Warning and Mitigation Technologies for Travelling Ionospheric Disturbances Effects

TechTIDE

D1.1

Initial Users´ Requirements report

Version 1.0

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Abstract

This deliverable collects and categorizes users' requirements.

Document history

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1.0	28.02.2018	ESSP SAS	First issue of the document

Disclaimer

Executive Summary

TechTIDE, funded by the European Commission Horizon 2020 research and innovation program [AD-1], will establish a pre-operational system to demonstrate reliability of a set of TID (Travelling Ionospheric Disturbances) detection methodologies to issue warnings of the occurrence of TIDs over the region extending from Europe to South Africa, to estimate the parameters that specify the TID characteristics and the inferred perturbation, and provide all additional geophysical information to the users to help them assess the risks and to develop mitigation techniques, tailored to their application. This document is TechTIDE D1.1 “Initial Users´ Requirements Report” and it is an output of TechTIDE WP1 Task 1.1. The document presents a set of mandatory and desirable requirements gathered among users affected by TIDs. Some TechTIDE consortium members represent users such as GFP for HF communications, UPC for N-RTK and ESSP SAS for EGNOS service. Additional HF and N-RTK users were contacted through a survey. Complementary requirements were brought in from ESA Space Situational Awareness Space Weather (SSA SWE) [RD-4]users' requirements. In this way, TechTIDE outputs can assess ESA SSA SWE Service Network prerequisites.

In D1.1, users' requirements are named, described and assigned an identification number and priority. For each requirement, we provide the targeted users and we include some clarifications notes, if necessary. Users' requirements are also classified according to the following categories: service, products, performance and interface.

D1.1 is a first set of the requirements from which system requirements will be derived and gathered in D1.2 “Warning system requirement report”. D1.2 will consider limitations to requirements from the TID detection state of the art.

D1.1 will be updated to become the D1.3 “Final Users’ Requirement Report” in month 26.

1. Introduction

1.1 Purpose and Scope of the Document

This document presents a set of mandatory and desirable requirements gathered among users affected by TIDs such as HF, N-RTK and EGNOS users. The document is divided into four sections:

Section 1 (the current section) includes the purpose of this document and its organization.

Section 2 lists the applicable and reference documents and also contains the list of acronyms used in this document.

Section 3 details the requirements identification and classification.

Section 4 lists the user requirements. This section is divided into four parts. Each part corresponds to a specific group of initial users' requirements types.

2 Associated documents

2.1 Applicable Documents

The following table contains the list of applicable documents.

Table 1. List of applicable documents

AD	Document title
[AD-1]	Grant Agreement number: 776011 — TechTIDE — H2020-COMPET-2017

2.2 Reference Documents

The following table contains the list of references used in this document.

Table 2. List of reference documents

RD	Document title
[RD-1]	European GNSS Agency, "EGNOS Safety of Life (SoL) Service Definition Document", Rev. 3.1. http://egnos-portal.gsa.europa.eu . September 2016
[RD-2]	Kartverket, "seSolstorm", http://sesolstorm.kartverket.no/moreplots.xhtml
[RD-3]	National Observatory of Athens, "Pilot for identification of travelling ionospheric disturbances", NATO SPS 984894, http://tid.space.noa.gr/index.php
[RD-4]	ESA SSA Team, "Space Situational Awareness – Space Weather Customer Requirements Document", Rev.5a, SSA-SWE-RS-CRD-1001, 2011-07-28

2.3 Acronyms

The following table contains the list of all acronyms used in this document.

Table 3. List of acronyms

Acronym	Definition
2D	2-Dimension
3D	3-Dimension
AATR	Along-arc TEC rate
ACE	Advanced Composition Explorer
ASCII	American Standard Code for Information Interchange
CDSS	Continuous Doppler Sounding System

Acronym	Definition
DPS4D	Digisonde-Portable-Sounder-4D
EDD	electron density distribution
EGNOS	European Geostationary Navigation Overlay Service
GBAS	Ground Based Augmentation System
GNSS	Global Navigation Satellite System
HF	High Frequency
HTI	Height-time-reflection intensity
HTML	HyperText Markup Language
IONEX	IONosphere map EXchange format
LSTID	Large Scale TID
MF	Medium Frequency
MSTID	Medium Scale TID
MT	Message Type
MUF	Maximum Usable Frequency
N-RTK	Network Real Time Kinematic
PA	Precision Approach
PFA	Probability of false alarm
POD	Probability of detection
ROT	Rate of TEC
SNR	Signal-to-Noise Ratio
SSA SWE	Space Situational Awareness Space Weather
SSN	Sunspot Number
TEC	Total Electron Content
TID	Travelling Ionospheric Disturbance
VHF	Very High Frequency
WP	Work-package

3. Introduction to users' requirements

3.1 Classification of requirements

The initial users' requirements have been divided into four categories:

- Service requirements define the general specifications of users' needs. They describe warning system general features and geographic scope.
- Product requirements correspond to specification of each final or intermediate product delivered by the system such as TID period, TID phase, TID amplitude, TEC gradients and AATR.
- Performance requirements contain the system performance indicators such as the maximum time to issue a warning, and temporal and spatial resolution of products.
- Interface requirements are related to the visualization, archiving and dissemination of system products. This category contains, for example, website, communication and archive features.

The requirements are presented in detail in section 4.

3.2 Description of requirements

Each of the requirements is represented by a table detailing the attributes associated with it:

Table 4. Example of requirement description

Name	**Scope: general TechTIDE**				
ID	TeT-SRV-0010.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK, ESA
Establish an operational system to issue warnings of the occurrence of TIDs over the region extending from Europe to South Africa.					
Notes:	[AD-1].				

Where:

- *Name* indicates full name of the requirement.
- *ID* is a unique identification code of the users' requirement.

  TeT-USR-Number.Version

  Where:

  - *TeT is a fixed string meaning TechTIDE .*
  - *USR is a string that can take the following strings:*
    - *SRV:* indicates the service requirement category.

        - *PRD:* identifies the product category.
        - *PRF:* identifies the performance category.
        - *INT:* identifies the interface category.
    - *Number* is a four-digit unique requirement identifier.
    - *Version* is a one-digit requirement edition identifier.
- *Priority* marks the requirement as "Mandatory" or "Desirable". Users consider a requirement:
    - "Mandatory" when it is important to fulfill users' primary needs.
    - "Desirable" when brings additional functionality to TechTIDE.
- *Users* indicate the users benefitting from fulfillment of this requirement:
    - *HF communication*
    - *N-RTK*
    - *ESA SSA SWE*
    - *EGNOS*
    - *GBAS*
- *Description* provides the full description of the requirement.
- *Notes* provide additional notes or references to clarify the requirement.

4 Users' requirements

This section lists and provides details for each users' requirement.

