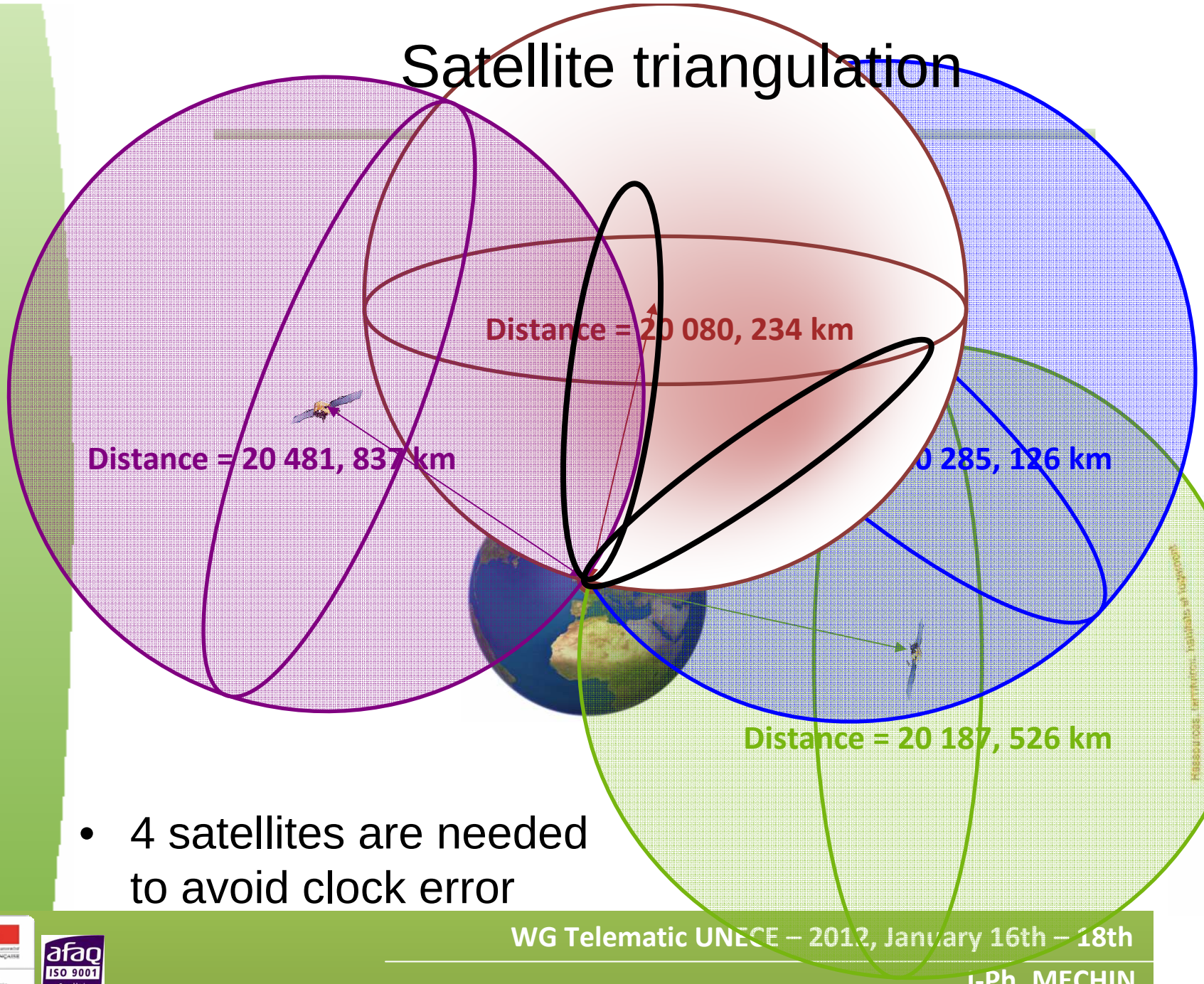
- Orbit is know
- Satellite position is known
- Travel time calculation =

(Arrival time on receiver – Start time from satellite)

x Speed of light

Présent pour l'avenir

Satellite triangulation

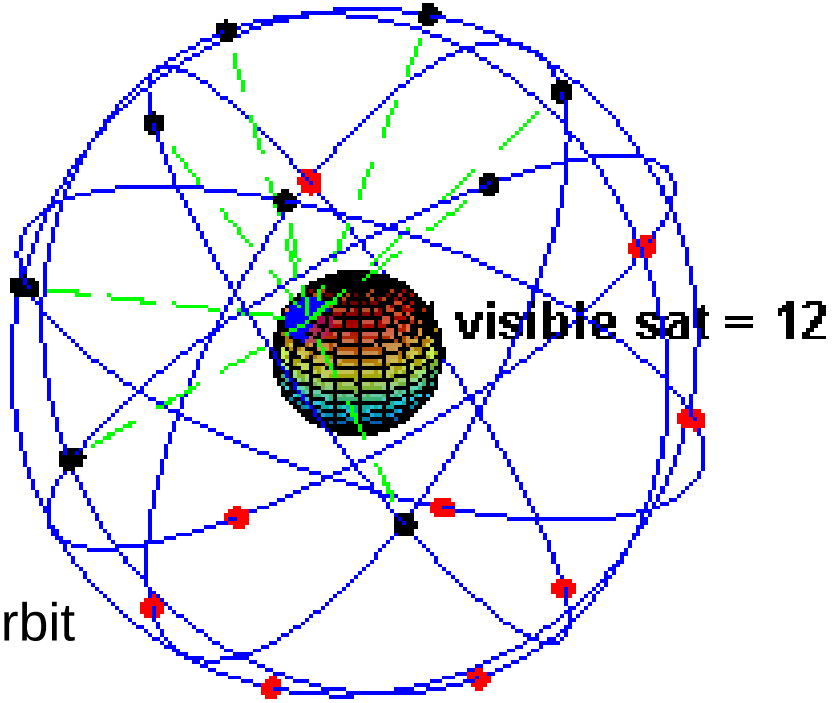


- 4 satellites are needed to avoid clock error

Présent pour l'avenir

Constellation constraints

GPS example

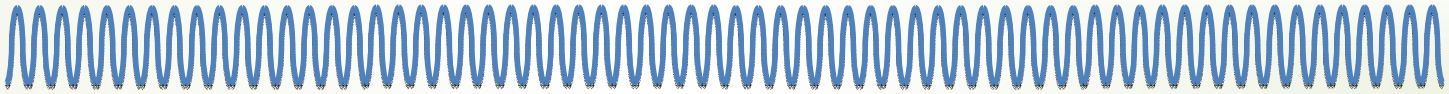


- 24 satellites at least
- 20,200 km Circular orbit
- 6 orbital planes
  4 satellites per plane at least
- 2 rounds / day
- each satellite sends signal permanently

