DORIS DAYS 2021

November 16,17 and 18

# Ground stations components

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Session 3 – Presentation 5

# Ground station components

## The beacon

generates two modulated signals: 401.25MHz / 2036.25MHz

contains the reference oscillator, the frequency synthesizer, and the management board

## The remote control system

allows basic settings and adjustments from the Control Center

## The power pack

supplies power and charges the battery

## The battery

supplies power in case of mains failure

## The antenna

transmits the signal generated by the beacon

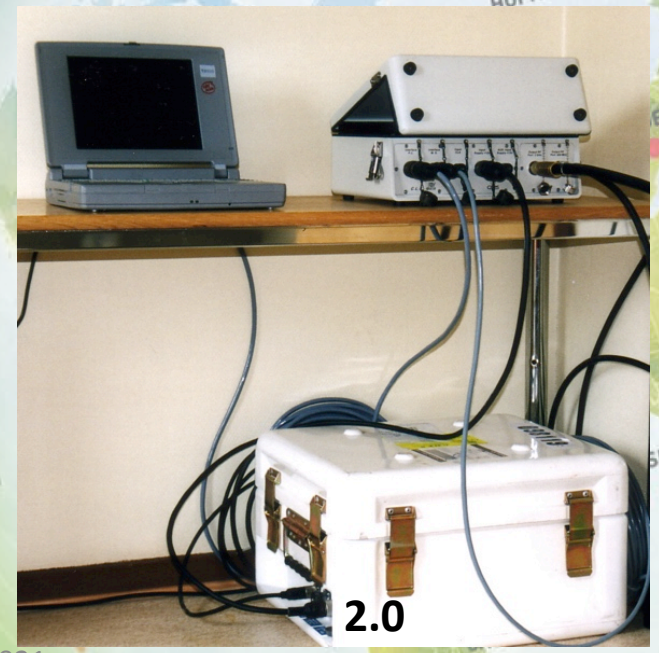
## The cables

keep every component connected


# Hardware development (1/2)

- **4 generations of beacons (transmitter)**
- **1990-1995-2001-2019:** 4 generations of beacons have been developed improving each time reliability, robustness and performance
  - **4th generation beacon deployment began in June 2019** => *see C. Manfredi (CNES) presentation 6*
- **Current network equipment:** 40 stations equipped with 3rd generation/19 with 4th generation beacon

