Advanced Data Chain Technologies for the Next Generation of Earth Observation Satellites Supporting On-Board Processing for Rapid Civil Alerts

# ADVANCED DATA CHAIN TECHNOLOGIES FOR THE NEXT GENERATION OF EARTH OBSERVATION SATELLITES SUPPORTING ON-BOARD PROCESSING FOR RAPID CIVIL ALERTS

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E-poster


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# Importance of Latency in Satellite based Remote Sensing

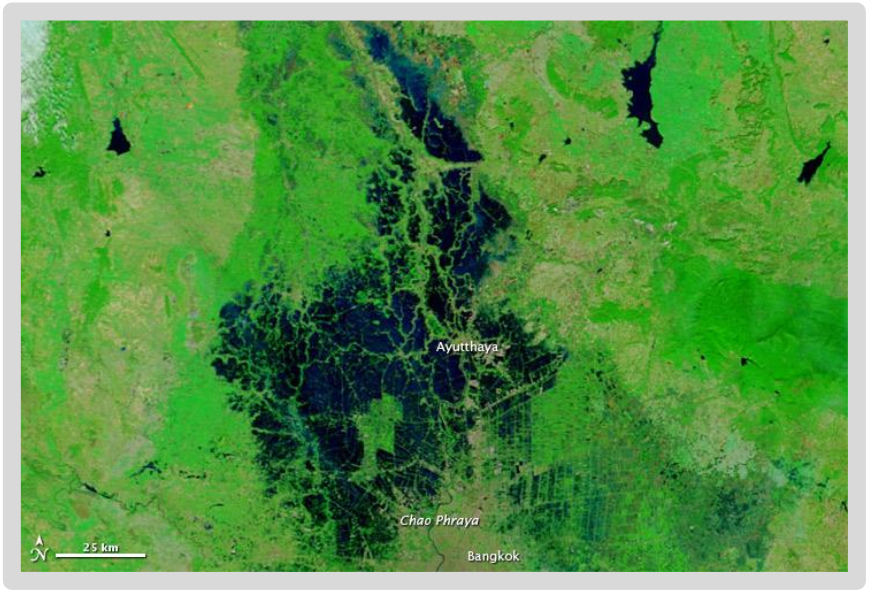
**System Responsiveness** is a driver for time-critical EO services (e.g. disasters, emergency response, forecasting, financial, security), both for NRT and real-time services

As part of this responsiveness, **EO Product latency** is an important contributor

e.g. current latencies of civil emergency products are between 20 minutes and several hours

Improved systems are required

Timely Earth Observation Products Can SAVE LIVES & PROPERTY




**2011 Floods**, (Ayutthata, Thailand) "**NASA Space Data Can Cut Disaster Response Times, Costs**", NASA, 2019

Credits: LANCE/EOSDIS MODIS Rapid Response Team, NASA's Goddard Space Flight Center

# EO-ALERT H2020 Project: Solution for Very Low Latency Products

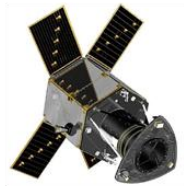
**Goal**: to address the need for increased data chain throughput and real-time products

- Develop a new approach for the provision of very low latency Earth Observation (EO) data products, exploiting the flight segment processing capabilities