Figure issued from Wikipedia

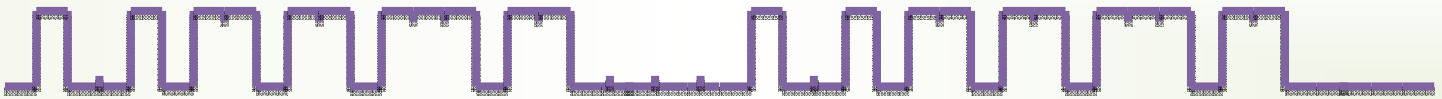
SIGNALS

- **Sinusoidal carrier**
  carries the signal
  Frequency : 1 575 420 000 cycle/second *(1575,42 MHz)*



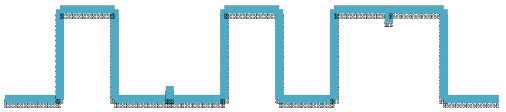
- **Navigation message** (composed by 0 & 1)
  transmits orbit information, satellite clock, ionospheric data…
  Data flow : 50 bits/second

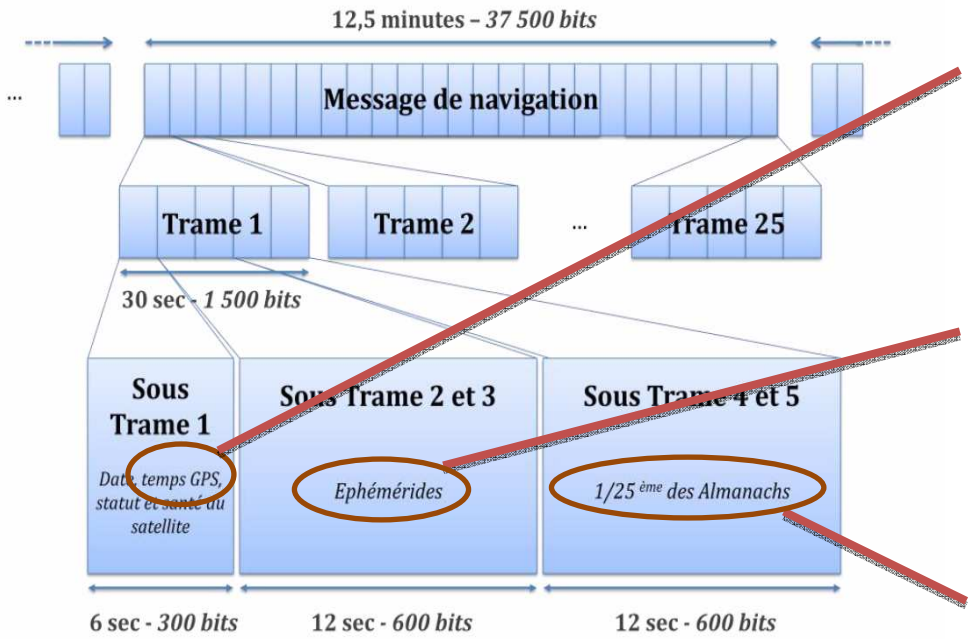
- **Code C/A** (composed by 0 & 1)
  transmits : satellite id, information for ranging Satellite-Reveiver
  Data flow : 1 023 000 bits/second *(1023 bits/ms)*



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

Présent pour l'avenir

C/A

Code C/A (***C**oarse **A**cquisition Code*) or PRN (Pseudo Random Noise) is the fixed signal which is broadcast

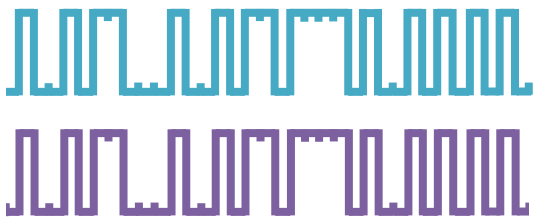
By comparison with the same code know by the receiver can be deduced:

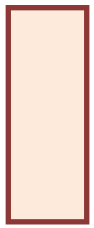
satellite Id

distance between the receiver and the satellite

Signal in the receiver

Signal sent





Cross Corrélation

C/A

Code C/A (***C**oarse **A**cquisition Code*) or PRN (Pseudo Random Noise) is the fixed signal which is broadcast

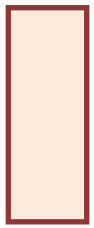
By comparison with the same code know by the receiver can be deduced:

satellite Id

distance between the receiver and the satellite

Signal in the receiver

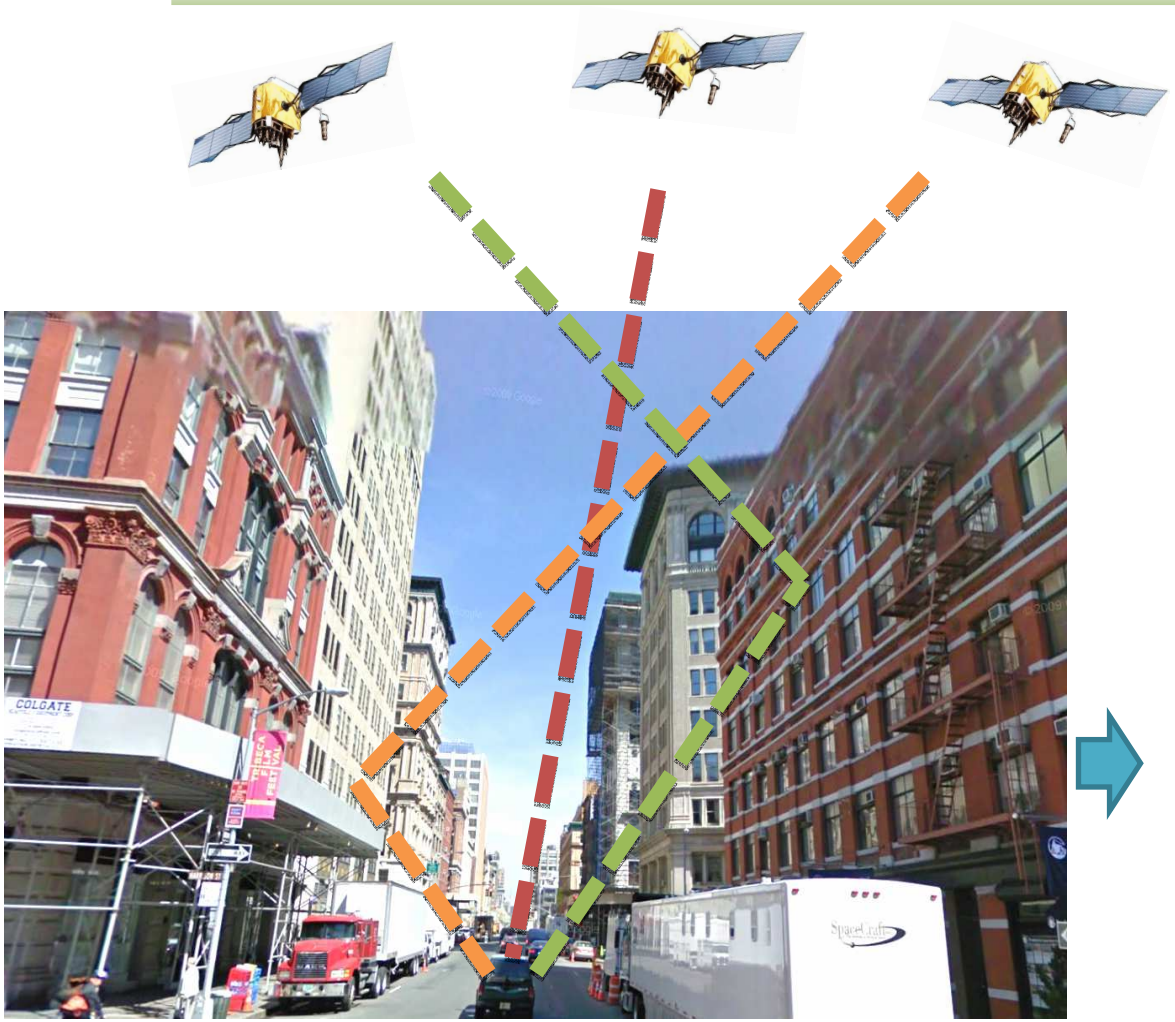
Signal sent



Cross Corrélation

Présent pour l'avenir

MULTIPATH

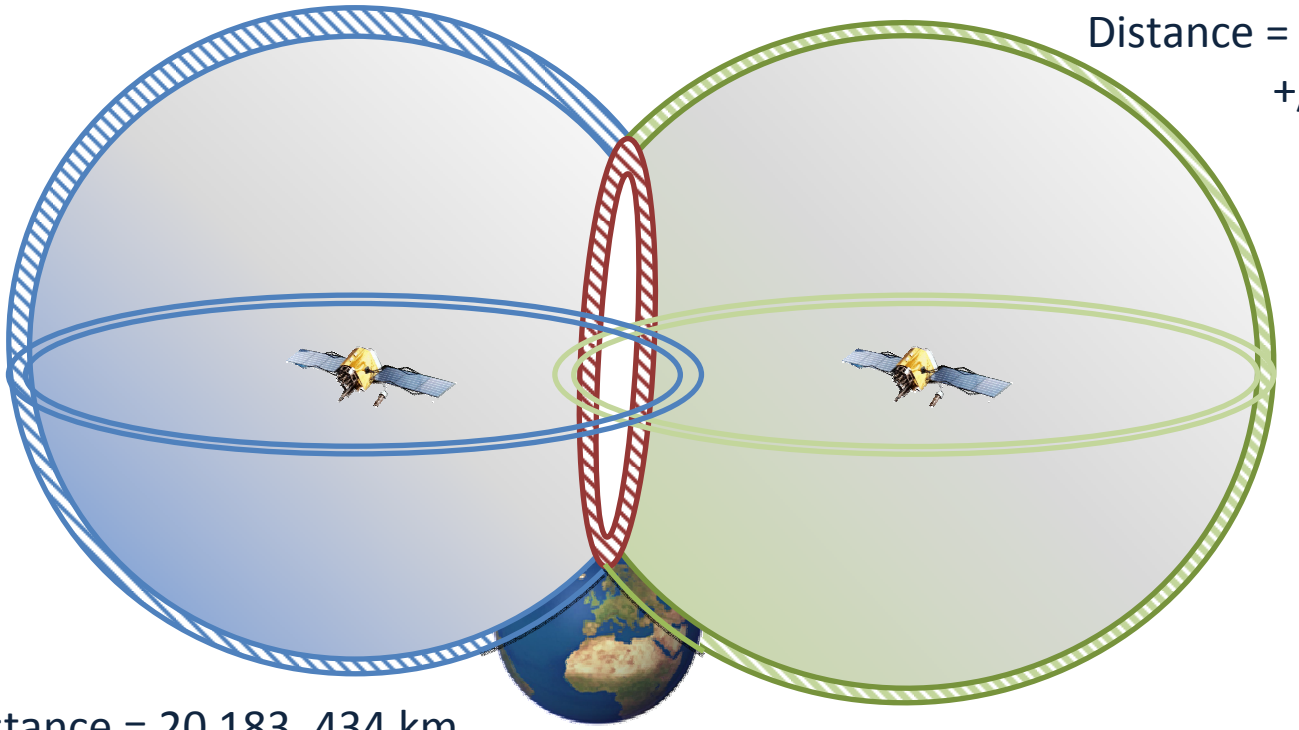


Distance between Receiver and Satellite is not direct

Errors

Présent pour l'avenir

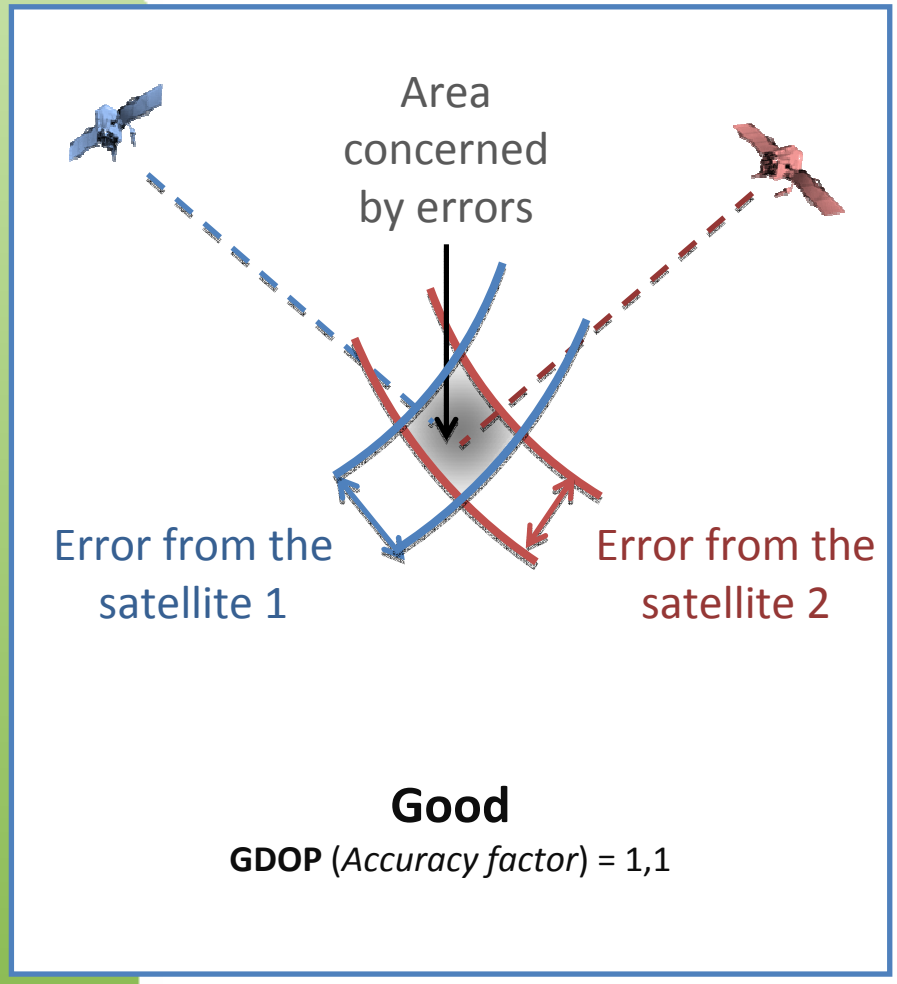
Impact of ranging error



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

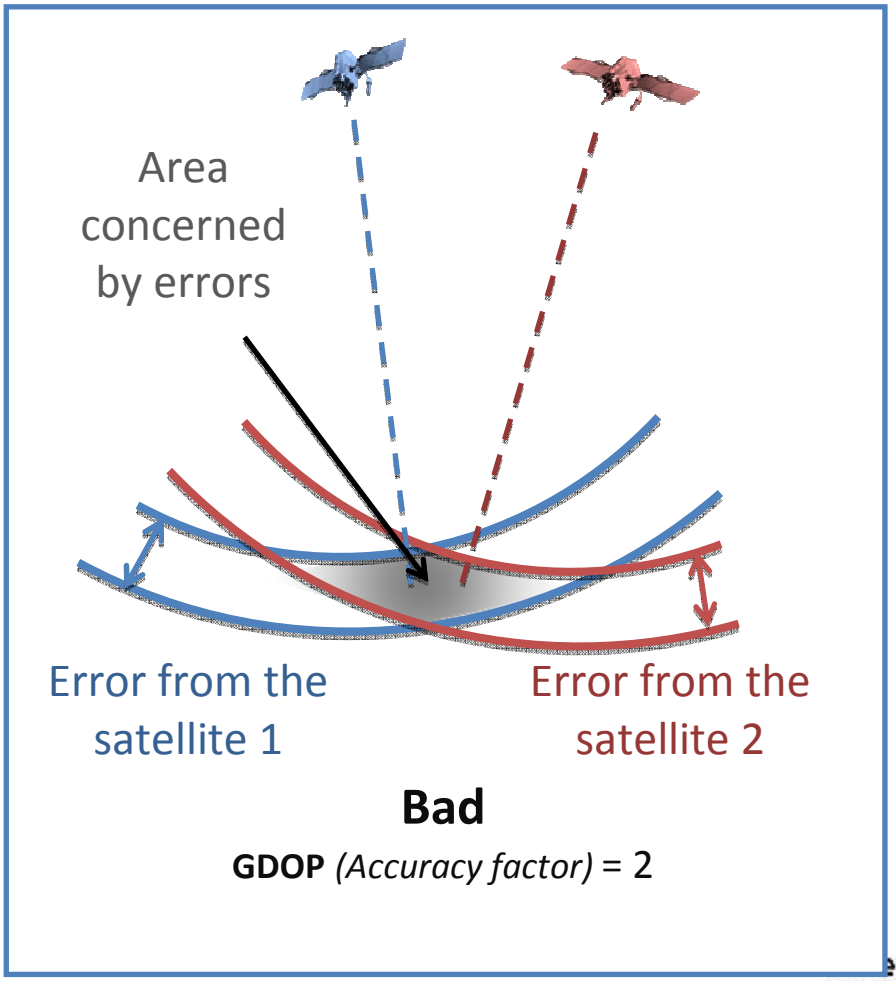
Distance = 20 183, 434 km
+/- 5 m

Geometry



Good

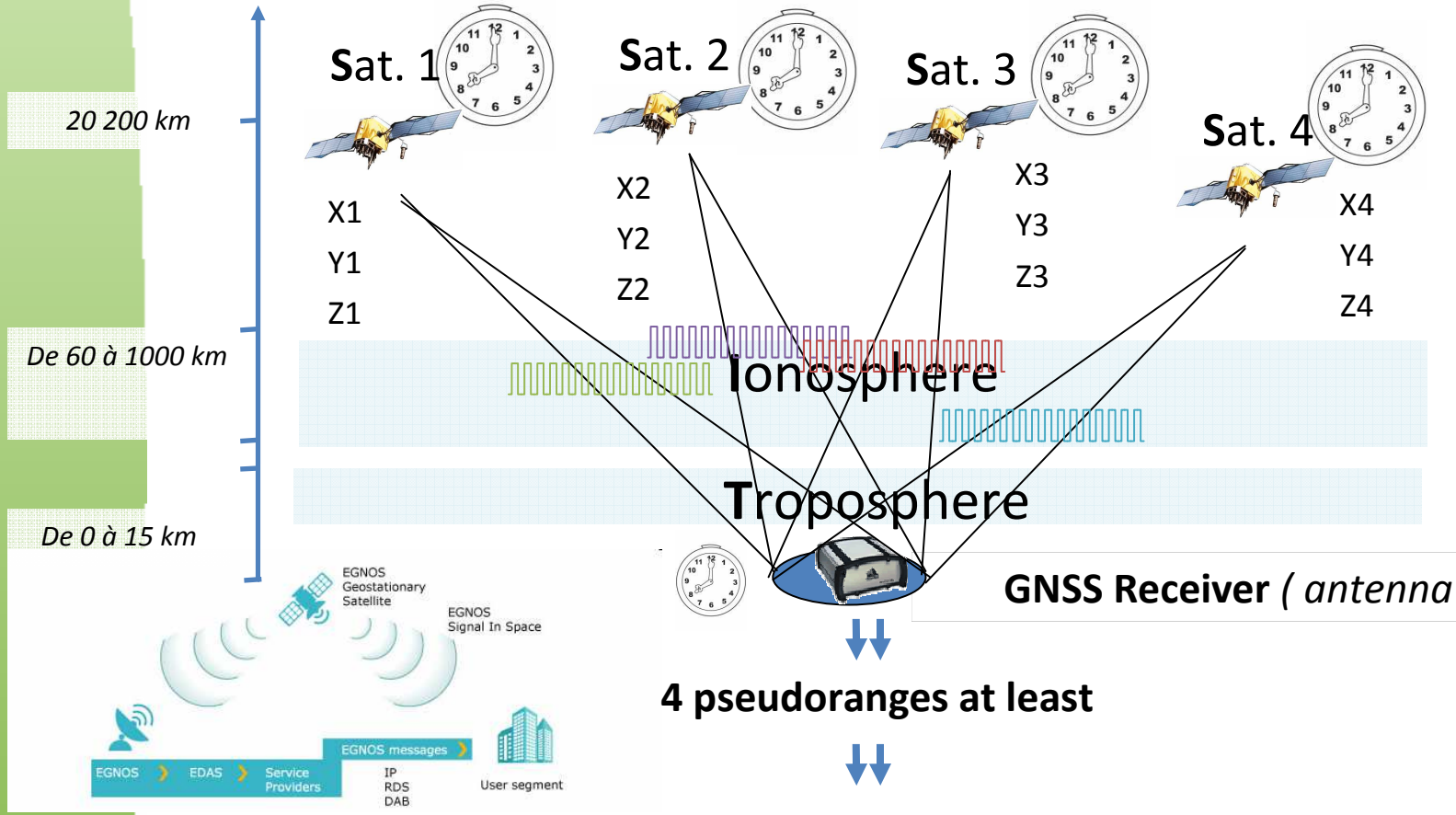
GDOP (*Accuracy factor*) = 1,1



Bad

GDOP *(Accuracy factor)* = 2

Global solution



GNSS Receiver *(antenna + clock)*

4 pseudoranges at least

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

Location, Speed, Time

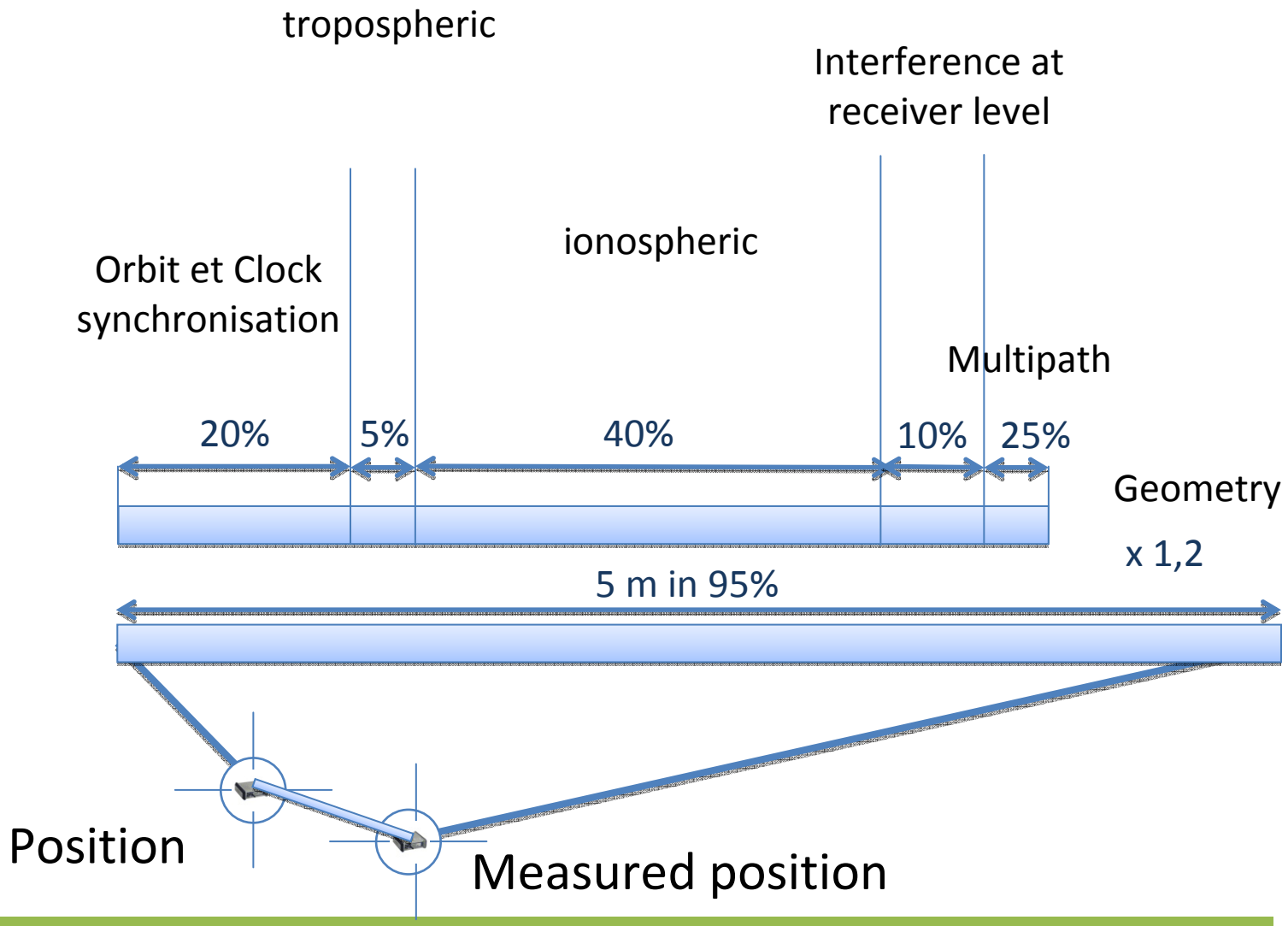
Egnos schema from GSA website

Présent pour l'avenir

J-Ph. MECHIN

Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

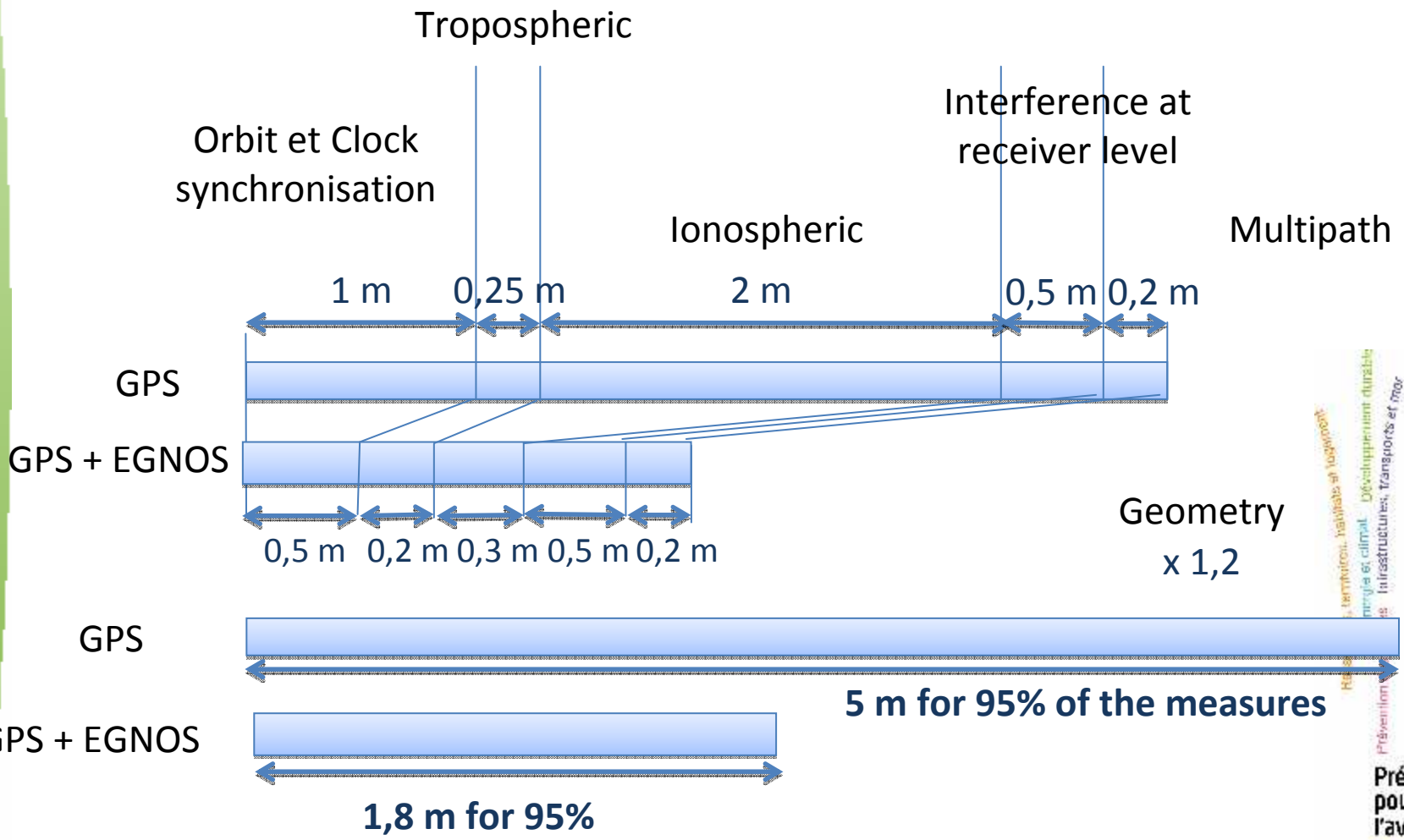
Accuracy: GPS Example



Présent pour l'avenir

EGNOS ad-value

One example with GPS only and GPS+EGNOS



Présent pour l'avenir

