A BRIEF OVERVIEW OF DORIS SYSTEM EVOLUTIONS

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- **System and Missions**
- **onboard instruments**
- **3rd generation beacon**
- **DORIS ground segment : SSALTO**

Satellites

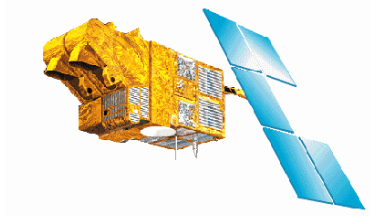
90 91 92 93 94 95 96 97 98 99 2000 01 02 03 04 05 06 07

SPOT2

TOPEX-POSEIDON

SPOT3

SPOT4



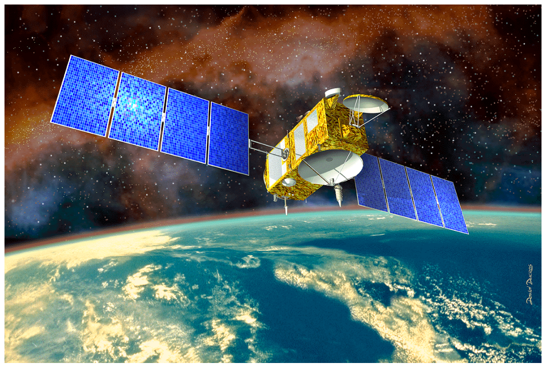
DORIS applications

- Orbit determination
- Gravity field
- Earth rotation
- Localization
- On-board real time orbit
- TAI Time-tagging

JASON1 TAI

ENVISAT1 TAI

SPOT5 TAI



CRYOSAT TAI

JASON2 TAI

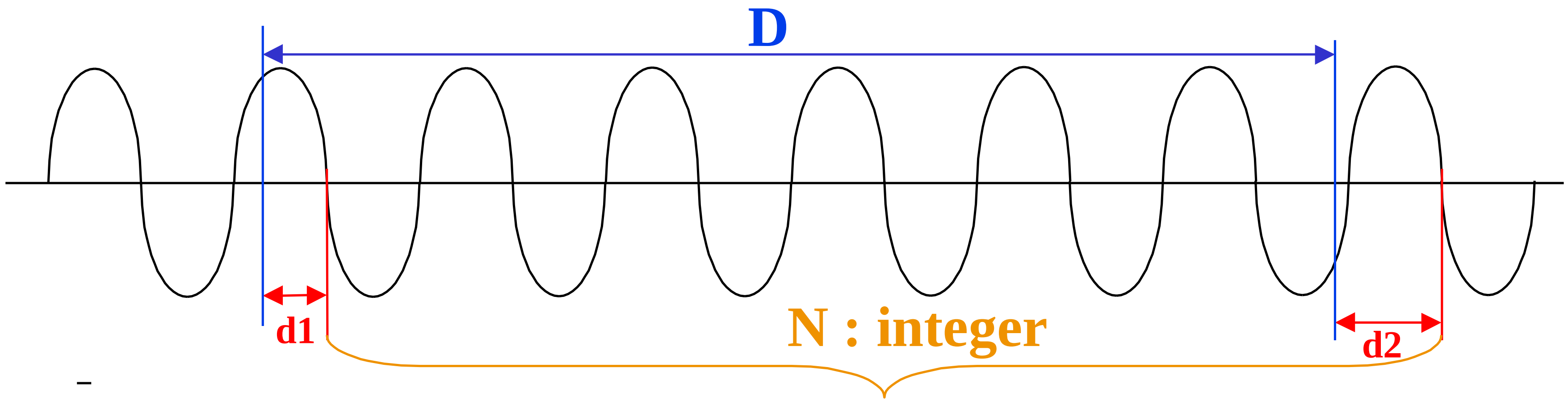
NPOESS, PLEIADES…

new features of the 2nd generation onboard instruments

- New routine measurement operation mode : Autonomous mode
  - based on DIODE directives for beacons signals acquisition
  - no more daily uploads
- 2 beacons tracking capability : ~ x2 measurements /day
- increased instrument operational robustness:
  - more autonomous onboard software
  - radiation-hardened electronic parts : processor, mass memories
- improved DIODE accuracy
  - orbit estimation : ~ 1 m rms 3-D position accuracy
  - TAI estimation : ~ 1-2 μsec rms
- 2nd miniaturized generation (JASON-1, SPOT5)
  - Instrument and DIODE self-initialization : from turn-on to routine mode without any ground commands
  - reception and processing of « system uploads » permanently broadcast by Master Beacons : automatic update of onboard beacons network description

