



# Traffic Information Service – Broadcast Requirements

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**EUROPEAN ORGANISATION FOR THE SAFETY OF  
AIR NAVIGATION**

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**Class**

**:**

**EATMP CONTROL**

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**EUROPEAN AIR TRAFFIC MANAGEMENT PROGRAMME**

# DOCUMENT IDENTIFICATION SHEET

## DOCUMENT DESCRIPTION

**Document Title**  
TIS-B REQUIREMENTS

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### Abstract

The document presents the requirements for Traffic Information Service – Broadcast (TIS-B) in a gate-to-gate environment.

The TIS-B requirements are driven by requirements defined for surveillance user functions of “mobile” (i.e. aircraft in the air or on the ground, or surface vehicles able to receive TIS-B information). The Surveillance User will in general be the Surveillance Data Processing and Distribution System of the Mobile

### Keywords

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**DOCUMENT APPROVAL**

The following table identifies all management authorities who have successively approved the present issue of this document.

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## DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

<b>EDITION</b>	<b>DATE</b>	<b>REASON FOR CHANGE</b>	<b>SECTIONS PAGES AFFECTED</b>
0.1	09 July 2001	Initial document for discussion at DG/16	
0.2	07 <sup>th</sup> September 2001	Processing of comments from DG/16 meeting	All
0.3d	5 <sup>th</sup> December 2001	Processing of comments from TF10 + new inputs and reorganisation of the document + processing of internal ADS Programme comments	All
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0.5	5 <sup>th</sup> July 2002	Clarification of requirements related to data items and surveillance service levels + new inputs	All
0.6	26th July 2002	Inputs relating to Package 1, data items & some performance aspects + minor corrections	All
0.7c	20 <sup>th</sup> September 2002	Processing of comments from the TIS-B Requirement "Technical Meeting" held on the 7 <sup>th</sup> of August 2002 + additional inputs	All

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## 1. INTRODUCTION

### 1.1 General

**TIS-B** (Traffic Information Service - Broadcast) is a surveillance technique that provides surveillance information from the ground to suitably equipped air or ground-based mobiles (an aircraft in the air or on the ground, or a surface vehicle) on **Objects Of Interest** (the physical objects for which any TIS-B user may require information, principally the aircraft and airport vehicles) with the intention of supporting ATSAW and COSEP related applications as defined in [3], with a focus on Package 1 applications as defined in [2]. The broadcast traffic information (i.e. **Track** data items for Objects Of Interest) is derived from one or more ground surveillance sources. The related ground system originating the broadcast has no knowledge of which systems are receiving the broadcast. Which tracks are to be broadcast (**Track Selection**) will be managed by TIS-B.

TIS-B can broadcast predefined sets of track data items, with an identified **Quality of Service** (such as availability, continuity, integrity, nominal accuracy and latency characteristics of the broadcast track data items).

TIS-B can support a number of **TIS-B services**, a service being defined as a data stream with predefined characteristics made available to the TIS-B Users.

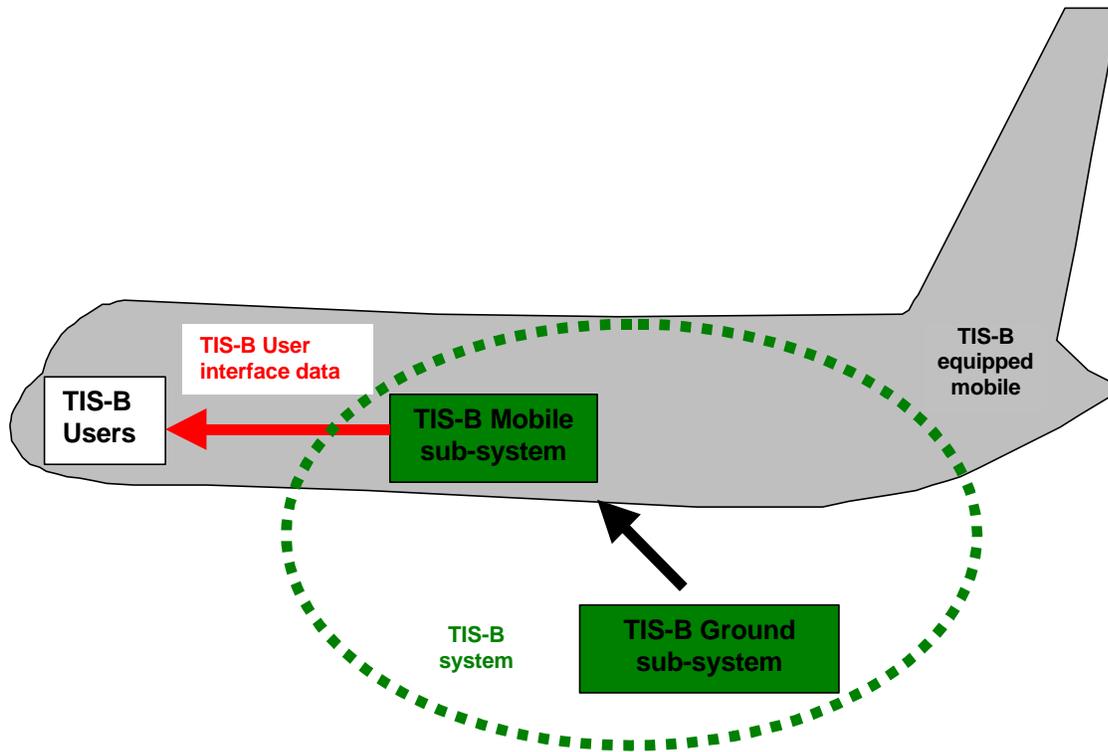
Each TIS-B service can be described through the following attributes:

- Track Selection, i.e. the definition of which Object Of Interest tracks will be broadcast by the TIS-B service.
- Track Data Items Definition, i.e. the definition of which track data items will be broadcast by the TIS-B service
- Transmission characteristics, i.e. which reporting period for each of the track data items
- Quality of Service, i.e. :
  - ⇒ the nominal accuracy and latency characteristics of the broadcast track data items
  - ⇒ the integrity
  - ⇒ the availability
  - ⇒ the continuity

### 1.2 Document Scope

This document collects the requirements for TIS-B expressed at TIS-B User interface level (see Figure 1: TIS-B System/TIS-B User interface data) plus some system level requirements.

TIS-B User will in general be the Surveillance Data Processing and Distribution system of the Mobile.



**Figure 1:** TIS-B System/TIS-B User interface data

This document is based on best current knowledge of the requirements from the operational level. It is noted that work on these issues is ongoing (see [2]). The TIS-B requirements correspond to the TIS-B Functional Requirements (section 3), Performance Requirements (section 4) plus some other TIS-B Requirements (section 5).

This document addresses all phases of flight, i.e. it includes also the relevant airport operations aspects.

In essence, the approach taken to compile the requirements aims at providing:

- The basis for further validation activities, thereby also providing the framework for feeding-back validation results, and
- For the inclusion of emerging operational requirements coming from the overall EATMP process.

The document is a key deliverable of the EUROCONTROL ADS Programme and is input for other work such as the ADS-B and TIS-B Architecture work.

### 1.3 Document Overview

This document contains the following sections:

- Section 2: document references.
- Section 3: TIS-B Functional Requirements
- Section 4: TIS-B Performance Requirements
- Section 5: other TIS-B Requirements

Throughout the document, requirements are referenced by the use of curly brackets along with a requirement identifier of the form  $\{2TX\}$  (beginning of the requirement), the requirement text followed by the symbol  $\blacklozenge$  (end of the requirement). Herein, 2 refers to the Technical requirement level, 3 & 4 are reserved to the requirements of the ADS-B and TIS-B Architecture work (Functional and Physical levels), 1 is reserved (e.g. for the operational level, not in the scope of this document), T refers to TIS-B and  $X$  is a simple requirement counter.

With the application of this identification scheme, the requirement  $\{2T7\}$ , for instance, would refer to the seventh TIS-B requirement expressed in this document. The nature of this requirement is technical.

## 1.4 Definitions

**Traffic Information Service – Broadcast (TIS-B)**

*Definition:* TIS-B is a surveillance technique that provides surveillance information from the ground to mobiles on Objects Of Interest.

*Status:* Proposed.

**Mobile**

*Definition:* an aircraft in the air or on the ground, or a surface vehicle

*Status:* Proposed.

**Objects Of Interest (OOI)**

*Definition:* The physical objects for which any TIS-B user may require information.

*Status:* Proposed.

**TIS-B User**

*Definition:* the surveillance function of a mobile that is able to receive TIS-B data. This function will in general process ADS-B and TIS-B data.

*Status:* Proposed.

**TIS-B Report**

*Definition:* one or more track data items corresponding to a single Object of Interest, delivered to the TIS-B user.

*Status:* Proposed.

**Track**

*Definition:* A time sequence of state vectors of an object, estimated by some real time filtering techniques

*Status:* Proposed.

## 2. BIBLIOGRAPHY AND REFERENCES

This section lists references and bibliography material and gives a brief indication of the relevance of each document to TIS-B requirements.

