



RF Technology Applied in Space and Ground Systems

on behalf of



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SSBV Introduction

Introduction

- SSBV is a system engineering house for the international space market with a more than substantial RF system content
- SSBV has a small RF design team in the UK (not in NL) dedicated to test & engineering front-ends for the aerospace market
- SSBV recognizes that, as an innovative SME, strong partners with specialized RF competences, capabilities and equipment increases the time to market and allow our engineers to focus on system, application and customer
- **Electro Rent Europe** is a partner allowing SSBV to work with the latest high-end RF test and measurement equipment whilst keeping the RF facility investments at acceptable level
- SSBV acknowledges **Electro Rent Europe** for the opportunity to share its RF applications in the space domain on the **RF Technology Days 2014**

SSBV activities



On-Board Electronics & Small Subsystems



Airborne & Space-based SAR Instruments



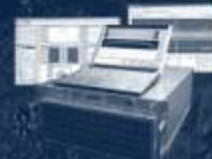
Precision Airdrop & Air Vehicle Recovery Systems



Small Satellite Sensors & Avionics



RF Spectrum Recording & Monitoring Systems



TTC & High-Rate Modems, LEO Ground Stations

RF Test Systems



CMDVS

Electrical Ground Support Equipment (EGSE)



SSBV-NL RF capability

- System Engineering
- RF Subsystem Requirements Specification
- RF Subsystem Design
 - Test & prototyping
 - Design (at SSBV-UK)
 - Outsource – specialized RF design partners
- System Integration, Verification & Validation



SSBV-NL RF space & ground applications

- Ground Segment Applications
 - RF SCOE/Suitcases (test systems for satellite transponders / ground stations)
 - RF Spectrum Recorder
 - 👉 **Multi-Purpose Wideband Modem**
 - 👉 **Deep-Space TTCP Modem**
- Space Segment Applications
 - Intelligent Transponders
 - 👉 **Panel SAR Instrument**
- Application topics of this presentation are new RF innovations, developed under contract, to be released in the coming years