4.1 List of requirements

The following table presents the full list of users' requirements including the ID, Name and Users benefitting from the requirement:

Table 5. List of users' service requirements

Service requirements		
ID	**Name**	**Users**
TeT-SRV-0010.1	Scope: general TechTIDE	ALL
TeT-SRV-0020.1	Scope: TID detection	ALL
TeT-SRV-0030.1	Scope: TID warning	ALL
TeT-SRV-0040.1	Geospace warning: TEC	EGNOS, N-RTK
TeT-SRV-0050.1	Geospace warning: HF	HF
TeT-SRV-0060.1	Ionospheric conditions: background	ALL
TeT-SRV-0070.1	Ionospheric conditions: forecast	ALL
TeT-SRV-0080.1	Interhemispheric circulation	ALL
TeT-SRV-0090.1	Geographical scope: Europe	EGNOS
TeT-SRV-0100.1	Geographical scope: extended Europe	HF
TeT-SRV-0110.1	Geographical scope: South Africa	HF, N-RTK
TeT-SRV-0120.1	Geographical scope: global real time	ESA
TeT-SRV-0130.1	Geographical scope: global archive	ESA
TeT-SRV-0140.1	Geographical scope: global forecast	ESA
TeT-SRV-0150.1	IONEX maps geographical scope	EGNOS
TeT-SRV-0160.1	IONEX maps geographical scope: extended	HF

Table 6. List of users' product requirements

Product requirements		
ID	**Name**	**Users**
TeT-PRD-1010.1	HF-TID final	ALL
TeT-PRD-1020.1	HF-TID intermediate	HF, N-RTK
TeT-PRD-1030.1	HF-correlation final	ALL
TeT-PRD-1040.1	HF-correlation intermediate	ALL
TeT-PRD-1050.1	Spatial and temporal GNSS analysis final	ALL
TeT-PRD-1060.1	Spatial and temporal GNSS analysis intermediate	EGNOS, N-RTK
TeT-PRD-1070.1	GNSS TEC gradients final	EGNOS, HF, N-RTK
TeT-PRD-1080.1	GNSS TEC gradients intermediate	EGNOS, HF, N-RTK
TeT-PRD-1090.1	3D-EDD maps final	ALL
TeT-PRD-1100.1	3D-EDD maps bottomside intermediate	EGNOS, HF, N-RTK
TeT-PRD-1110.1	3D-EDD maps topside intermediate	EGNOS, HF, N-RTK
TeT-PRD-1120.1	HTI intermediate	HF
TeT-PRD-1130.1	HTI final	HF
TeT-PRD-1140.1	CDSS intermediate	HF
TeT-PRD-1150.1	CDSS final	HF
TeT-PRD-1160.1	AATR intermediate	EGNOS, HF, N-RTK
TeT-PRD-1170.1	AATR final	ALL
TeT-PRD-1180.1	foF2 maps	N-RTK
TeT-PRD-1190.1	Maximum Usable Frequency	HF
TeT-PRD-1200.1	Sunspot Number	HF
TeT-PRD-1210.1	TID activity metrics report	ALL
TeT-PRD-1220.1	Signal-to-Noise ratio on links	HF
TeT-PRD-1230.1	Path probability ratio on links	HF
TeT-PRD-1240.1	Ionosphere perturbation index	N-RTK

Table 7. List of users' performance requirements

Performance requirements		
ID	**Name**	**Users**
TeT-PRF-2010.1	Service operational availability	ESA
TeT-PRF-2020.1	Service operational availability: aviation	GBAS
TeT-PRF-2030.1	Service maximum contiguous downtime	ESA
TeT-PRF-2040.1	Service unavailability information delay	ESA
TeT-PRF-2050.1	Service recovery information delay	ESA
TeT-PRF-2060.1	Service scheduled maintenance information	ESA
TeT-PRF-2070.1	Timeliness: near real-time data	ESA
TeT-PRF-2080.1	Timeliness: archive data	ESA
TeT-PRF-2090.1	Timeliness: forecast	ESA
TeT-PRF-2100.1	Timeliness: MSTID warnings	N-RTK
TeT-PRF-2110.1	Timeliness: TEC gradients	EGNOS, N-RTK
TeT-PRF-2120.1	Timeliness: TEC gradient warnings	EGNOS, N-RTK
TeT-PRF-2130.1	Timeliness: HF-TID	EGNOS, HF, N-RTK
TeT-PRF-2140.1	Timeliness: HF-correlation	EGNOS, HF, N-RTK
TeT-PRF-2150.1	Timeliness: 3D-EDD maps	EGNOS, HF, N-RTK
TeT-PRF-2160.1	Timeliness: CDSS	HF
TeT-PRF-2170.1	Timeliness: Ionosphere perturbation index	N-RTK
TeT-PRF-2180.1	Timeliness: Ionosphere perturbation index warnings	N-RTK
TeT-PRF-2190.1	Timeliness: SNR on links warnings	HF
TeT-PRF-2200.1	Timeliness: Path probability ratio on links warnings	HF
TeT-PRF-2210.1	Timeliness: Spatial and temporal GNSS analysis	EGNOS, HF, N-RTK
TeT-PRF-2220.1	Spatial resolution: near real-time data	ESA
TeT-PRF-2230.1	Spatial resolution: archive data	ESA
TeT-PRF-2240.1	Spatial resolution: forecasts	ESA
TeT-PRF-2250.1	Spatial resolution: MSTID (deg)	N-RTK

Performance requirements		
ID	**Name**	**Users**
TeT-PRF-2260.1	Spatial resolution: MSTID (km)	GBAS
TeT-PRF-2270.1	Spatial resolution: TEC gradients (deg)	EGNOS, N-RTK
TeT-PRF-2280.1	Spatial resolution: TEC gradients (km)	GBAS
TeT-PRF-2290.1	Spatial resolution: Ionosphere perturbation index	N-RTK
TeT-PRF-2300.1	Spatial resolution: IONEX	EGNOS, HF
TeT-PRF-2310.1	Temporal resolution: near real-time data	ESA
TeT-PRF-2320.1	Temporal resolution: archived data	ESA
TeT-PRF-2330.1	Temporal resolution: forecasts	ESA
TeT-PRF-2340.1	Temporal resolution: MSTID warning	N-RTK, GBAS
TeT-PRF-2350.1	Temporal resolution: MSTID forecast	N-RTK
TeT-PRF-2360.1	Temporal resolution: TEC gradients	EGNOS, N-RTK
TeT-PRF-2370.1	Temporal resolution: Ionosphere perturbation index	N-RTK
TeT-PRF-2380.1	Temporal resolution: ionosphere perturbation index forecast	N-RTK
TeT-PRF-2390.1	Temporal resolution: IONEX	EGNOS, HF
TeT-PRF-2400.1	Minimum advance: MSTID forecast	N-RTK
TeT-PRF-2410.1	Minimum advance: TEC gradient forecast	EGNOS, N-RTK
TeT-PRF-2420.1	Minimum advance: Ionosphere perturbation index	N-RTK
TeT-PRF-2430.1	HTI: postprocessing	HF
TeT-PRF-2440.1	POD: MSTID warnings	N-RTK
TeT-PRF-2450.1	POD: TEC gradient warnings	EGNOS, N-RTK
TeT-PRF-2460.1	POD: Ionosphere perturbation index warnings	N-RTK
TeT-PRF-2470.1	PFA: MSTID warnings	N-RTK
TeT-PRF-2480.1	PFA: TEC gradient warnings	EGNOS, N-RTK
TeT-PRF-2490.1	PFA: Ionosphere perturbation index warnings	N-RTK

