

GNSS Application Catalogues User Requirement Electronic Questionnaire Status

By ICG WG-B Application Subgroup

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9, November, 2016



International Committee on
Global Navigation Satellite Systems

OUTLINES

1. Backgrounds and motivations
2. GNSS Application Catalogues Update
3. User Requirement Electrical Questionnaire
 - Function definition and system design
 - Questions allocations and logic
 - Technical solutions and system tests
4. Future plan

1. Backgrounds

- Mission Review
 - Task from ICG-9 on Application Catalogues
 - To compile the findings in a report
 - The target is to quantify a range for the user needs per application domain and consequently make catalogues
 - Task from ICG-10 on Requirement Questionnaire
 - ICG Participants are invited to fill questionnaire and feedback to co-chairs
 - Questionnaire will be made available at ICG website

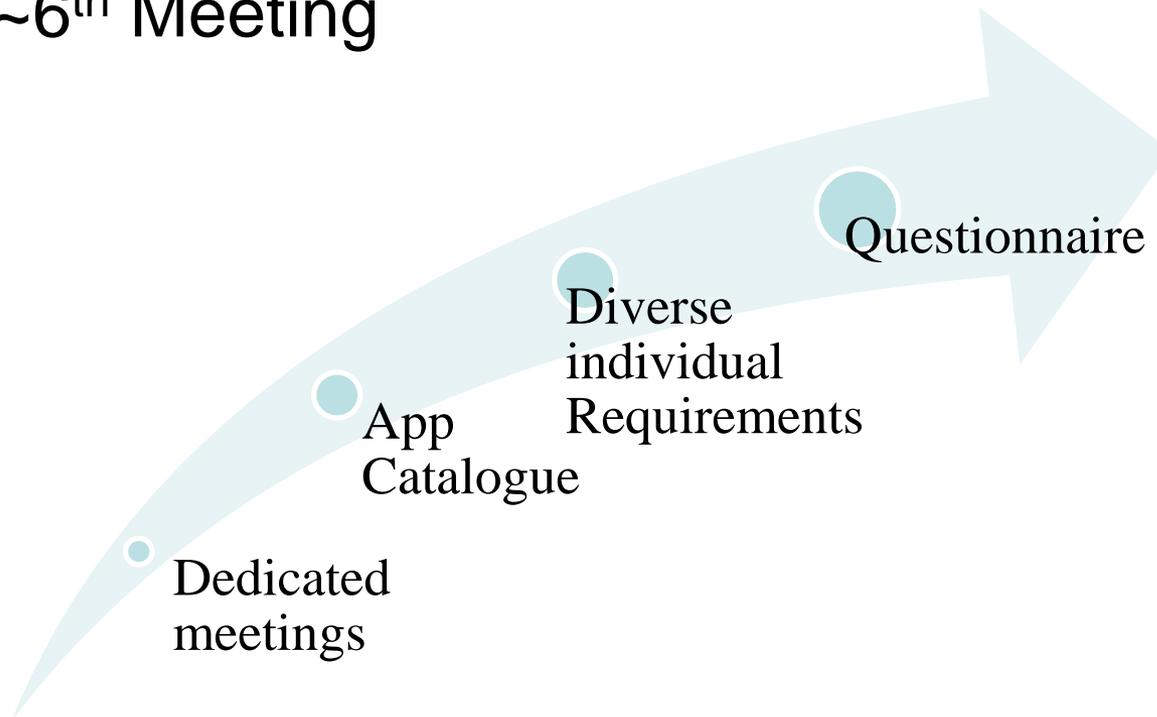
1. Backgrounds

App SG Meetings Summary since ICG-6

Mtg	Venue	Date	Theme	In conjunction with
1st	Munich, Germany	2012/03/12,13	App on Mass Market Liability	Munich Summit
2nd	Wuhan, China	2013/05/14	App on Surveying, Disaster Management, Maritime, Liability	China Satellite Navigation Conference
3rd	Daejeon, Korea	2013/07/18	App on Disaster Management, Agriculture, Surveying, Timing	National GNSS Research Center Symposium
4th	Jeju, Korea	2014/10/22	App on SBAS, Surveying, Mass Market, Disaster	International Symposium on GNSS
5th	Vienna, Austria	2015/06/10	Application Catalogue Architecture	ICG series meetings
6th	Munich, Germany	2016/03/01	Catalogue Architecture and methodology	Munich Summit

1. Backgrounds

- Outcomes from App SG meetings
 - Core applications and enabling technologies were identified during SG 1st~4th Meeting;
 - Application Catalogue were defined during SG 5th~6th Meeting