1.0

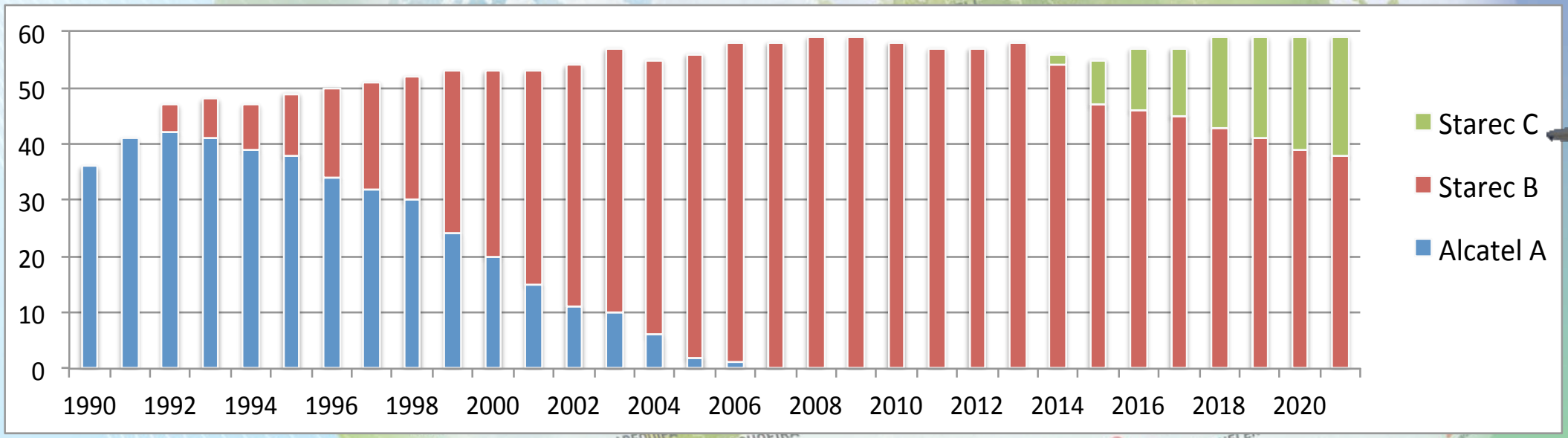

2.0

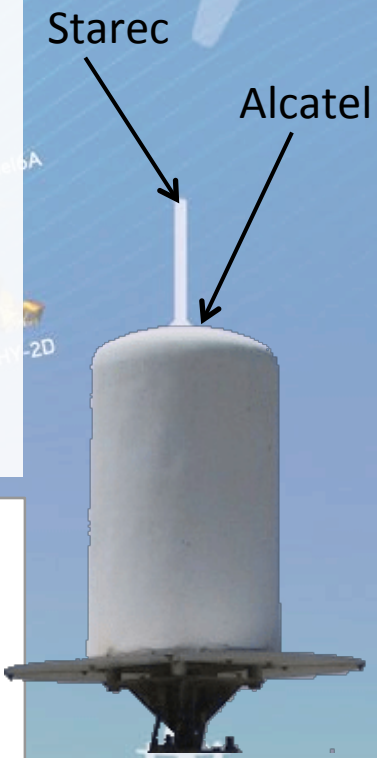

3.0

4.0

# Hardware development (2/2)

- **3 generations of antennae**
- **1992-2006:** gradual replacement of Alcatel antennae with Starec antennae
- **Different design**: compact / helical antenna **and better DORIS measurement accuracy**
- **2014: key development: Antenna C type:** same design as Starec B but with consolidated specifications: the uncertainty of the vertical location of the 2GHz phase center is reduced from 5 mm to 2 mm



# Equipment requirements

## 1. Continuous service 24/7 365 days operation

**a.Mains**

- Continuous feed and power stability is required to generate and transmit the DORIS signal

**b.Signal transmission**

- Deliberate or automatic switch to stand-by mode are prohibited
- Possible interferences with other nearby equipment must be considered before installation

**c.Troubleshooting**

- Site accessibility and fast customs clearance are necessary for the shipping of spare equipment

# 1a. Mains

**Power supply / EX. I_80:** Maximum duration of power failures ≤ 1 hour
**Power supply / EX. I_90:** Maximum frequency of power failures = 1 per day
**Power supply / EX. I_270:** Monthly total of power failures < 6 hours
**Power supply / EX. I_100:** Electric current characteristics: 100 VAC to 264 VAC voltage
**Power supply / EX. I_110:** Mains frequency 48 to 66 Hz
**Power supply / EX. I_260:** Minimum rating of the circuit-breaker/fuse on the power supply line equal to at least 10 amps

⇒ **In most cases, domestic electricity mains supply complies with these requirements. In difficult areas, uninterrupted power supply (UPS) system or backup power is required**

⇒ **The maximum operating life of the DORIS battery is two hours**

⇒ **Beacon power consumption: 130 Wh**

⇒ **Note that the DORIS system does not require any connectivity for data transmission**

# 1b. Signal transmission

**Signal transmission/ EX. I_50:** Sites requiring a deliberate switch to stand-by are prohibited

**Signal transmission/ EX. I_60:** The use of a timer for automatic switch to stand-by is prohibited

**Signal transmission/ EX. I_70:** A transmission authorization from the cognizant authority in the host country is mandatory prior to installation of the equipment on site

**Signal transmission/ EX. F_181:** The characteristics of each radiofrequency system on the station site shall be listed : frequencies used, emitting/receiving, permanently/episodically, power

**Signal transmission/ EX. F_182:** Before installation, radiofrequency interferences with other systems shall be managed

⇒ **During radiosonde balloon launches or VLBI observations, inhibiting DORIS transmission from the beacon using the stand-by mode is no longer granted because of:**

- Difficulties in managing the network (one-way switch, return to transmission overlooked…)
- Incurred measurement losses that reduce the station performance

⇒ **Possible RF interferences with nearby equipment must be examined prior installation and on a regular basis afterwards to prevent problems**

- In any case, radiofrequency authorization from local Authority must be granted or renewed

# 1c. Troubleshooting

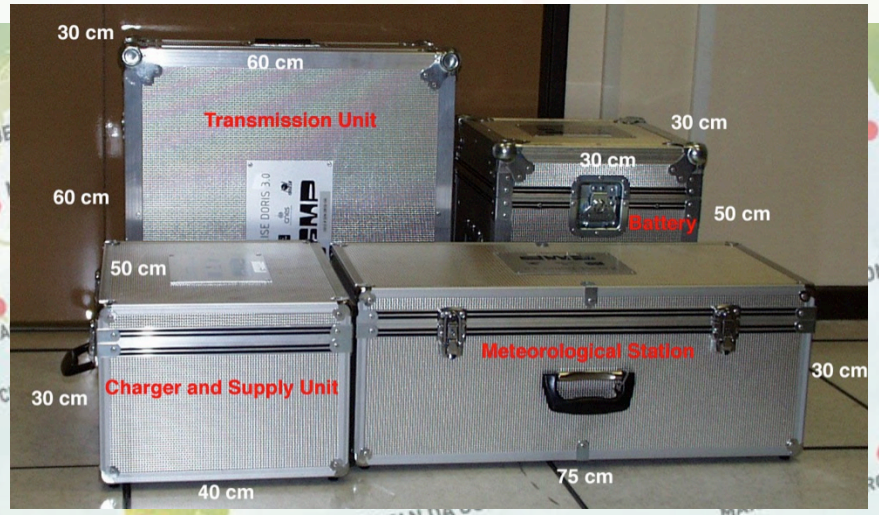
**Maintenance / EX. F_160:** In case of failure, the replacement beacon must be configured so as to have exactly the same number and the same hexadecimal code as the faulty equipment