**Latency goal of 1 minute**

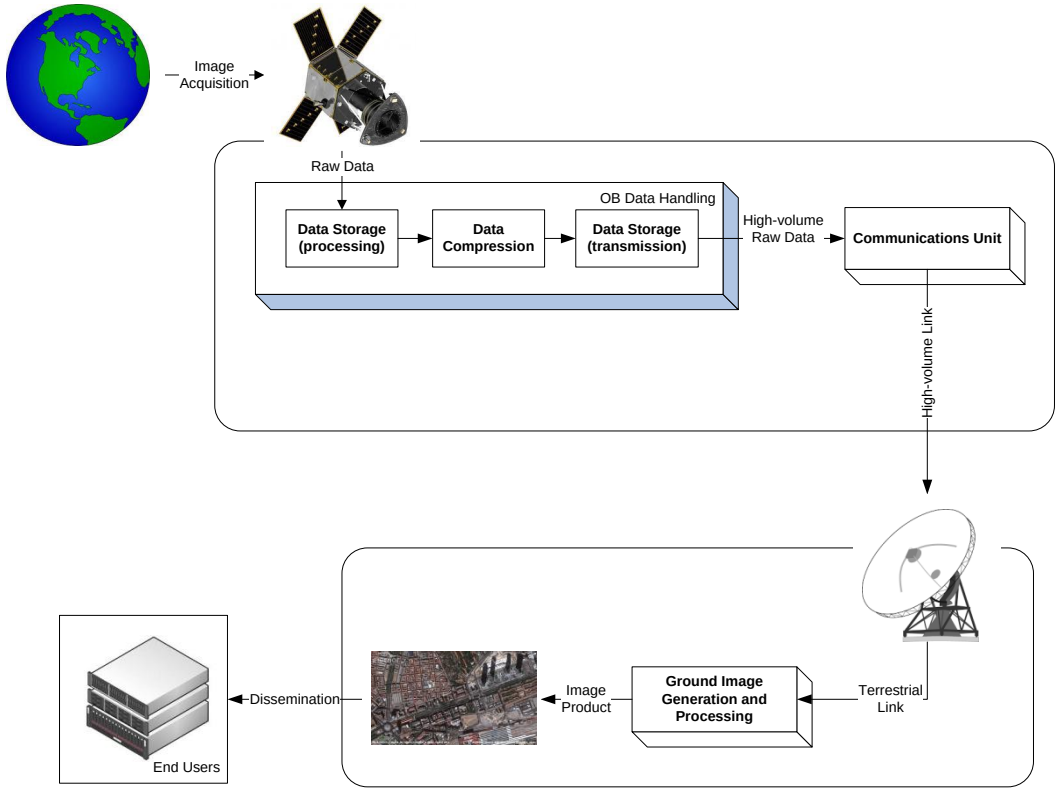
**Idea**: focus on the EO product and what is needed with very low latency

- Move key EO data processing elements from the ground segment to the satellite
- Prove this for various EO instruments
  - TerraSAR-X (SAR) VHR satellite
  - DEIMOS-2 (OPT VIS/NIR) VHR satellite
  - MSG SEVIRI (Multi-spectral VIS/TIR)
- Test in two scenarios: ship detection/classification and extreme weather detection/tracking



