CNES

SBAS DSVP PHASE 3

WP7-D1.2:
SBAS DSVP USER MANUAL

CONTRACT N°C3502

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DOCUMENT REVIEW

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DOCUMENT LOG

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V1.1	18/07/2018	Include RINEXn, RINEXb, Replay, RIMS smoothing filter, corrections model	
V1.2	03/12/2018	New SBAS DSVP functions: • run modes: console and HMI • list of user coordinates	
V1.3	12/06/2019	Update for evolutions in SBAS DSVP Phase 3	
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1 INTRODUCTION

1.1 Background

The deployment of new dual-frequency GNSS constellations (modernized GPS, Galileo, GLONASS, BeiDou) will support in the coming years an improved positioning service in terms of number of available signals, geometry, ionosphere delay mitigation, etc.

Different working groups are dedicated to the evolution of the satellite based augmentation systems (SBAS) towards the future Dual-Frequency Multi-Constellation (DFMC) GNSS environment. In particular, the SBAS Interoperability Working Group (IWG) is working on the development of an SBAS DFMC Definition Document including an SBAS DFMC L5 Interface Control Document (ICD) in order to initiate the standardisation of the future SBAS DFMC system and services. Other working groups such as the EUROCAE WG-62 and the RTCA SC 159 are also committed by their respective terms of reference in the development of standards to support the introduction of future SBAS DFMC user receivers.

In Europe, the EGNOS Version 3 development as an SBAS DFMC system is expected to be operational at the horizon of the completeness of the 24 GPS L1/L5 constellation (2024). A consolidated SBAS DFMC standard is a key element to freeze the final system design with respect to the targeted aeronautical services, as well as to assure the interoperability among other DFMC SBAS systems in the future to maximise the benefits of SBAS DFMC avionics.

1.2 Project objective

The project aims at developing an SBAS DFMC Service Volume software Prototype (DSVP) to support the consolidation of SBAS DFMC standardisation activities and to contribute to the system performance assessment. The prototype should also provide outputs that could feed test activities of future SBAS DFMC receiver prototypes.

1.3 Scope of the document

The present document is produced within the SBAS DSVP Phase 3 project and provides the updated installation and user manual of the SBAS DSVP.

1.4 References

Items	Name	Author	Issue

2 SBAS DSVP INSTALLATION

2.1 MATLAB Compiler Runtime

To run the SBAS DSVP executable file it is required to have installed first the Matlab Compiler Runtime (MRC), which can be downloaded from the Mathworks site:

http://www.mathworks.com/products/compiler/mcr/index.html

2.2 Main directory

The set of files required to run the SBAS DSVP, and generated by the SBAS DSVP, are contained in the three following folders:

- "Code"
  - Containing the executable file and/or the source code;
- "conf"
  - Containing the configuration files;
- "outputs"
  - Containing the output files generated by the prototype after running a simulation. The SBAS DSVP can be run if the folder "outputs" does not exist; it will be created automatically in the same folder as the folder "conf".

Default configuration

In the default configuration, these three folders should be located in the same directory (Figure 1). The name of the "Code", "conf" and "outputs" folders should not be modified, but the main directory containing these folders can have any name. The files contained in "Code" and "conf" should not be moved to a different folder.

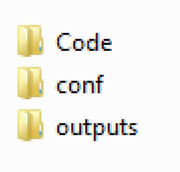

Figure 1. Content of SBAS DSVP main directory.

Modified configuration

The SBAS DSVP can be run with an optional argument to specify the path to the folder "conf" (see section 2.4). In this case, the folders "Code" and "conf" can be located at different folders. The SBAS DSVP outcomes are saved in the folder "outputs" located in the same folder as the folder "conf" (the folder "outputs" is created if it does not exist).

2.3 Configuration files

The directory "conf" contains the configuration files organised in the following 5 folders (Figure 2):

- "1_directory_conf", containing the directory configuration file:
  - "directory_conf.txt"
    - Default configuration file names (almanac file names, ground station file, etc.) and directory names.

- “2_system_conf”, containing two files:
    - “system_conf.txt”
        - Default SBAS DFMC system configuration file.
    - “priority_messages.txt”
        - Priority messages configuration file (to define for example SBAS DFMC alert messages).
- “3_RIMS”, containing the ground station coordinates file;
- “4_almanacs”, containing the almanac files for each constellation in YUMA format;
- “5_IGP_grid”, containing the L5 IGP grid configuration file:
    - “IGP_grid.xlsx”
        - Defines the L5 IGP grid
- “6_RINEX_N”, containing the navigation RINEX files that can be used to extract the satellite ephemeris. These RINEX N files can be V2 and V3 and need to follow the RINEX N naming conventions;
- “7_RINEX_B”, containing the binary RINEX files that can be used to extract the navigation messages if the Replay function is selected. These RINEX B files need to contain SBAS DFMC messages indicating they have been broadcast on the L5 frequency, and need to follow the RINEX B naming conventions. The file names need to have “dsvp” as station ID;

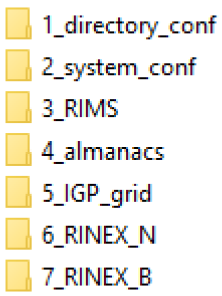

Figure 2. Configuration directory.

The folder “1_directory_conf” and the file “directory_conf.txt” cannot be renamed. The name of the rest of folders and files can be modified provided they are modified in the file “directory_conf.txt” as well.

2.4 Running the SBAS DSVP

The SBAS DSVP is launched running the executable file “sbas_dsvp.exe” or the MATLAB function “sbas_dsvp.m” contained in the “Code” folder. The function ‘sbas_dsvp’ can be called with 0, 1 or 2 arguments as follows, where the arguments within brackets are optional:

sbas_dsvp([run_mode], [conf_path])

- [run_mode]: optional argument. If it is used, it must be always the first argument. It has two possible text values:
    - ‘hmi’: runs the SBAS DSVP through the MATLAB GUI
    - ‘console’ : runs the SBAS DSVP without the MATLAB GUI
    - ‘YUMA2RINEX’ : runs the conversion from almanac YUMA files into ephemerides navigation RINEX files

- [conf_path]: optional argument. If it is used, it must be always the second argument.
  - It specifies the path to the folder containing the different SBAS DSVP configuration files.

The default run mode, used if the argument [run_mode] is not given, is ‘hmi’.

The default configuration path, used if the argument [conf_path] is not given, is a folder named ‘conf’ located in the parent directory of the function ‘sbas_dsvp.m’.

Table 1 summarises the different options to call the SBAS DSVP function.

Table 1. SBAS DSVP function call options

Nr.	SBAS DSVP function call	MATLAB GUI	Conf path
1	**sbas_dsvp**	Yes	Default
2	**sbas_dsvp()**	Yes	Default
3	**sbas_dsvp(**‘hmi’**)**	Yes	Default
4	**sbas_dsvp(**‘console’**)**	No	Default
5	**sbas_dsvp(**‘hmi’, ‘specific_path’**)**	Yes	‘specific_path’
6	**sbas_dsvp(**‘console’, ‘specific_path’**)**	No	‘specific_path’

2.5 Output directory

The directory “outputs” is created after running the prototype if it does not exist. It contains the output files of all scenarios that have been run. The outputs of a given scenario are stored in a folder with the scenario name defined by the prototype operator. Each of these folders contains several folders with the scenario configuration structure in MATLAB format and the different output types selected by the prototype operator.

3 SBAS DSVP CONFIGURATION

3.1 Introduction

All SBAS DSVP configuration parameters can be configured via several configuration files, mainly:

- Directory configuration file
- System configuration file

Additionally, the Graphical User Interface (GUI) allows configuring a significant number of parameters.

3.2 Directory configuration file

The directory configuration file defines the name of the different configuration directories and configuration files, as well as the name of the output directories.

It is a text file named “directory_conf.txt” contained in the configuration folder “conf/1_directory_conf”. It is the only configuration file which name cannot be modified.

The configuration parameters are organised by “data fields” within the directory file. Each data field is composed of all text file lines since the start of the data field until the start of the next data field. A data field can contain empty lines. The first line of a data field starts by at least 4 equality signs (====) followed by the name of the data field. The data field name cannot be modified, but it can be preceded by more than 4 equality signs, and it can be followed by a string of equality signs. It is possible to modify the order of the different parameters within a data field. It is also possible to modify the order of the data fields within the file. Comment lines start by two asterisks.

Table 2 describes the configuration file line by line. The elements highlighted in grey should not be modified. Blue background identifies the data field start lines.