**Maintenance / EX. I_30:** Presence on site (i.e. less than 30 minutes away from the beacon) of personnel qualified to carry out standard maintenance operations on DORIS stations is required

**Maintenance/ EX. I_40:** The dispatch of equipment must be possible at least every two months, with customs clearance time shorter than two months

⇒ **Quick troubleshooting is essential to ensure a good data availability**

⇒ **Time for fault diagnosis, equipment shipping, customs clearance, and equipment replacement should be minimized**



# Equipment requirements
## 2. Installation specifications

### a. Equipment housing

- Dedicated shelter or room or space for the indoor equipment

### b. Beacon environment

- Suitable operating conditions: temperatures, no corrosive environment…

### c. Cables routing

- No tension forces on cables and connectors

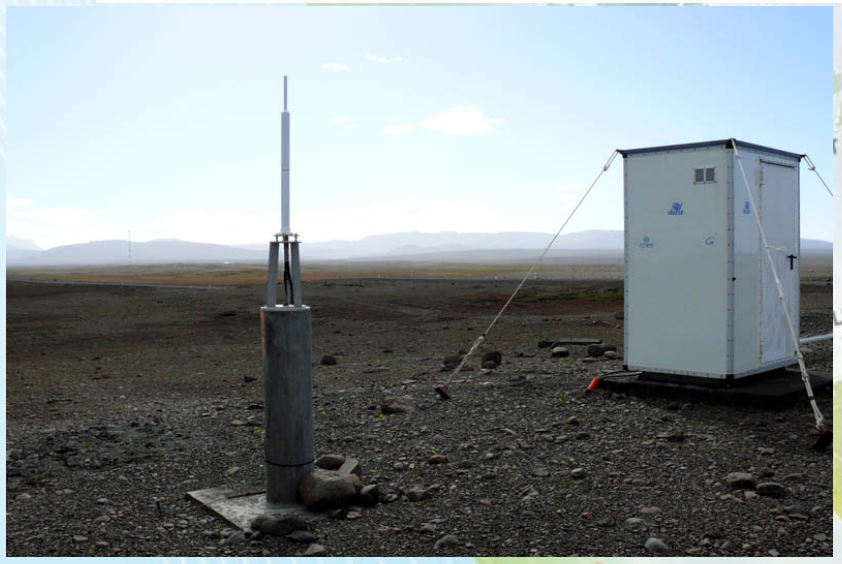
# 2a. Equipment housing

**Beacon room / EX. I_295:** The room where the beacon is to be stored must present cleanliness conditions (no excessive amount of dust, no animal droppings…)

**⇒ to accommodate the indoor equipment, 2 square meters facility is enough**

**⇒ a standard 19” equipment rack is provided by CNES**

**⇒ a dedicated shelter might be the best option**



# 2b. Beacon environment

**Beacon room / EX. I_120:** The operating temperature range must be between 0°C and 45°C with maximum gradient 10°C/hour inside the beacon room

**Beacon room / EX. I_370:** No DORIS beacon shall be installed in a place subjected to vibrations (OUS and electronic unit vibrations)

**Beacon room / EX. I_295:** Avoid too much corrosive moods as much as possible

⇒ **Air conditioning system is recommended to regulate temperature and avoid moisture**

⇒ **Avoid place where people are constantly coming and going (dedicated room or shelter is better)**

# 2c. Cables routing

**Cables / EX. I_210:** The use of right-angled adapters is prohibited at the antenna bottom and the beacon rear panel

**Cables / EX. I_220:** The cables bend radius must be greater than 20 cm (margins in relation to 12.5 centimeters in the beacon specification of requirement)

**Cables / EX. I_230:** Cable length = 15 meters for sites fitted out with a 3.0 or 3.1 beacon. Cable length = 25 or 50 meters for sites fitted out with a 4.0 beacon.

**Cables / EX. I_320:** The preforming of cables and their fastening on the antenna support must be such that the connectors can be screwed and unscrewed by hand, with no need for a tool.

**Cables / EX. I_330:** The cables must be mechanically fastened to the antenna support, as close as possible to the connectors, without applying any stress.

⇒ **Ensuring that no stresses, no tension forces are exerted on the cables or the connectors due to improper installation or external cause (wind, hanging…)**

⇒ **Cable trays or buried cable ducts are recommended**

# Equipment requirements in summary

- Continuous service and reliable power supply
- Continuous signal transmission (least possible amount of downtime)
- Fastest possible troubleshooting
- Dry, clean and quiet room to ensure smooth operation of the beacon
- Reasonable temperature variations inside the room
- Particular attention to the cables routing to avoid signal disruption