Doppler measurement principle (1)

- 1st generation (T/P,S2,S4) and 2nd generation (ENVISAT) receivers

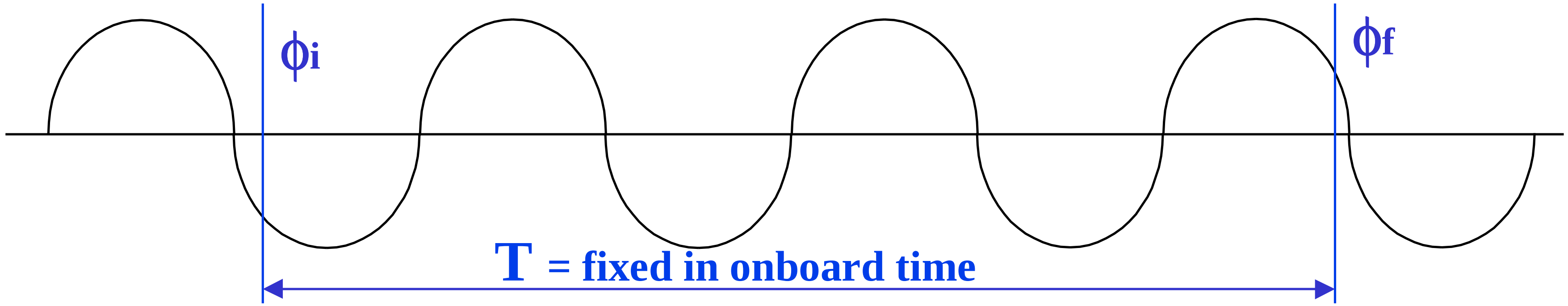


- Fdoppler = [N / (D + d2 - d1)] - Fc   Fc = 125 kHz

- 1st generation receiver
  - quantification error on di = ± 50 nanoseconds
  - => max error on measured Doppler frequency : 1,65 mHz <=> 0,24 mm/sec.
- 2nd generation : same measurement method but
  - reduced quantification error on di = ± 12,5 nanoseconds
  - => error on measured Doppler frequency : 0,41 mHz <=> 0,06 mm/sec

Doppler measurement principle (2)

- **2nd miniaturized receivers (JASON-1, SPOT5)**



- **no more Fc : Doppler measurements are realized on Doppler signal**
- **Fdoppler = (ϕf - ϕi) / 2 πT**
  - **(ϕf - ϕi) : cumulated phase variation of « Doppler signal » during T**
  - **T = 7 (unchained mode) or 10 (chained mode) « onboard seconds »**
  - **quantification error on ϕ : ± 3 milliradians**
    - max error on measured Doppler frequency : 0,1 mHz <=> 0,015 mm/sec
- **on 2nd miniaturized receivers : phase measurements ϕi and ϕf are realized simultaneously on each RF channel (400MHz, 2GHz), for both tracked beacons signals.**

3rd generation beacon : main new features

- 400 MHz & 2 Ghz emitted frequencies can be shifted with respect to DORIS nominal frequencies : ± 50 kHz / 2GHz ; ± 10 kHz / 400 MHz
- Beacon modulation (beacon message and synchronization word) is transmitted on 400 MHz & 2 GHz frequencies
- Broadcasting of current TAI date (with a LSB of 10 seconds)
- Improved observability of beacon operation status
- auto-initialization mode : 3rd generation beacon can be received without any time set-up
- possibility of remote control
- can be easily upgraded into Master Beacon

SSALTO : the new multi-missions orbitography and altimetry center

➨ Early and new instruments and/or missions

- **Early missions (SPOT 2 & 4, TOPEX/Poseidon)**
- **+ JASON (DORIS, GPS, Laser, altimeter, radiometer)**
- **+ ENVISAT (DORIS, altimeter, radiometer)**
- **+ SPOT 5 (DORIS)**
- **expected increasement of DORIS system performances**
  - **x2 in-flight instruments ; x3 tracking capability**

➨ SSALTO improved characteristics

- **modular conception allowing new instruments to be easily integrated**
- **centralized data archiving**
- **includes public results interface and distribution**
- **beacons positionning is included in operational processing**
- **capability to deliver from SSALTO a DORIS instrument Control Center for a « DORIS user » project => to be embedded in the Satellite Control Center**