Parasol –

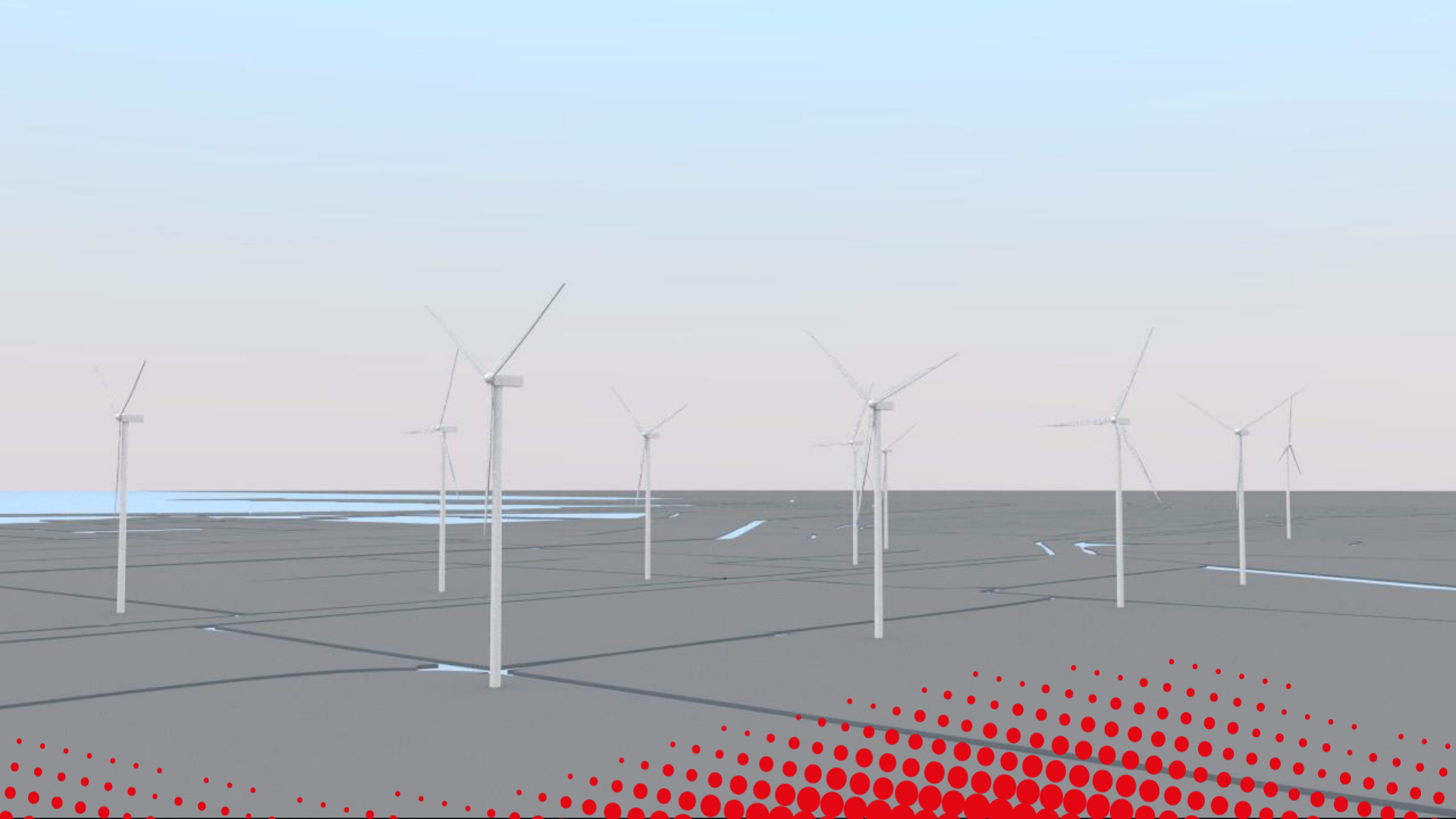
Passiv Radar basierte Schaltung der Objektkennzeichnung für die Luftfahrt