### 2.1 ICAO documents

To be completed

### 2.2 Non-ICAO documents

- [1] “Automatic Dependent Surveillance Concept”, EUROCONTROL document, ADS/SPE/CR/D1-06, edition 1.7 (dated 28 September 2001), Working Draft. This document describes the ECAC concept for ADS and TIS-B.
- [2] “CARE ASAS Activity 5 – Proposal for a first Package of GS/AS Applications”, version 2.0, dated 1<sup>st</sup> of July 2002.
- [3] “Toward Co-operative ATS – the COOPATS Concept” Release 1.0 (EATMP – AGC Programme) dated 18/06/2001
- [4] “Automatic Dependent Surveillance Requirements”, EUROCONTROL document, ADS/SPE/CR-TF-REQ/D1-08, edition 1.2 (dated 13 March 2002), Working Draft.

### 3. TIS-B FUNCTIONAL REQUIREMENTS

This section provides the functional requirements related to the User interface presented in section 1.2. It addresses the TIS-B requirements for the TIS-B Track selection, the TIS-B Track data items and transmission characteristics.

#### 3.1 TIS-B Tracks Selection Requirements

##### 3.1.1 Selection based on Object Of Interest

**2T 001:** TIS-B Objects Of Interest (OOI) for which tracks are to be delivered to the TIS-B users **shall** be limited to<sup>(1)</sup>:

- the ADS-B equipped objects as defined in ref. [4] “Emitter Category”,
- the non ADS-B equipped airborne aircraft
- the non-ADS-B equipped aircraft or vehicles on the airport surface.

◆

##### 3.1.2 Selection based on National Security and Defence

**2T 002:** Tracks corresponding to Object Of Interest identified for suppression based on National Security and Defence requirements **shall** not be delivered to the TIS-B Users

◆

##### 3.1.3 Selection based on TIS-B Mode

Two modes<sup>2</sup> can supported by TIS-B: the “Gap Filler” mode where TIS-B can provide equipped Users with the ability to receive state information on traffic that cannot be adequately be obtained directly via ADS-B (e.g. not ADS-B equipped Users) and the “Full Picture” mode where TIS-B can provide equipped Users with all traffic.

**2T 003:** TIS-B **shall** be able to support two modes, the Gap Filler mode and the Full Picture mode.

◆

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<sup>1</sup> the “false track” issue is performance related and is therefore addressed in section 4.1.1

<sup>2</sup> the investigation of the various TIS-B selection criteria (Gap Filler/ Full Picture) will be one of the objectives of the validation process which is foreseen. In the ADS Concept document [1], Gap Filler in Manage Airspace and Gap Filler or Full Picture in Unmanaged Airspace is proposed.

**2T 004:** TIS-B **shall** be able to support one mode per TIS-B service<sup>3</sup>



### 3.1.3.1 *Gap filler mode*

**2T 005: in the Gap Filler mode,** TIS-B **shall** be able to deliver to the TIS-B Users only tracks for OOI that are “not adequately ADS-B equipped”

OOI **shall** be considered as being “not adequately ADS-B equipped”, if

- i) they are not ADS-B equipped, or
- ii) they have not recently<sup>5</sup> transmitted ADS-B data (e.g. mobile equipment in failure, transmitter turned off by the pilot, going outside ADS-B coverage, etc.), or
- iii) they are transmitting ADS-B data using a link technology not supported by the TIS-B user (s)´ mobile (this is referred to as the “**multi-link**” case in this document)



### 3.1.3.2 *Full Picture mode*

**2T 006: In the Full Picture mode,** TIS-B **shall** be able to deliver to the TIS-B Users, tracks for all Objects Of Interest



## 3.2 TIS-B Track Data Items Definition Requirements

### 3.2.1 Introduction

TIS-B is expected to enable a wide range of EATMP Operational Improvements. In order to realise this, TIS-B should support the provision of track data items that correspond to what may be required to enable User’s applications.

### 3.2.2 TIS-B Track Data Items requirements

As all applications don’t necessarily require the same data items to be delivered, predefined track data items per TIS-B Service will be required. Therefore:

**2T 007:** TIS-B **shall** be able to provide the TIS-B Users with track data items predefined per Service



Which data item are required by which group of application is defined in section 4.2.

<sup>3</sup> The geographical TIS-B selection criteria per service (e.g. Service Volume) will be described at TIS-B Functional Architecture level

<sup>5</sup> to be discussed how ‘recently’ an ADS-B equipped aircraft should have transmitted, thus being considered as adequately equipped (time parameter to be defined)

Sub-section 3.2.2 defines the track data items requirements and sub-section 3.2.5 relates to the definition of the relevant parameter range and resolution

### 3.2.3 TIS-B transmission characteristics

Track data items are not necessarily required to be delivered all at the same refresh period, therefore:

**2T 008:** TIS-B **shall** be able to provide each data item at a given refresh period<sup>6,7</sup>, per service.



The required periods are specified in the tables in section 4.