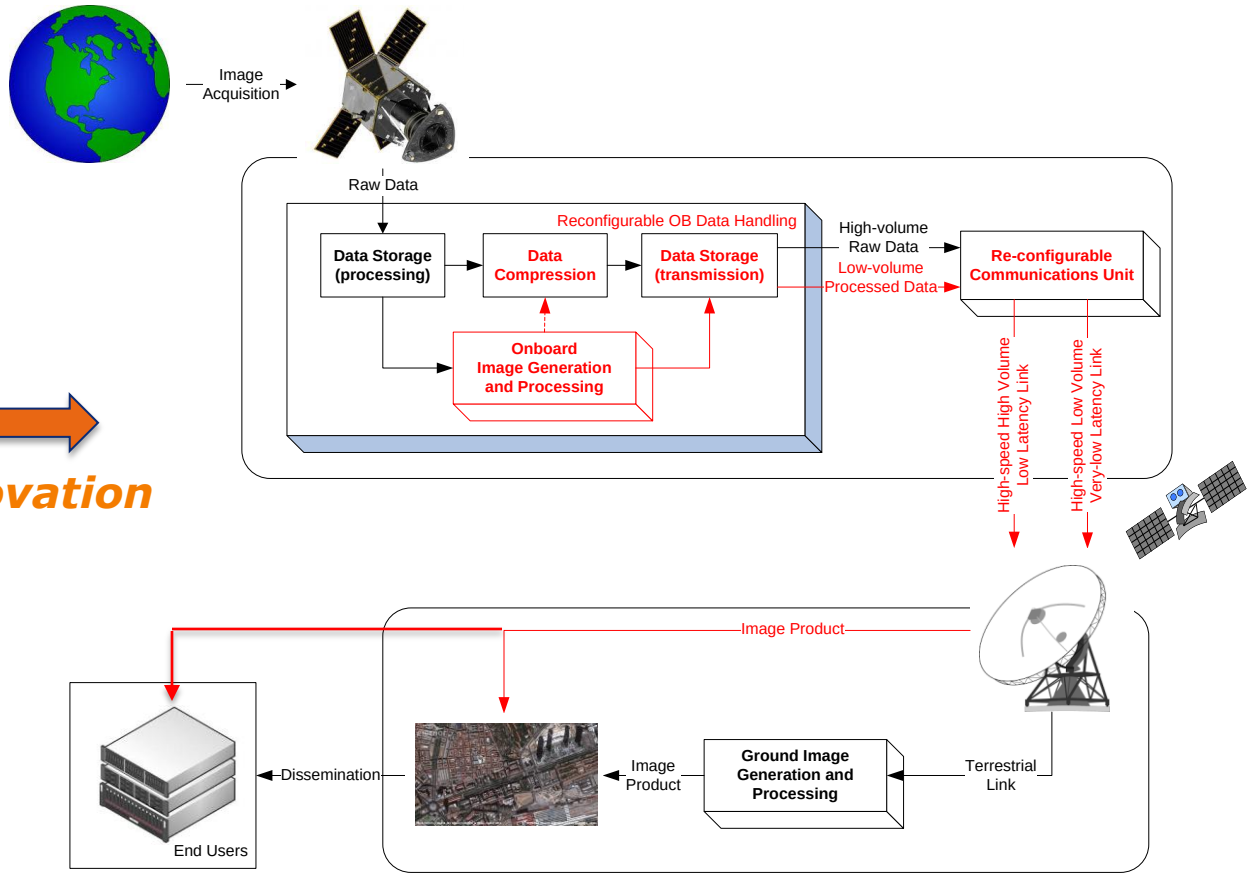
# EO-ALERT Project Innovation

## Classical EO Data Chain




Innovation

## "New" EO Data Chain

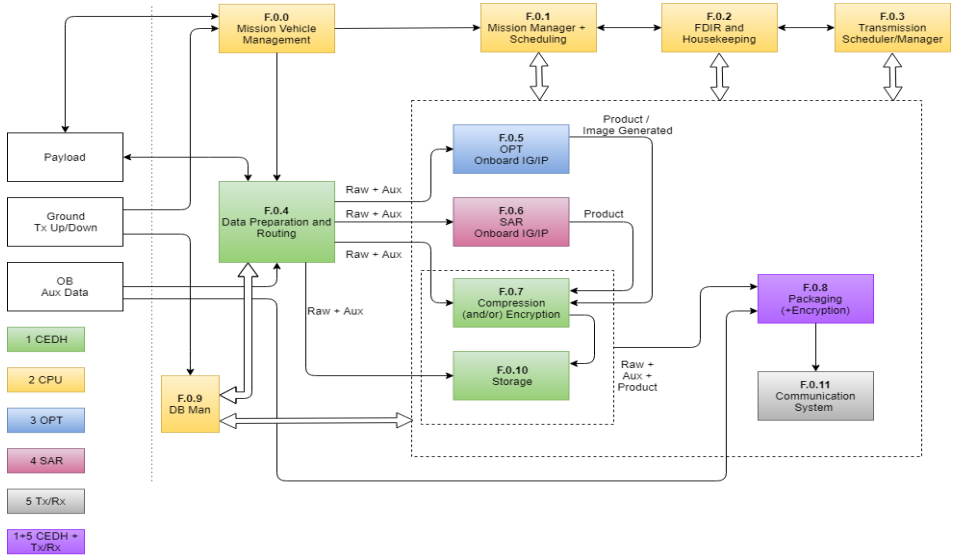


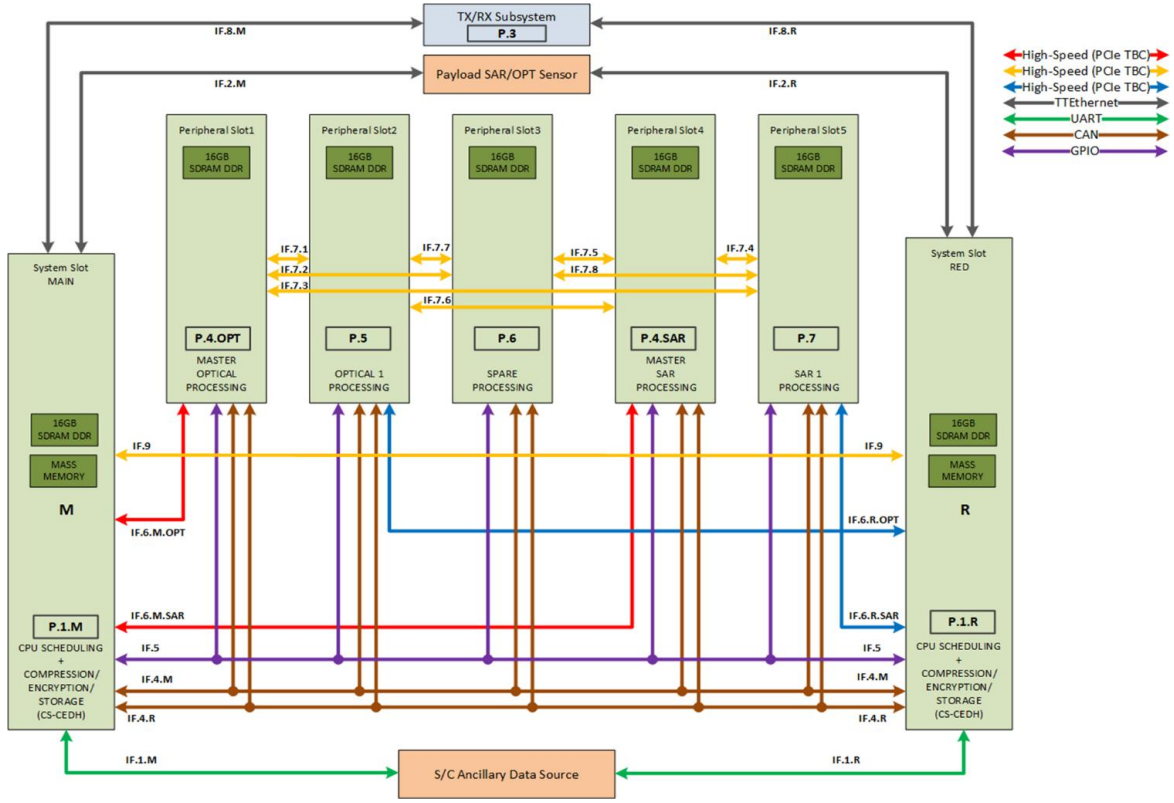
# EO-ALERT Project Results
# Functional & Physical Architecture