Table 2. Directory configuration file parameters

Configuration file data lines	Comment
====== Configuration directories ======	Data field
System config., 2_system_conf	Directory containing the system configuration file and the priority messages file
RIMS, 3_RIMS	Directory containing the RIMS configuration file
Almanacs, 4_almanacs	Directory containing the almanac YUMA file names
IGP grid, 5_IGP_grid	Directory containing the IGP grid conf. file
Rinex_N, 6_RINEX_N	Directory containing the navigation RINEX files (ephemerides) and the UTC-GPS time difference file
Rinex_B, 7_RINEX_B	Directory containing the input binary RINEX files used in the Replay mode
====== SBAS system configuration files ====	Data field
System conf., system_conf.txt	System configuration file name

Configuration file data lines	Comment
Alerts, priority_messages.txt	Priority messages file name
====== Almanac files (YUMA) =======	Data field
Galileo, alm_gal.txt	Galileo almanac YUMA file name
GPS, alm_gps.txt	GPS almanac YUMA file name
SBAS,	SBAS almanac YUMA file name (it is possible if constant SBAS satellite coordinates are used)
GLONASS, alm_glo.txt	GLONASS almanac YUMA file name
Beidou, alm_bds.txt	BeiDou almanac YUMA file name
===== RIMS =====	Data field
RIMS coordinates, RIMS_EGNOS_44.txt	RIMS configuration file name (contains RIMS names, coordinates and mask angles)
======= IGP grid files ======	Data field
IGP grid, IGP_grid_EGNOS.xlsx	IGP grid configuration file name (used in the single-frequency mode)
======= UTC-GPS time difference =====	Data field
UTC-GPS time difference, UTC_GPS_time_difference.txt	UTC-GPS time difference file name (used to convert GLONASS time into GPS time)
====== IODN ======	Data field
IODN, IODN_changes.txt	IODN change file name (used to compute MT32 corrections)
====== Output directories =========	Data field
Main output dir., outputs	Name of the directory containing the DSVP run output folder
Configuration, conf	Name of the output MATLAB variable containing the configuration
Messages, messages	Name of the directory containing the output text files and figures for the broadcast messages
RINEX, RINEX	Name of the directory containing the output binary RINEX files The DSVP will search in this directory navigation RINEX files for the simulation dates based on the RINEX file name conventions. Note: DSVP broadcasts in MT 32 the IODN obtained from the ephemerides. When almanacs are used, the IODN is set to constant '1'.
DFRE, DFRE	Name of the directory containing the output text files and figures for the DFRE
Covariance matrix, DFRE_mat	Name of the directory containing the covariance matrix output text files
Nr. monitored sat., monitored_sat	Name of the directory containing the output text files and figures for the number of satellites monitored by the ground segment
GIVE, GIVE	Name of the directory containing the output text files for the GIVE

Configuration file data lines		Comment
Corrections,	dfmc_correct	Name of the directory containing the output text files and figures for the MT32 corrections
IODN table,	iodn_table	Name of the directory containing the output text file containing the IODN changes obtained from the ephemerides files
SV coordinates,	sat_xyz	Name of the directory containing the output text files for the satellite coordinates
Nr. satellites,	N_sat	Name of the directory containing the output text files and figures for the number of visible and used satellites by the user segment
VPL,	VPL	Name of the directory containing the output text files for the user VPL
HPL,	HPL	Name of the directory containing the output text files for the user HPL
xPL performance,	performance	Name of the directory containing the output text files and figures for the user HPL/VPL performance metrics like availability and continuity maps and VPL percentile maps
Pseudorange info.,	psr	Name of the directory containing the output text files for the user pseudorange error models
DOP,	DOP	Name of the directory containing the output text files for the user DOP
Scintillation,	scintillation	Name of the directory containing the output text files and figures for the scintillation
YUMA2RINEX,	RINEX_N	Name of the directory containing the output navigation RINEX files (ephemerides) obtained from almanacs

3.3 System configuration file

The system configuration file defines the DFMC SBAS operational parameters.

It is a text file named [system_conf_file] contained in the configuration folder "conf/[system_conf_dir]", where:

- [system_conf_file] is the file name defined in the directory configuration file (data field "SBAS system configuration files", parameter "System conf.")
- [system_conf_dir] is the directory name defined in the directory configuration file (data field "Configuration directories", parameter "System config.,"),

The configuration parameters are organised by "data fields" within the directory file. Each data field is composed of all text file lines since the start of the data field until the start of the next data field. A data field can contain empty lines. The first line of a data field starts by at least 4 equality signs (====) followed by the name of the data field. The data field name cannot be modified, but it can be preceded by more than 4 equality signs, and it can be followed by a string of equality signs. It is possible to modify the order of the different parameters within a data field. It is also possible to modify the order of the data fields within the file. Comment lines start by two asterisks.

Table 3 describes the configuration file line by line. The elements highlighted in grey should not be modified. Blue background identifies the data field start lines.

Table 3. System configuration file parameters

Configuration file data lines	Comment
==== Run ID =========	Data field
Run_ID, run_1	Name of the folder created inside the "outputs" folder containing all output data of the run
==== Simulation period ============	Data field
Start Date, 09/02/2019	Simulation start date in GPS time (dd/mm/yyyy)
Start Time, 23:00:00	Simulation start time in GPS time (HH:MM:SS)
End Date, 10/02/2019	Simulation finish date in GPS time (dd/mm/yyyy)
End Time, 00:59:59	Simulation finish time in GPS time (HH:MM:SS)
Initialisation (s), 1500	Simulation initialisation time, before simulation start time (seconds)
==== Satellite coordinates ============	Data field
Alm_eph, 1	Satellite coordinates source: • 0: almanacs (YUMA files) • 1: ephemerides (nav. RINEX files)
Alm_week_roll, 1	Almanac week rollover mode: • 0: use GPS week number provided in almanac without rollovers • 1: compute GPS week rollover using the simulation start date Applicable only when almanacs are used.
Health_filter, 1	Health filter: • 0: use all satellites from the almanac or ephemerides files • 1: use only the satellites with healthy status in the almanac or ephemerides files
==== Monitored constellations and mask angle	Data field. Each line contains three configurable parameters per constellation, separated by commas: GNSS, 1), 2), 3) 1) Constellation augmented by the SBAS system • 0: not augmented • 1: augmented 2) RIMS mask angle (degrees) (same for all RIMS) 3) User mask angle (degrees)

Configuration file data lines	**Comment**
Galileo, 1, 10, 5	Constellation selection and mask angles for Galileo
GPS, 1, 10, 5	Constellation selection and mask angles for GPS
SBAS, 0, 10, 5	Constellation selection and mask angles for SBAS
GLONASS, 0, 10, 5	Constellation selection and mask angles for GLONASS
Beidou, 0, 10, 5	Constellation selection and mask angles for BeiDou
==== RIMS mask angle ======	Data field
mask_angle_type, 0	RIMA mask angle: • 0: use a unique mask angle defined in the data field “Monitored constellations and mask angle” per constellation for all RIMS • 1: use an individual mask angle per constellation and per RIMS, as given in the RIMS configuration file
==== PRNs belonging to the SBAS service provider ====	Data field
136 123	Each line contains the PRN of one SBAS satellite belonging to the SBAS service provide. The first one is the broadcasting one. As many lines as SBAS satellites.
==== GEOs coordinates ======	Data field. Each line contains 6 configurable parameters per SBAS satellite, separated by commas: 1) SBAS satellite PRN 2) SBAS satellite constant latitude (deg) 3) SBAS satellite constant longitude (deg) 4) SBAS satellite constant height (m) 5) SBAS satellite constant clock bias 6) SBAS satellite constant clock drift
136, 0, 05.0, 36786000, 0, 0 123, 0, 31.5, 36786000, 0, 0	One line per SBAS satellite
==== Service volume ========	Data field The service volume is a grid of points over the Earth surface where the computed DFREI needs to be valid
Shape, 2	Service volume shape: • 1: rectangular • 2: SBAS GEOs footprints union

Configuration file data lines	Comment
Rectangular: latitude (min max) (deg), 20, 72	For a rectangular shape, minimum and maximum latitudes (degrees)
Rectangular: longitude (min max) (deg), -40, 40	For a rectangular shape, minimum and maximum longitudes (degrees)
GEO footprint: mask angle (deg), 5	For a GEO footprint shape, the mask angle (degrees)
Latitude step (deg), 5	For both rectangular and GEO footprints, the latitude grid step (degrees)
Longitude step (deg), 5	For both rectangular and GEO footprints, the longitude grid step (degrees)
==== Monitoring area ========	Data field The monitoring area is a grid of points over the Earth surface used in dynamic PRN Mask modification and in some MT32 broadcast options
Shape, 2	Service volume shape: • 1: rectangular • 2: SBAS GEOs footprints union
Rectangular: latitude (min max) (deg), 20, 72	For a rectangular shape, minimum and maximum latitudes (degrees)
Rectangular: longitude (min max) (deg), -40, 40	For a rectangular shape, minimum and maximum longitudes (degrees)
GEO footprint: mask angle (deg), 5	For a GEO footprint shape, the mask angle (degrees)
Latitude step (deg), 5	For both rectangular and GEO footprints, the latitude grid step (degrees)
Longitude step (deg), 5	For both rectangular and GEO footprints, the longitude grid step (degrees)
==== User grid ========	Data field The user grid is the grid of points where the HPL and VPL will be computed and used for obtaining the availability and continuity maps
Shape, 2	Service volume shape: • 1: rectangular • 2: SBAS GEOs footprints union
Rectangular: latitude (min max) (deg), 20, 72	For a rectangular shape, minimum and maximum latitudes (degrees)
Rectangular: longitude (min max) (deg), -40, 40	For a rectangular shape, minimum and maximum longitudes (degrees)
GEO footprint: mask angle (deg), 5	For a GEO footprint shape, the mask angle (degrees)
Latitude step (deg), 5	For both rectangular and GEO footprints, the latitude grid step (degrees)