Attributes

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

Matrix

No.	INFORMATION	WHO IS IT FOR?															WHAT IS IT FOR?	WHEN IS IT NEEDED? 3)	HOW IS IT PROVIDED?	AVAILABILITY		USE OF TELEMATICS		
		Driver / Crew	Shipper/Consignor/ Sender[1]	Freight forwarder	Consignee	Loader	Carrier	Tank-wagon operator	Packer	Filler	Tank-container operator	Infrastructure manager[2]	Public authorities: Competent authority	Public authorities: Emergency responders	Public authorities: Enforcement bodies	Public authorities: Security bodies		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.		Operational	In case of incident/accident	Technical feasible	Better availability in case of incidents/accidents	Operational advantage
C.	**New informations**[4]																							
48	Alert-system for incident/accident - fire	S	O	O	O		O	O			O	S		S			Various	During loading, throughout journey, in case of incident/accident	Fire detector	N	N	Y	Y	N
72	Positionning information (Coordinates, speed, direction, ….)	S	O	O	O	O	S	O		O	O	S		S	S	S	Knowing the position	In relation with alerts. Throughout journey	Location Reference based OBU providing GNSS information (Use of EGNOS correction and Integrity) (It has to refere to the container or the transport unit and not to the package inside the container or the transport unit)	E	N	Y	Y	Y
73	Tunnel Safety and Access Control Information	S	O	O	O		O	O			O	S		S	O		Monitoring of vehicles approaching and traversing the tunnel to avoid potential dangerous vehicle to acces the tunnel	Before entering and troughout the tunnel	Link between vehicle with infrastructure management systems	N	N	Y	Y	Y

Présent pour l'avenir

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

SCUTUM CEN Workshop Agreement

- Define a minimum set of data to
  - Get from receiver raw data to apply Egnos-EDAS corrections
  - Transmit result of computation
- Highlight with 3 examples :
  - Service architecture for commercial services
  - LBS using 3GPP standard
  - Datex II extension

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

Field	Length / Data Type	Notes
Message Type	1 byte / Unsigned Integer	At present only message type 1 (current message) is implemented. Other values are reserved for future use.