1. Motivations

- Questionnaire benefits to WGB
 - To provide sufficient and significant data for GNSS application report
 - To provide a guideline for WGB future work
- Questionnaire benefits to application domains
 - To identify GNSS performance requirements in each domain as many as possible
 - To offer suggestions to GNSS service providers and product manufacturers

2. Application Catalogues Updates

- 8 different application domains In total are covered and ranges for performance targets are identified
 1. Personal Navigation
 2. Timing
 3. Real-Time Monitoring
 4. Space Utilities
 5. Disaster Management
 6. Transportation
 7. Agriculture
 8. Surveying & Mapping
- The achieved performance targets are expected to find a requirement balance between User community and Service Providers through a joint effort.

2. Application Catalogues Updates

Domain 1

Personal Navigation(1/2)

Field	Function	precision	comments
Pedestrian	Sightseeing	/5m ~ 10 m	/ Find and navigate to a place where you want to go
		/1m ~ 2 m	/ information with Augmented Reality
	Shopping	1m ~ 2 m	Find and navigate to a shop where you want to go
	Disable people guidance	0.5m ~2 m	Wheelchair navigation
Personal monitoring	Safety monitoring	5m ~ 10 m	Body guards
	Guardianship	5m ~ 10 m	Watching for children, the sick and the aged safety

2. Application Catalogues Updates

Domain 1

Personal Navigation(2/2)

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 cellular phone is really important to grow the market
- / message authentication is really required, especially to use the guidance for disable people

2. Application Catalogues Updates

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
Electronic business transaction	\sim 10ms 	Standardization between transactions is required

Important mentions

- / the goal is to replace high precision atomic clock installed in these systems
- / time information error detection is a critical function
- / message authentication is really required, especially to use the electronic business transaction 

2. Application Catalogues Updates

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

2. Application Catalogues Updates

Domain 4

Space Utilities

Field	Function	precision	comments
TSV	Attitude Determination	0.2° ~ 0.4°	Low-cost
	Orbit Determination	10m ~ 100m	High dynamic range
	Rendezvous & Docking	1cm ~ 10cm	High-precision required
SSV	GEO Orbit Determination	10m ~100m	Weak signals Few satellite signals
Beyond SSV	Lunar Exploration	100m ~1000m	Even Weaker and fewer
	Mars Exploration	100m ~1000m	Even Weaker and fewer

Important mentions

/ enough GNSS satellites is the most important issue

/ weak signal process methods need to be researched in depth

/ Multi-constellation interoperability

2. Application Catalogues Updates

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.

2. Application Catalogues Updates

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 along 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
- / Coordination between position and map is important, especially cm-level



2. Application Catalogues Updates

Domain 7

Agriculture

Field/Function	precision	comments
Robot and auto-guidance system	A few cm ~ 30 cm	To be determined with working field size

Important mentions

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

2. Application Catalogues Updates

Domain 8

surveying & mapping

Field/Function	precision	Comments
Surveying	A few mm ~ 0.5 m	/ depend on users
Registry of land	A few mm ~ 3 cm	/ depend on country law
Mapping	0.1m ~ a few m	/ Map for automatic driving is requested for high accuracy. / depend on users