Configuration file data lines	**Comment**
Longitude step (deg), 5	For both rectangular and GEO footprints, the longitude grid step (degrees)
Height (m), 0	For both rectangular and GEO footprints, the user height over the Earth surface (m)
==== Single-point user coordinates =====	Data field. Single-point user coordinates are not used in the computation of the availability and continuity maps. They can be used to output detailed information that would require too much memory to generate for the whole user grid.
50.7980611, 4.3585611, 158.3 43.5497125, 1.4850415, 208.753	Latitude (deg), Longitude (deg), Height (m) One line per single-point user.
==== DFREI calculation method ========	Data field
1	DFREI computation method: • 1: DFREI computed with the satellite-RIMS geometry matrix, computing as well the satellite covariance matrix • 2: DFREI computed with a look-up table function of the number of visible RIMS by the satellite
==== Message sequencing method ====	Data field
1	Message scheduler type: • 1: dynamic scheduler • 2: predetermined message sequence
==== Integrity messages options ======	Data field
1	Broadcast integrity messages: • 1: MT 34 + MT 35 / MT 36 if required • 2: MT 35 + MT 36 if required • 3: MT 34 only
==== Correction Messages broadcasting method ====	Data field
2	Correction messages (MT 32) broadcast : • 1 : Messages broadcast for all PRNs selected in the PRN Mask • 2 : Messages broadcast for the PRNs selected in the PRN Mask AND monitored by the RIMS network (i.e. the DFRE can be calculated: 4 or more visible RIMS) • Messages broadcast for the PRNs selected in the PRN Mask AND monitored by the RIMS network AND visible from the monitoring area ➔ DFMC SBAS standards require option 2
==== PRN Mask method =====	

Configuration file data lines	Comment
1	Satellite mask (MT 31) update type : • 1 : Constant satellite mask • 2 : Dynamic satellite mask (the satellites visible from the monitoring area are selected) Note: only option 1 has been validated. No strategy for assuring a smooth satellite mask transition has been implemented.
==== Replay ====	Data field. The Replay mode gets the broadcast DFMC SBAS messages from binary RINEX files.
Replay_on, 0	Replay mode ON/OFF : • 0 : Replay mode OFF • 1 : Replay mode ON
CRC_check, 1	CRC check of messages read from binary RINEX files : • 0 : Use all messages without checking the CRC • 1 : Check the CRC of DFMC SBAS messages read from binary RINEX files. If the CRC check fails, the message is lost at user level.
==== Output data ====	Data field. Each line is an output parameter. Ground segment output parameters are followed by one selection flag. User segment output parameters are followed by two selection flags, the first one for the user grid and the second one for single-point users. The selection flag is: • 0 : Do not output the parameter • 1 : Output the parameter.
RINEX, 1	Output binary RINEX files: no/yes
DFRE, 1	Output DFRE data: no/yes
Covariance, 1	Output covariance matrix data: no/yes
Messages, 1	Output broadcast messages data: no/yes
Monitored sat., 1	Output monitored satellites data: no/yes
GIVE, 1	Output GIVE data: no/yes
DFMC Correction, 1	Output corrections data (MT 32): no/yes
SV coordinates, 1	Output satellite coordinates data: no/yes
Nr. of satellites, 1, 1	Output number of visible and used satellites by the users: no/yes

Configuration file data lines	Comment
Pseudorange info, 1, 1	Output pseudorange error model data: no/yes
VPL file, 1, 1	Output VPL files: no/yes
HPL file, 1, 1	Output HPL files: no/yes
xPL statistics, 1, 1	Output HPL/VPL statistics (availability and continuity maps): no/yes
Scintillation lost SV, 1, 1	Output scintillation data: no/yes
DOP, 1, 1	Output DOP data: no/yes
xPL percentiles, 95, 99, 99.9	List of HPL/VPL percentiles to output. As many values separated by commas as percentiles.
==== Output periods =====	Data field
Ground segment period flag, 0	• 0 : ground segment outputs calculated for the whole simulation • 1 : ground segment outputs calculated only for the period of time given in the “Ground segment (sec)” configuration parameter
Ground segment (sec), 0, 9999999999	Initial output time period (sec), Final output time period (sec) for the ground segment
User segment period flag, 0	• 0 : user outputs calculated for the whole simulation • 1 : user outputs calculated only for the period of time given in the “Ground segment (sec)” configuration parameter
User segment (sec), 0, 9999999999	Initial output time period (sec), Final output time period (sec) for the user segment
==== DFREI table =====	Data field
0, 0.1875, 1.0625 1, 0.25, 2.125 2, 0.375, 2.25 3, 0.5, 2.375 4, 0.625, 2.5 5, 0.75, 4.5 6, 1.0, 4.75 7, 1.25, 5.0 8, 1.5, 5.25 9, 1.75, 5.5 10, 2.0, 9.5 11, 4.5, 10.0 12, 15.0, 18.0 13, 46.0, 49.0	Each line contains 3 parameters separated by commas : DFREI, σ_{DFREI} (m), range max σ_{DFREI} (m) As many lines as DFREI.

Configuration file data lines	Comment
14, 94.0, 100.0	
==== DFREI Minimum ======	Data field
Galileo, 5	Minimum allowed broadcast DFREI for Galileo
GPS, 5	Minimum allowed broadcast DFREI for GPS
SBAS, 5	Minimum allowed broadcast DFREI for SBAS
GLONASS, 5	Minimum allowed broadcast DFREI for GLONASS
Beidou, 5	Minimum allowed broadcast DFREI for BeiDou
==== DFREI minimum number of visible RIMS	Data field
5	Minimum number of visible RIMS to calculate the DFREI with the "satellite ephemeris-clock covariance matrix" method Note: the minimum number of visible RIMS must be >= 4
==== Broadcast Message Types ======	Data field
PRN_MASK, 31, 120, 1, 90, 1, 1 INTEGRITY, 34/35/36, 6, 1, 99, 1, 1 CLK_EPH_CORR_COV, 32, 120, 2, 90, 1, 1 SBAS_EPH_COV, 39/40, 120, 3, 90, 1, 1 DEGR_DFREI, 37, 120, 1, 90, 1, 1 SBAS_ALMANACS, 47, 120, 4, 90, 1, 1 GNSS_TIME, 42, 120, 1, 90, 1, 1 DO_NOT_USE, 0, 6, 1, 90, 1, 0 INTERNAL_TEST, 62, 120, 1, 90, 1, 0 NULL, 63, 120, 1, 90, 1, 0 IGP_MASK_L5, 48, 300, 1, 90, 1, 0 IONO_CORR_L5, 56, 300, 1, 90, 1, 0 IONO_DEGR_L5, 41, 120, 1, 90, 1, 0 OTHER, 59, 120, 1, 90, 5, 0	As many lines as SBAS message types. Each line contains 7 parameters separated by commas defining a SBAS message type. A), B), C), D), E), F), G) A): Message Function. One of the following key words: • PRN_MASK • INTEGRITY • SAT_CORR_COV • SBAS_EPH_COV • DEGR_DFREI • SBAS_ALMANACS • GNSS_TIME • DO_NOT_USE • TEST_SBAS • NULL_SBAS • IGP_MASK_L5 • IONO_CORR_L5 • IONO_DEGR_L5 • OTHER Note: The content of the “OTHER” messages is empty. The objective of this message function is

Configuration file data lines	Comment
	to analyse the impact in the bandwidth occupation of additional Message Types. It is possible to define multiple message functions “OTHER” (for example “OTHER2”, OTHER3”, etc.). B): Message Type ID • Example: 31 • Note: Message function 'INTEGRITY' needs 3 message IDs in the format: 34/35/36 • Note: Message function 'SBAS_EPH_COV' needs 2 message IDs in the format: 39/40 C): Maximum Update Interval (sec) D): Broadcasting method: • '1' no satellite associated • '2' one message per monitored satellite except the SBAS broadcasting SV • '3' one message only for the broadcasting SBAS satellite • '4' one message per 2 SBAS satellites belonging to the SBAS provider • '5' one message per monitored satellite except the satellites belonging to the SBAS provider Note: the following broadcasting method configuration is compliant with DFMC SARPs: • ‘2’ for MT 32 • ‘3’ for MT 39/40 • ‘4’ for MT 47 • ‘1’ for other Message Types E): Dynamic scheduler maximum update interval percentage (%) This parameter used only by the dynamic message scheduler gives the time elapsed since the transmission of a message, expressed as a percentage of the message maximum update interval, after which the message increases its transmission priority within the scheduler. F): Number of independent messages This parameter should be set to ‘1’ for all message types except the message type ‘OTHER’. It indicates how many messages of type ‘OTHER’ should be broadcast considering each of them independent from an update interval point of view.