Table 8. List of users' interface requirements

Interface requirements		
ID	**Name**	**Users**
TeT-INT-3010.1	Dissemination means: website	ALL
TeT-INT-3020.1	Website: graphical indication of MSTID	N-RTK
TeT-INT-3030.1	Website: tabular output of TID	EGNOS, HF, N-RTK
TeT-INT-3040.1	Website: graphical ionosphere perturbation index	N-RTK
TeT-INT-3050.1	Website: graphical TEC gradients	EGNOS, N-RTK
TeT-INT-3060.1	Website: graphical TEC rates and maps	EGNOS, N-RTK
TeT-INT-3070.1	Website: simple scale warning	EGNOS, N-RTK
TeT-INT-3080.1	Website: geomagnetic activity	HF
TeT-INT-3090.1	Website: subscription	ALL
TeT-INT-3100.1	Website: availability	ALL
TeT-INT-3110.1	Website: online help	ALL
TeT-INT-3120.1	Website: contact information	ALL
TeT-INT-3130.1	Website: users' feedback	ALL
TeT-INT-3140.1	Website: compatible interface	ALL
TeT-INT-3150.1	Website: past graphical information	ALL
TeT-INT-3160.1	Website: measurements	ALL
TeT-INT-3170.1	Website: last update	ALL
TeT-INT-3180.1	Website: users sections	EGNOS, HF, N-RTK
TeT-INT-3190.1	Website: users' selection of warnings and forecasts	EGNOS, HF, N-RTK
TeT-INT-3200.1	Dissemination means: emails	EGNOS, HF, N-RTK
TeT-INT-3210.1	Dissemination means: Twitter	EGNOS, HF, N-RTK
TeT-INT-3220.1	Email format: HTML	EGNOS, HF, N-RTK
TeT-INT-3230.1	Email/Twitter: TID warning	EGNOS, HF, N-RTK
TeT-INT-3240.1	Email/Twitter: TID forecast	EGNOS, HF, N-RTK
TeT-INT-3250.1	Email/Twitter: TID cancellation	EGNOS, HF, N-RTK
TeT-INT-3260.1	Email/Twitter: product threshold warnings	EGNOS, HF, N-RTK

Interface requirements		
ID	**Name**	**Users**
TeT-INT-3270.1	Email/Twitter: TEC gradient warning threshold	EGNOS, N-RTK, GBAS
TeT-INT-3280.1	Email/Twitter: TEC gradient warning area	EGNOS, N-RTK, GBAS
TeT-INT-3290.1	Email/Twitter: TID characteristics warnings	EGNOS, HF, N-RTK
TeT-INT-3300.1	Email/Twitter: impact on SNR HF warning	HF
TeT-INT-3310.1	Email/Twitter: SNR on HF warning	HF
TeT-INT-3320.1	Email/Twitter: path probability ratio on links warning	HF
TeT-INT-3330.1	Email/Twitter: positioning error warning	GBAS
TeT-INT-3340.1	Email/Twitter: operational effects warnings	EGNOS, HF, N-RTK
TeT-INT-3350.1	Email/Twitter: simple scale warning	EGNOS, N-RTK
TeT-INT-3360.1	Dissemination means: smartphone app	EGNOS, HF, N-RTK
TeT-INT-3370.1	Dissemination means: MF/HF/VHF communication	ALL
TeT-INT-3380.1	Dissemination means: Network State Space representation	N-RTK
TeT-INT-3390.1	Dissemination means: archive	ALL
TeT-INT-3400.1	Archive: TID annual record file	ALL
TeT-INT-3410.1	Archive: TEC gradient annual record file	EGNOS, HF, N-RTK
TeT-INT-3420.1	Archive: Data files	ALL
TeT-INT-3430.1	Archive: TEC maps	EGNOS
TeT-INT-3440.1	Archive: TID activity report ASCII format	EGNOS
TeT-INT-3450.1	Archive: TID activity report graphical format	EGNOS
TeT-INT-3460.1	Archive: time range	ESA
TeT-INT-3470.1	Archive: time range of MSTID warnings	N-RTK
TeT-INT-3480.1	Archive: time range of MSTID occurrence	N-RTK
TeT-INT-3490.1	Archive: time range of MSTID forecast	N-RTK
TeT-INT-3500.1	Archive: time range of TEC gradients	EGNOS, N-RTK, GBAS

Interface requirements		
ID	**Name**	**Users**
TeT-INT-3510.1	Archive: time range of TEC gradient forecasts	EGNOS, N-RTK
TeT-INT-3520.1	Archive: time range of TEC gradient warnings	EGNOS, N-RTK, GBAS
TeT-INT-3530.1	Archive: time range of Ionosphere perturbation index warnings	N-RTK
TeT-INT-3540.1	Archive: time range of Ionosphere perturbation index images	N-RTK
TeT-INT-3550.1	Archive: time range of Ionosphere perturbation index forecasts	N-RTK

4.2 Service requirements

Service requirements are general project specifications:

Name	**Scope: TechTIDE**				
ID	TeT-SRV-0010.1	**Priority:**	Mandatory	**Users:**	ALL
Establish an operational system to issue warnings of the occurrence of TIDs over the region extending from Europe to South Africa.					
Notes:	[AD-1]				

Name	**Scope: TID detection**				
ID	TeT-SRV-0020.1	**Priority:**	Mandatory	**Users:**	ALL
Users shall be informed in near real-time on TIDs occurrence: both LSTIDs and MSTIDs.					
Notes:					

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Name	**Scope: TID warning**				
ID	TeT-SRV-0030.1	**Priority:**	Desirable	**Users:**	ALL
Users shall be warned when specific locations are likely to be affected by TIDs according to TIDs propagation characteristics.					
Notes:	Having TIDs propagation characteristics will help forecasting to which areas and when will TIDs travel to. These data are used for forecasting availability of HF radio links, EGNOS and N-RTK.				

Name	**Geospace warning: TEC**				
ID	TeT-SRV-0040.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
Users shall be warned when conditions on the geospace or aurora oval are likely to generate TIDs or significant TEC gradients.					
Notes:	This is used to indicate that an event (TID, TEC gradients) may develop. It is intended to provide information to those who need considerable lead time to prepare for an event.				