Track data items are not necessarily required to be delivered all at the same time to the Users. Anyhow, there is a need that certain data items are obligatorily grouped together when delivered (e.g. position and position uncertainty together), therefore:

**2T 009:** TIS-B **shall** be able to deliver a set of track data items grouped together (on a per service basis)



Some track data items that may be requested by the TIS-B Users are not always necessarily available and cannot therefore be obligatorily required for all targets, but only for those targets for which the data is available via some means (for example Mode S or ADS-B in the multi-link case).

These “when available” items are (see section 3.2.4 for data item description):

TIS-B “when available” Data Items
Label (Call sign/ Registration Marking/Mode A code)
Emitter Category
Geometric altitude
Barometric altitude
Track status
Status Information
Selected altitude
Meteorological turbulence <sup>8</sup>
Aircraft address <sup>8</sup>

**Table 3-3: TIS-B - “when available” data items**

A set of track data items (i.e. one or more track data items<sup>9</sup>) corresponding to a single Object Of Interest, delivered to the TIS-B User compose a TIS-B Report. Each TIS-B report must contain a TIS-B service identifier and a time of applicability.

<sup>6</sup> Relating performance requirements are presented in section 1.1.1.1 .

<sup>7</sup> The reporting period defines the period of time between successive track data items. It is not to be confused with the data-link transmission rate.

<sup>8</sup> to be further discussed whether “Aircraft address” and “Meteorological Turbulence” data items are needed (e.g. in and beyond Package 1)

<sup>9</sup> a TIS-B Report does not necessarily include all data items required by a user in 1 message but can be

**2T 010:** Each TIS-B report **shall** include a TIS-B service identifier<sup>10</sup>



**2T 011:** Each TIS-B report **shall** include a time of applicability.



**2T 012:** The Time Of Applicability of a TIS-B Report **shall** be valid for all track data items of a report



### 3.2.4 TIS-B Data Item Requirements

The track data items are presented along with their general characteristics in the following sub-sections. Note that data item resolution and range characteristics are presented separately in section 3.2.5.

The term "*shall be able to provide*" is used in this section to mean that the system is required to support the delivery of this data, for example the data link formats shall support this data.

Section 4.2 specify whether or not the data is obligatorily required for any particular target together with the corresponding required performances.

#### 3.2.4.1 *Track Unique Identifier*

It is assumed that the TIS-B User will need a simple way to identify to which OOI each TIS-B report relates, hence an identifier<sup>11</sup> for the OOI is required in each TIS-B report. From the perspective of a TIS-B User each OOI must be uniquely identified and the same identifier must be used until the OOI is no longer of interest to the TIS-B User.

**2T 013:** TIS-B **shall** be able to provide a track unique identifier



#### 3.2.4.2 *Time of Applicability*

**2T 014:** TIS-B **shall** be able to provide the time of applicability of the track.



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split into different ones

<sup>10</sup> the details relating to the geographical area in which the identifier is required to be unique is addressed at Functional Architecture level

<sup>11</sup> as the 24 bit address is not always available, an alternative identifier must be created (24 bit address could be used when available but this choice is left to design)

### 3.2.4.3 *Track position*

#### 3.2.4.3.1 Track Horizontal Position

**2T 015:** TIS-B **shall** be able to provide the track horizontal position (latitude, longitude).

◆

**2T 016:** The horizontal latitude and longitude track positions **shall** be provided as a geometric position referenced to the WGS-84 system.

◆

#### 3.2.4.3.2 Track altitude

**2T 017:** TIS-B **shall** be able to provide a track altitude.

◆

**2T 018:** The track altitude **shall** be the “on the ground” indicator if indicating the OOI is on the ground, otherwise the barometric altitude when available plus the altitude type, otherwise the geometric altitude plus the altitude type<sup>12</sup>.

◆

**2T 019:** TIS-B **shall** be able to provide an indication of whether an Object Of Interest is on the ground (“on the ground” indicator)

◆

**2T 020:** TIS-B **shall** be able to provide a “measured” Barometric altitude<sup>13</sup>

◆

**2T 021:** TIS-B **shall** be able to provide Geometric altitude.

◆

**2T 022:** The barometric altitude **shall** be reported with reference to the International Standard Atmosphere for Dry Air as defined by ICAO 1964.