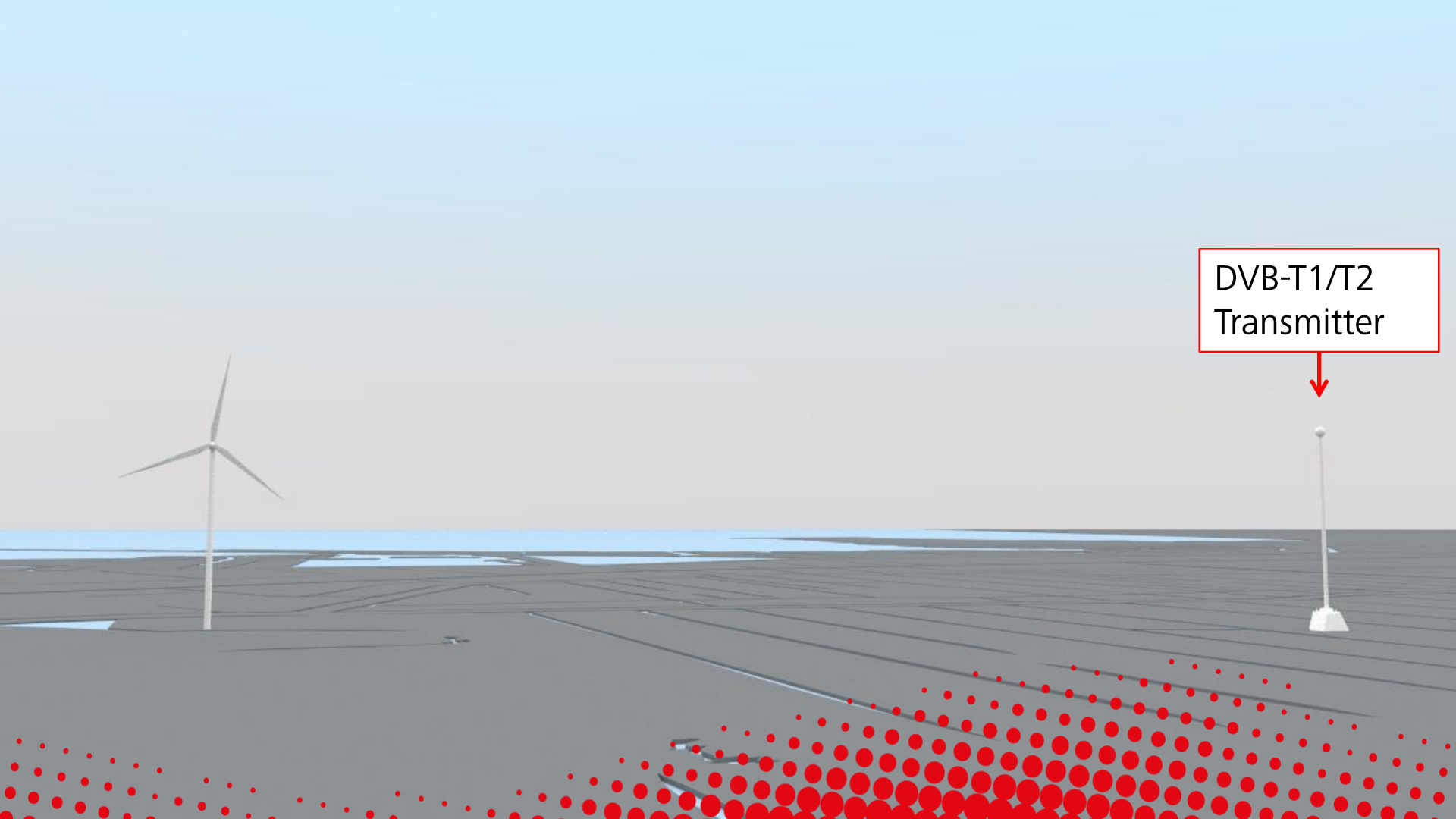
The Passive-Radar-System for Wind Turbines