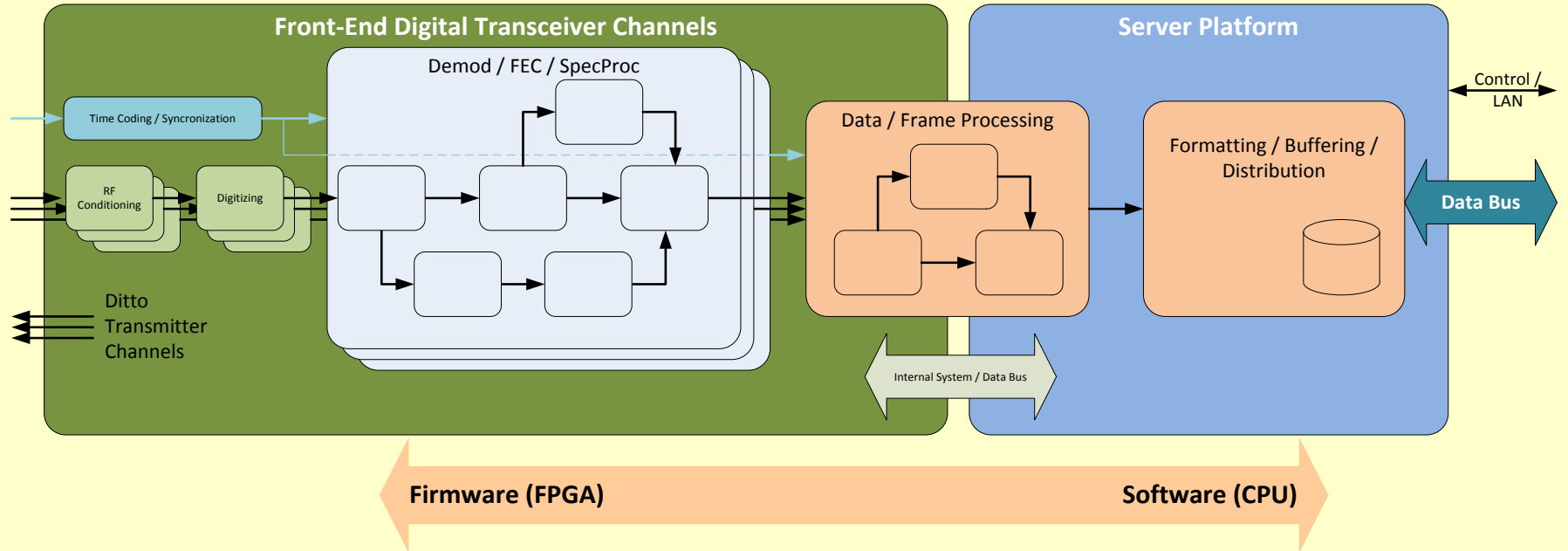
Ground Segment

Multi-Purpose Wideband Modem

Multi-Purpose Wideband Modem (MWM)

- The Multi-Purpose Wideband Modem (MWM) system concept is the basis of SSBV's next generation Earth observation modems and wide band spectrum recording product lines
- Multi-channel wideband (>1 GHz) IF or RF signal capturing from an antenna front-end
- Direct RF sampling techniques with streaming real-time performance (>1 Gbps per channel)
- Semi-finished data products (e.g. image data frames, spectrum frames) on output delivered in real-time
- The service oriented architecture guarantees interoperability with ground station infrastructure and backend application services and processes