Important mentions

/

2. Application Catalogues Updates

Domain 9

Others

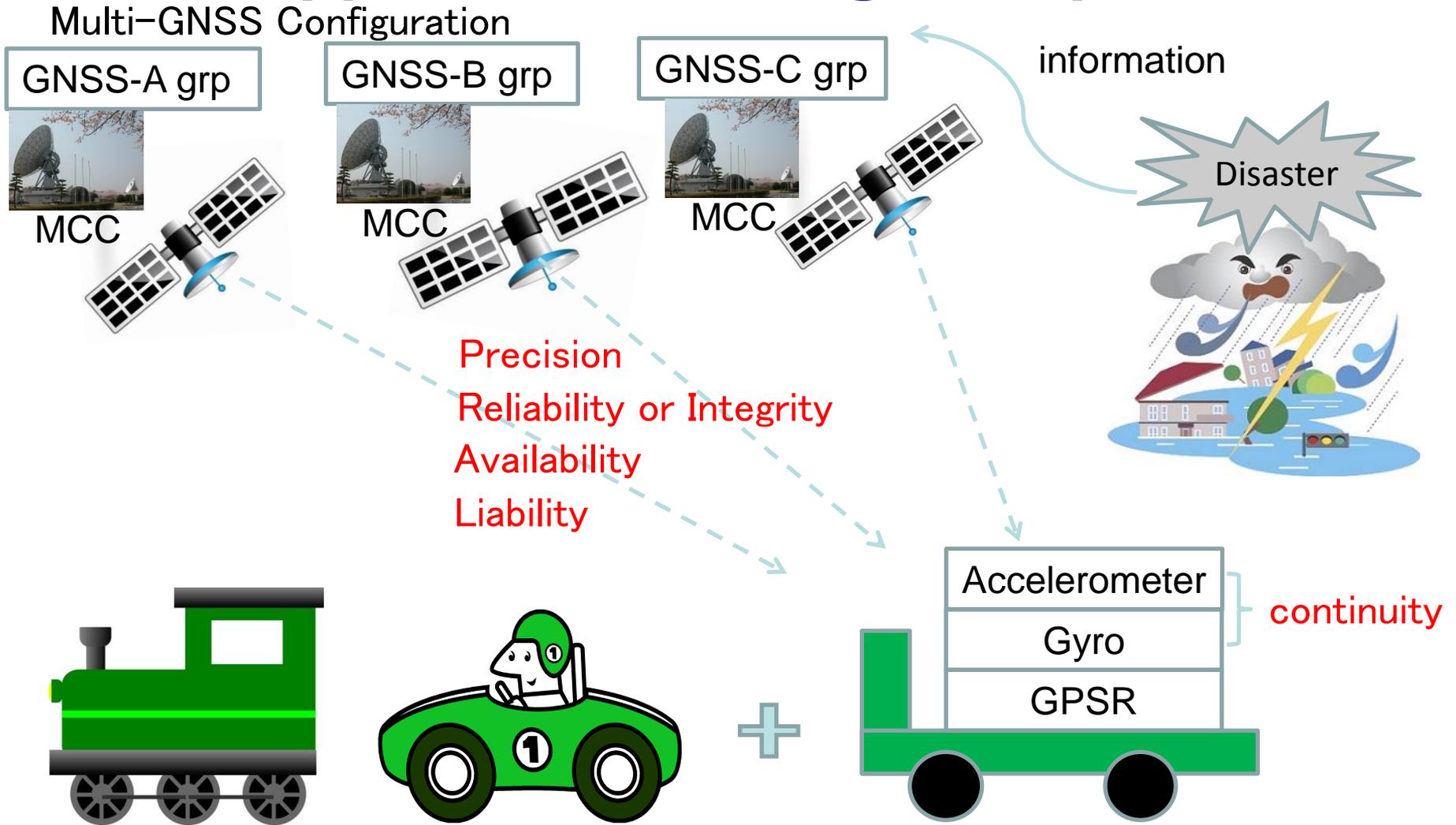
Field/Function	precision	comments
Aviation	Detailed by ICAO	No further discussion but its requirements would be cited in the catalogues
Meteorology & Hydrology	TBD	Lack of detailed presentations in the previous App SG meetings

