



GNSS Application Catalogues

WG-B Application Subgroup

Xingqun ZHAN, SJTU, China

Mine MASAYA, SPAC, Japan

4, November, 2015

OUTLINE

- 1. Work Review
- 2. GNSS Application Classification
- 3. Suggestions to GNSS Providers
- 4. Future Plans

1. Work Review

- *We ,Application SG, had 4 meetings and 30 presentations for a couple of years, and realized some trends of GNSS applications.*
- *The main task of App SG is to come up with a GNSS application catalogues from ICG-9.*
- *The structure of the document was discussed on 5th App SG Meeting in Vienna in this June.*
- *The application achievements from China and Japan were summarized.*
- *Email asking for application achievements was circulated to other GNSS providers.*

Overview of App SG Meetings

Meeting	Venue	Date	Theme	In conjunction with
1st	Munich, Germany	2012/3/12~13	Mass Market Liability	Munich Summit 2012
2nd	Wuhan, China	2013/5/14	Surveying Disaster Management Maritime Liability	China Satellite Navigation Conference 2013
3rd	Daejeon, Korea	2013/7/18	Mass Market Disaster Management Agriculture Surveying Timing	National GNSS Research Center Symposium 2013
4th	Jeju, Korea	2014/10/22	SBAS Surveying Mass Market Disaster	International Symposium on GNSS 2014



Outcomes from 1st ~4th App SG meetings

- Several core applications were identified by SG to monitor, such as, Disaster management, Personal Navigation, Transportation, Surveying, Agriculture, Liability Applications, Timing

– Dominant subject (presentation numbers):

Disaster management 30%

Transportation 13%

Personal Navigation 30%

Surveying 13%

– Notice :

- Indoor – Outdoor Seamless PNT services are highly required for disaster management, personal navigation and etc.

Outcomes from 1st ~4th App SG meetings

- Several enabling technologies were identified by SG, such as, Precision, Communication, Integrity, Authentication, SBAS

- Dominant subjects (presentation numbers) :

Precision 40%

Communication 30%

including the collaboration with communication system

- Notice :

- Multi-GNSS is effective for improving the availability, especially GEO and IGSO satellite is more.
- High precision positioning (~cm-level) is required for some APPs.

Outcomes from 1st ~4th App SG meetings

- Additional discussions :
 - Short message is useful for disaster management.
 - GNSS reliability is important for users.
 - SBAS corrections are useful to enhance positioning accuracy for Open Service Users

2. GNSS Application Classification

- We compile the findings in a report, targeting to quantify a range for the user needs per application domain and consequently make catalogues.*
- We will update these as new applications.*

Domain 1

Personal Navigation

Field	Function	precision	comments
Pedestrian	Sightseeing	1m ~ 10 m	Find a place which you want to go and navigate
	Shopping	1m ~ 2 m	Find a shop which you want to go and navigate
Personal monitoring	Safety monitoring	5m ~ 10 m	Body guards
	Guardianship	5m ~ 10 m	Watching for children, the sick and the aged safety

Important mentions

/ Multi-GNSS, especially with hybrid constellation are effective for improving the availability even on city canyon

/ indoor-outdoor seamless PNT services are highly required

/ indoor positioning using WiFi, Bluetooth, IMES, etc. are discussed now

/ hand-carry based equipment like cell phone is really important to grow the market

Domain 2

Timing

Field/Function	precision	comments
Power grid time synchronization	<50ns	This function is critical for widespread areas and regions
Communication base station time synchronization	<1.5 μ s	It is important for the integrity of communication systems

Important mentions

- / the goal is to replace high precision atomic clock installed in these systems
- / time information error detection is a critical function

Domain 3

Real-time Monitoring

Field/Function	precision	comments
Tailings monitoring	1cm ~ 5cm	Safety insurance
Bridge health monitoring	1cm ~ 5cm	Trend data, Continuous monitoring
Dam monitoring	1cm ~ 5cm	Trend data
Building monitoring	1cm ~ 5cm	Trend data, Wind load
Landslide monitoring	1cm ~ 5cm	Trend data, Predict disaster damages and reduce ones
Railway track	1 mm ~ 1 cm	Trend data