Name	**Geospace warning: HF**				
ID	TeT-SRV-0050.1	**Priority:**	Desirable	**Users:**	HF
Users shall be warned when HF-link-conditions significant influenced on the geospace or aurora oval are likely to generate TIDs or significant TEC gradients.					
Notes:					

Name	**Ionospheric conditions: background**				
ID	TeT-SRV-0060.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall assess the ionospheric background conditions.					
Notes:					

Name	**Ionospheric conditions: forecast**				
ID	TeT-SRV-0070.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall forecast ionospheric conditions for the next 24h.					
Notes:					

Name	**Interhemispheric circulation**				
ID	TeT-SRV-0080.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall identify TIDs travelling equatorward and being observed in the other hemisphere.					
Notes:					

Name	**Geographical scope: Europe**				
ID	TeT-SRV-0090.1	**Priority:**	Mandatory	**Users:**	EGNOS
Users shall be informed on TIDs in the area: 20 to 72 deg lat and -40 to 40 deg lon.					
Notes:	This is the area where EGNOS provides its precision approach service [RD-1].				

Name	**Geographical scope: extended Europe**				
ID	TeT-SRV-0100.1	**Priority:**	Desirable	**Users:**	HF
Users shall be informed on TIDs in the area: 0 to 72 deg lat and long -40 to 80 deg lon.					
Notes:	International missions use HF-communication-links in this area.				

Name	**Geographical scope: South Africa**				
ID	TeT-SRV-0110.1	**Priority:**	Mandatory	**Users:**	HF, N-RTK
Users shall be informed on TIDs in the area: -20 to -35 deg lat and 15 to 35 deg lon.					
Notes:	South Africa region.				

Name	**Geographical scope: global real time**				
ID	TeT-SRV-0120.1	**Priority:**	Desirable	**Users:**	ESA
The spatial coverage of near real-time data shall be: -90 to 90 deg lat and 0 to 360 deg long.					
Notes:	ESA PSD IT-011-N [RD-4].				

Name	**Geographical scope: global archive**				
ID	TeT-SRV-0130.1	**Priority:**	Desirable	**Users:**	ESA
The spatial coverage of archived data shall be long: -90 to 90 deg lat and 0 to 360 deg long.					
Notes:	ESA PSD IT-011-P [RD-4].				

Name	**Geographical scope: global forecast**				
ID	TeT-SRV-0140.1	**Priority:**	Desirable	**Users:**	ESA
The spatial coverage of forecast data shall be long: -90 to 90 deg lat and 0 to 360 deg long.					
Notes:	ESA PSD IT-011-F [RD-4].				

Name	**IONEX maps geographical scope**				
ID	TeT-SRV-0150.1	**Priority:**	Desirable	**Users:**	EGNOS
TEC maps shall be provided in the area: 10 to 90 deg lat and -60 to 60 deg long.					
Notes:	The area represents where EGNOS provides ionospheric corrections which is different to the area where EGNOS provides precision approach.				

Name	**IONEX maps geographical scope: extended**				
ID	TeT-SRV-0160.1	**Priority:**	Desirable	**Users:**	HF
TEC maps shall be provided in the area: 10 to 90 deg lat and -60 to 80 deg long.					
Notes:					

4.3 Product requirements

Products are outputs of the TIDs detection methodologies. Methodologies provide final products which present TIDs characteristics and intermediate products which are additional results that can be of users' interest:

Name	**HF-TID final**				
ID	TeT-PRD-1010.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall estimate for LSTIDs and MSTIDs the values of: TID period, phase velocity, direction of propagation, wavelength and amplitude.					
Notes:					

Name	**HF-TID intermediate**				
ID	TeT-PRD-1020.1	**Priority:**	Desirable	**Users:**	HF, N-RTK
The system shall estimate for HF communication: the Doppler frequency, angle of arrival, and time-of-flight from transmitter to receiver, both oblique and vertical incidence sounding.					
Notes:					

Name	**HF-correlation final**				
ID	TeT-PRD-1030.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall estimate for LSTID: dominant period, amplitude and 2D vector velocity.					
Notes:					

Name	**HF-correlation intermediate**				
ID	TeT-PRD-1040.1	**Priority:**	Desirable	**Users:**	ALL
The system shall estimate: de-trended ionospheric characteristics and spectral energy contribution for specific measuring stations.					
Notes:					

Name	**Spatial and temporal GNSS analysis final**				
ID	TeT-PRD-1050.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall estimate TID velocity, direction of propagation and amplitude.					
Notes:					

Name	**Spatial and temporal GNSS analysis intermediate**				
ID	TeT-PRD-1060.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
The system shall estimate de-trended GNSS products that remove the nominal ionospheric variations.					
Notes:					

Name	**GNSS TEC gradients final**				
ID	TeT-PRD-1070.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
The system shall deliver TEC gradients.					
Notes:					

Name	**GNSS TEC gradients intermediate**				
ID	TeT-PRD-1080.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
The system shall deliver maps of TEC and TEC rate.					
Notes:					

Name	**3D-EDD maps final**				
ID	TeT-PRD-1090.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall estimate for LSTIDs and MSTIDs: altitude of the maximum TID perturbation and TID propagation trajectory.					
Notes:					

Name	**3D-EDD maps bottomside intermediate**				
ID	TeT-PRD-1100.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
The system shall estimate 3D electron density distribution (EDD) for the bottomside ionosphere.					
Notes:					

Name	**3D-EDD maps topside intermediate**				
ID	TeT-PRD-1110.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
The system shall estimate 3D electron density distribution (EDD) for the topside ionosphere.					
Notes:					

Name	**HTI intermediate**				
ID	TeT-PRD-1120.1	**Priority:**	Desirable	**Users:**	HF
The system shall estimate the dominant period of wave activity.					
Notes:					

Name	**HTI final**				
ID	TeT-PRD-1130.1	**Priority:**	Mandatory	**Users:**	HF
The system shall estimate the signal-to-noise ratio variation of vertically reflected radio signals above a given measuring station.					
Notes:					

Name	**CDSS intermediate**				
ID	TeT-PRD-1140.1	**Priority:**	Mandatory	**Users:**	HF
The system shall estimate the period, amplitude and phase of Doppler shift measurements.					
Notes:					

Name	**CDSS final**				
ID	TeT-PRD-1150.1	**Priority:**	Mandatory	**Users:**	HF
The system shall estimate continuous Doppler shifts of fixed sounding radio frequencies.					
Notes:					

Name	**AATR intermediate**				
ID	TeT-PRD-1160.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
The system shall estimate TEC rate.					
Notes:					

Name	**AATR final**				
ID	TeT-PRD-1170.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall use AATR and TEC rate to identify regions where the ionosphere is disturbed with respect to nominal conditions.					
Notes:					

Name	**foF2 maps**				
ID	TeT-PRD-1180.1	**Priority:**	Desirable	**Users:**	N-RTK
The system shall deliver a real-time foF2 map showing the effects of the TID incorporated.					
Notes:	Product requested by an N-RTK user.				

Name	**Maximum Usable Frequency**				
ID	TeT-PRD-1190.1	**Priority:**	Desirable	**Users:**	HF
The system shall deliver MUF.					
Notes:	Product requested by a HF user.				

Name	**Sunspot Number**				
ID	TeT-PRD-1200.1	**Priority:**	Desirable	**Users:**	HF
The system shall deliver sunspot number.					
Notes:	SSN requested by a HF user. Additionally to SSN, the F10.7 cm solar radio flux could provide an added value.				