Fleet ID	2 bytes / Unsigned Integer	= 0 in case not used, <> 0 in case of fleet or Company ID
Number of messages	1 byte / Unsigned Integer	
Following fields are repeated for each mobile terminal message.		
Terminal ID	2 bytes / Unsigned Integer	= 0 in case of service architecture with SL ,<> 0 in case of service architecture with SL0/ 1
GPS time of week	4 bytes / Unsigned Integer	Milliseconds
Extended GPS week number	2 bytes / Unsigned Integer	
Status	1 byte / Bit mask	Bit 0: GPS / SBAS 0 = GPS only 1 = SBAS-corrected Other bits: Reserved for future use.
X	8 bytes / Double Precision	Meters
Y	8 bytes / Double Precision	Meters
Z	8 bytes / Double Precision	Meters
Number of Satellites in view	1 byte / Unsigned Integer	
Following fields are repeated for each satellite in view.		
Satellite ID	1 byte / Unsigned Integer	PRN[1]
Signal Strength (C/N0)	1 byte / Unsigned Integer	dB-Hz
Pseudo Range	8 bytes / Double Precision	Meters
Phase	8 bytes / Double Precision	Meters (optional), in case not used = NaN
Doppler	8 bytes / Double Precision	Hertz (optional), in case not used = NaN
Optional Data Length	1 byte / Unsigned Integer	Length of following optional data section