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<sup>12</sup> to be discussed whether there would be applications that would need geometric altitude instead or in addition to barometric altitude. If yes, altitude type could an additional TIS-B service attribute

<sup>13</sup> it is assumed that an extrapolated barometric altitude would not be appropriate/accepted and therefore that a “measured” one is required.

**2T 023:** The geometric altitude **shall** be reported with reference to WGS84.



**2T 024:** TIS-B shall be able to provide an altitude type indicator (barometric or geometric altitude).



#### **3.2.4.4 Track Ground Vector Information**

##### 3.2.4.4.1 Track Ground Speed

**2T 025:** TIS-B **shall** be able to provide the ground speed.



##### 3.2.4.4.2 Track Angle

**2T 026:** TIS-B **shall** be able to provide the track angle.



##### 3.2.4.4.3 Track Vertical Rate

**2T 027:** TIS-B **shall** be able to provide the track vertical rate



##### 3.2.4.4.4 Track Angle Rate

**2T 028:** TIS-B **shall** be able to provide the track angle rate



#### **3.2.4.5 Track Position, Altitude and Velocity Uncertainty**

##### 3.2.4.5.1 Track Position Uncertainty

**2T 029:** TIS-B **shall** be able to provide the uncertainty of the track position.



##### 3.2.4.5.2 Track Altitude Uncertainty

**2T 030:** TIS-B **shall** be able to provide the uncertainty of the track barometric altitude.



**2T 031:** TIS-B **shall** be able to provide the uncertainty of the track geometric altitude.



##### 3.2.4.5.3 Track Velocity Uncertainty

**2T 032:** TIS-B **shall** be able to provide the uncertainty of the track velocity



#### 3.2.4.5.4 Track integrity

Placeholder<sup>14</sup>

#### 3.2.4.6 *Track Status*

**2T 033:** TIS-B **shall** be able to provide an indication that the track does not relate anymore to an Object Of Interest<sup>15</sup>



#### 3.2.4.7 *Status Information Reporting Capability*

**2T 034:** TIS-B **shall** be able to provide an indication of whether the mobile supports reporting of emergency or priority status [Ref 4].



#### 3.2.4.8 *Status Information*

**2T 035:** : TIS-B **shall** be able to provide an indication of emergency or priority status.



**2T 036:** The following types of status shall be supported (ref [4]):

1. No emergency/Not reported
2. General emergency
3. Lifeguard/medical
4. Minimum fuel
5. No communications
6. Unlawful interference
7. Spare
8. Spare



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<sup>14</sup> Track integrity relating to accuracy bounds (e.g. like NIC and SIL): in the context of Package 1 enabled applications [2], no need has been identified to deliver a per track related integrity data item. This is a placeholder in case future applications would require it. See also 4.1.4.3. Track integrity relating to the fact it is likely corresponding to an Object Of Interest or not: in the context of Package 1, no need has been identified to deliver such a track related integrity data item. This is a placeholder in case future applications would require it (an ideas could be that this confidence indicator reflects track is “tentative” versus “confirmed”)

<sup>15</sup> This would also include the case where the OOI has left the TIV (TIS-B Information Volume). This would allow the airborne SDPD to be able to remove it more quickly.

**2T 037:** when “Status Information Capability” is true, TIS-B shall provide - the full set of Status Information in the “multi-link” case, the subset (“Unlawful interference”, “No Communications” and “General Emergency”) otherwise.

◆

#### ***3.2.4.9 Aircraft Address***

**2T 038:** TIS-B **shall** be able to provide the Aircraft Address.

◆

#### ***3.2.4.10 Label***

**2T 039:** TIS-B **shall** be able to provide the Call Sign

◆

**2T 040:** TIS-B **shall** be able to provide the Registration Marking

◆

**2T 041:** TIS-B **shall** be able to provide the Mode A code

◆

**2T 042:** The Label **shall** contain Callsign if available, otherwise the registration marking if available, otherwise the Mode A code if available.

◆

#### ***3.2.4.11 Selected altitude***

**2T 043:** TIS-B **shall** be able to provide the selected altitude.

◆

#### ***3.2.4.12 Emitter Category***

**2T 044:** TIS-B **shall** be able to provide the Emitter Category

◆

#### ***3.2.4.13 Meteorological Turbulence information***

**2T 045:** TIS-B **shall** be able to provide the Meteorological Turbulence.

◆

### **3.2.5 TIS-B Data Item Resolution and Range Characteristics Requirements**

To be completed.