Important mentions

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

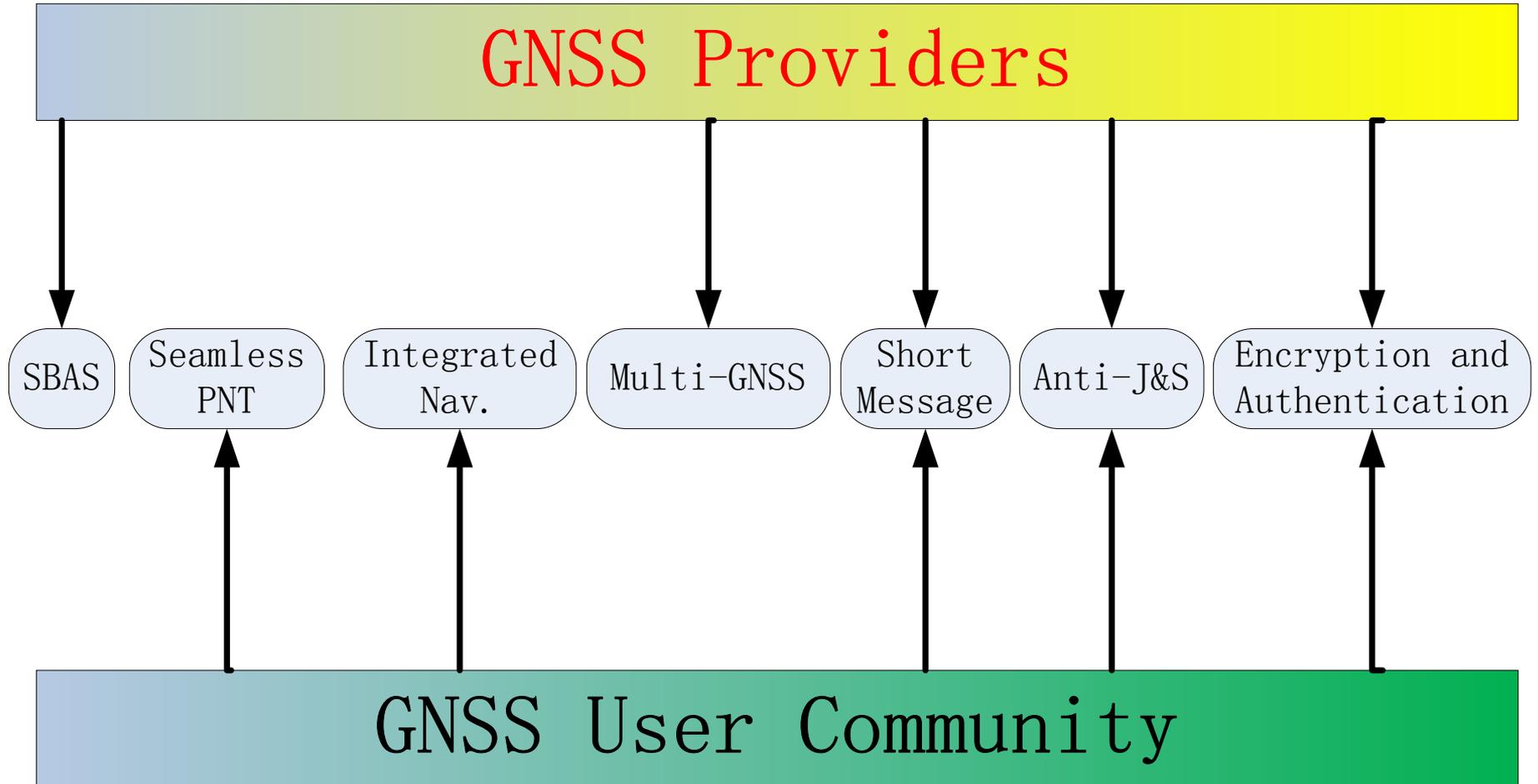
/ The subgroup will invite new emerging applications and take them in the classification as updates