Important mentions

- / high precision and integrity are required
- / reliable information network is one significant part
- / collaborate with communication systems

Domain 4

Space Utilities

Field	Function	precision	comments
TSV	LEO Satellite Attitude Determination	$(0.2/R)^\circ \sim (0.4/R)^\circ$	Low-cost
	LEO OD	10m ~ 100m	High dynamic range
	Rendezvous and Docking	1cm ~ 10cm	High-precision required
SSV	GEO OD	10m ~ 100m	Weak signals Few satellite signals
Over SSV	Lunar Exploration	100m ~ 1000m	Even Weaker Even fewer
	Mars Exploration	100m ~ 1000m	Even Weaker Even fewer

Important mentions

- / enough GNSS satellites is the most important issue
- / weak signal process methods need to be researched in depth
- / Multi-constellation interoperability

Domain 5

Disaster Management

Field/Function	precision	comments
Earthquake	1cm ~ 5m	Earthquake prediction Rescue after disaster occurred
Volcano	1cm ~ 10m	Volcano prediction Rescue & keep off disaster area
Forest fire	5m ~ 10m	Forest fire-spread prediction Rescue & keep off disaster area
Mudslide	A few mm ~ 1cm	Mudslide prediction Rescue & keep off disaster area
Flood	5m ~ 10m	Rescue after disaster occurred

Important mentions

- / 3S(GNSS & Remote Sensing & GIS)+C(Communication) are really important
- / Short message is really useful because ground stations in disaster area are mostly collapsed
- / indoor-outdoor seamless PNT services are required, especially to rescue.

Domain 6

Transportation

Field/Function	precision	comments
Road (car, bike)	10cm ~ 2m	Traffic control, automatic-driving Accuracy requirement leaded on tire size ,body size or road-lane size
Water (ship)	1cm ~ 10m	Ship control (e.g. bring a ship alongside the pier) Presence for safety
Rail (train, streetcar)	1cm ~ 15m	rail parallel management train operation management & control
Road pricing	1 m ~ 5 m	Concern in the traffic management, environmental management ,or so on

Important mentions

- / the integrity and the authentication are especially required
- / combination with other positioning system like gyro is recommended
- / Multi-GNSS, especially with hybrid constellation is effective for improving the availability even on city canyon

Domain 7

Agriculture

Field/Function	precision	comments
Robot and auto-guidance system	A few cm ~ 30 cm	e.g. Depend on working field size

Important mentions

/ IT agriculture market is expected to grow as the farmer aging and the world population growing



International Committee on
Global Navigation Satellite Systems

Domain 8

Others

Field/Function	precision	comments
Aviation	Detailed by ICAO	No further discussion but its requirements would be cited in the catalogues
Surveying & Mapping	???	Applications not included in Domain 3 Lack of presentations in the previous App SG meetings
Meteorology & Hydrology	???	Lack of detailed presentations in the previous App SG meetings