MWM reconfigurability



- ... akin *Software Defined Radio (SDR)* concept

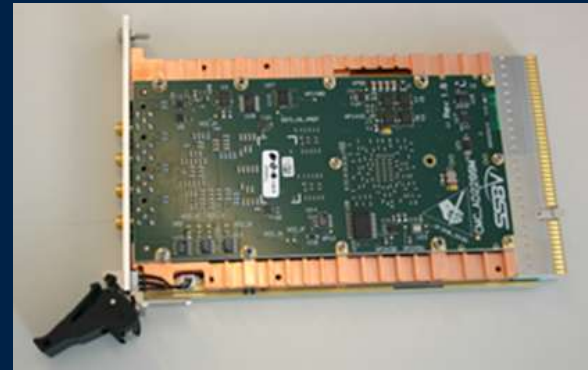
Digital RF receiver modules

MWM system, 4 receiver channels, 1 transmit channel

Channel RF conditioning

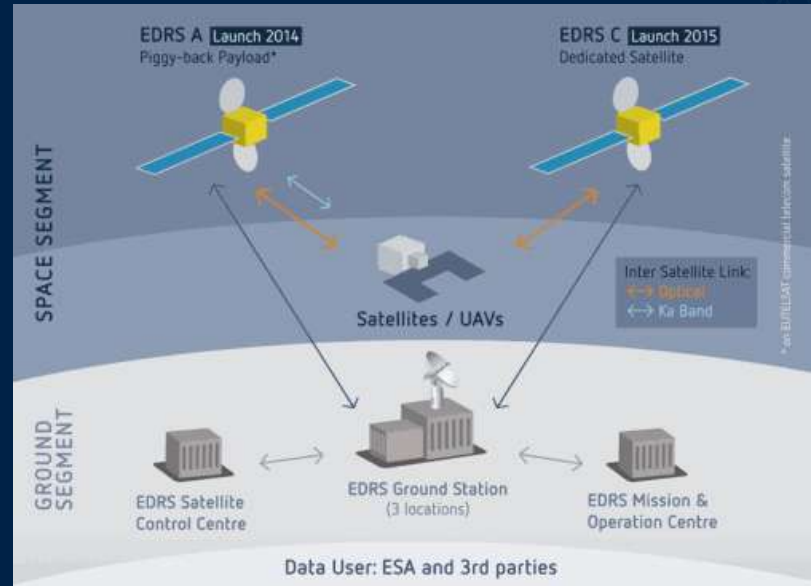
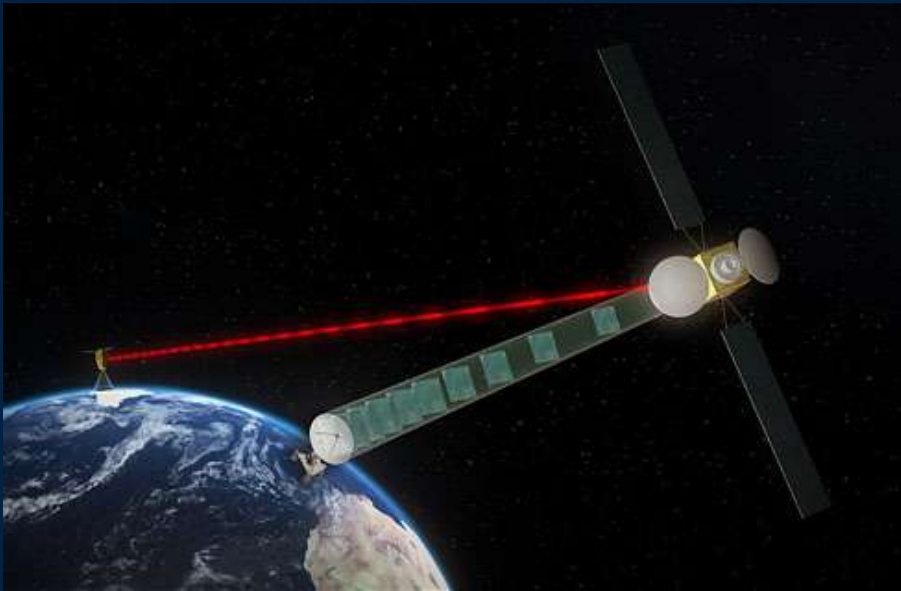


Chanel dig. receiver (2.1GHz),
incl. demod, coding, frame
synch and packetizing



MWM launching customer

- Launching MWM customer is Airbus Defense & Space for the European Data Relay System (EDRS) ground stations
- EDRS are multiple Geostationary (GEO) satellites that provides the means of data relay from Low Earth Orbit (LEO) satellites to earth