2. Application Catalogues Updates



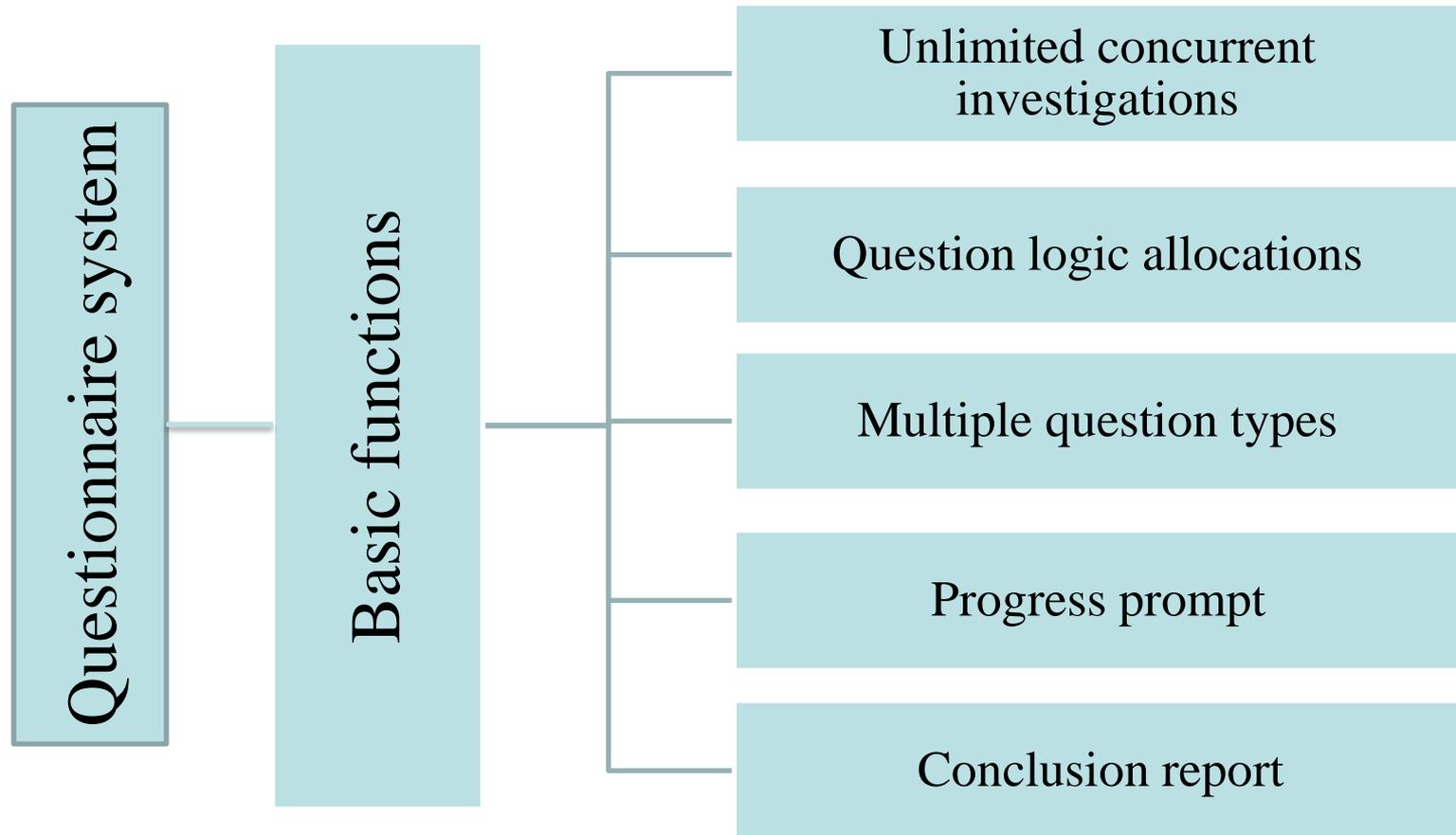
Requirement Trends

2. Application Catalogues Updates



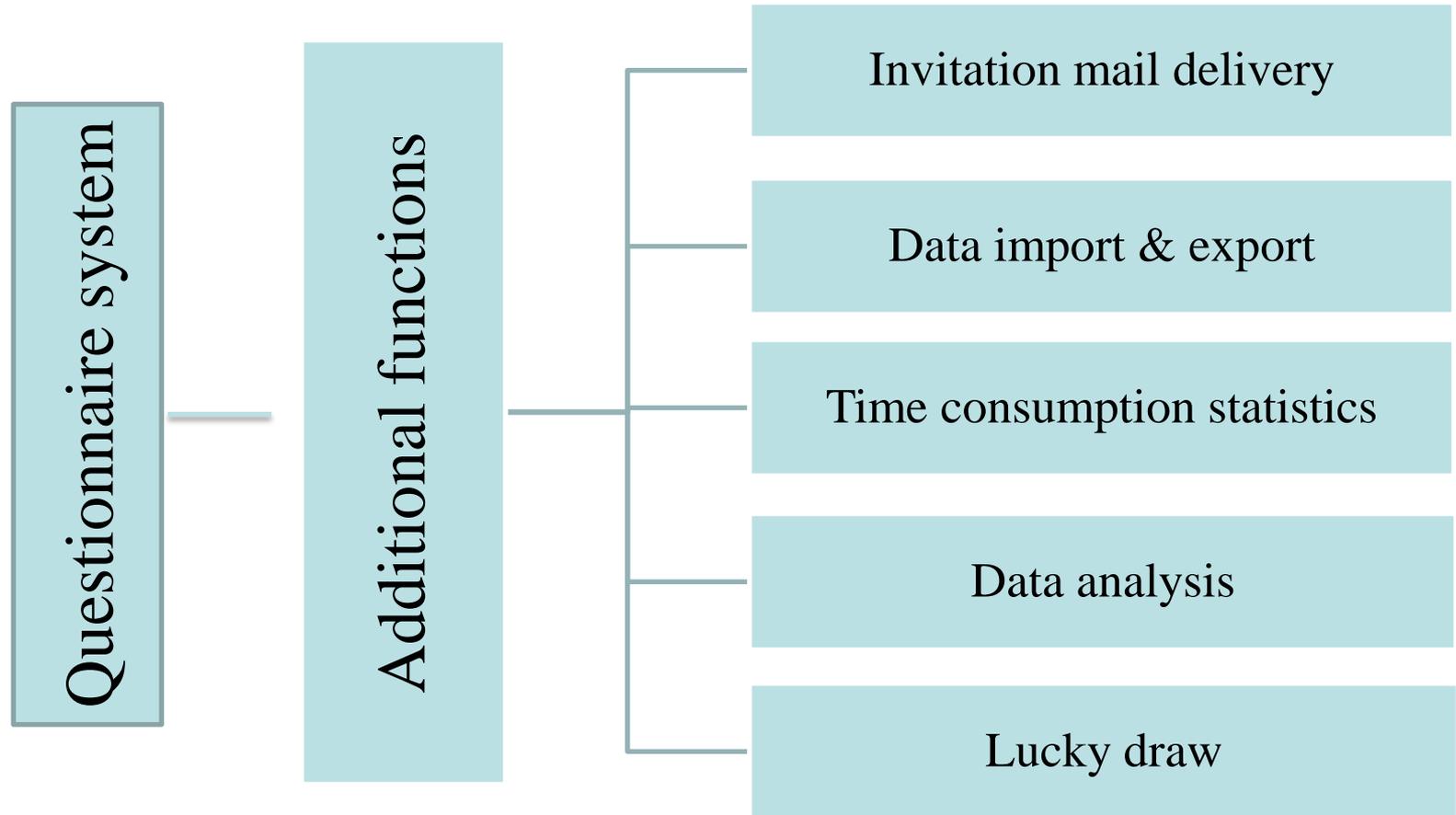
Technical Trends

3. Electronic Questionnaire



Function Definition – Basic

3. Electronic Questionnaire