Important mentions

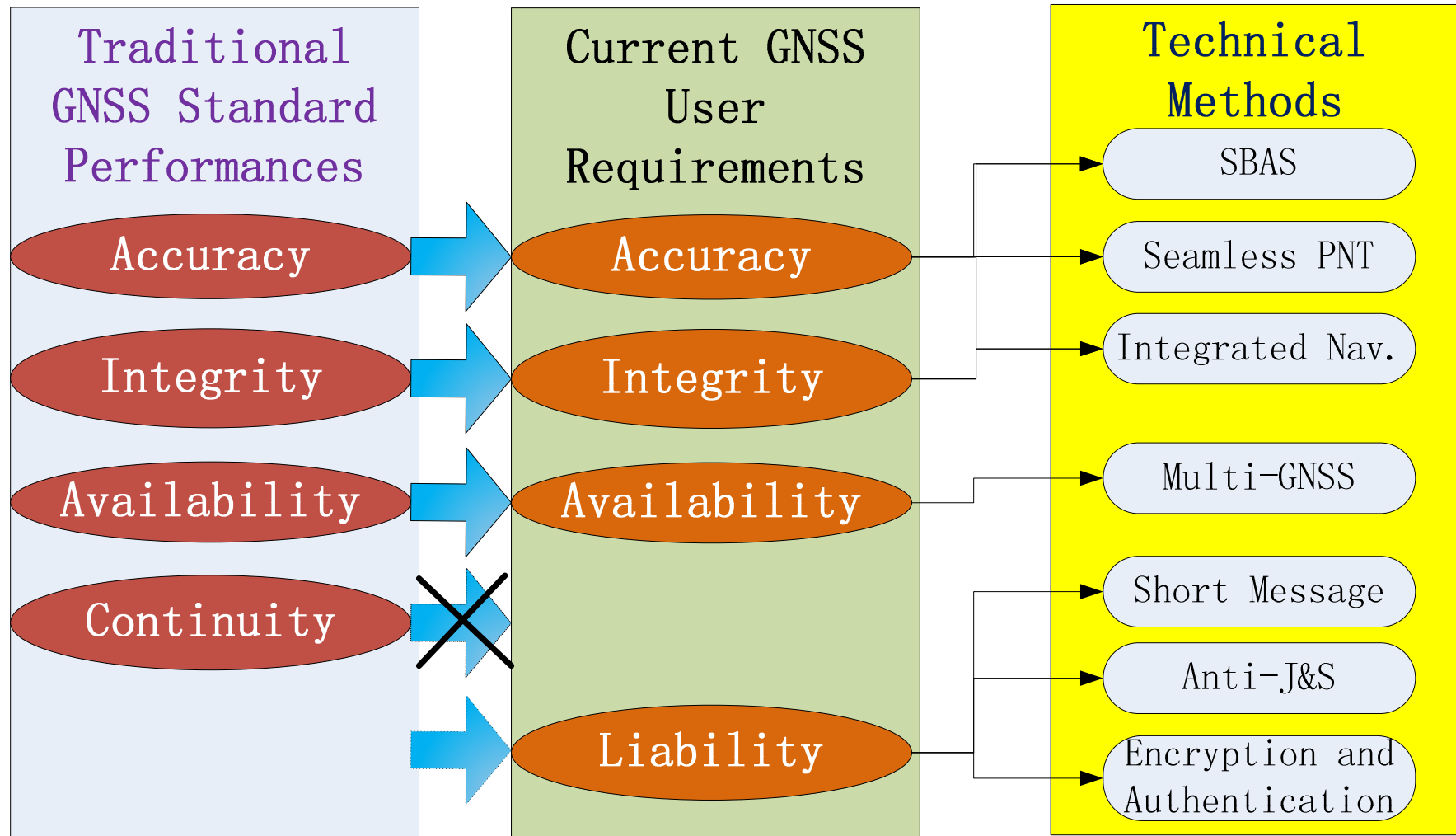
/ There are increasing new GNSS applications not included in our past presentations

/ The subgroup will invite new emerging applications and take them in the classification as updates