Name	**TID activity metrics report**				
ID	TeT-PRD-1210.1	**Priority:**	Mandatory	**Users:**	ALL
The system shall output all the products, ionospheric background conditions and a classification of the TID activity in the TID activity metric report.					
Notes:					

Name	**Signal-to-Noise ratio on links**				
ID	TeT-PRD-1220.1	**Priority:**	Mandatory	**Users:**	HF
The system shall calculate the signal-to-noise ratio on link sections between the DPS4D sounders.					
Notes:					

Name	**Path probability ratio on links**				
ID	TeT-PRD-1230.1	**Priority:**	Mandatory	**Users:**	HF
The system shall calculate path probability ratio on link sections between the DPS4D sounders.					
Notes:	This is helpful to detect bearing deviation.				

Name	**Ionosphere perturbation index**				
ID	TeT-PRD-1240.1	**Priority:**	Mandatory	**Users:**	N-RTK
The system shall calculate an ionosphere perturbation index indicating any current ionosphere small scale perturbations (scale below 80 km) in Europe					
Notes:					

4.4 Performance requirements

Performance requirements are performance goals for an operational TID detection system:

Name	**Service operational availability**				
ID	TeT-PRF-2010.1	**Priority:**	Desirable	**Users:**	ESA
The operational availability shall be better than 99% per year.					
Notes:	SWE-SRD-9168 [RD-4].				

Name	**Service operational availability: aviation**				
ID	TeT-PRF-2020.1	**Priority:**	Mandatory	**Users:**	GBAS
For aviation, the operational availability shall be better than 99.9% per year.					
Notes:					

Name	**Service maximum contiguous downtime**				
ID	TeT-PRF-2030.1	**Priority:**	Desirable	**Users:**	ESA
The maximum contiguous downtime of the service shall be less than 5 minutes with the exception of scheduled maintenance					
Notes:	SWE-SRD-9167, SWE-CRD-TIO-164 [RD-4].				

Name	**Service unavailability information delay**				
ID	TeT-PRF-2040.1	**Priority:**	Desirable	**Users:**	ESA
The Supplier shall inform its users of any limitations of the service that may occur due to unexpected unavailability with a minimum delay and within a maximum of 1 hour from the start of the unavailability.					
Notes:	SWE-SRD-10861 [RD-4].				

Name	**Service recovery information delay**				
ID	TeT-PRF-2050.1	**Priority:**	Desirable	**Users:**	ESA
The Supplier shall inform its users when it is functioning normally following an unavailability period with a minimum delay and within a maximum of 1 hour from the end of the unavailability.					
Notes:	SWE-SRD-10860 [RD-4].				

Name	**Service scheduled maintenance information**				
ID	TeT-PRF-2060.1	**Priority:**	Desirable	**Users:**	ESA
The Supplier shall inform users of scheduled maintenance and limitations of service that may occur due to planned unavailability periods 30 days in advance.					
Notes:	ESA SRD SWE-SRD-11847 [RD-4].				

Name	**Timeliness: near real-time data**				
ID	TeT-PRF-2070.1	**Priority:**	Desirable	**Users:**	ESA
Time between measurement and product provision shall be less than 5 minutes					
Notes:	ESA PSD IT-011-N [RD-4].				

Name	**Timeliness: archive data**				
ID	TeT-PRF-2080.1	**Priority:**	Desirable	**Users:**	ESA
Time between completion of measurements and product archive shall be less than 2 days.					
Notes:	ESA PSD IT-011-P [RD-4].				

Name	**Timeliness: forecast**				
ID	TeT-PRF-2090.1	**Priority:**	Desirable	**Users:**	ESA
Time between forecast and product provision shall be at least 15 minutes up to 3 days ahead.					
Notes:	ESA PSD IT-011-F [RD-4].				

Name	**Timeliness: MSTID warnings**				
ID	TeT-PRF-2100.1	**Priority:**	Mandatory	**Users:**	N-RTK
Warnings on the localized occurrence of MSTIDs shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: TEC gradients**				
ID	TeT-PRF-2110.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
TEC gradients shall be provided not more than 5 minutes after observation (completion of measurements).					
Notes:	N-RTK service providers monitor TEC and TEC gradients. For the purpose of validation, they want to check TEC gradient products.				

Name	**Timeliness: TEC gradient warnings**				
ID	TeT-PRF-2120.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
Warnings on TEC gradients exceeding a certain threshold shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: HF-TID**				
ID	TeT-PRF-2130.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
HF-TID (intermediate and final products) shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: HF-correlation**				
ID	TeT-PRF-2140.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
HF-correlation (intermediate and final products) shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: 3D-EDD maps**				
ID	TeT-PRF-2150.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
3D-EDD maps (intermediate and final products) shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: CDSS**				
ID	TeT-PRF-2160.1	**Priority:**	Mandatory	**Users:**	HF
CDSS (intermediate and final products) shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: ionosphere perturbation index**				
ID	TeT-PRF-2170.1	**Priority:**	Mandatory	**Users:**	N-RTK
Ionosphere perturbation index shall be provided not more than 5 minutes after completion of measurements.					
Notes:	N-RTK service providers are interested in small and medium scale ionospheric perturbations.				

Name	**Timeliness: ionosphere perturbation index warnings**				
ID	TeT-PRF-2180.1	**Priority:**	Mandatory	**Users:**	N-RTK
Warnings on ionosphere perturbation index exceeding a certain threshold shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Timeliness: SNR on links warnings**				
ID	TeT-PRF-2190.1	**Priority:**	Desirable	**Users:**	HF
Warnings on SNR on links shall be issued less than 5 minutes after measurement.					
Notes:					

Name	**Timeliness: Path probability ratio on links warnings**				
ID	TeT-PRF-2200.1	**Priority:**	Desirable	**Users:**	HF
Warnings on path probability ratio on links shall be issued and through the website in less than 5 minutes.					
Notes:					

Name	**Timeliness: Spatial and temporal GNSS analysis**				
ID	TeT-PRF-2210.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
Spatial and temporal GNSS analysis (intermediate and final products) shall be issued not later than 5 minutes after observation (completion of measurements).					
Notes:					

Name	**Spatial resolution: near real-time data**				
ID	TeT-PRF-2220.1	**Priority:**	Desirable	**Users:**	ESA
The spatial resolution of near real-time data shall be 100 km.					
Notes:	ESA PSD IT-011-N [RD-4].				

Name	**Spatial resolution: archive data**				
ID	TeT-PRF-2230.1	**Priority:**	Desirable	**Users:**	ESA
The spatial resolution of archive data shall be 100 km.					
Notes:	ESA PSD IT-011-P [RD-4].				

Name	**Spatial resolution: forecasts**				
ID	TeT-PRF-2240.1	**Priority:**	Desirable	**Users:**	ESA
The spatial resolution of forecast data shall be 100 km.					
Notes:	ESA PSD IT-011-F [RD-4].				