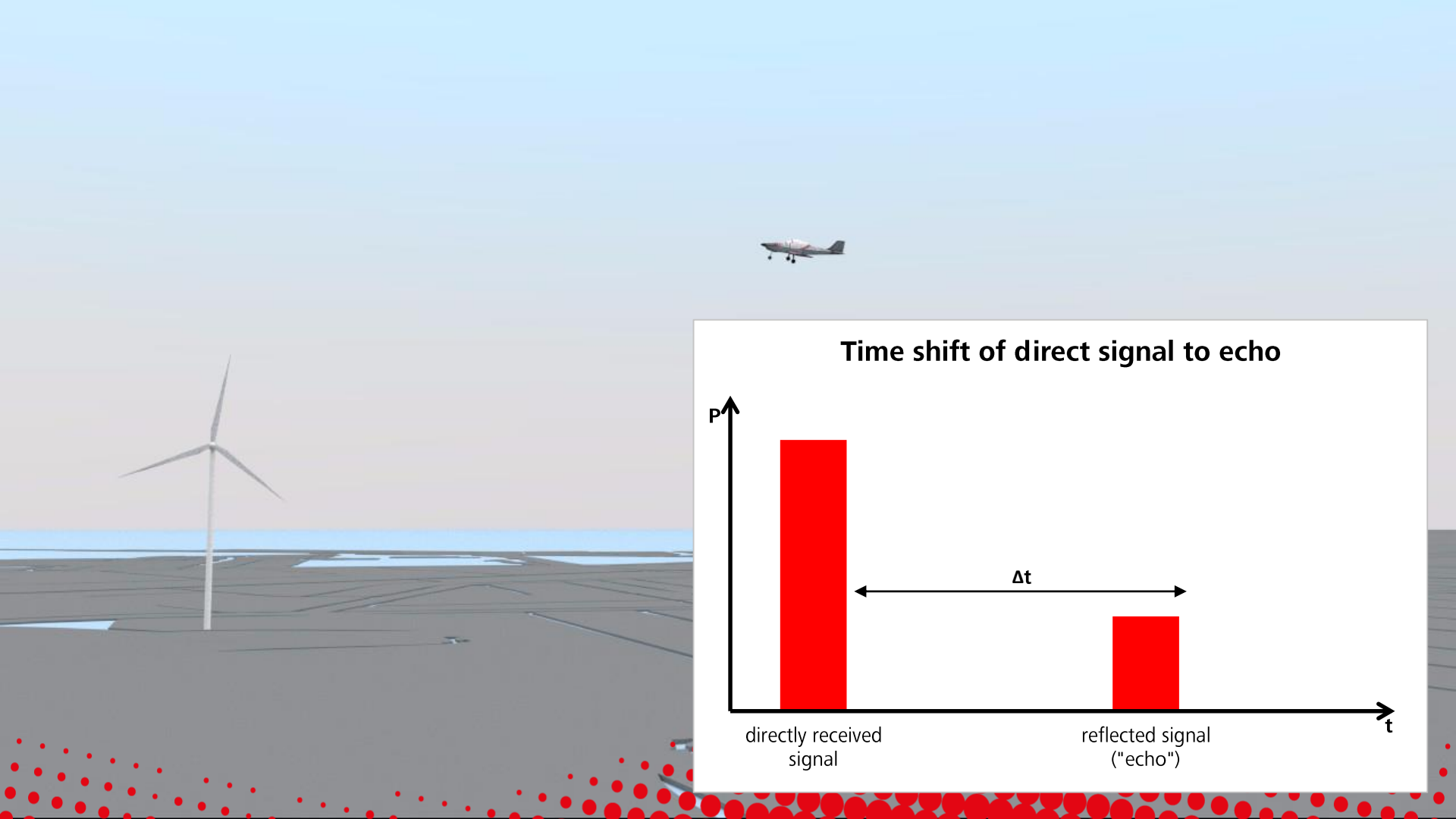
Mode of Operation

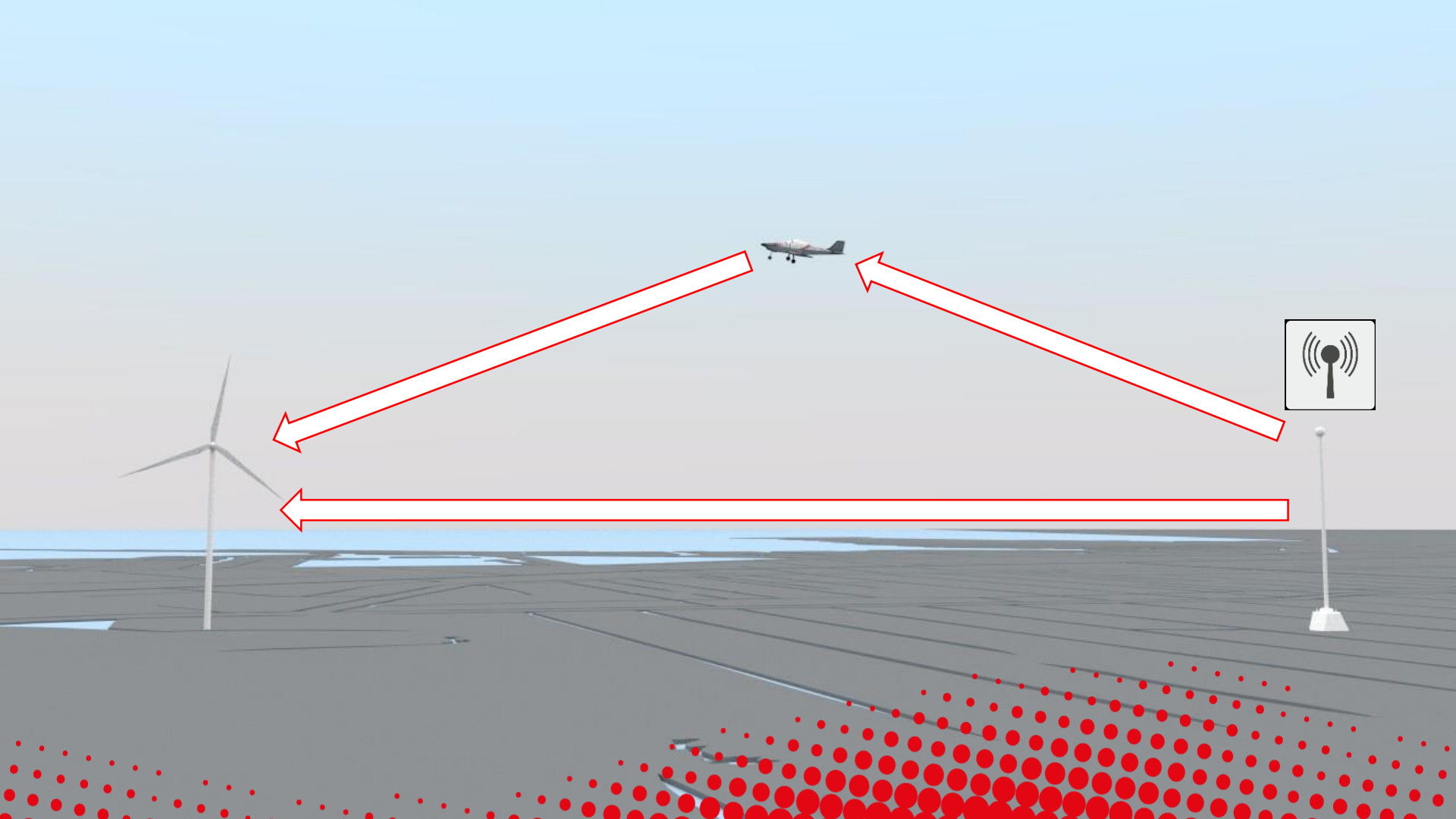
PASSIVE-RADAR-SYSTEM

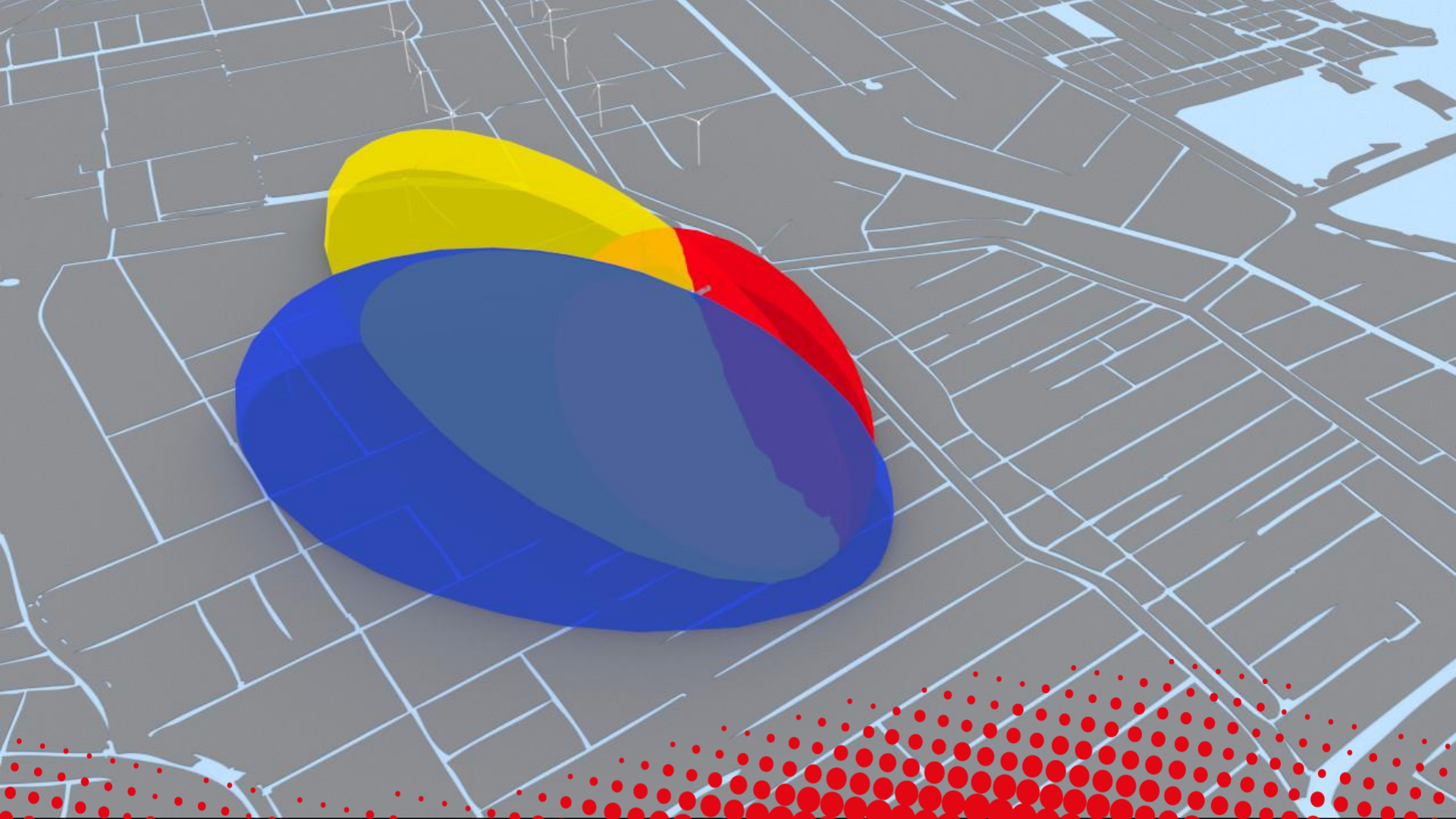
Parasol




DVB-T1/T2
Transmitter


Time shift of direct signal to echo
P
Δt
t
directly received signal
reflected signal ("echo")





Passive-Radar-System

Advantages

- no need of frequency assignment
- no emission of additional electromagnetic radiation
- (good at price – no radar transmitter needed)
- DVB-T1 and DVB-T2 as transmitters extensively available
- not subject to weather conditions
- no cone of silence

Challenges

- Object classification (swarms of birds / small A/C / vehicles)
- Object altimetry
- Sensor dislocation

History of development

PARASOL

Parasol – History of development