Configuration file data lines	Comment
	G): Used in dynamic message scheduler • 0: message type not used • 1: message type used This parameter indicates which message types are broadcast by the dynamic scheduler. If the dynamic scheduler is used, at least one message type needs to be selected. If a static scheduler is used, this parameter is not used.
==== Fixed Message Sequence ==========	Data field
35, 0 32, 1	Message sequence used in the predetermined scheduler mode. The sequence repeats once it is finished. As many lines as messages in the predetermined sequence. Each line contains two parameters separated by commas: Message Type ID, PRN ('0' if no PRN) Note: MT 32, MT 39 and MT 40 require a PRN
==== Common degradation parameters =====	Data field
C_er, 0 C_covariance, 0.5 I_valid_GNSS, 240 I_valid_SBAS, 240	Common degradation parameters broadcast in MT 37. C_er: En route step degradation factor (m) C_covariance: Covariance matrix quantization degradation parameter (unitless) I_valid_GNSS: Satellite Clock-Ephemeris error corrections and covariance matrix validity (sec) I_valid_SBAS: SBAS Satellite Clock-Ephemeris error corrections and covariance matrix validity (sec)
==== Constellation degradation parameters	Data field
Galileo, 1, 120, 1, 7.8, 1 GPS, 1, 120, 1, 7.8, 1 SBAS, 1, 120, 1, 7.8, 1 GLONASS, 1, 120, 1, 7.8, 1 Beidou, 1, 120, 1, 7.8, 1	Each line contains 5 constellation degradation parameters broadcast in MT 37 (there are as many lines as constellations): GNSS, A), B), C), D), E) A) RSS_DFC: Root Square Sum (RSS) Dual Frequency Corrections (DFC) flag • 0: σ_DFC^2 = ((σ_DFRE*δ_DFRE) + ε_corr + ε_er)^2 • 1: σ_DFC^2 = (σ_DFRE*δ_DFRE)^2 + ε_corr^2 + ε_er^2

Configuration file data lines	**Comment**
	Note: RSS_DFC must be '1' for compatibility with DFMC SBAS standards B) I_corr: Step degradation factor time interval (sec) C) C_corr: Step degradation magnitude (m) D) R_corr: 1st order degradation slope (mm/sec) E) d_R_corr: Scale factor of R_corr (unitless) Note: Default values obtained from EGNOS V2 broadcast mesages
==== A Priori Covariance Matrix (P0) ===	Data field
16384, 16384, 16384, 168100	Diagonal elements of the a priori covariance matrix P0 used to calculate the satellite ephemeris-clock covariance matrix: [x,y,z,clock_bias] (meters^2) Note: default values are the Maximum SBAS corrections in MOPS DO 229-D: 128^2, 128^2, 128^2, 410^2
==== DFMC Correction Parameters ======	Data field
correction_type, 2 correction_min, 0.05 correction_delay, 120	Corrections broadcast in MT 32. Three lines of parameters. • correction_type o 0 = No correction; o 1 = Corrections from IODN changes obtained from text file; o 2 = Corrections from IODN changes obtained from ephemerides (No correction for almanacs) • correction_min: initial minimum correction, between 0.01m and 0.1m (metres) • correction_delay: time between IODN change and correction update (seconds) (between 2 and 5 minutes)
==== RIMS smoothing filter ==============	Data field
t_smoothing, 1000 t_smoothing_rec, 300 t_rec, 1	RIMS smoothing filter. Three lines with configuration parameters: • t_smoothing : RIMS standard smoothing filter period [s] • t_smoothing_rec : RIMS smoothing filter period in recovery mode [s] • t_rec : Maximum time elapsed since a receiver losses track of a satellite until it tracks it again to apply the smoothing filter in recovery mode [s]

Configuration file data lines	**Comment**
	Note: 't_smothing" should be equal to or greater than 300 seconds to comply with the SARPs requirement that, for any satellite, SBAS shall only broadcast a Type 32 message when SBAS has continuously monitored that satellite's ephemeris and clock data for at least 300 seconds.
==== User smoothing filter ==============	Data field
t_smoothing, 1000 t_smoothing_rec, 300 t_rec, 1	User smoothing filter. Three lines with configuration parameters: • t_smoothing : RIMS standard smoothing filter period [s] • t_smoothing_rec : RIMS smoothing filter period in recovery mode [s] • t_rec : Maximum time elapsed since a receiver losses track of a satellite until it tracks it again to apply the smoothing filter in recovery mode [s]
==== SBAS service provider ID ======	Data field
1	SBAS Service Provider Identifier: • 0: WAAS • 1: EGNOS • 2: MSAS • 3: GAGAN • 4: SDCM • 5: BDSBAS • 6: KASS • 7: A-SBAS • 8: AUSBAS • 9-31: Spare/Reserved Note: DSVP broadcasts the SBAS service provider ID in the corresponding SBAS message, but it does not use it at user level.
==== Time Reference Identifier ====	Data field
2	Time reference identifier broadcast in MT 37: • 0: GPS • 1: GLONASS • 2: Galileo • 3: BDS • otherwise: not defined

<table>
<tr><th>Configuration file data lines</th><th>Comment</th></tr>
<tr><td></td><td>Note: DSVP broadcasts thetime reference ID in the corresponding SBAS message, but it does not use it at user level.</td></tr>
<tr><td>==== User processing configuration ====</td><td>Data field</td></tr>
<tr><td>process_user, 1
process_user_grid, 1
process_user_point, 1
single_frequency, 0
nominal_bias, 0
PA, 1</td><td>Configuration of user segment options. Six lines with configuration parameters:
• process_user:
o 0: do not process user (process ground segment only)
o 1: process user
• process_user_grid:
o 0: do not process user grid locations
o 1: process user grid locations
• process_user_point:
o 0: do not process single user location
o 1: process single user location
• single_frequency
o 0: dual-frequency user
o 1: single frequency L5 user
• nominal_bias:
o 0: do not use nominal bias in VPL/HPL computation
o 1: calculate VPL/HPL with nominal bias
• PA:
o 0: not precision approach
o 1: Precision Approach</td></tr>
<tr><td>==== User error models =======</td><td>Data field</td></tr>
<tr><td>Galileo, 0.40, 0.1
GPS, 0.40, 0.1
SBAS, 4.70, 0.1
GLONASS, 0.65, 0.1
Beidou, 0.80, 0.1</td><td>Each line contains two user error models per constellation (there are as many lines as constellations):
GNSS, σ_{noise} (m), σ_{divg} (m)

Note: σ_{noise} is the residual noise error model for the iono-free pseudorange combination in dual-frequency mode, and for the single-frequency pseudorange in single-frequency mode (the same value is used for both single-frequency and dual-frequency modes)
Note: σ_{divg} is used only in Single-Frequency mode (it is ignored in Dual-Frequency mode)</td></tr>
</table>

Configuration file data lines	Comment
==== User service =====	Data field
K_v, 5.33 K_h, 6.00 VAL, 50, 35, 10 HAL, 40 T_continuity, 15	Five lines with parameters related to the HPL/VPL, availability and continuity computation: • K_v: factor for VPL computation • K_h: factor for HPL computation • VAL: Vertical Alert Limit (m) • HAL: Horizntal Alert Limit (m) • T_continuity: continuity interval (s) Note: it is possible to define multiple HAL and VAL, the DSVP will compute the availability/continuity for any combination of them
==== Nominal Bias =======	Data field
Galileo, 0.75 GPS, 0.75 SBAS, 0.75 GLONASS, 0.75 Beidou, 0.75	Nominal bias per constellation (metres), as many lines as constellations
==== Static PRN Mask ===========	Data field
1:32, 75:110	List of PRNs selected in the static PRN Mask PRNs can be separated by a colon (:) to select the whole segment. Ex.: "2, 4:6, 8" is equivalent to "2, 4, 5, 6, 8"
==== Almanac minimum satellite ID =====	Data field
GPS, 1 Galileo, 1 GLONASS, 38 Beidou, 174 SBAS, 120	Lowest PRN to be considered Reading YUMA files. For example, if a Galileo YUMA file has PRNs from 1 to 30, the parameter is 1; if the Galileo YUMA file has PRNs 75 to 100, the parameter is 75 (note that the second almanac file does not respect the YUMA standard)
==== GIVEI Look-up Table =====	Data field
0, 0.0084, 0.0, 100, 9999 1, 0.0333, 0.0, 100, 9998 2, 0.0749, 0.0, 100, 9997 3, 0.1331, 0.0, 100, 9996 4, 0.2079, 0.0, 100, 9995 5, 0.2994, 0.0, 100, 9994 6, 0.4075, 0.5, 40, 10 7, 0.5322, 2.0, 30, 8	GIVEI lookup table. Each line contains 5 parameters for one GIVEI (there are as many lines as GIVEIs): A), B), C), D), E) A) GIVEI B) sigma_GIVE^2 (m^2) C): Minimum distance between satellite-RIMS LOS IPPs barycenter and the iGP (deg)

