

GENERIC REQUIREMENTS FOR FLIGHT SOFTWARE CONSISTENCY

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Pour le responsable Cohérence Système

Date and Signature

09/12/2025

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For	DS4	DS5	DH2A	DH2B	DPP	DJ1	DJ2	DCY2	DOA	D3S	DHY2	DST3
Application												
to	DJ3	DSW									DOR	SMM
											X	

DORIS project internal management :			
Applicable configuration :	YES	Géré par : CCM DORIS	depuis : first issue
As_Built :	YES		



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DIFFUSION LIMITEE DORIS



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Issue	Date	Modifications
1.00	03/07/2014	Initialisation du document
1.01	13/01/2015	DM 3013 : Ajout d'un paragraphe concernant le COMMAND PARAMETER (réunion TM-TC générique 04/12/2014)
1.02	13/04/2015	DM 3049 : New SAT-IDs for Jason-CS et SWOT
1.03	08/12/2015	DM 3055 : New SAT-IDs for Sentinel-3C and 3D
1.04	11/10/2016	DM 3106 : Precision about ID_TCH structure
1.05	14/03/2017	DM 3131 : HY-2C and HY-2D IDs
1.06	08/04/2025	DM 3387 : New SAT-IDs for HY-2E and HY-2F
1.07	09/12/2025	DM3400 : New SAT-ID for Genesis

APPLICABLE AND REFERENCE DOCUMENTS

The contents of applicable documents, in their common edition, have to be applied as a supplement to the text of the present document. If an applicable document, listed in the table below, is not called in the text of the present document with detailed application condition, he can be considered to be a reference document for supplementary benefit of information and, because of that, not mandatorily applicable.

Référence	Titre du document
CO-SP-D0-EA-16222-CN	DR1. DEFINITION OF TM PACKETS AND TC FORMATS
CO-IF-D1/B-EA-16314-CN	DR2. DORIS BROADCAST UPLOADS DEFINITION
CO-IF-D1/B-EA-10823-CN	DR3. INTERFACE SPECIFICATIONS BETWEEN THE DORIS NETWORK BEACONS AND THE ONBOARD INSTRUMENT
CO-SP-R-EA-15226-CN	DR4. SYSTEM REQUIREMENTS FOR MANAGEMENT OF THE DORIS STATION NETWORK
	DR5. DORIS SPECIAL ISSUE, JOURNAL OF GEODESY, NOV. 2006
CO-SP-D1-EA-15704-CN	DR6. SPECIFICATION TECHNIQUE DE BESOIN DE L'INSTRUMENT DORIS
	DR7. PROBLEMATIQUES DE DISPONIBILITE DORIS
CO-NT-D0-OP-12571-CN	DR8. CONFIGURATION DU MATERIEL EN VOL
CO-DF-D112-EA-16562-CN	DR9. DOSSIER DE JUSTIFICATION DU PARAMETRAGE DORIS-DIODE DGXX-S
CO-PL-D0-EA-15414-CN	DR10. CALIBRATION PLAN
CO-DJ-D0-EA-15777-CN	DR11. PRINCIPES DE LA SYNCHRONISATION ET DE LA DATATION DORIS
	DR12. CONVENTION CNES-IGN ET PROTOCOLE D'ACCORD POUR DORIS
DSW-SP-0-EA-16807-CN	DR13. DEFINITION OF TM PACKETS AND TC FORMATS
DJCS-SP-0-EA-16710-CN	DR14. DEFINITION OF TM PACKETS AND TC FORMATS
CO-IF-D1/B-EA-16314-CN	DR15. DORIS BROADCAST UPLOADS DEFINITION
DHY2-DF-0-EA-15949-CN v3.4	DR16. DEFINITION OF DORIS/HY2 TM PACKETS AND TC FORMATS
DOGE-SP-D0-EA-17261-CN	DR17. DEFINITION OF DORIS/GENESIS TM PACKETS AND TC FORMATS

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TBC AND TBD LIST

(in case of no TBC or TBD mention "none" is mandatory in the table here after)