## 4. TIS-B PERFORMANCE REQUIREMENTS

### 4.1 TIS-B Performance characteristics

This section describes the performance characteristics related to:

- TIS-B Objects Of Interest
- TIS-B track data items
- TIS-B transmission characteristics
- TIS-B Quality of Service

#### 4.1.1 Objects Of Interest performance characteristics

The TIS-B performance characteristic related to the OOI are:

- the probability that a track update is up-linked by TIS-B for something that is not an OOI :  $P_{\text{nonOOI track update up-linked}}$
- the probability that an OOI exists for which a track update has not been up-linked by TIS-B:  $P_{\text{OOI track update not up-linked}}$

#### 4.1.2 Track unique identifier performance characteristics

The TIS-B performance characteristic related to the track unique identifier is the probability that an OOI is not continuously uniquely numbered<sup>16</sup>:  $P_{\text{OOI not continuously uniquely numbered}}$ .

#### 4.1.3 Transmission characteristics

The track data item reporting period at which the information is supplied to the user has the following characteristics:

- The reporting period value
- The Probability that at least one TIS-B report (containing the data item) is received per track every reporting period

#### 4.1.4 Quality of Service performance characteristics

TIS-B with a given level of Quality of Service means that the data that are provided are of a minimum performance regarding the following characteristics:

- Nominal Accuracy of certain track data items,

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<sup>16</sup> an example of this is the case where a track swap has occurred at ground SDPD (Surveillance Data Processing System).

- Nominal Latency of certain track data items,
- Integrity of the TIS-B service,
- Availability of the TIS-B service,
- Continuity of the TIS-B service,
- Loss of TIS-B service detection time.

It is proposed that the TIS-B Quality performance and the indication of where TIS-B is available are not dynamically up-linked but are centrally published.

These characteristics are developed in the following sub-sections.

#### ***4.1.4.1 Nominal<sup>17</sup> accuracy performance characteristics***

It should be noted that Accuracy and Latency characteristics will not both apply to all data items that can be provided by TIS-B. Data items can be indeed be grouped into three categories:

- Track horizontal position, track geometric altitude, track ground speed, track angle, track angle rate, track vertical rate and track position and velocity uncertainty for which accuracy only has to be defined, but in such a way that latency aspects are covered (the impact of the delay in the delivery to the end-user can be translated into a decrease of the corresponding accuracy),
- Selected altitude, Label, Meteorological Turbulence, (measured) barometric altitude and Status track data items for which there is no notion of accuracy therefore latency only has to be defined,
- The rest of the data items, i.e. the track identifier, time of applicability, the aircraft address and emitter category for which it is assumed there are no requirements for accuracy nor latency (they are assumed not to change during the flight life time).

Therefore Accuracy applies to track horizontal position, track geometric altitude, track ground speed, track angle, track angle rate, track vertical rate, track position and velocity uncertainty data items

The end user is interested by the data item accuracy at current (user) time and therefore the corresponding user accuracy requirements should be expressed at the user current time (i.e. extrapolated from Time Of Applicability).

How the nominal accuracy will be defined is to be further discussed.

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<sup>17</sup> A global characteristic of the service and not what is required on a per track basis (presented in section 3.2.4.5)

#### 4.1.4.2 *Nominal latency performance characteristics*

As indicated in section 4.1.4.1, latency performance applies to Label, Meteorological Turbulence, (measured) barometric altitude, Selected Altitude and track Status. The performance is expressed through the following characteristics:

- the average ( $L_{\text{average}}$ ) and maximum ( $L_{\text{maximum}}$ ) delta time between an input in the system and the related TIS-B output change delivered to the user (e.g. aircraft selects an altitude and this is available in output of TIS-B within an average/maximum delay). How these two delays will be measured is to be further defined, in particular with respect to the TIS-B system input.
- the maximum “age” ( $L_{\text{max age}}$ ) of data before it is of no use (at user level) and therefore should not be output by TIS-B

#### 4.1.4.3 *TIS-B service integrity*

The integrity risk is the probability to have an error greater than a specified value without annunciation for a period longer than a specified time-to-alert. As a consequence it is generally characterised by three figures:

- A probability (with respect to a given exposure time) of an error exceeding the containment bound for extreme error
- A containment bound for extreme error,
- A maximum time to alert

The relating track data items for which nominal integrity performance figures will be required are to be defined<sup>18</sup>.