Configuration file data lines	**Comment**
8, 0.6735, 3.0, 30, 5 9, 0.8315, 3.5, 20, 4 10, 1.1974, 4.0, 20, 4 11, 1.8709, 5.0, 15, 4 12, 3.3260, 5.5, 15, 4 13, 20.7870, 6.0, 10, 3 14, 187.0826, 7.0, 10, 3	D): Minimum area covered by satellite-RIMS LOS IPPs around the iGP (%) E): Minimum number of satellite-RIMS LOS IPPs around the iGP
==== GIVEI Computation =========	Data field
igp_radius, 8 n_radial_sectors, 16 n_circular_sectors, 1	Three lines with parameters for GIVEI computation: • igp_radius: radius around the IGP to consider satellite-RIMS LOS in the GIVEI computation (metres) • n_radial_sectors: number of radial sectors to divide the circle centred at the IGP used to calculate the area covered by satellite-RIMS LOS in the GIVEI computation • n_circular_sectors: number of circular sectors to divide the circle centred at the IGP used to calculate the area covered by satellite-RIMS LOS in the GIVEI computation
==== Ionospheric degradation parameters ==	Data field
RSS_iono, 0 C_iono_step, 0.657 C_iono_ramp, 0 I_iono, 300	Four lines with single-frequency ionospheric degradation parameters (constant throughout the simulation): • RSS_iono: Root Sum Square flag (unitless) • C_iono_step: Bound on the difference between successive ionospheric grid delay values (m) • C_iono_ramp: Rate of change of the ionospheric corrections (m/s) • I_iono: Minimum update interval for ionospheric correction messages (s)
==== Aiding constellations =======	Data field
GPS, 0 Galileo, 0	Selection of aiding constellations for GIVEI computation in single-frequency mode: • 0: do not use constellation to aid GIVE computation • 1: use constellation to aid GIVE computation
==== Scintillation model: ON/OFF =========	Data field
0	Selection of scintillation mode: • 0: do not use scintillation model

Configuration file data lines	Comment
	• 1: use scintillation model
==== Scintillation model: impact area ====	Data field
Geomagnetic latitude MIN (deg), -23.44 Geomagnetic latitude MAX (deg), 23.44	The area impacted by the equatorial scintillation is between the minimum and maximum geomagnetic latitudes (degrees)
==== Scintillation model: Ploss =====	Data field
00, 0.003 05, 0.003 10, 0.003 15, 0.003 20, 0.0025 25, 0.002 30, 0.0015 35, 0.001 40, 0.001 45, 0.001 50, 0.0 55, 0.0 60, 0.0 65, 0.0 70, 0.0 75, 0.0 80, 0.0 85, 0.0 90, 0.0	Probability of loss of a LOS at user level due to equatorial scintillation as a function of the elevation angle. Each line gives the probability of loss for an elevation angle (as many lines as elevation angles): elevation angle (deg), probability of loss [0..1]
==== Scintillation model: local time impact ====	Data field
18.5, 0.0 19.0, 0.1 19.5, 0.3 20.0, 0.8 20.5, 0.9 21.0, 1.0 22.0, 0.9 23.0, 0.85 24.0, 0.7 01.0, 0.6 02.0, 0.3 03.0, 0.1 03.5, 0.0	Probability of loss of a LOS at user level due to equatorial scintillation as a function of the local time. Each line gives the probability of loss for an elevation angle (as many lines as elevation angles): local time (hour)[0..24], k (multiplicative factor of Ploss) Note: start and end the list with a multiplicative factor of 0.0

Configuration file data lines	Comment
==== Scintillation model: loss duration ==	Data field
loss_duration (s), 4 no_loss_duration (s), 1	Two parameters of the duration of a loss due to scintillation: • loss_duration (s): duration of the loss of a LOS (seconds) • no_loss_duration (s): id a LOS is not lost, period of time during which that LOS cannot be lost (seconds)
==== YUMA2RINEX: constellations =====	Data field
GPS, 1 Galileo, 1 BeiDou, 0 GLONASS, 1 SBAS, 0	Selection of constellations for which convert he almanac into ephemerides with the YUMA2RINEX mode • 0: do not convert • 1: convert
==== YUMA2RINEX: other parameters ====	Data field
Initial day, 09/02/2019 Initial time, 21:00:00 Final day, 10/02/2019 Final time, 02:59:59 Epoch step (s), 1800	YUMA2RINEX conversion parameters: • Initial day: day/month/year • Initial time: hour:minute:second • Final day: day/month/year • Final time: hour:minute:second • Epoch step (s): time between consecutive ephemerides (seconds)

Note: the rest of parameters in the system configuration file have been fixed to constant values in DFMC SBAS standards and have been set to those values. The DSVP has been validated only for those standardised values and it is not recommended to modify them.

Because the DSVP user module does not use the time reference identifier, SBAS provider ID and WNROcount parameters, no timeout associated to those parameters is defined in the configuration file.

3.4 Priority messages file

The priority messages file defines the SBAS messages broadcast at specific epochs with higher priority than those from the SBAS standard message scheduler. It can be used to for instance simulate the transmission of SBAS alerts or the transmission of MT 0.

It is a text file named [priority_messages_file] contained in the configuration folder "conf/[system_conf_dir]", where:

- [priority_messages_file] is the file name defined in the directory configuration file (data field "SBAS system configuration files", parameter "Alerts")
- [system_conf_dir] is the directory name defined in the directory configuration file (data field "Configuration directories", parameter "System config.,"),

The prioritary messages configuration file has one data fields named “prioritary messages”. Table 4 describes the configuration file line by line. The elements highlighted in grey should not be modified. Blue background identifies the data field start lines.

Table 4. Priority messages configuration file parameters

Configuration file data lines	Comment
====== Prioritary messages ======	Data field
INTEGRITY_1, 10, 500, 0, 4 DO_NOT_USE, 1600, 0, 0, 1	One line per priority message with 5 configuration parameters separated by comas: A), B), C), D), E) A) Message Type function (key words defined in the system configuration file data field ‘Broadcast Message Types’, except for integrity messages. For integrity messages use: • ‘INTEGRITY_1’: for MT 34 only • ‘INTEGRITY_23’: for MT35 – it can be used only if the PRN mask contains less than 53 selected slots) B) Initial transmission time (seconds since simulation start time) C) Periodicity (sec) D) PRN ('0' if no specific PRN) E) Number of consecutive messages

3.5 Graphical interface

Launching the executable file “sbas_dsvp.exe” in the HMI mode opens the SBAS DSVP graphical interface. The interface allows configuring most of the SBAS DSVP parameters and running the prototype.

The default configuration is read from the system configuration file “system_conf.txt”.

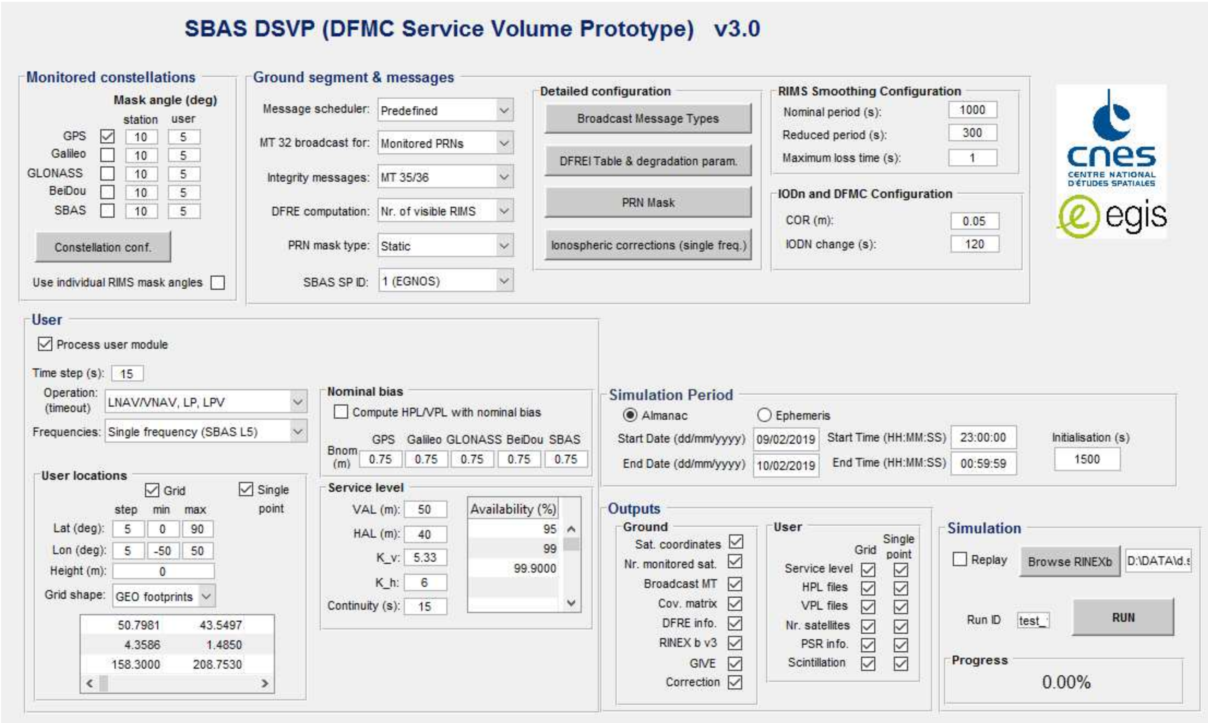

Figure 3. SBAS DSVP graphical interface.

3.5.1 Monitored constellations

"Monitored constellations" configurable parameters (Figure 4):

- Selection of the constellations monitored by the SBAS DFMC (GPS, Galileo, SBAS, GLONASS, BeiDou);
- Ground segment stations elevation mask angle per constellation (degrees);
- User elevation mask angle per constellation (degrees);
- Use of a common elevation mask angle per constellation for all RIMS, or an individual mask angle per constellation and per RIMS.