TBC/TBD	Section	Brief description
TBC	none	
TBD	none	

ABBREVIATIONS

SIGLE	DEFINITIONS
AOCS	Attitude and Orbit Control System
DIODE	<u>D</u> oris <u>I</u> mmEDIATE on-board <u>O</u> rbit <u>D</u> etermination (Détermination Immédiate d'Orbite par DORIS Embarqué) : advanced function of the DORIS receiver, that computes the position and the velocity of the satellite : <i>a real time on-board orbit determination software</i>
DORIS	Doppler Orbitography and Radio Positioning Integrated by Satellite
IDS	International Doris Service
IERS	International Earth Rotation and Reference Systems Service
ITRF	International Terrestrial Reference Frame
POD	Precise Orbit Determination
SALP	Service d'Altimétrie et de Localisation Précise is the project devoted to DORIS system operation and to altimetry missions control and processing.
SSALTO	Multi-Mission Ground Segment for Altimetry precise positionning and Orbitography, (CNES)
TAI	International Atomic Time
TC	Telecommands
TM	Telemetry
USO	Ultra-Stable Oscillator



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1 SUBJECT

The DORIS (Doppler Orbitography and Radiopositioning Integrated by Satellite) system has been developed jointly by CNES, IGN (Institut National de l'information Géographique et Forestière), and GRGS (Groupe de Recherche de Géodésie Spatiale) in the frame of the TOPEX/Poséidon altimetric project. A first demonstration occurred in 1990 with SPOT2, hosting a DORIS receiver developed by Thalès Systèmes Aéroportés (TSA). Processing of those measurements has allowed very precise orbit determination and station positioning.

After SPOT2, since that time, different DORIS receivers were flown on different missions, such as TOPEX, Jason, Envisat, SPOT, Pléiades, HY-2A and AltiKa. Future versions are being designed for Sentinel 3 or SWOT.

Those very different missions have very different characteristics, very different requests and ask DORIS for very different services.

This document aims at describing the generic requests which are necessary to ensure constancy of the different DORIS Flight Software.

2 SCOPE

This document applies to the DORIS system from the DGXX-S generation (Jason-3, Sentinel-3A and B, SWOT, Sentinel-3C and D, Jason-CSA and B). Former DORIS generation (SPOT, TOPEX, ...) are only mentioned as historical references.



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3 DORIS MISSIONS AND REQUIREMENTS :

3.1 SATELLITE IDENTIFIER :

Through time, different, SAT_ID have been used in the different DORIS software.

IDENTIFICATEUR_DU_SATELLITE_SPOT2	: constant := 16#01#;
IDENTIFICATEUR_DU_SATELLITE_HELIOS2A	: constant := 16#02#;
IDENTIFICATEUR_DU_SATELLITE_HELIOS2B	: constant := 16#03#;
IDENTIFICATEUR_DU_SATELLITE_SPOT4	: constant := 16#04#;
IDENTIFICATEUR_DU_SATELLITE_SPOT5	: constant := 16#05#;
IDENTIFICATEUR_DU_SATELLITE_TOPEX	: constant := 16#06#;
IDENTIFICATEUR_DU_SATELLITE_ENVISAT	: constant := 16#07#;
IDENTIFICATEUR_DU_SATELLITE_JASON1	: constant := 16#0A#;
IDENTIFICATEUR_DU_SATELLITE_CRYOSAT	: constant := 16#0C#;
IDENTIFICATEUR_DU_SATELLITE_JASON2	: constant := 16#A2#;
IDENTIFICATEUR_DU_SATELLITE_JASON3	: constant := 16#A3#;
IDENTIFICATEUR_DU_SATELLITE_ALTIKA	: constant := 16#AA#;
IDENTIFICATEUR_DU_SATELLITE_HY2A	: constant := 16#AC#;
IDENTIFICATEUR_DU_SATELLITE_HY2C	: constant := 16#B1#;
IDENTIFICATEUR_DU_SATELLITE_HY2D	: constant := 16#B2#;
IDENTIFICATEUR_DU_SATELLITE_HY2E	: constant := 16#B3#;
IDENTIFICATEUR_DU_SATELLITE_HY2F	: constant := 16#B4#;
IDENTIFICATEUR_DU_SATELLITE_SWOT	: constant := 16#C0#;
IDENTIFICATEUR_DU_SATELLITE_CRYOSAT2	: constant := 16#C2#;
IDENTIFICATEUR_DU_SATELLITE_SENTINEL3A	: constant := 16#C3#;
IDENTIFICATEUR_DU_SATELLITE_SENTINEL3B	: constant := 16#C4#;
IDENTIFICATEUR_DU_SATELLITE_SENTINEL3C	: constant := 16#C5#;
IDENTIFICATEUR_DU_SATELLITE_SENTINEL3D	: constant := 16#C6#;
IDENTIFICATEUR_DU_SATELLITE_JASON-CSA	: constant := 16#CA#;
IDENTIFICATEUR_DU_SATELLITE_JASON-CSB	: constant := 16#CB#;
IDENTIFICATEUR_DU_SATELLITE_PLEIADES1	: constant := 16#D1#;
IDENTIFICATEUR_DU_SATELLITE_PLEIADES2	: constant := 16#D2#;
IDENTIFICATEUR_DU_SATELLITE_GENESIS	: constant := 16#E1#;