Function Definition – Additional

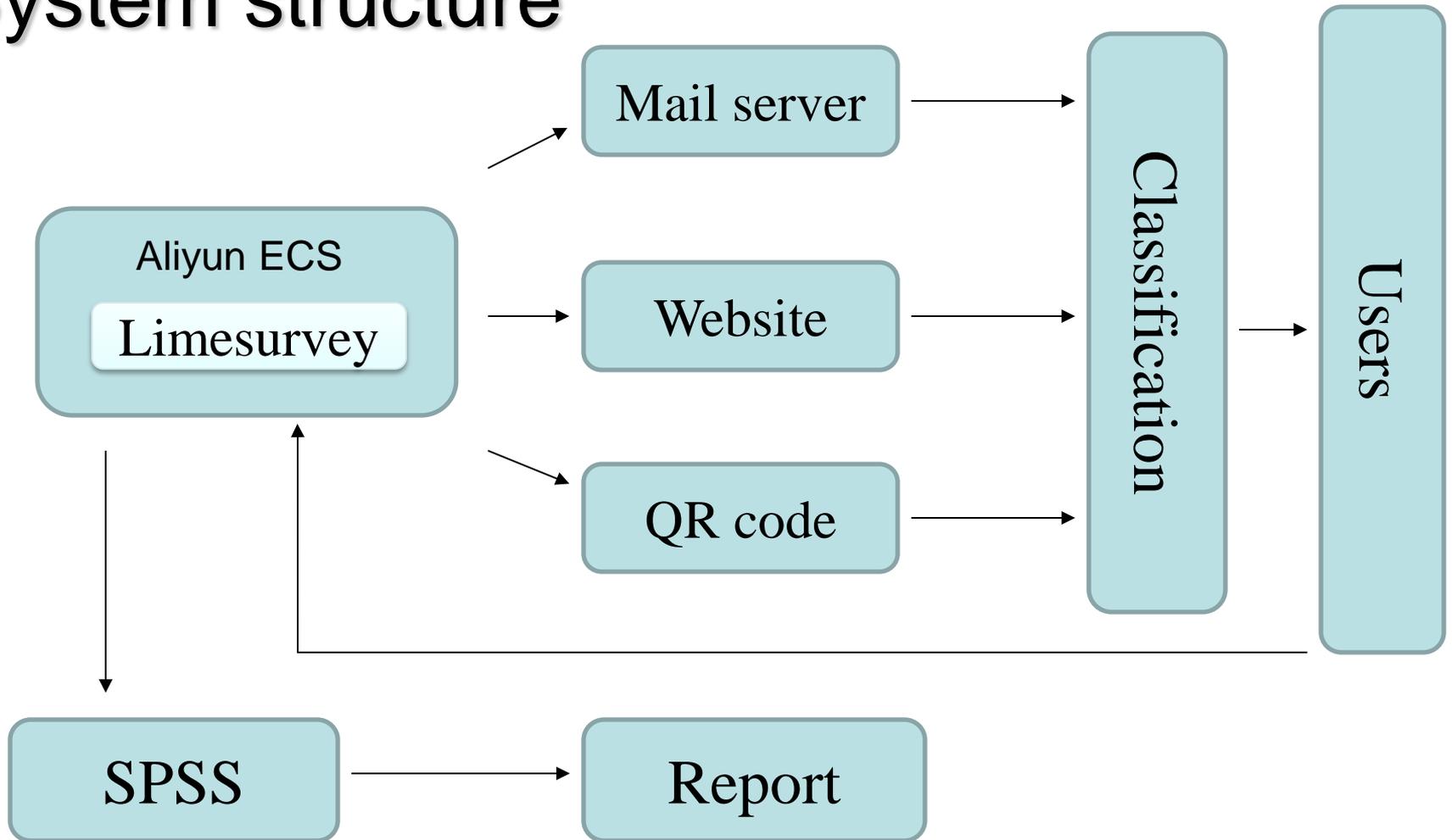
3. Electronic Questionnaire

System parameters

Parameter	Type	Note
Survey tool	Limesurvey	Open source
Database	MySQL	Version:5.5.49
Code language	PHP	Version:5.5.9
Server	Aliyun ECS	Single-core,1G,25M
Data analysis	SPSS	Version: 22.0