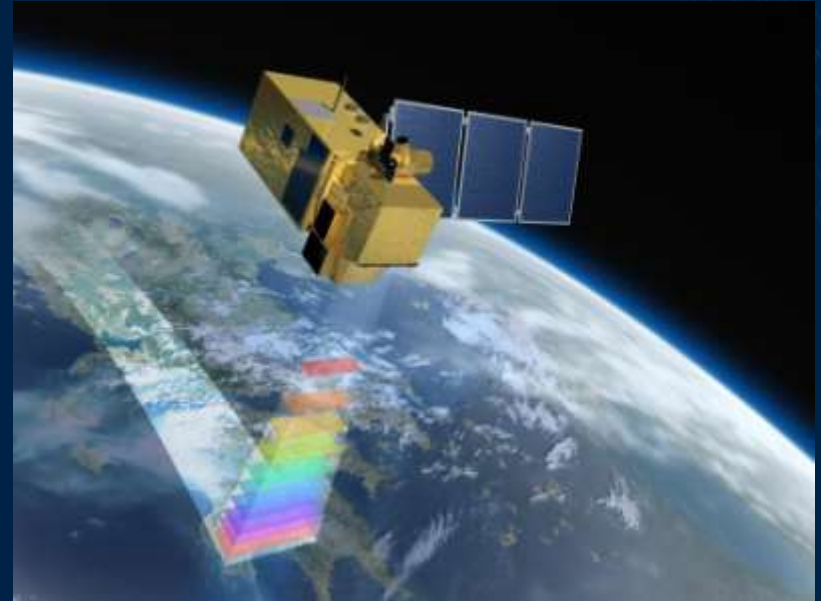
Sentinel-1 and Sentinel-2 satellites

Sentinel-1 - courtesy of ESA



ESA - P. Carril

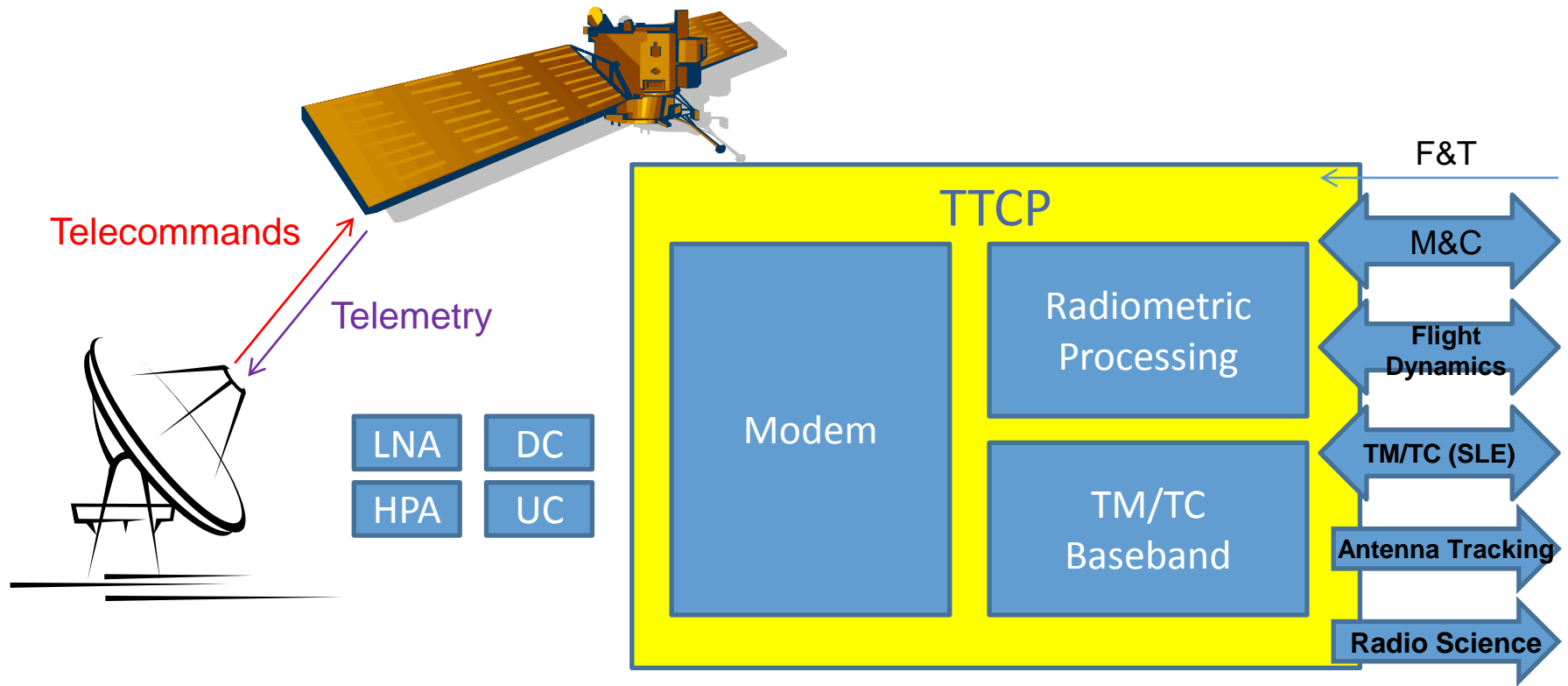
Sentinel-2 - courtesy of ESA



Ground Segment

Deep Space TTC Processor

Tracking, Telemetry & Command (TTC)



TTC Processor background

- TTC Processor (TTCP) is a deep-space TTC modem and baseband processor to meet and exceed performance of ESA's current deep space ground station equipment
- TTCP is being developed by SSBV in consortium with BAE Systems and Makalumedia
- Very sensitive RF front-ends as TTC signals of deep space mission space are deeply hidden in the noise
- TTCP will be delivered to 13 ESA ground stations around the globe as of end 2014