Minimum set of data after calculation

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

Minimum set of data for low level service

Field	Length / Data Type	Notes
Terminal ID	2 bytes / Unsigned Integer	
Status	2 bytes / Bit mask	Bit 0: GPS / SBAS 0 = GPS only 1 = SBAS-corrected Other bits: Reserved for future use
Extended GPS Week	2 bytes / Unsigned Integer	
GPS time of week	4 bytes / Unsigned Integer	Milliseconds
X	8 bytes / Double Precision	Meters
Y	8 bytes / Double Precision	Meters
Z	8 bytes / Double Precision	Meters
The following fields are repeated for each satellite in view		
Satellite ID	1 byte / Unsigned Integer	PRN[1]
Pseudo Range	8 bytes / Double Precision	Meters
Signal Strength (C/N0)	1 byte / Unsigned Integer	dB-Hz (optional)

[1] Valid for GPS / Galileo

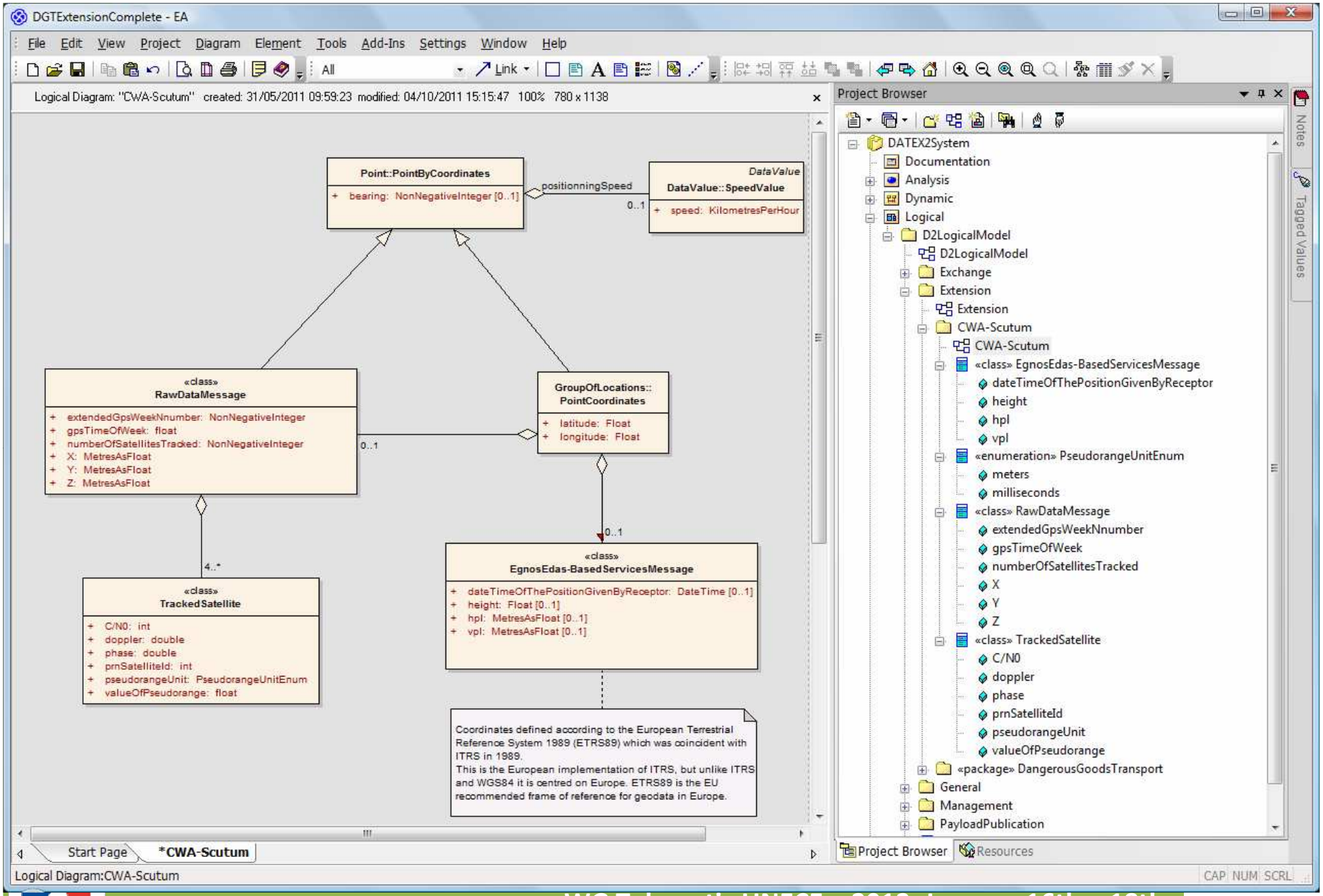
Présent pour l'avenir

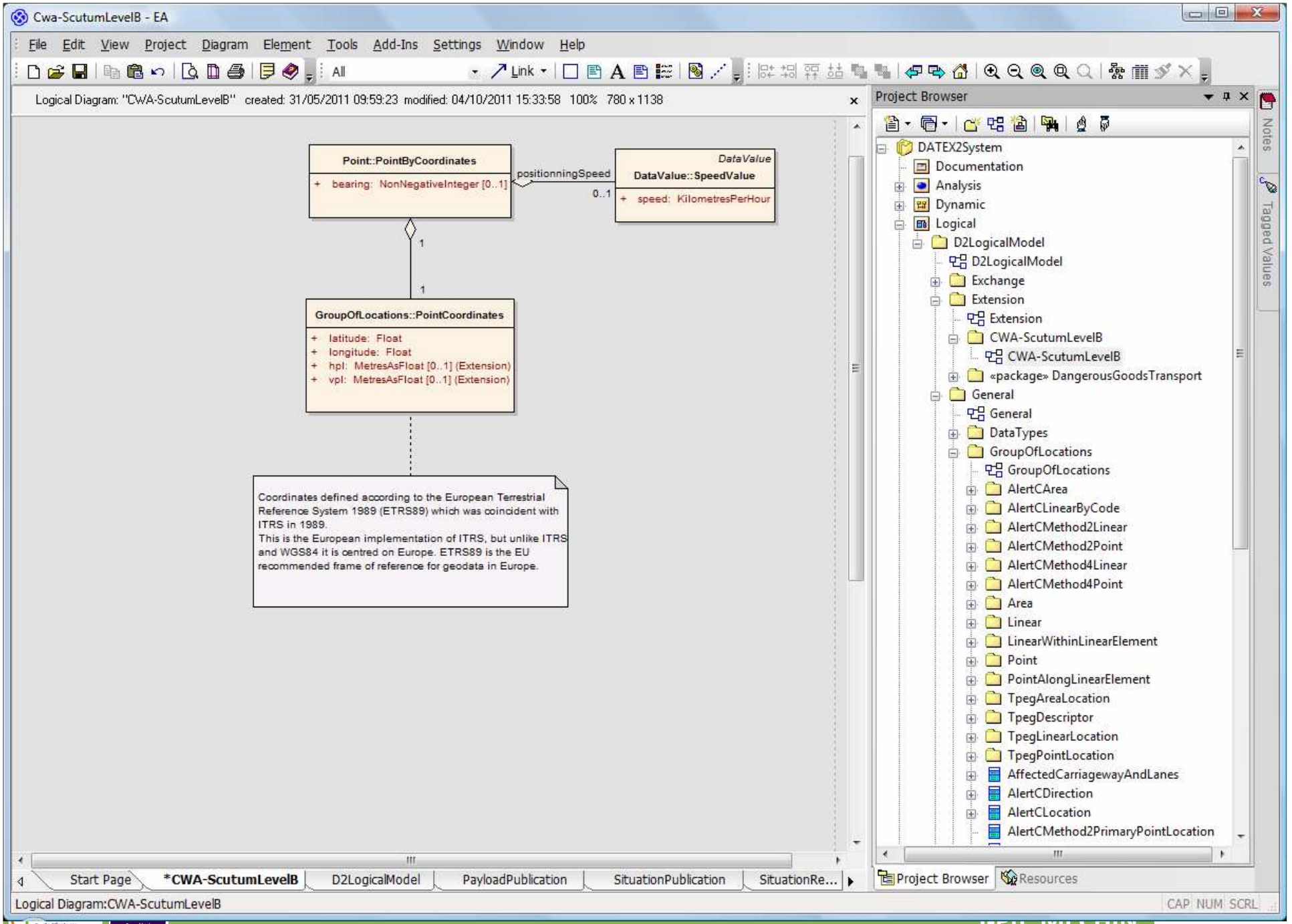
Model

J-Ph. MECHIN
Satellite Applications & Télécommunication Task Force – CETE Sud Ouest

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


DGTExtensionComplete - EA
File Edit View Project Diagram Element Tools Add-Ins Settings Window Help
Logical Diagram: "CWA-Scutum" created: 31/05/2011 09:59:23 modified: 04/10/2011 15:15:47 100% 780 x 1138
Point::PointByCoordinates
+ bearing: NonNegativeInteger [0..1]
positionningSpeed
0..1
DataValue
DataValue::SpeedValue
+ speed: KilometresPerHour
«class»
RawDataMessage
+ extendedGpsWeekNnumber: NonNegativeInteger
+ gpsTimeOfWeek: float
+ numberOfSatellitesTracked: NonNegativeInteger
+ X: MetresAsFloat
+ Y: MetresAsFloat
+ Z: MetresAsFloat
0..1
GroupOfLocations::
PointCoordinates
+ latitude: Float
+ longitude: Float
0..1
4..*
«class»
TrackedSatellite
+ C/N0: int
+ doppler: double
+ phase: double
+ prnSatelliteId: int
+ pseudorangeUnit: PseudorangeUnitEnum
+ valueOfPseudorange: float
«class»
EgnosEdas-BasedServicesMessage
+ dateTimeOfThePositionGivenByReceptor: DateTime [0..1]
+ height: Float [0..1]
+ hpl: MetresAsFloat [0..1]
+ vpl: MetresAsFloat [0..1]
Coordinates defined according to the European Terrestrial Reference System 1989 (ETRS89) which was coincident with ITRS in 1989.
This is the European implementation of ITRS, but unlike ITRS and WGS84 it is centred on Europe. ETRS89 is the EU recommended frame of reference for geodata in Europe.