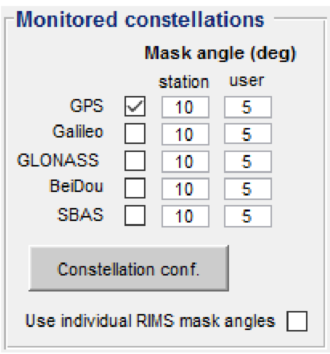

Figure 4. SBAS DSVP graphical interface: monitored constellations

Clicking on the "Constellation conf." button opens a new window with the detailed constellation configuration (Figure 5):

- Browse almanac file per constellation;
- Coordinates of SBAS GEOs;
- List of broadcasting SBAS L5 DFMC PRNs.

SBAS satellite orbits can be defined either with an almanac file or with the fixed coordinates for each GEO.

The first satellite in the list of SBAS DFMC broadcasting PRNs is assumed to be the one for which the broadcast message sequence is simulated (i.e. it is the one for which MT 39/40 are broadcast).

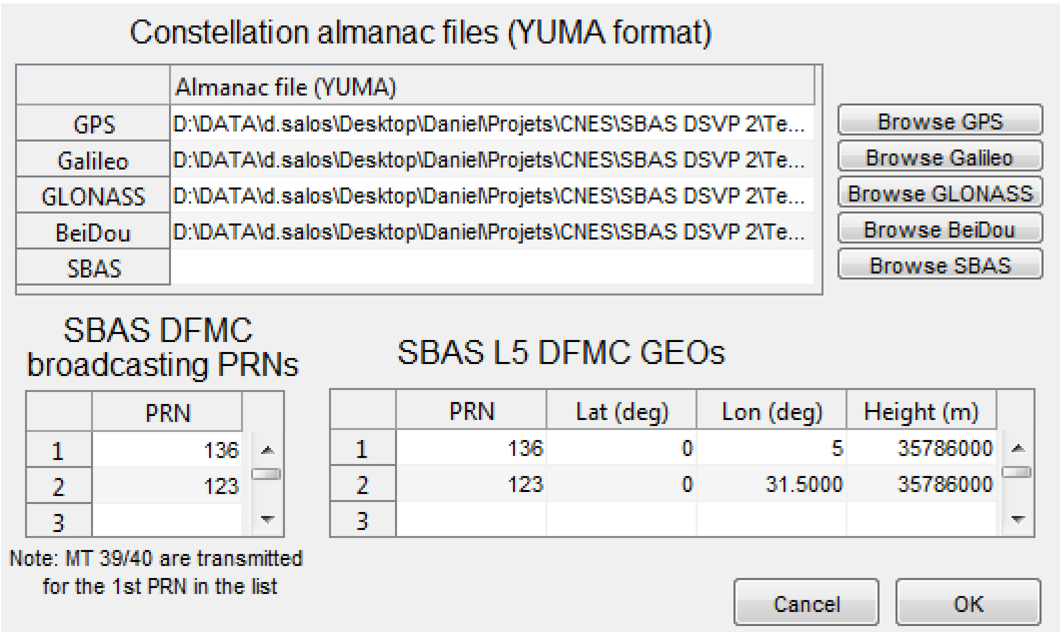

Figure 5. SBAS DSVP graphical interface: monitored constellations detailed configuration

3.5.2 Ground segment & messages

"Ground segment & messages" configurable parameters (Figure 6):

- Message scheduler
    - o Dynamic
        - The messages are broadcast according to a message scheduler taking into account different parameters like the maximum update interval of each message type.
    - o Predefined
        - The messages are broadcast according to a predefined list.
- MT 32 (satellite corrections and covariance matrix) broadcasting strategy employed in the dynamic message scheduler:
    - o Whole PRN mask

        - MT 32 messages are broadcast for each PRN selected in the PRN mask all the time, even for those satellites that cannot be monitored currently by the system.
    - Monitored PRNs
        - MT 32 messages are broadcast for PRNs selected in the PRN mask and monitored by the system (i.e. visible by a minimum number of ground reference stations).
    - Monitored PRNs inside the monitoring area
        - MT 32 messages are broadcast for PRNs selected in the PRN mask, monitored by the system (i.e. visible by a minimum number of ground reference stations) and visible from the "monitoring area" defined in the "system_conf.txt" file.
- Integrity messages
    - MT 34 + MT 35/36
        - Broadcasting MT 34. Broadcasting MT 35/36 at epochs in which the number of DFREI changes exceeds the maximum number supported by MT 34.
    - MT 35/36
        - Broadcasting MT 35 and MT 36 (if required)
    - MT 34
        - Broadcasting MT 34 only (if the number of DFREI changes exceeds the maximum number supported by MT 34, some DFREI may be degraded).
- DFRE computation mode
    - Covariance matrix
        - Computation covariance matrix and derivation of the DFREI based on the satellite-ground station geometry.
    - Nr. of visible RIMS
        - DFREI obtained from a look-up table depending on the number of visible ground reference stations.
- PRN Mask type
    - Static
        - The PRN mask is configured at the beginning of the simulation and remains constant throughout the simulation.
    - Dynamic
        - The PRN Mask adapts continually to the visible satellites from the "monitoring area".
- RIMS smoothing configuration
    - The measurements made by the RIMS are smoothed at the CPF before processing them, so those signals are not available to the system during the smoothing filter initialisation. This section allows configuring the nominal smoothing period and the reduced smoothing period (after a short loss of a

tracked signal), as well as the maximum duration of the signal loss to consider the reduced smoothing period.

- IODn
    - o Model of the broadcast corrections function of the IODn changes (COR).
    - o Time after an IODN change in which that IODN change is considered by the system (IODN change).

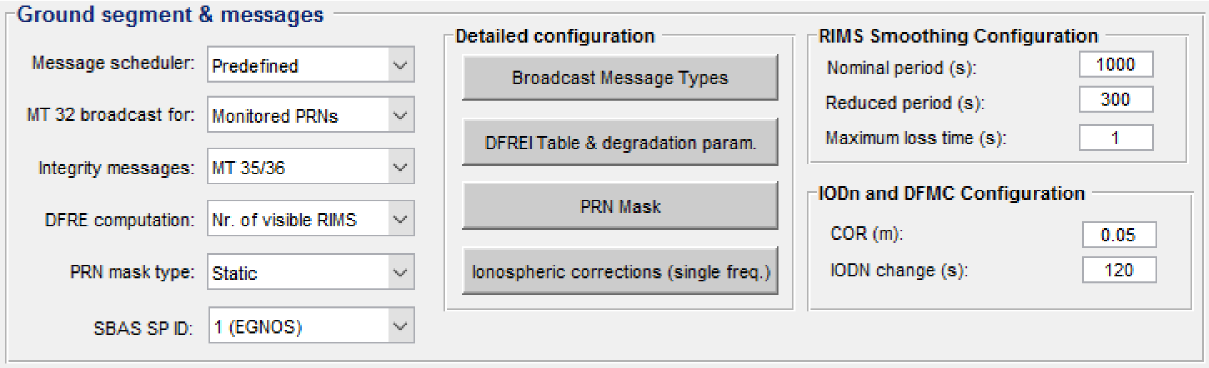

Figure 6. SBAS DSVP graphical interface: ground segment & messages

Clicking on the “Broadcast Message Types” button opens a new window with the detailed message type configuration (Figure 7):

- Broadcast Message Types configuration
    - o Broadcast
        - ▪ Broadcast/Not Broadcast
    - o Function of the message. A code is associated to each Message Type:
        - ▪ PRN_MASK (i.e. MT 31)
        - ▪ INTEGRITY (i.e. MT 34/35/36)
        - ▪ CLK_EPH_CORR_COV (Clock ephemeris & corrections Covariance matrix, i.e. MT 32)
        - ▪ SBAS_EPH_COV (SBAS ephemeris covariance matrix, i.e. MT 39/40)
        - ▪ DEGR_DFREI (Correction degradation parameters and DFREI table, i.e. MT 37)
        - ▪ SBAS_ALMANACS (i.e. MT 47)
        - ▪ GNSS_TIME (i.e. MT 42)
        - ▪ DO_NOT_USE (i.e. MT 0)
        - ▪ INTERNAL_TEST (i.e. MT 62)
        - ▪ NULL (i.e. MT 63)
        - ▪ IGP_MASK_L5 (L5 IGP mask, for L5 single-frequency SBAS only)
        - ▪ IONO_CORR_L5 (L5 ionospheric corrections, for L5 single-frequency SBAS only)

        - IGP_DEGR_L5 (L5 iono. Corrections degradation parameters, for L5 single-frequency SBAS only)
        - OTHER (any other message type)
    - ID. Message Type name
        - For the message function "INTEGRITY", three Message Type IDs must be given separated by "/". For example for integrity messages named MT 34, MT35 and MT 36: "34/35/36".
        - For the message function "SBAS_EPH_COV", two Message Type IDs must be given separated by "/". For example for SBAS ephemeris and covariance messages named MT 39 and MT40: "39/40".
    - Maximum update interval (seconds)
    - PRN associated to the message type:
        - 1 – No satellite (the message type does not provide information for a specific PRN)
        - 2 – One message per monitored satellite except the SBAS broadcasting SV
        - 3 – One message only for the broadcasting SBAS satellite
        - 4 – One message per 2 SBAS satellites belonging to the SBAS provider
        - 5 – One message per monitored satellite except the satellites belonging to the SBAS provider
    - Dynamic (%) (one of the parameters used by the dynamic message scheduler).
- Fixed Message Sequence (used if the "Predetermined" message scheduler is selected)
- Timeout period (for en-route to LNAV and for LNAV/VNAV, LP, LPV operations. The type of operation is selected in the user configuration.