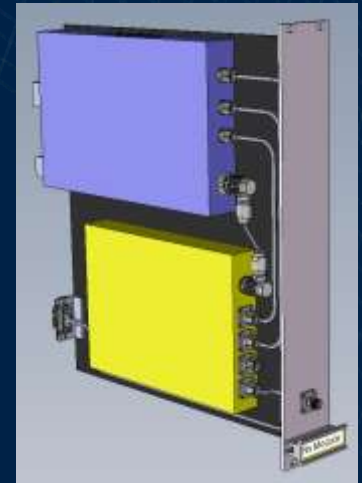
ESA's current
deep space TTC
modem



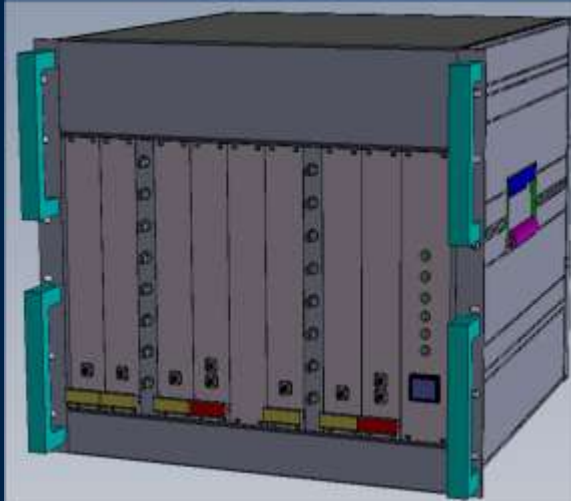
TTCP RF subsystems



RF Switch Matrix



RF Receiver (Rx)
Module prototype



Modem &
Baseband
Processor



Space Segment

PanelSAR Instrument

PanelSAR background

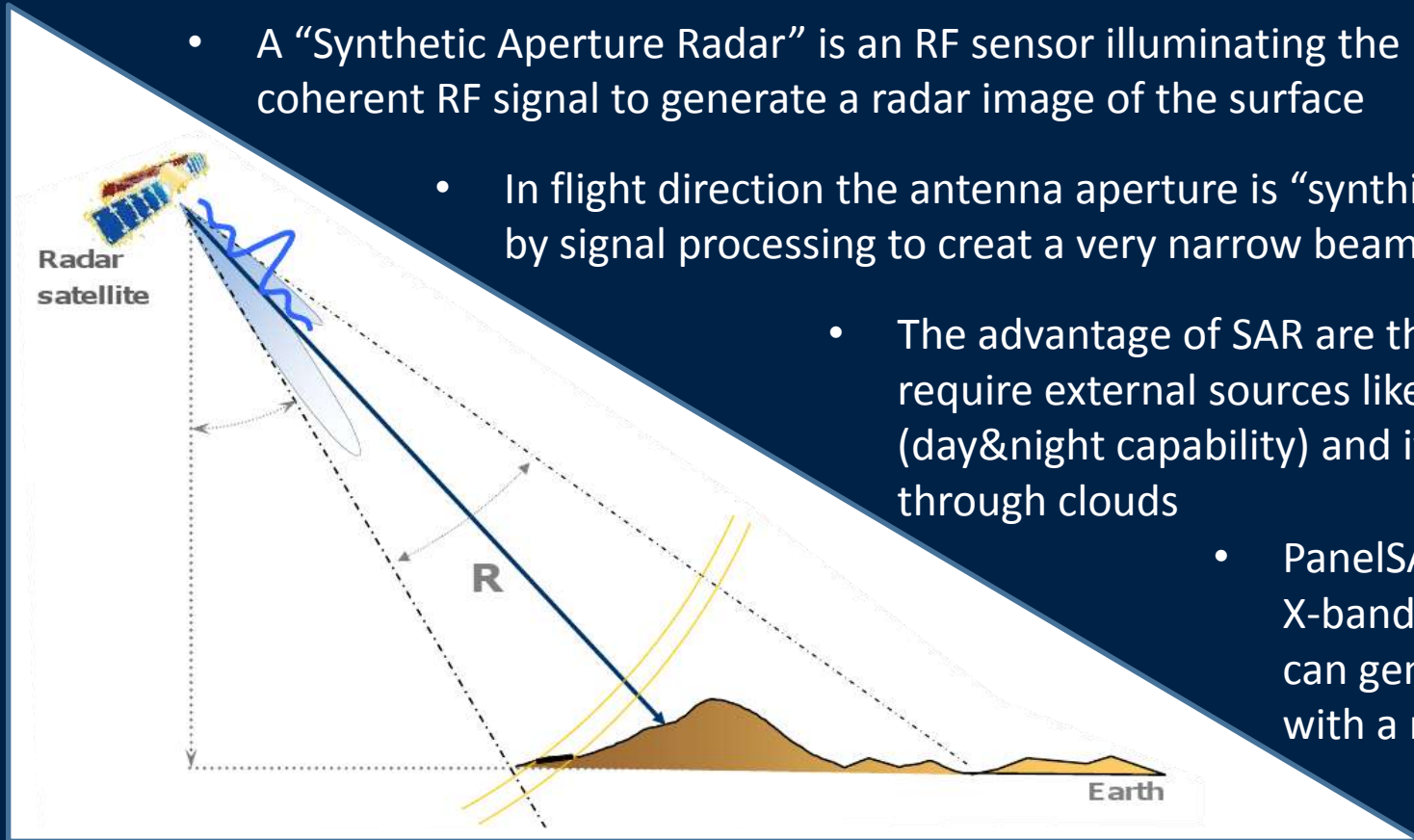
- In 2011, SSBV started R&D activities to design and develop a (commercial) smallsat-capable Synthetic Aperture Radar (SAR) based on experience and technology from the airborne radar domain
- Development phase started this year, funded by the Netherlands Space Office (NSO) and managed under ESA PRODEX office, focusing on the demonstration of the PanelSAR instrument; partnership with NL R&D organisations (TNO, NLR) and (preferred NL) industrial consortium pending
- Expected in-orbit **Flight Demonstration** in 2017 as hosted payload, including full mission concept, instrument operations, data downlinking and processing through SSBV GSN stations