July 2012 the institut FHR contacts Dirkshof in search of an industrial partner (Dirkshof is not only project developer and operator of wind farms but offers also the know-how and ressources of the aviation industry as aircraft manufacturer at „Breezer Aircraft“)

Sept.2013 Together with the FHR, Dirkshof installs the first Passive-Radar-System at a wind farm in Reußenköge for a test operation period of one year

Parasol – History of development

April 2014 competence and project promotion is taken over by the Bundesministerium für Wirtschaft und Energie (BMWi)

Sept 2014 successful completion of the test period

Sept 2014 Parasol GmbH & Co. KG is founded

Nov. 2014 beginning of the fist prototype production

April 2015 application of the system at the Deutsche Flugsicherung GmbH (DFS)

Parasol – History of development

July 2015 passing of the AVV (german administration regulation) identification of wind turbines

Aug.2015 general approval of the Parasol-System through DFS
= approval step I

Mar.2016 implementation of the infrastructure for the Parasol-System at the wind farm Reußenköge

June 2016 completion of the control center for the surveillance of the system

Parasol – History of development

July 2016 location-based evaluation through DFS GmbH for final approval

Nov.2016 Installation of new computer units as well as improvement in performance of the sensor network

Jan.2017 long-term tests of each sensor cluster as well as test flights

to improvement of false target discrimination

Dec.2017 preparation for change to DVB-T2

Optimisation of the dislocation, installation of reference antennas

Parasol – History of development

Feb.2018 test flights at 300m and 600m

Mar.2018 practical acceptance test on site (FHR, DFS)

Mai 2018 final approval of the system through DFS

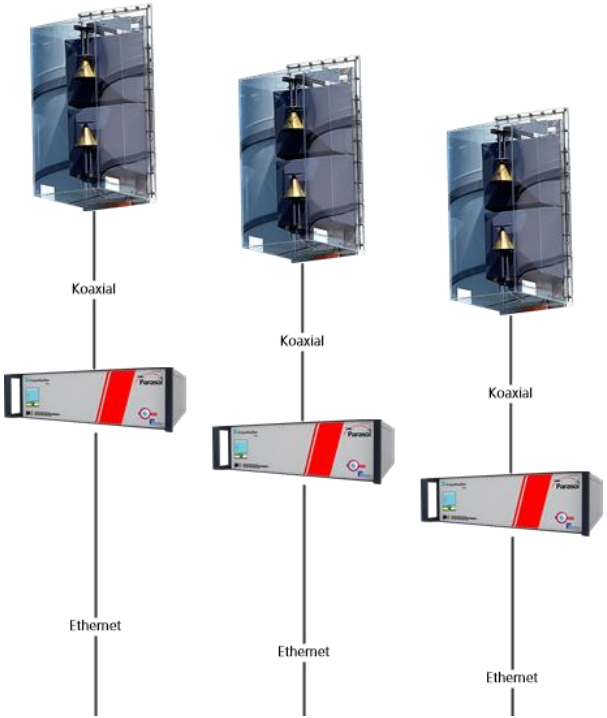
06.2018 optimisation of the total system for serial production