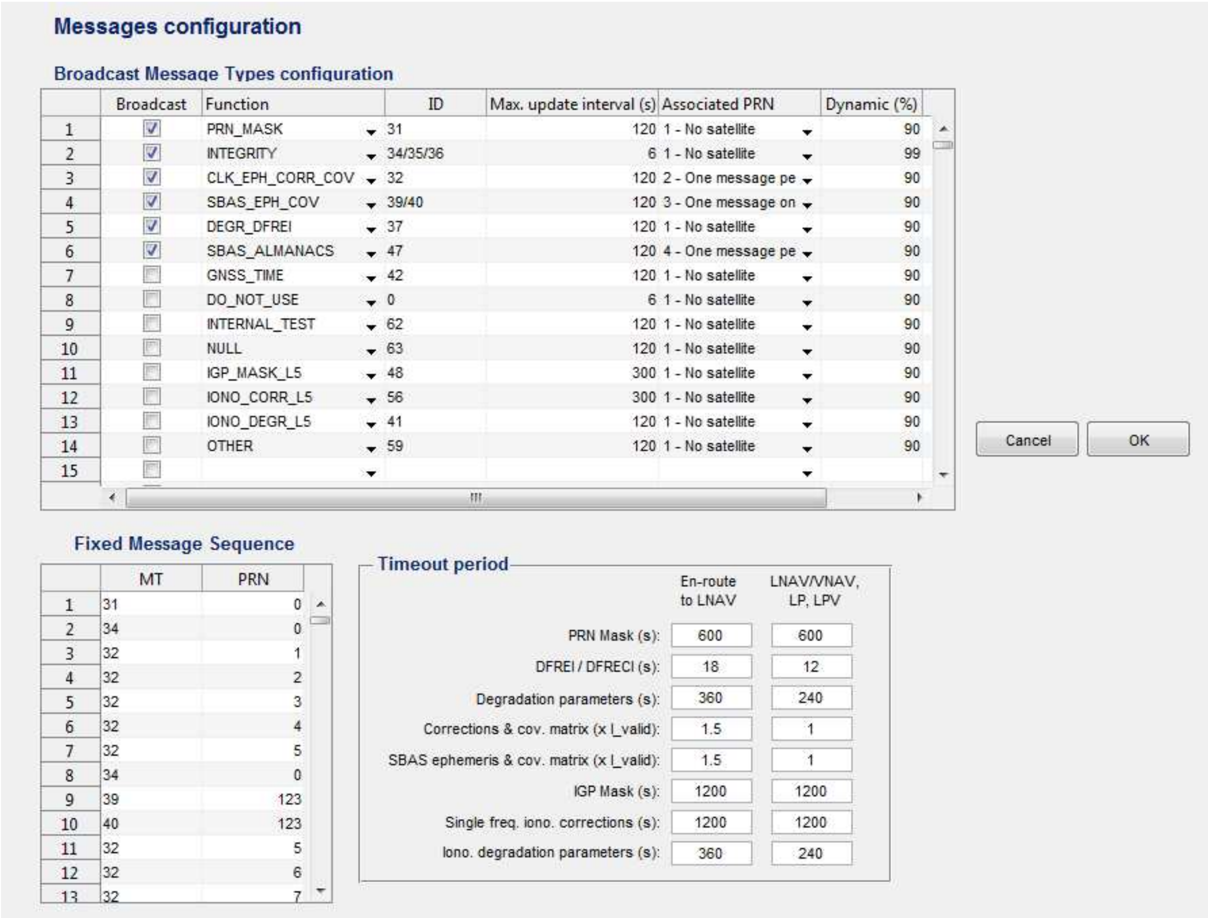

Figure 7. SBAS DSVP graphical interface: Message Type detailed configuration

Clicking on the "DFREI Table and degradation parameters", the following configuration options appear (Figure 8):

- OBAD Common degradation parameters;
- Degradation parameters per constellation;
- DFREI scale table
- Minimum allowable DFREI per constellation.
- Minimum number of ground stations from which a satellite is visible required to monitor it.
- DFREI look-up table, if this DFREI computation method is selected (instead of the covariance matrix method).

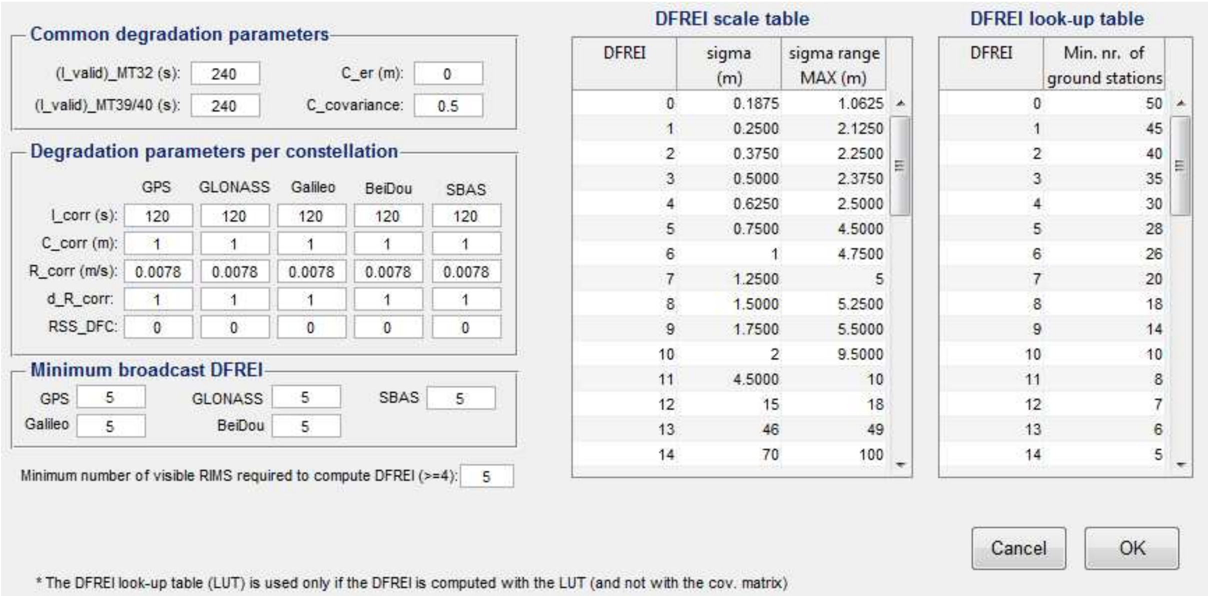

Figure 8. SBAS DSVP graphical interface: Message Type detailed configuration

Clicking on the “PRN Mask” button opens the PRN mask configuration window (Figure 9):

- PRN slot distribution per constellation
- Selected PRNs (used if the option “static PRN mask” has been selected)
- The number of selected slots in the static PRN mask can be obtained clicking on the “Compute” button.

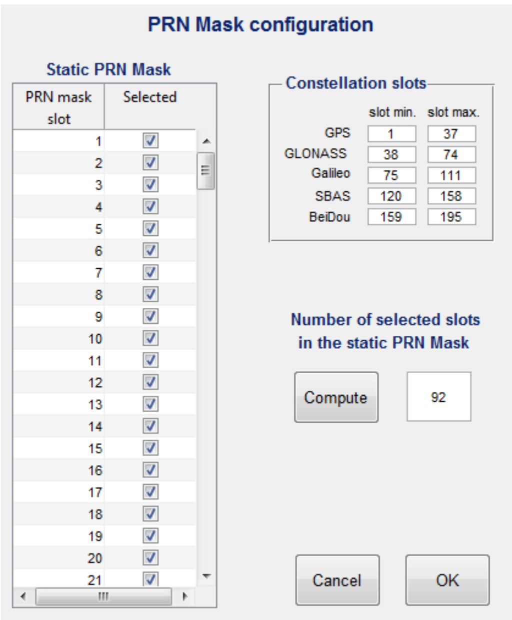

Figure 9. SBAS DSVP graphical interface: PRN Mask detailed configuration

Clicking on the “Ionospheric corrections” button opens the single-frequency L5 corrections configuration (used only if the corresponding message types are broadcast) (Figure 10):

- GIVEI computation (look-up table parameters and other internal parameters)
- Ionospheric correction degradation parameters.
- Selection of the IGP grid