PanelSAR satellite remote sensing



SAR principle

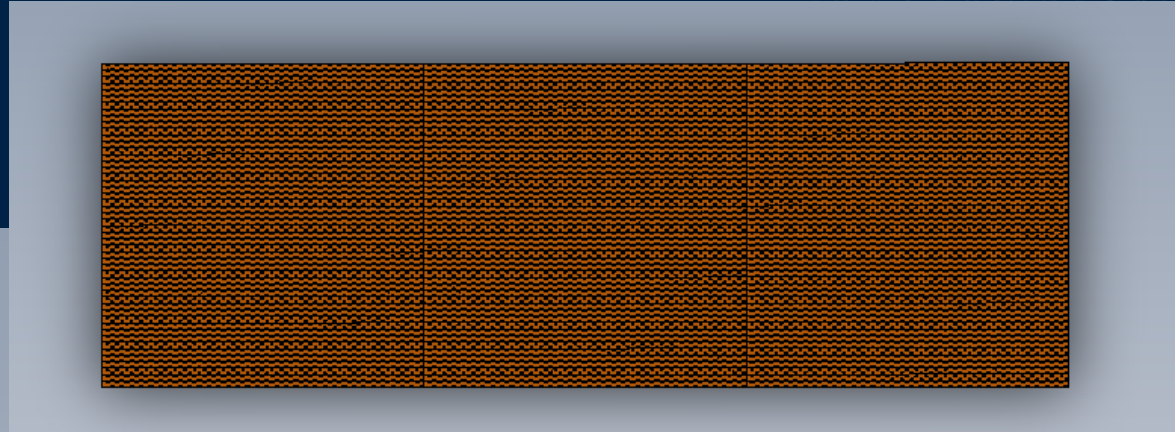
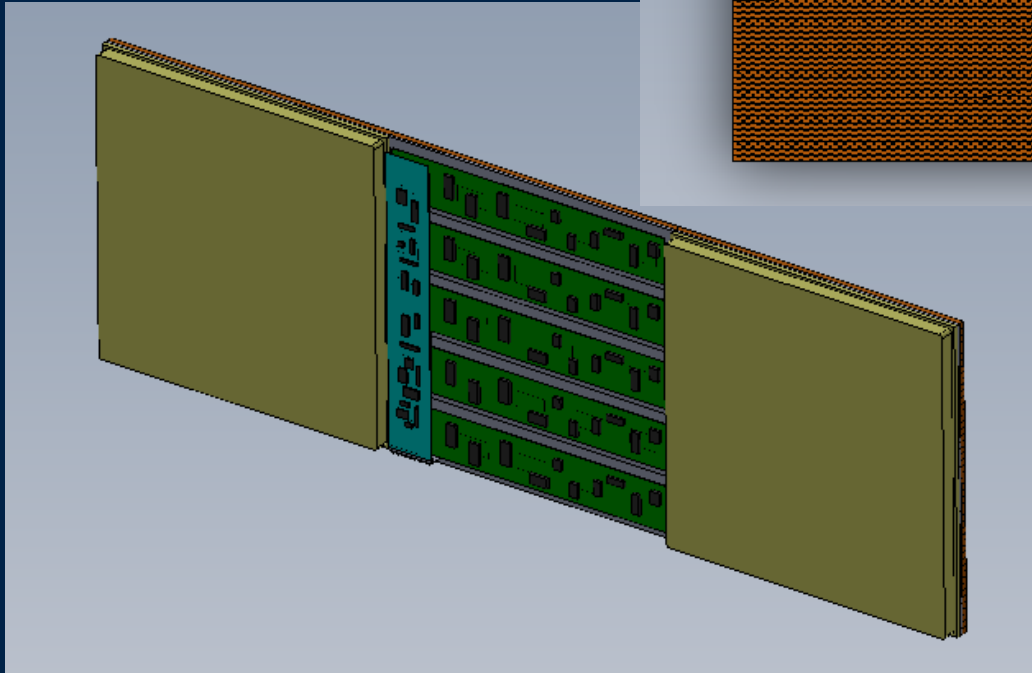
- A “Synthetic Aperture Radar” is an RF sensor illuminating the Earth with a coherent RF signal to generate a radar image of the surface
- In flight direction the antenna aperture is “synthically” generated by signal processing to create a very narrow beam
- The advantage of SAR are that it does not require external sources like optical images (day&night capability) and it can penetrate through clouds
- PanelSAR operates at X-band (9.6 GHz) and can generate images with a resolution of 4m



PanelSAR radar images (simulated)