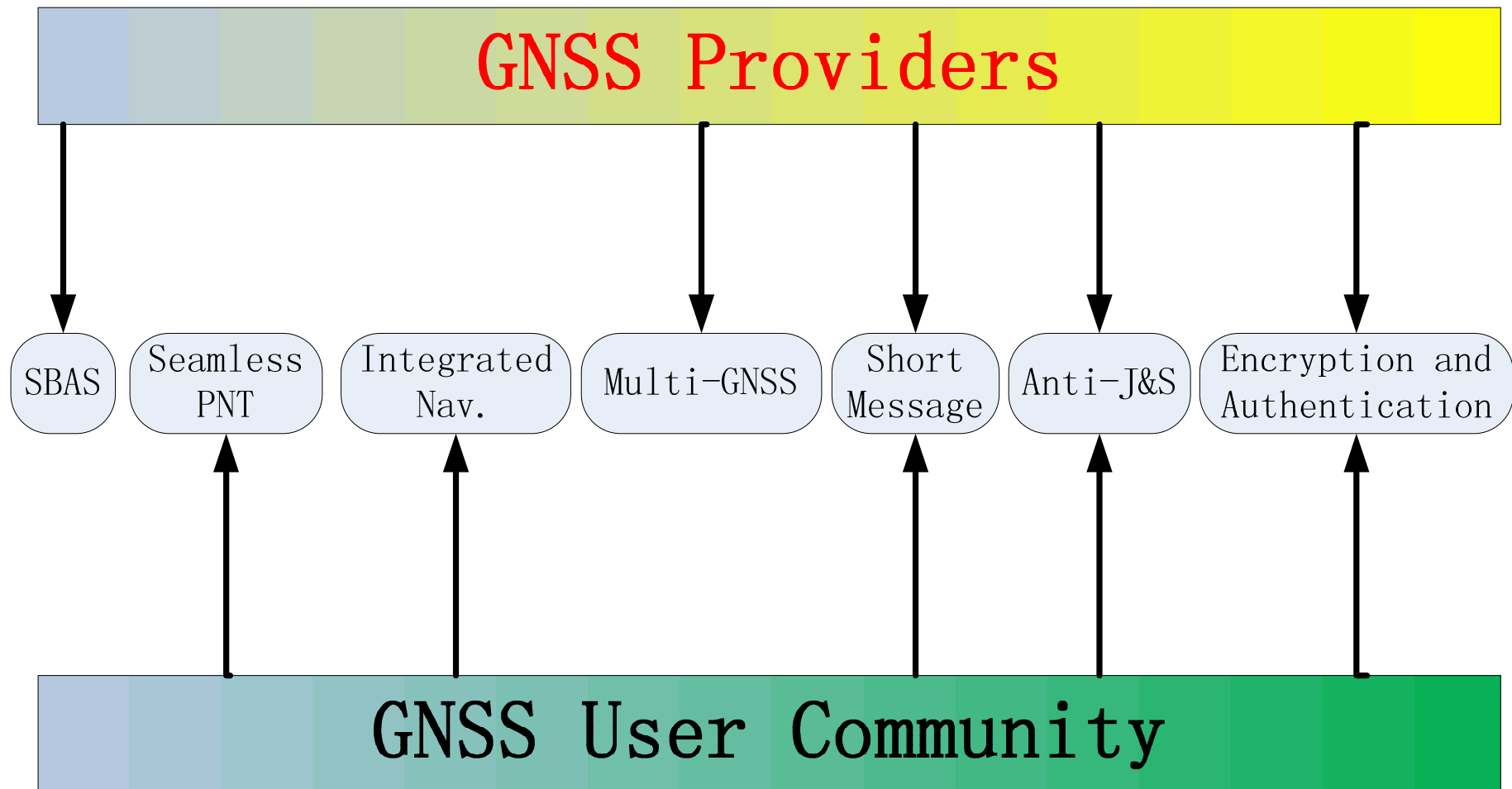
3. Suggestions to GNSS Providers

- *Alteration trend of GNSS user requirements*
- *Key technologies to be developed*

Alteration of GNSS user requirements



Key technologies to be developed



4. Future Plans

1. *A printed questionnaire about GNSS market will be distributed to all the representatives of GNSS providers for suggestions in the margin of ICG-10.*
2. *We are planning to develop a cellular questionnaire App in 2016 to improve the task of the 1st step, with the benefits of enlarging the investigation popularity and automatically statistical analysis.*
3. *The next App SG meeting is scheduled to be held in conjunction with Munich Summit 2016, or ION GNSS+ 2016, or CSNC 2016, in which the international organizations, product manufacturers and service providers will be invited to take part.*
4. *All the suggestions will be collected and collated in the draft report before ICG-11.*
5. *GNSS industry report (V1.0) will be released on the official website of UNOOSA through ICG-11 discussion.*

*THANK YOU
FOR YOUR ATTENTION*