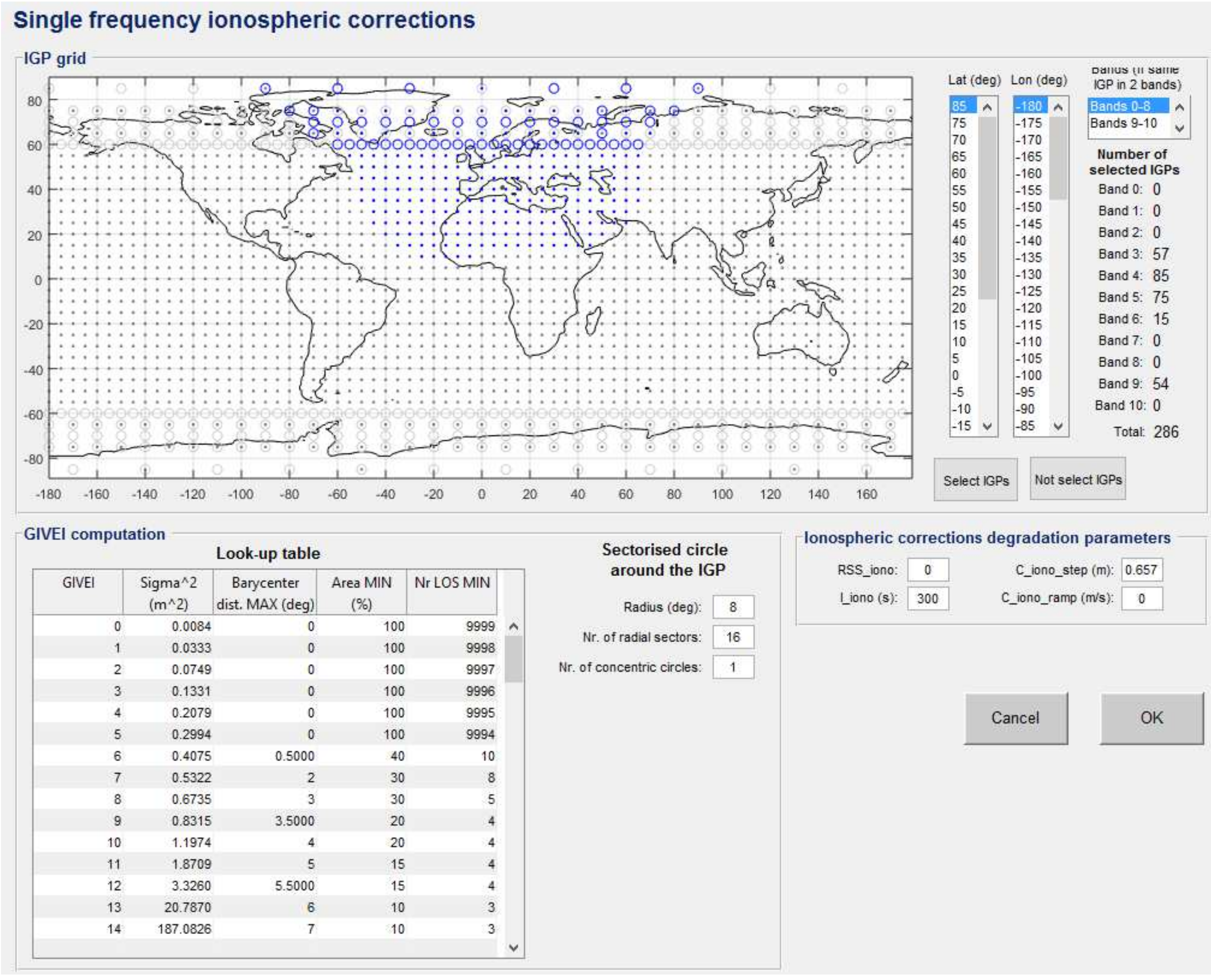

Figure 10. SBAS DSVP graphical interface: Ionospheric corrections configuration

3.5.3 User configuration

The user module configurable parameters are (Figure 11):

- Select if the user module is processed or not;
- User module time step (ground module time step is always fixed to 1 s);
- Intended operation (used to obtain the message update and timeout intervals);
- Frequency mode (dual-frequency, single-frequency SBAS L5);
- User locations
  - User grid, used to obtain the service levels maps
    - If the GEO footprints shape is selected, the maximum and minimum longitude and latitude parameters are not used.

    - Single point, used to obtained detailed information (ex. Pseudorange error information). It is possible to define multiple single point users.
- Select if the HPL/VPL is computed including the nominal bias.
- Required service level
    - VAL, HAL (metres)
    - Kh, Kv
    - Continuity window (s)
    - Required availability (percentage). Multiple values can be given.

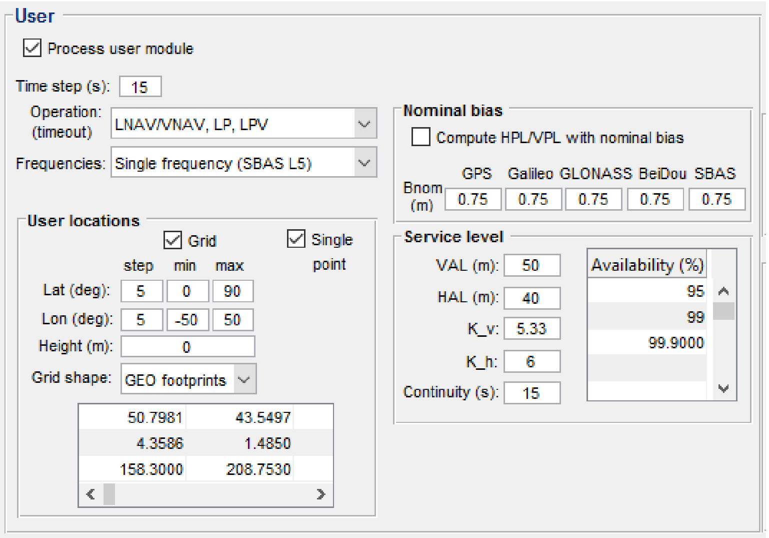

Figure 11. SBAS DSVP graphical interface: User configuration

3.5.4 Outputs configuration

Ground segment module outputs:

- Satellite coordinates
- Number of monitored satellites
- Broadcast Message Types
    - Bandwidth occupation
    - Time To First Fix
    - Message update interval
- Covariance matrix computation
- DFRE computation information
- RINEX b v3 of broadcast messages
- GIVE information (only for single frequency)
- Corrections broadcast in MT 32

User segment module outputs (for the user grid or for the single point user coordinates):

- Service level (availability, continuity, HPM/VPL percentile maps)
- HPL files
- VPL files
- Nr. of visible and used satellites
- Pseudorange error information
- Scintillation information files (number of LOS lost a each user location)

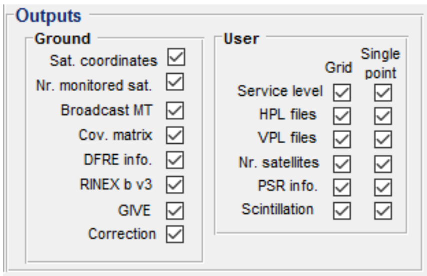

Figure 12. SBAS DSVP graphical interface: outputs configuration

3.5.5 Simulation period and mode configuration

Configuration parameters:

- Simulation start and final time (GPS time)
- Initialisation time
- Run name
- Replay function
    - If the replay function is selected, the DSVP does not compute the scheduling and the content of the broadcast SBAS L5 messages; instead, they are read from the RINEX B files. The ground segment outputs are disabled when the replay option is selected, The satellite coordinates computation and the user segment module work as in the nominal mode.

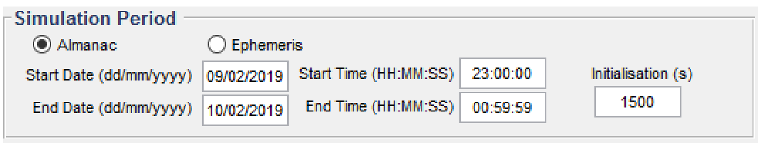

Figure 13. SBAS DSVP graphical interface: simulation time configuration

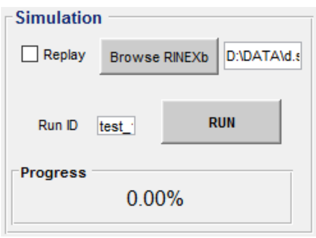

Figure 14. SBAS DSVP graphical interface: simulation type and name configuration

4 STEPS FOR RUNNING A SIMULATION

1) Create or modify a system configuration file with the selected configuration, using the information of the User Manual, and place it in the system configuration file.
    a. Check the coherence between the different parameters (for example, a PRN mask coherent with the augmented constellations)
2) Copy the corresponding almanac files in the almanac directory or copy the corresponding navigation RINEX files in the navigation RINEX directory, depending on the satellite coordinates source (almanacs or ephemerides). If the ephemerides are used, the DSVP will search the navigation RINEX files corresponding to the simulation dates according to the file names assuming the RINEX file name convention.
3) Create or modify the RIMS configuration file, and place it in the RIMS configuration directory
4) Create or modify the IGP grid configuration file, and place it in the IGP grid configuration directory (only used in the single-frequency mode)
5) Create or modify the directory configuration file to have the same configuration file names and directory names as the ones used in the previous steps.
6) Run the SBAS DSVP

*** End of document ***