Name	**Spatial resolution: MSTID (deg)**				
ID	TeT-PRF-2250.1	**Priority:**	Mandatory	**Users:**	N-RTK
The localization of MSTIDs shall have a spatial resolution of 1 degree or better in latitude and longitude.					
Notes:	N-RTK providers are especially interested MSTIDs of wavelength less than 160km because N-RTK has about 80 km distance between the reference stations and they usually interpolate the ionosphere in-between. MSTID impact the interpolation result				

Name	**Spatial resolution: MSTID (km)**				
ID	TeT-PRF-2260.1	**Priority:**	Desirable	**Users:**	GBAS
The TID amplitudes shall be provided with 30km x 30km spatial resolution.					
Notes:					

Name	**Spatial resolution: TEC gradients (deg)**				
ID	TeT-PRF-2270.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
TEC gradients shall have a spatial resolution of 1 degree or better in latitude and longitude.					
Notes:	N-RTK service providers monitor TEC and TEC gradients. For the purpose of validation, they want to check TEC gradient products.				

Name	**Spatial resolution: TEC gradients (km)**				
ID	TeT-PRF-2280.1	**Priority:**	Desirable	**Users:**	GBAS
The TEC gradients shall be provided with 30km x 30 km spatial resolution.					
Notes:					

Name	**Spatial resolution: ionosphere perturbation index**				
ID	TeT-PRF-2290.1	**Priority:**	Mandatory	**Users:**	N-RTK
Current ionosphere perturbation index shall have a spatial resolution of not more than 1 degree in latitude and longitude.					
Notes:					

Name	**Spatial resolution: IONEX**				
ID	TeT-PRF-2300.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF
TEC maps for IONEX shall be provided with a spatial resolution of at least 5 degrees or better.					
Notes:	The 5 degrees resolution matches EGNOS ionospheric corrections.				

Name	**Temporal resolution: near real-time data**				
ID	TeT-PRF-2310.1	**Priority:**	Desirable	**Users:**	ESA
The time interval between two near real-time product/data points shall be less than 5 minutes.					
Notes:	ESA PSD IT-011-N [RD-4].				

Name	**Temporal resolution: archive data**				
ID	TeT-PRF-2320.1	**Priority:**	Desirable	**Users:**	ESA
The time interval between two product/data points shall be less than 5 minutes.					
Notes:	ESA PSD IT-011-P [RD-4].				

Name	**Temporal resolution: forecasts**				
ID	TeT-PRF-2330.1	**Priority:**	Desirable	**Users:**	ESA
The time interval between two product/data points shall be less than 15 minutes.					
Notes:	ESA PSD IT-011-F [RD-4].				

Name	**Temporal resolution: MSTID warning**				
ID	TeT-PRF-2340.1	**Priority:**	Mandatory	**Users:**	N-RTK, GBAS
The localization of MSTIDs shall have a temporal resolution of 5 minutes.					
Notes:					

Name	**Temporal resolution: MSTID forecast**				
ID	TeT-PRF-2350.1	**Priority:**	Mandatory	**Users:**	N-RTK
The forecast information on localized occurrence of MSTIDs shall be updated at least every 5 minutes.					
Notes:					

Name	**Temporal resolution: TEC gradients**				
ID	TeT-PRF-2360.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
Current TEC gradients shall have a temporal resolution of 5 minutes.					
Notes:					

Name	**Temporal resolution: ionosphere perturbation index**				
ID	TeT-PRF-2370.1	**Priority:**	Mandatory	**Users:**	N-RTK
Current ionosphere perturbation index shall have a temporal resolution of 5 minutes.					
Notes:					

Name	**Temporal resolution: ionosphere perturbation index forecast**				
ID	TeT-PRF-2380.1	**Priority:**	Mandatory	**Users:**	N-RTK
The forecast ionosphere perturbation index shall be updated at least every 5 minutes.					
Notes:					

Name	**Temporal resolution: IONEX**				
ID	TeT-PRF-2390.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF
TEC maps for IONEX shall be provided with a temporal resolution of 5 minutes or better.					
Notes:	The 5 minutes resolution matches EGNOS ionospheric corrections.				

Name	**Minimum advance: MSTID forecast**				
ID	TeT-PRF-2400.1	**Priority:**	Desirable	**Users:**	N-RTK
Warnings on forecast of the localized occurrence of MSTIDs shall be issued at least 10 minutes ahead of forecast occurrence.					
Notes:					

Name	**Minimum advance: TEC gradient forecast**				
ID	TeT-PRF-2410.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
Warnings on forecast of TEC gradients exceeding a certain threshold shall be issued at least 10 minutes ahead of forecasted occurrence.					
Notes:	Forecast of TEC gradients are important for N-RTK service providers.				

Name	**Minimum advance: ionosphere perturbation index**				
ID	TeT-PRF-2420.1	**Priority:**	Mandatory	**Users:**	N-RTK
Warnings on forecast of ionosphere perturbation index exceeding a certain threshold shall be issued at least 10 minutes ahead of forecasted occurrence.					
Notes:					

Name	**HTI: postprocessing**				
ID	TeT-PRF-2430.1	**Priority:**	Mandatory	**Users:**	HF
HTI (intermediate and final product) shall be available in postprocessing.					
Notes:					

Name	**POD: MSTID warnings**				
ID	TeT-PRF-2440.1	**Priority:**	Desirable	**Users:**	N-RTK
Warnings for the occurrence of MSTIDs shall at least 50 % probability of detection.					
Notes:					

Name	**POD: TEC gradient warnings**				
ID	TeT-PRF-2450.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
Warnings for TEC gradients exceeding a certain threshold shall at least 50 % probability of detection.					
Notes:					

Name	**POD: Ionosphere perturbation index warnings**				
ID	TeT-PRF-2460.1	**Priority:**	Desirable	**Users:**	N-RTK
Warnings for **Ionosphere perturbation index** exceeding a certain threshold shall at least 50 % probability of detection.					
Notes:					

Name	**PFA: MSTID warnings**				
ID	TeT-PRF-2470.1	**Priority:**	Desirable	**Users:**	N-RTK
Warnings for the occurrence of MSTIDs shall have a maximum of 5% probability of false alarm.					
Notes:					

Name	**PFA: TEC gradient warnings**				
ID	TeT-PRF-2480.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
Warnings for TEC gradients exceeding a certain threshold shall have a maximum of 5 % probability of false alarm.					
Notes:					

Name	**PFA for Ionosphere perturbation index warnings**				
ID	TeT-PRF-2490.1	**Priority:**	Desirable	**Users:**	N-RTK
Warnings for **Ionosphere perturbation index** exceeding a certain threshold shall have a maximum of 5 % probability of false alarm.					
Notes:					

4.5 Interface requirements

Interface requirements present the user's needs in terms of dissemination means:

Name	**Dissemination means: website**				
ID	TeT-INT-3010.1	**Priority:**	Mandatory	**Users:**	ALL
Users shall receive TechTIDE information and warnings by means of dedicated website.					
Notes:	The website is the main gateway to users.				