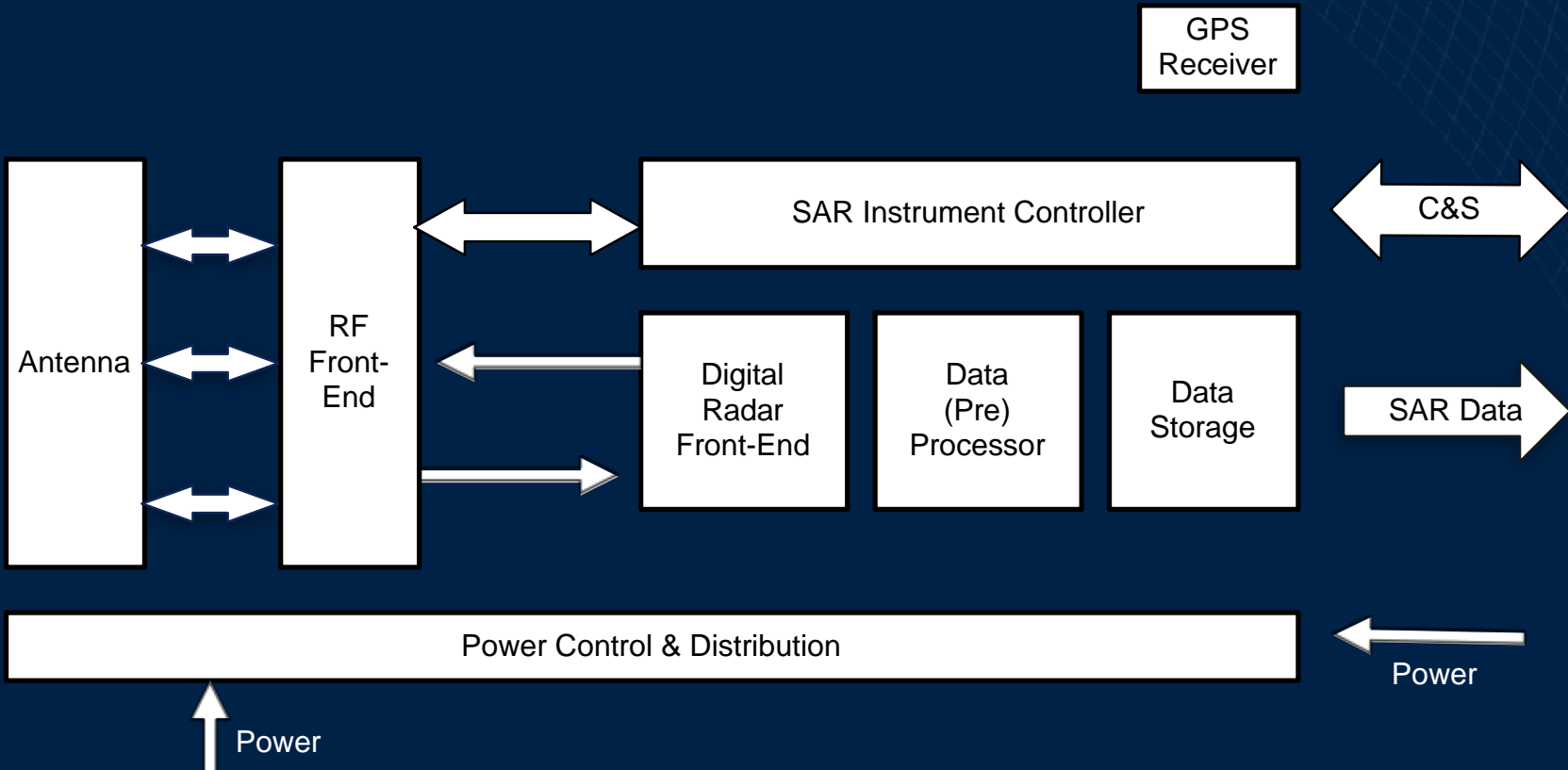


RF antenna 3m x 1m (3 panels)



Each PanelSAR antenna panel
down-convert and digitizes
received RF radar data

PanelSAR high-level block diagram



PanelSAR

A flexible small-satellite SAR Instrument

Innovative Dutch technology for small satellite applications

PanelSAR is based on ESR technology especially developed for space. It features low power and high resolution capability.

An end-end solution from space to ground



The instrument features an active array antenna, digital beam steering and a highly modular design allowing easy tailoring to different missions / platforms.

#WideRangeofApplications

#Imaging

#Interferometry

#AgriculturalMonitoring

#WaterManagement

#FloodDetection

#InfrastructureMonitoring

#IceMonitoring

#OilSpillDetection

#MovingTargetDetection

#LandSlidePrediction

#DikeMonitoring

#LandHeightMonitoring

Operates day and night, through clouds and rain

Conclusive remarks

- SSBV Space & Ground Systems presented its innovative space and ground system solutions with a more than substantial RF system content
- From the ground based activities we have presented the next generation Earth Observation modem and deep space TTC modem
- From the space segment SSBV presented its involvement in the development of instruments and electronics for a new generation of smallsat SAR imaging radar
- RF technology plays a crucial role in the front-ends of all of these space and ground systems

Thank You for your attention

also on behalf of



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