from
July 2018 dislocation of wind farms of individual clients
on

Technical specifications

PARASOL

Parasol - System



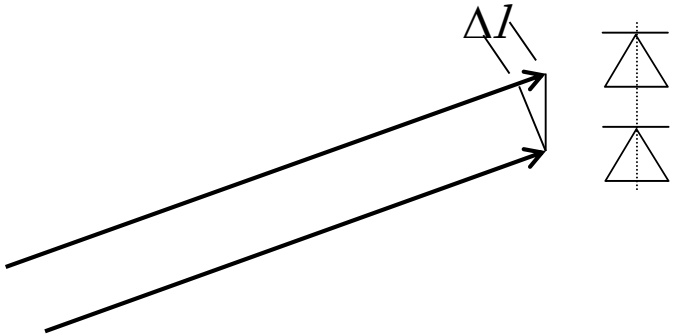
The Parasol-System consists of the following components:

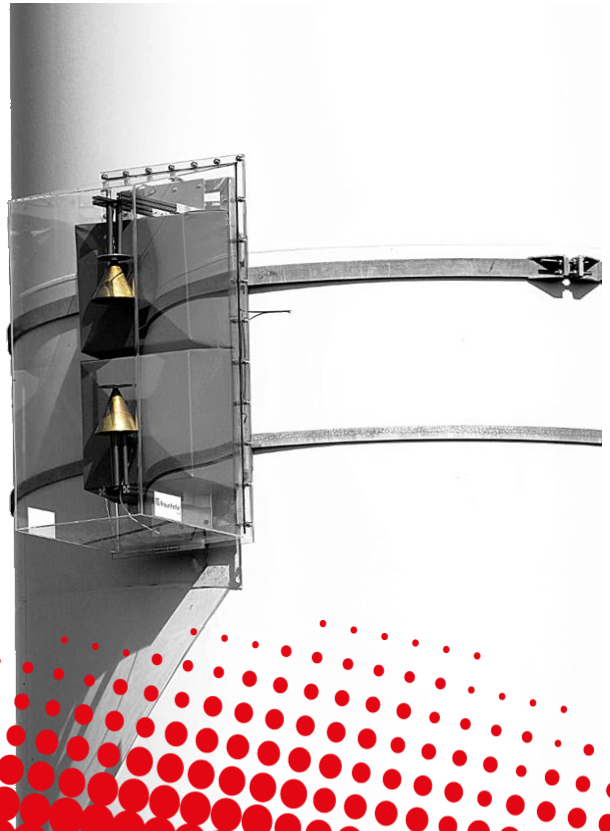
- 3 sensor units incl. tower fastening
- 3 analysing units incl. uninterrupted power supply (USV)
- 3 cable sets

Parasol – sensor unit

By installation of 2 antennas which are offset in their heights, an additional height measurement by interferometry takes place.

Thus, a reliable difference between ground vehicles and aircrafts (even in low heights) can be made.