Name	**Website: graphical indication of MSTID**				
ID	TeT-INT-3020.1	**Priority:**	Mandatory	**Users:**	N-RTK
The website shall provide graphical indication where MSTIDs are currently present.					
Notes:					

Name	**Website: tabular output of TID**				
ID	TeT-INT-3030.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
The website shall provide a tabular output (ASCII table) displaying the TIDs characteristics.					
Notes:	Similar to [RD-3]				

Name	**Website: graphical ionosphere perturbation index**				
ID	TeT-INT-3040.1	**Priority:**	Mandatory	**Users:**	N-RTK
The website shall provide graphical indication of ionosphere perturbation index.					
Notes:					

Name	**Website: graphical TEC gradients**				
ID	TeT-INT-3050.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
The website shall provide graphical indication of current TEC gradients.					
Notes:					

Name	**Website: graphical TEC rates and maps**				
ID	TeT-INT-3060.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
The website shall provide a graphical indication of TEC rates and TEC maps.					
Notes:					

Name	**Website: simple scale warning**				
ID	TeT-INT-3070.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
The website shall show simple warnings (e.g. green, amber or red) to indicate the likelihood of a disruption to GNSS users.					
Notes:	N-RTK user suggested a simple scale warning (e.g. green, amber or red).				

Name	**Website: geomagnetic activity**				
ID	TeT-INT-3080.1	**Priority:**	Mandatory	**Users:**	HF
The user should be informed about the local geomagnetic index at the location of the ionospheric sounder by a "mouse over" function.					
Notes:					

Name	**Website: subscription**				
ID	TeT-INT-3090.1	**Priority:**	Desirable	**Users:**	ALL
The website shall be able to register users.					
Notes:	Registration can be done through the website and users will configure the alerts they are interested.				

Name	**Website: availability**				
ID	TeT-INT-3100.1	**Priority:**	Mandatory	**Users:**	ALL
Standardized website information shall be available to non-registered users.					
Notes:					

Name	**Website: online help**				
ID	TeT-INT-3110.1	**Priority:**	Mandatory	**Users:**	ALL
The website shall provide on-line help describing the generation, interpretation, usage and formats of the output products.					
Notes:	An explanation on products meaning and format.				

Name	**Website: contact information**				
ID	TeT-INT-3120.1	**Priority:**	Mandatory	**Users:**	ALL
The website shall provide a clear path to contact TechTIDE team by email.					
Notes:					

Name	**Website: users' feedback**				
ID	TeT-INT-3130.1	**Priority:**	Mandatory	**Users:**	ALL
The website shall provide the means to collect users' feedback.					
Notes:					

Name	**Website: compatible interface**				
ID	TeT-INT-3140.1	**Priority:**	Desirable	**Users:**	ALL
The website shall provide the interface for displaying the results to a remote user using a PC/Mac and different browsers.					
Notes:					

Name	**Website: past graphical information**				
ID	TeT-INT-3150.1	**Priority:**	Desirable	**Users:**	ALL
The website shall provide a functionality to display archived graphical outputs by selecting the start and end date and time.					
Notes:	This functionality will help users to retrieve past graphical outputs such as maps or time series so users can perform their first analysis using a graphical approach. Similar to [RD-2].				

Name	**Website: measurements**				
ID	TeT-INT-3160.1	**Priority:**	Desirable	**Users:**	ALL
The website shall provide information on where to find all measurements used as system inputs.					
Notes:	Website links to measurements sources.				

Name	**Website: last update**				
ID	TeT-INT-3170.1	**Priority:**	Mandatory	**Users:**	ALL
The user should be informed when the data on the website was last updated.					
Notes:					

Name	Website: users' sections				
ID	TeT-INT-3180.1	Priority:	Desirable	Users:	EGNOS, HF, N-RTK
The website shall differentiate products targeting different user communities.					
Notes:	Website can have different sections for HF, EGNOS and N-RTK. For common information, a general section can be included.				

Name	Website: users' selection of warnings and forecasts				
ID	TeT-INT-3190.1	Priority:	Desirable	Users:	EGNOS, HF, N-RTK
The website shall provide registered users with means to select a subset of warnings and forecasts.					
Notes:	Users must be only interested in TIDs with specific characteristics.				

Name	Dissemination means: emails				
ID	TeT-INT-3200.1	Priority:	Mandatory	Users:	EGNOS, HF, N-RTK
Users shall receive warnings and forecasts by means of dedicated emails.					
Notes:	Several users said emails were a good way to communicate with them.				

Name	Dissemination means: Twitter				
ID	TeT-INT-3210.1	Priority:	Mandatory	Users:	EGNOS, HF, N-RTK
Users shall receive warnings and forecast by means of dedicated tweets.					
Notes:	Users showed interest on text messages or tweets as it can be more effective at alerting users "in the field."				

Name	Email format: HTML				
ID	TeT-INT-3220.1	Priority:	Mandatory	Users:	EGNOS, HF, N-RTK
The email format shall be HTML.					
Notes:					

Name	**Email/Twitter: TID warning**				
ID	TeT-INT-3230.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall receive warning emails/tweets when a TID has been detected.					
Notes:	Other intermediate products might be candidates to be used to raise warnings.				

Name	**Email/Twitter: TID forecast**				
ID	TeT-INT-3240.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall receive forecast emails/tweets when a TID is expected to travel to a specific area.					
Notes:					

Name	**Email/Twitter: TID cancellation**				
ID	TeT-INT-3250.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall receive cancellation emails/tweets to revoke warnings or forecasts.					
Notes:					

Name	**Email/Twitter: product threshold warnings**				
ID	TeT-INT-3260.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall be offered a set of selectable email/Twitter warnings and forecasts depending on a specific product and an adjustable threshold for this product.					
Notes:	Not all products are expected to be used to generate warnings and forecast.				

Name	**Email/Twitter: TEC gradient warning threshold**				
ID	TeT-INT-3270.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK, GBAS
Users shall receive warning emails/tweets when a TEC gradient exceeds a specific threshold.					
Notes:					

Name	**Email/Twitter: TEC gradient warning area**				
ID	TeT-INT-3280.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK, GBAS
Users shall receive warning emails/tweets when a TEC gradient exceeds a specific threshold in a geographical area.					
Notes:	Users might be able to select a specific location and a radius for which the warnings for TEC gradients are received.				

Name	**Email/Twitter: TID characteristics warning**				
ID	TeT-INT-3290.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall be offered a set of selectable email/Twitter warnings and forecasts depending on the TIDs characteristics: period, phase velocity, direction of propagation, wavelength, amplitude and geographical location.					
Notes:	Users may be only interested in TIDs with specific characteristics.				

Name	**Email/Twitter: impact on SNR HF warning**				
ID	TeT-INT-3300.1	**Priority:**	Desirable	**Users:**	HF
Users shall be offered a range of selectable email/Twitter warnings depending on the expected impact on the signal-to-noise ratio on HF links.					
Notes:					

Name	**Email/Twitter: SNR on HF warning**				
ID	TeT-INT-3310.1	**Priority:**	Desirable	**Users:**	HF
Users shall receive warning emails/tweets the signal-to-noise ratio on HF links exceeding the 20% threshold.					
Notes:	Warning could also be located in the website.				