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<sup>18</sup> *The latest ADS-B MASPS (RTCA/DO-242A) introduces 3 indicators to qualify the accuracy and quality/integrity of each report. These are briefly described below:*

*NAC – The Navigational Accuracy Category indicates the width of the 95% error bounds. The NAC category value (0-10?) is expressed separately for position ( $NAC_P$ ) and rate ( $NAC_R$ ). Note, however, that each category value defines the accuracy of both lateral and vertical information.*

*NIC – The Navigational Integrity Category specifies a containment radius for extreme errors and is used in conjunction with SIL, described below.*

*SIL – The Surveillance Integrity Level defines the probability of an error exceeding the containment radius described in NIC.*

*Hence, the NAC value describes the ‘normal’ accuracy (i.e. it defines the 2 s points of a normal error distribution), whilst NIC and SIL define the likelihood of much larger errors in the tails of the distribution (which are of most concern to separation assurance applications). The NAC/NIC/SIL value will affect how the ADS-B information is to be used by a particular application.*

*For ADS-B, the NAC/NIC/SIL values will be determined from the aircraft’s navigational equipment and navigational sources available at the time.*

#### ***4.1.4.4 TIS-B service availability***

Availability is the ability of a system to perform its required function at the initiation of the intended operation. It is quantified as the proportion of the time the system is available to the time the system is planned to be available. (Refer to [4])<sup>19</sup>

#### ***4.1.4.5 TIS-B service continuity***

Continuity is defined as the probability of a system to perform its required function without unscheduled interruptions during the intended period of operations. [4]

To be discussed whether this is airspace category/phase of flight dependent or not.

#### ***4.1.4.6 Loss of TIS-B service detection time***

In relation with paragraph 5.4, a performance requirement on how fast TIS-B unavailability is detectable by the users should be developed. To be also considered that this could be expressed on a per application basis.

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<sup>19</sup> *Availability is used to define requirements on continuous system operation over a long period of time (e.g. max downtime of n minutes per year). Downtime due to maintenance is not included. Availability is different from continuity, as discussed below.*

## 4.2 TIS-B Performance Requirements per airspace category / phase of flight

This section contains the TIS-B requirements with respect to the consideration of airspace categories and flight. This is done by applying both the classification of three airspace categories as follows:

- Managed Airspace/Continental High-Density (MAS Cont-HD);
- Managed Airspace/Continental Low-Density (MAS Cont-LD);
- Unmanaged Airspace (UMAS),

as well as the consideration of – in general – three flight phases :

- Airport surface movements (take-off, landing, taxiing);
- TMA flight phase (climb-out and descent)
- En-route flight phase.

The according requirements are summarised in a set of tables, in which each of the pair “Airspace/Flight Phase” is described by the definition of TIS-B attributes. In general, the most stringent requirements will be expressed representing the present best knowledge of operational requirements as being derived from the respective references as listed in section 2. This is to be completed.

### 4.2.1 Managed Airspace/Continental High-Density

**2T 046:** For the provision of TIS-B in “Managed Airspace/Continental High-Density”, the following interface requirements **shall** be met:

◆

Type of Airspace	MAS/Continental High-Density		
Phase of Flight	Airport Surface <sup>20</sup>	TMA	En-route
Track Selection (Gap Filler versus Full Picture)	Gap Filler + Full Picture for certain airport surface areas	only tracks for OOI that are “not adequately ADS-B equipped”	
TIS-B track data items			
TIS-B track selection (OOIs) relating performance parameters			
<ul style="list-style-type: none"> <li>• P<sub>nonOOI</sub> track update up-linked</li> <li>• P<sub>OOI</sub> track update not up-linked</li> </ul>			

<sup>20</sup> Airport Surface requirements for MAS/Continental “High density” relate to “Busy Airports”

Track data items Reporting period(s) <ul style="list-style-type: none"> <li>• Average</li> <li>• Probability</li> </ul>			
Availability, Continuity			
Loss of service detection time			
Integrity <ul style="list-style-type: none"> <li>• A probability of an error exceeding the containment bound for extreme error</li> <li>• A containment bound for extreme error,</li> <li>• A maximum time to alert</li> </ul>			
Nominal Accuracy <ul style="list-style-type: none"> <li>• Track horizontal position</li> <li>• Track geometric altitude</li> <li>• Track ground speed</li> <li>• Track angle</li> <li>• Track angle rate</li> <li>• Track vertical rate</li> </ul>			
Nominal Latency (selected altitude, Label, Meteorological Turbulence, (measured) barometric altitude and status) <ul style="list-style-type: none"> <li>• Average</li> <li>• Maximum</li> </ul>			

**Table 4-1: MAS/Continental-HD Interface Requirements**

#### 4.2.2 Managed Airspace/Continental Low-Density

**2T 047:** For the provision of TIS-B in “Managed Airspace/Continental Low-Density”, the following interface requirements **shall** be met:



Type of Airspace	MAS/Continental Low-Density		
Phase of Flight	Airport Surface	TMA	En-route
Track Selection (Gap Filler versus Full Picture)	only tracks for OOI that are “not adequately ADS-B equipped” / tracks for all Objects Of Interest (see note 1) for certain airport surface	only tracks for OOI that are “not adequately ADS-B equipped”	
TIS-B track data items			
TIS-B track selection (OOIs) relating performance parameters <ul style="list-style-type: none"> <li>• <math>P_{\text{nonOOI}}</math> track update up-linked</li> <li>• <math>P_{\text{OOI}}</math> track update not up-linked</li> </ul>			
Track data items Reporting period(s) <ul style="list-style-type: none"> <li>• Average</li> <li>• Probability</li> </ul>			
Availability, Continuity			
Loss of service detection time			
Integrity <ul style="list-style-type: none"> <li>• A probability of an error exceeding the containment bound for extreme error</li> <li>• A containment bound for extreme error,</li> <li>• A maximum time to alert</li> </ul>			
Nominal Accuracy <ul style="list-style-type: none"> <li>• Track horizontal position</li> <li>• Track geometric altitude</li> <li>• Track ground speed</li> <li>• Track angle</li> <li>• Track angle rate</li> <li>• Track vertical rate</li> </ul>			
Nominal Latency (selected altitude, Label, Meteorological			

Turbulence, (measured) barometric altitude and status) <ul style="list-style-type: none"><li>• Average</li><li>• Maximum</li></ul>			
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**Table 4-2: MAS/Continental-LD Interface Requirements**

### 4.2.3 Unmanaged Airspace

**2T 048:** For the provision of TIS-B in “Unmanaged Airspace”, the following interface requirements shall be met:



Type of Airspace	UMAS		
Phase of Flight	Airport Surface	Approach	En-route
Track Selection (Gap Filler versus Full Picture)	only tracks for OOI that are “not adequately ADS-B equipped” / tracks for all Objects Of Interest (see note4) for certain airport surface	only tracks for OOI that are “not adequately ADS-B equipped” / tracks for all Objects Of Interest (see note 4) for certain airport surface	
TIS-B track data items			
TIS-B track selection (OOIs) relating performance parameters <ul style="list-style-type: none"> <li>• <math>P_{\text{nonOOI}}</math> track update up-linked</li> <li>• <math>P_{\text{OOI}}</math> track update not up-linked</li> </ul>			
Track data items Reporting period(s) <ul style="list-style-type: none"> <li>• Average</li> <li>• Probability</li> </ul>			
Availability, Continuity			
Loss of service detection time			
Integrity <ul style="list-style-type: none"> <li>• A probability of an error exceeding the containment bound for extreme error</li> <li>• A containment bound for extreme error,</li> <li>• A maximum time to alert</li> </ul>			
Nominal Accuracy <ul style="list-style-type: none"> <li>• Track horizontal position</li> <li>• Track geometric altitude</li> <li>• Track ground speed</li> <li>• Track angle</li> <li>• Track angle rate</li> <li>• Track vertical rate</li> </ul>			
Nominal Latency (selected altitude, Label, Meteorological			

Turbulence, (measured) barometric altitude and status) <ul style="list-style-type: none"><li>• Average</li><li>• Maximum</li></ul>			
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**Table 4-4: UMAS Interface Requirements**

## 5. OTHER TIS-B REQUIREMENTS

This section collects complementary requirements applicable to TIS-B.

### 5.1 Security

**2T 049:** In order to protect flight safety, as well as commercial and military interests, the TIS-B Users **shall** only receive TIS-B data delivered by authorised ground sources.



### 5.2 Weather Operation Issues

**2T 050:** TIS-B **shall** be available in all-weather operations.



### 5.3 Anonymity

**2T 051:** It **shall** be possible for TIS-B to mask or change certain data items for identified tracks based on National Security and Defence requirements, so that the mobile can remain anonymous<sup>21, 22</sup>.



### 5.4 Degraded modes

**2T 052:** A means **shall** be provided to the TIS-B Users to indicate whether TIS-B is available or not.



### 5.5 Recording

**2T 053:** TIS-B shall provide a means to perform recording in accordance to ICAO XXX (to be defined) reference.



### 5.6 Time

**2T 054:** **all** TIS-B time references **shall** be with respect to UTC (Universal Time Co-ordinated).



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<sup>21</sup> this is a different case as expressed in section 3.1. Here, only a part of the aircraft related information is to be masked or changed. This could be requested in e.g. the case of a presidential aircraft.

<sup>22</sup> the details relating to which data items can be masked/changed or not will be addressed at a lower level, i.e. at the ADS-B and TIS-B Architecture level.