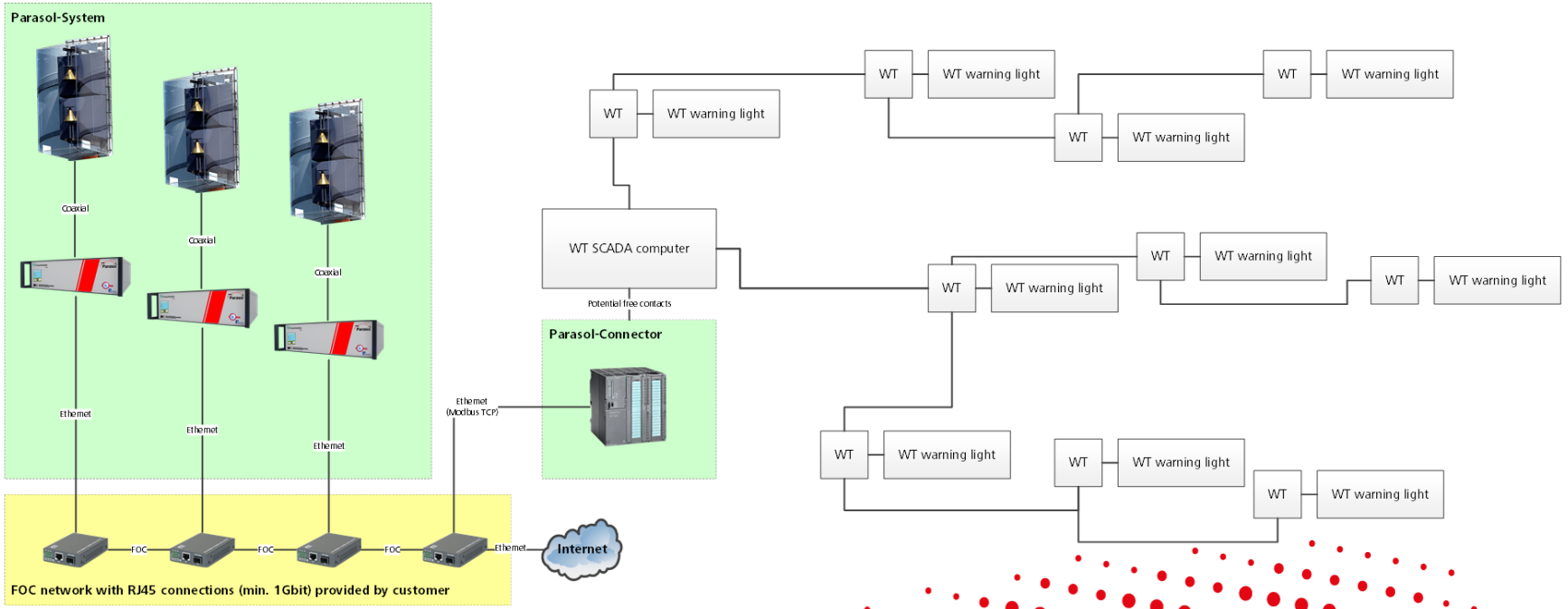




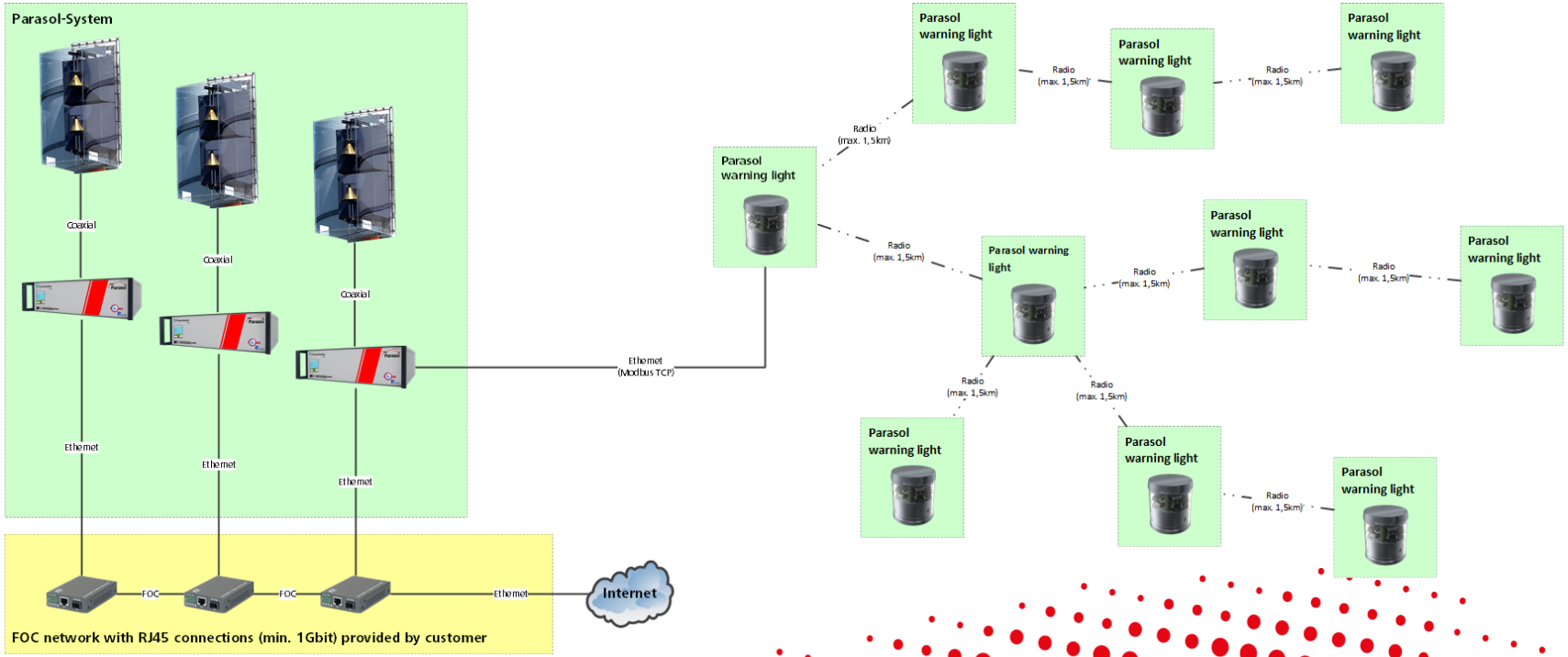
Parasol – Analysing unit

- 2 receiver modules 470-870 MHz
- 3 signal generators
  (1. local oscillator, 2. local oscillator, clock generator)
- 2 analog to digital converter, 16 bit
- 1 FPGA for pre-processing
- 1 computer unit for pre-processing and control
- data memory

Infrastructure plan for existing warning lights



Infrastructure plan for Parasol warning lights

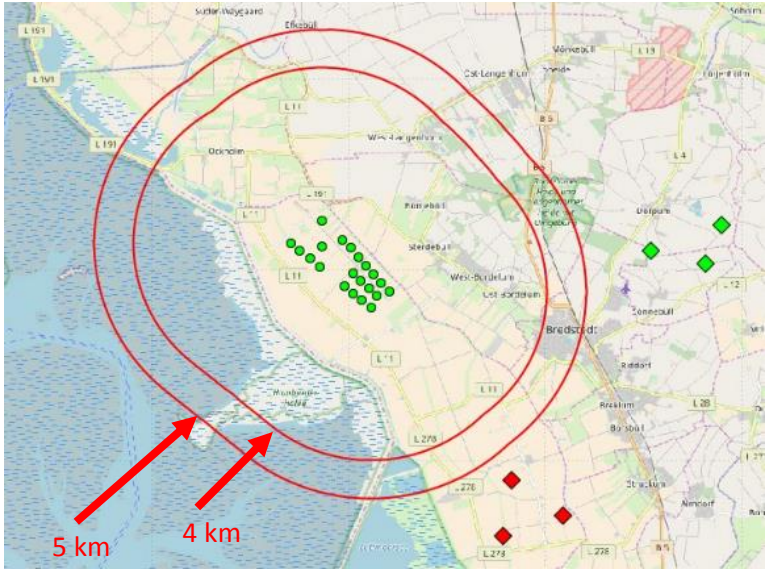


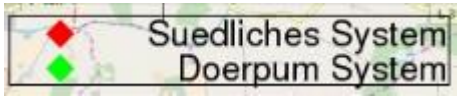
The reference project – Wind farm Reußenköge

PASSIVE-RADAR-SYSTEM

Parasol