Name	**Email/Twitter: Path probability ratio on links warning**				
ID	TeT-INT-3320.1	**Priority:**	Desirable	**Users:**	HF
Users shall be warned by email/tweet, when the path probability ratio on link sections between the DPS4D sounders deviates by more than 20% from the average standard value.					
Notes:	Depending on the selected radio frequency and transmission power used and the geomagnetic activity, a percentage of the path availability is given for an HF link. An average value is obtained for a reference period of time.				

Name	**Email/Twitter: positioning error**				
ID	TeT-INT-3330.1	**Priority:**	Desirable	**Users:**	GBAS
Users shall be able to select a specific positioning error threshold caused by TEC gradients for which warnings are received.					
Notes:	Any strong TEC gradient causing error in positioning of more than 2 meters is of importance for GBAS based landing.				

Name	**Email/Twitter: operational effects warnings**				
ID	TeT-INT-3340.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall be offered a set of selectable email/Twitter warnings depending on the expected operational effects on HF, EGNOS and N-RTK.					
Notes:	Users may be only interested in TIDs effects on operational systems.				

Name	**Email/Twitter: Simple scale warning**				
ID	TeT-INT-3350.1	**Priority:**	Desirable	**Users:**	EGNOS, N-RTK
Users shall receive warning emails/tweets with simple warnings (e.g. green, amber or red) to indicate the likelihood of a disruption to GNSS users.					
Notes:					

Name	**Dissemination means: smartphone app**				
ID	TeT-INT-3360.1	**Priority:**	Desirable	**Users:**	EGNOS, HF, N-RTK
Users shall receive TechTIDE information by means of dedicated smartphone app.					
Notes:	Suggested by N-RTK user: “For N-RTK end users, warnings should be pushed, not retrieved once the user experiences problems”.				

Name	**Dissemination means: MF/HF/VHF communication**				
ID	TeT-INT-3370.1	**Priority:**	Desirable	**Users:**	ALL
Users shall be informed through radio broadcast and MF/HF/VHF.					
Notes:	Suggested by a user: "All the messages must be transmitted via radio broadcasting and MF/HF/VHF radio alerts for vessels and aircrafts."				

Name	**Dissemination means: Network State Space representation**				
ID	TeT-INT-3380.1	**Priority:**	Desirable	**Users:**	N-RTK
The system shall deliver warnings according to the format required by N-RTK manufacturers.					
Notes:	Suggested by N-RTK user: "A suggestion is to contact the N-RTK software suppliers like Geo++, Leica and Trimble to check the possibility to offer TechTide data as additional input for the Network State Space Modelling and Representation."				

Name	**Dissemination means: Archive**				
ID	TeT-INT-3390.1	**Priority:**	Mandatory	**Users:**	ALL
All intermediate and final products shall be stored in a dedicated archive available to users.					
Notes:	I.e. FTP archiving all products and the metric report.				

Name	**Archive: TID annual record file**				
ID	TeT-INT-3400.1	**Priority:**	Mandatory	**Users:**	ALL
For every year, the system shall maintain an annual record file in flat text file (ASCII) of all TIDs identified including TIDs main characteristics.					
Notes:	User noted that for analysis of aviation accidents, historic data for at least the recent 4 weeks are important.				

Name	**Archive: TEC gradient annual record file**				
ID	TeT-INT-3410.1	**Priority:**	Mandatory	**Users:**	EGNOS, HF, N-RTK
For every year, the system shall maintain an annual record file in flat text file (ASCII) of all TEC gradients identified exceeding a specific threshold.					
Notes:					

Name	**Archive: data files**				
ID	TeT-INT-3420.1	**Priority:**	Desirable	**Users:**	ALL
All intermediate and final products shall be stored in human-readable files.					
Notes:	File format is an open point. Data can be stored in human readable (ASCII) format, or binary format accompanied by reading and interpreting software				

Name	**Archive: TEC maps**				
ID	TeT-INT-3430.1	**Priority:**	Mandatory	**Users:**	EGNOS
An archive of TEC maps shall be provided in IONEX format.					
Notes:	IONEX is the standard way to present TEC maps in the GNSS.				

Name	**Archive: TID activity report ASCII format**				
ID	TeT-INT-3440.1	**Priority:**	Mandatory	**Users:**	EGNOS
TID activity metric report shall be provided in ASCII format.					
Notes:					

Name	**Archive: TID activity report graphical format**				
ID	TeT-INT-3450.1	**Priority:**	Mandatory	**Users:**	EGNOS
TID activity metric report shall be provided in graphical format.					
Notes:					

Name	**Archive: time range**				
ID	TeT-INT-3460.1	**Priority:**	Mandatory	**Users:**	ESA
The time range of archived data shall be from the oldest date of data to most recent.					
Notes:	ESA PSD IT-011-P [RD-4].				

Name	**Archive: time range of MSTID warnings**				
ID	TeT-INT-3470.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of warnings on the localized occurrence of MSTIDs shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of MSTID occurrence**				
ID	TeT-INT-3480.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of images on the localized occurrence of MSTIDs shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of MSTID forecast**				
ID	TeT-INT-3490.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of forecast images on the localized occurrence of MSTIDs shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of TEC gradients**				
ID	TeT-INT-3500.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK, GBAS
An archive of images on TEC gradients shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of TEC gradient forecast**				
ID	TeT-INT-3510.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK
An archive of forecast images on TEC gradients shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of TEC gradient warnings**				
ID	TeT-INT-3520.1	**Priority:**	Mandatory	**Users:**	EGNOS, N-RTK, GBAS
An archive of warnings on TEC gradients shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of Ionosphere perturbation index warnings**				
ID	TeT-INT-3530.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of warnings on Ionosphere perturbation index shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of Ionosphere perturbation index images**				
ID	TeT-INT-3540.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of images on Ionosphere perturbation index shall be provided for the past 6 month.					
Notes:					

Name	**Archive: time range of Ionosphere perturbation index forecast**				
ID	TeT-INT-3550.1	**Priority:**	Mandatory	**Users:**	N-RTK
An archive of forecasts on Ionosphere perturbation index shall be provided for the past 6 month.					
Notes:					

5. Way forward

This document is TechTIDE D1.1 “Initial Users´ Requirements Report” and it is an output of TechTIDE WP1 Task 1.1. The document presents a set of mandatory and desirable requirements gathered among users affected by TIDs. In D1.1, users' requirements are named, described and assigned an identification number and priority. For each requirement, the targeted users are indicated and clarifications notes are included, if necessary. Users' requirements are also classified according the following categories: service, products, performance and interface.

The way forward includes using D1.1 as first set of the requirements from which system requirements will be derived and gathered in D1.2 “Warning system requirement report”. D1.2 will consider limitations to requirements from the TID detection state of the art.

D1.1 will be updated to become the D1.3 “Final Users’ Requirement Report” in month 26.