These 'SAT_ID' values are not used anymore in the on-board software but only in the ZQS headers.

Nevertheless, for ground use of the on-board software, it is necessary to avoid two different satellites having the same SAT_ID.

EX_1 : When a new SAT_ID is chosen, select in the above list an unused value.

EX 2 : once the new SAT_ID chosen, publish a new version of the present document, with the new value added in the above list.

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3.2 UPLOAD PARAMETER LENGTH :

Theoretically, Upload_Parameters are defined in the TM/TC packets, with a length of 64 bytes (32 words of 16 bits).

In fact, those Upload_Parameters may be sent either by satellite channel, or by master beacon channel. This possibility should be kept, as it is a secure redundancy in case of failure of satellite channel (SPOT5 for instance).

But there is a limitation in the on-board software (due to past DORIS formats definition), that limits beacon uploads length up to 24 words of 16 bits (48 bytes). Especially, in the package "pile_tch.adb", the array where on-board software receives the Upload_Parameters is limited to this "short length".

When a "long_length" Upload_Parameter is received, the software only puts in the array 24 words (beginning with the Upload_ID). The rest is simply lost (see package "tm_tc_packets.adb").

DIODE does the same when it copies the "Last Upload Parameter TC DIODE » in the auxiliary data packet.

EX_3 : When a new UPLOAD_PARAMETER is defined in the TM-TC formats document of a new satellite, it should not contain any significant data beyond the 24th word of 16 bits beginning with the Upload_ID.

3.3 COMMAND PARAMETER :

The Command Parameter is partially redundant with Upload_Id (section 3.4) in the case of Upload_Parameter or Upload_Memory.

Command Parameter is required to allow identification by the Flight Software of the type and the length of the in-coming TC. This is especially true in the case of the RS 422 protocol (no other information available). In the case of 1553 Proteus protocol, the value of the sub-address gives an information. In the case of the CryoSat-like Protocol, the length is contained AC.

Furthermore, the Command Parameter is used for TC acknowledgement (see DR1, field "last_command" of report packets).

Thus Command Parameter has to be kept present in TC formats.

Note : Command Parameter is not transmitted to DIODE

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3.4 UPLOAD ID :

Either for beacon Broadcast_Uploads or for satellite "Upload_Parameters", a special word called "Upload_ID" has been defined.

For Broadcast_Uploads (Cf DR15 parag 4) this word is DONNEES_TCH's first word (number 25).

For Upload Parameters (cf DR1 for Jason-3, Sentinel-3ABCD or DR14 for Jason-CS), this word is bytes 2-3 "Upload_ID". There is no Upload Parameters for SWOT.

There is a partial redundancy with Command_Parameter (which is not present by Beacon Channel).

This Upload_ID is defined as follows :

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Upload_ID	0	0	0	0	KIND	TYPE	ID_TCH									

with the following definitions :

KIND : two bits. Execution mode : 00= immediately on reception, 11= execution time given in the TCH

TYPE : two bits. Destination : 00= DIODE, 11= DORIS

ID_TCH : one byte identifier (may be re-used if KIND or TYPE are different)

These fields are used by the on-board software to control upload validity.