Parasol - the supervised area





Wind farm with 21 turbines (Vestas V 112)

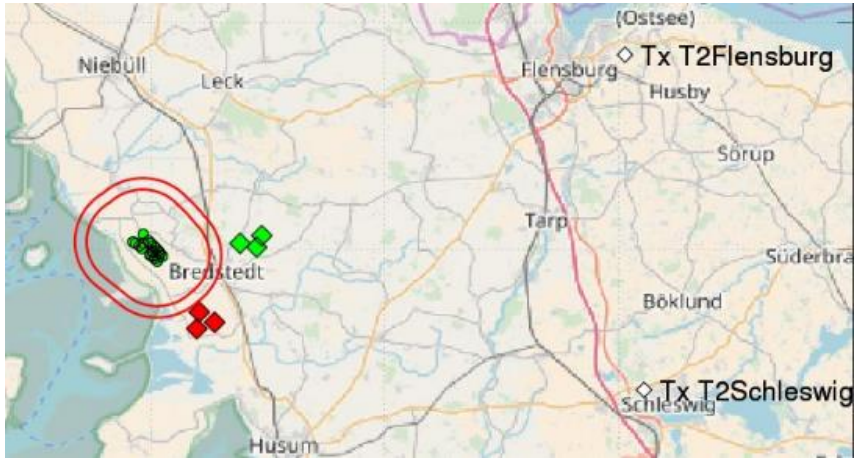
Sensors installed on:

2x Vestas V80
1x Vestas V112 = South System

2x Enercon E-82
1x Senvion 3.4M-114 = Dörpum System

applied transmitter: Flensburg (474 MHz)
Kiel

Parasol - the supervised area



Result:

Because of the elongate extend of the farm over 12 km, 2-3 systems are required to cover the whole farm.

At smaller farms up to 15 turbines, one system will normally be sufficient.

This example shows a great potential for synergy effects with further farms.

Thanks for your attention.