Start Page
*CWA-Scutum
Logical Diagram:CWA-Scutum
Project Browser
DATEX2System
Documentation
Analysis
Dynamic
Logical
D2LogicalModel
D2LogicalModel
Exchange
Extension
Extension
CWA-Scutum
CWA-Scutum
«class» EgnosEdas-BasedServicesMessage
dateTimeOfThePositionGivenByReceptor
height
hpl
vpl
«enumeration» PseudorangeUnitEnum
meters
milliseconds
«class» RawDataMessage
extendedGpsWeekNnumber
gpsTimeOfWeek
numberOfSatellitesTracked
X
Y
Z
«class» TrackedSatellite
C/N0
doppler
phase
prnSatelliteId
pseudorangeUnit
valueOfPseudorange
«package» DangerousGoodsTransport
General
Management
PayloadPublication
Project Browser
Resources
Notes
Tagged Values
CAP NUM SCRL


Cwa-ScutumLevelB - EA
File Edit View Project Diagram Element Tools Add-Ins Settings Window Help
Logical Diagram: "CWA-ScutumLevelB" created: 31/05/2011 09:59:23 modified: 04/10/2011 15:33:58 100% 780 x 1138
Point::PointByCoordinates
+ bearing: NonNegativeInteger [0..1]
positionningSpeed
0..1
DataValue
DataValue::SpeedValue
+ speed: KilometresPerHour
1
1
GroupOfLocations::PointCoordinates
+ latitude: Float
+ longitude: Float
+ hpl: MetresAsFloat [0..1] (Extension)
+ vpl: MetresAsFloat [0..1] (Extension)
Coordinates defined according to the European Terrestrial Reference System 1989 (ETRS89) which was coincident with ITRS in 1989.
This is the European implementation of ITRS, but unlike ITRS and WGS84 it is centred on Europe. ETRS89 is the EU recommended frame of reference for geodata in Europe.
Project Browser
DATEX2System
Documentation
Analysis
Dynamic
Logical
D2LogicalModel
Exchange
Extension
CWA-ScutumLevelB
«package» DangerousGoodsTransport
General
DataTypes
GroupOfLocations
AlertCArea
AlertCLinearByCode
AlertCMethod2Linear
AlertCMethod2Point
AlertCMethod4Linear
AlertCMethod4Point
Area
Linear
LinearWithinLinearElement
Point
PointAlongLinearElement
TpegAreaLocation
TpegDescriptor
TpegLinearLocation
TpegPointLocation
AffectedCarriagewayAndLanes
AlertCDirection
AlertCLocation
AlertCMethod2PrimaryPointLocation
Notes
Tagged Values
Start Page
*CWA-ScutumLevelB
D2LogicalModel
PayloadPublication
SituationPublication
SituationRe...
Project Browser
Resources
Logical Diagram:CWA-ScutumLevelB
CAP NUM SCRL

Thank you for your attention

Jean-Philippe.Mechin@developpement-durable.gouv.fr

Présent pour l'avenir