3.4.1 PAST 2GM GENERATION :

Here are the already used UPLOAD_ID (from SPOT5 "TM-TC packets")) :

Concerning DORIS :

UPLOAD_ID	(there wasn't any Command Parameter at the time)
0301	Date RAZ
0F02	Constantes Système Doris
0F03	Gain Récepteurs
0304	Abaque
0F05	Optimisation Mode Aidé
0306	Tueur



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0F07	Heures Commutation TM
0308	Pas de IDOP3
0F09	Voie Prioritaire
0F0A	Coordonnées Balise Spécifique
0F0B	Coord Balise Broadcast
0F0C	Correspondance Temps Broadcast
0F0D	Autoinitialisation

For DIODE :

UPLOAD_ID	(there wasn't any Command Parameter at the time)
0C01	Bulletin initial
0C04	Manoeuvres sol
0C05	Kalman
0C06	Kalman datation
0C07	Configuration Diode
0C08	Pression de Radiation
0C09	Attitude J1
0C0A	Qualité Diode
0CF0	Constantes Doris pour DIODE

3.4.2 DGXX AND DGXX-S GENERATION :

Concerning DORIS :

UPLOAD_ID	
0306	Tueur (Command Parameter D005)
0F0A	Coordonnées Balise Spécifique (Command Parameter D004)

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	(sur DGXX-S, fonctionnalité de test)
0F0B	Coordonnées Balise Broadcast
0F0C	Correspondance Temps Broadcast
0FF1	Réservé

For DIODE :

UPLOAD_ID	
0C01	Bulletin Initial (Command Parameter D003) (sur DGXX-S, fonctionnalité de test)
0C04	Manoeuvres sol (Command Parameter D002)
0C06	Solar array (Command Parameter D006)

Filtering of these Upload_Parameters Packets by the software is made as follows :

For the 1553 protocol #1 (Jason-3, StnI3) defined in DORIS_ZQS

```
function VERIFICATION_UPLOAD_PARAMETERS_TC_PACKET_C1 :

if LA_TC.COMMAND_PARAMETER = TC_INITIAL_BULLETIN
or else
LA_TC.COMMAND_PARAMETER = TC_MANOEUVRE_CHARACTERISTIC
or else
LA_TC.COMMAND_PARAMETER = TC_BEACON_COORDINATES
or else
LA_TC.COMMAND_PARAMETER = TC_DATA_KILLER
or else
-- Ce TCHD Diode est envoye par voie satellite uniquement sur Jason3.
-- Mais ici, qq soit le satellite, il est accepte et depose dans la
table de TCHD.
-- C'est Diode en aval qui le filtre en fonction d'un parametre de la
ZQS Diode.
LA_TC.COMMAND_PARAMETER = TC_J3_SOLAR_ARRAY
then
LA_VERIFICATION_DU_PACKET := NO_ANOMALY;
else
-- TC invalide
LA_VERIFICATION_DU_PACKET := ILLEGAL_COMMAND_PARAMETER;
end if;
```

(in particular, Broadcast are not allowed by Satellite Channel).



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For the 1553 protocol #2 (CryoSat-2) defined in DORIS_ZQS

Idem + PUS control

3.4.3 DGXX-S SWOT GENERATION :

Concerning DORIS :

UPLOAD_ID	
0F0B	Coordonnées Balise Broadcast
0F0C	Correspondance Temps Broadcast
0FF1	Réservé

For DIODE :

UPLOAD_ID	
0C0B	OCM TC (Command Parameter D007)
0C0C	Solar array position (Command Parameter D008)

And the test commands :

UPLOAD_ID	(fonctionnalité de test)
0C01	Bulletin Initial (Command Parameter D003)
0F0A	Coordonnées Balise Spécifique (Command Parameter D004)
0306	Tueur (Command Parameter D005)

EX_4 : When a new UPLOAD_ID is defined in the TM-TC formats document of a new satellite, please select in the above lists an unused value.



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EX 5 : once the new UPLOAD_ID chosen, publish a new version of the present document, with the new value added in the above list.



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