3. Electronic Questionnaire

System structure

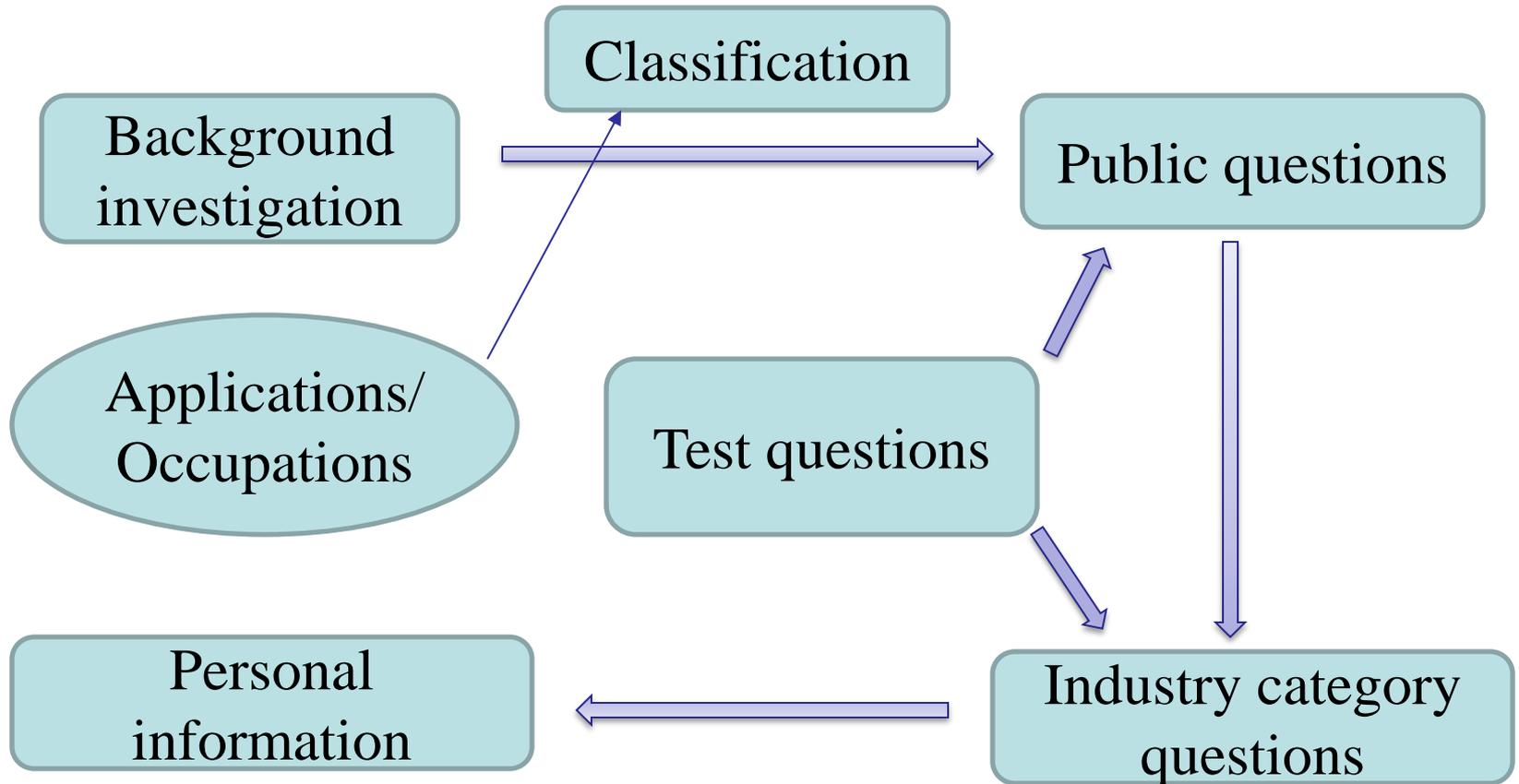


3. Electronic Questionnaire



Question allocations

3. Electronic Questionnaire



Question logic

3. Electronic Questionnaire

- Technical issues with solutions
 1. Data analysis:
 - Filter and export the data (*.dat)
 - Analyze the data (or text) with SPSS
 2. Reduction of data noise:
 - Consider the time consumption the users spend for each question
 - Consider the answers to the test questions
 - Analyze the logical consistence among answers

3. Electronic Questionnaire

- Technical issues with solutions
 3. Email invitation service:
 - Establish the mail server
 - Build up the address book
 4. Lucky draw function:
 - Develop a novel algorithm
 - A unique verification code corresponds a winner
 - Investigator get gifts from future sponsors

3. Electronic Questionnaire

Beta2 Test: May 13,2016

Question bank modified;
Question added and deleted;
Mail server built.

Beta1 Test: May 6,2016

Display optimized;
Notes Added;
Order adjusted.

Beta3 Test: May 26,2016

Luck draw function added;
Mail service added;
Questionnaire system optimized.

**V1.0:
Sep 13th,
2016**

3. Electronic Questionnaire

- Test results:
 - Total time consumption (Beta1)

Total time(s)	0~500	500~1000	1000~1500	1500~2000	2000~2500	Above 2500
Proportion	0	35.7%	21.4%	21.4%	7.1%	21.4%

- Duration in average : ~ 25 mins
- Note: Requests to beta users:
 - To check the logic among the questions;
 - To point out mistakes in the questionnaire;
 - To give suggestions for system optimization.

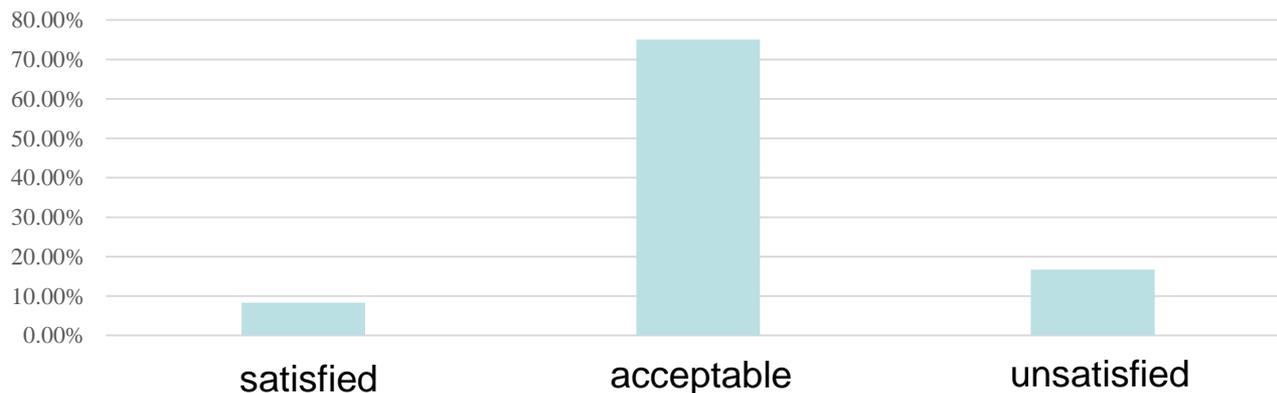
3. Electronic Questionnaire

- Test results:
 - The number of questions and samples in total:

Version	beta1	beta2	beta3	V1.0	V1.1
questions	79	94	97	96	~35
samples	14	14	6	27	10

- A sample result of one specific question:

Are you satisfied with the GNSS service?



4. Future plan

Distribute to all ICG11 participants for further improvement.

*Release modified questionnaire
UNOOSA ICG portal.*

*Collect samples,
Analyze data &
Draft report.*



Nov



Mar



Before
ICG-12



Future Plan

GNSS Application Requirement Questionnaire (v1.1)

Website: <http://121.42.29.87/index.php/377458?lang=en>



Investigation would request you about 15 mins.

**THANKS VERY MUCH
FOR YOUR ATTENTION**

If you browse the questionnaire and share it to your colleagues/ students/ customers, it would be highly appreciated.