New C&DH architecture provides for on-board **data prioritisation** and **global real-time EO product/information generation and delivery**

Uses global communications relay

TRL 4/5 in 2020/2021 with Avionics Test Bench (ATB) testing



# EO-ALERT Project Results
# Latency from current HW testing

## Current Product Latencies

- Example of EMSA Vessel Detection Service (VDS)-like products
  - ship detection, classification, positioning
- HW tested (OBC & FPGA)
- TSX and DEIMOS-2 payload data

### On-board SAR product tested

- L1B & VDS
- TSX StripMap mode
- ~ 4m resolution; 30 km swath

### On-board Optical product tested

- L1B & VDS
- DEIMOS-2 PAN
- ~ 0.9m resolution; 10km swath

**SAR** (TerraSAR-X)

- ~ 35 seconds for SAR image and ship product generation on-board
- ~ 35 seconds for global FS-GS comms
- **~ 70 seconds** for E2E global delivery

**OPTICAL** (DEIMOS-2)

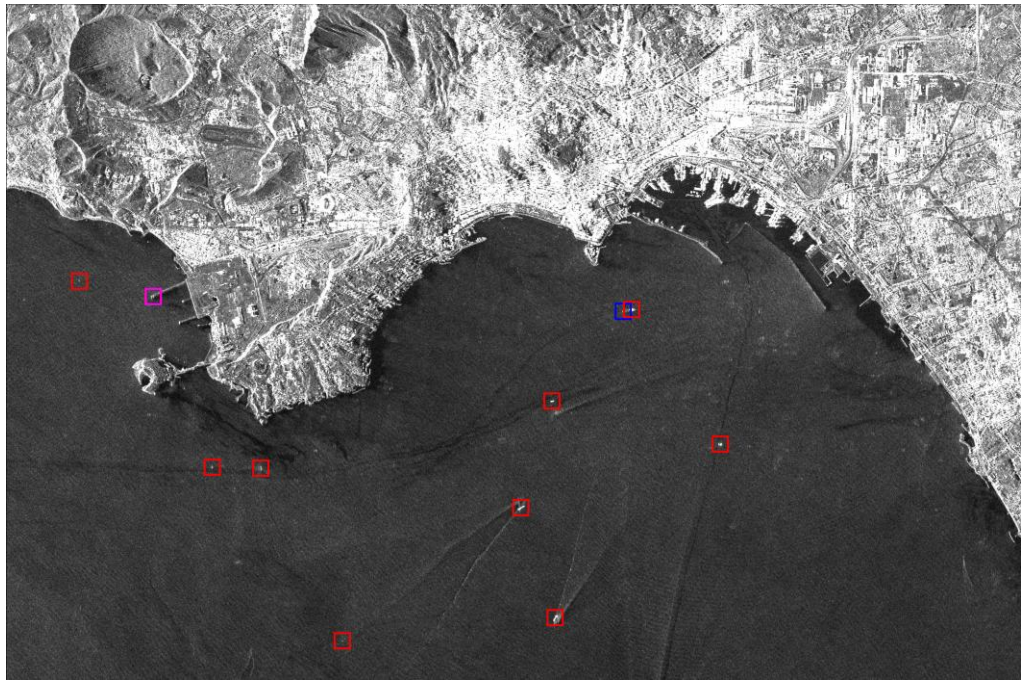
- ~ 20 to 40 seconds for OPT image and ship product generation on-board
- ~ 35 seconds for global FS-GS comms
- **~ 55 to 75 seconds** for E2E global delivery

✓ **Goal of 1 minute E2E product generation and delivery**

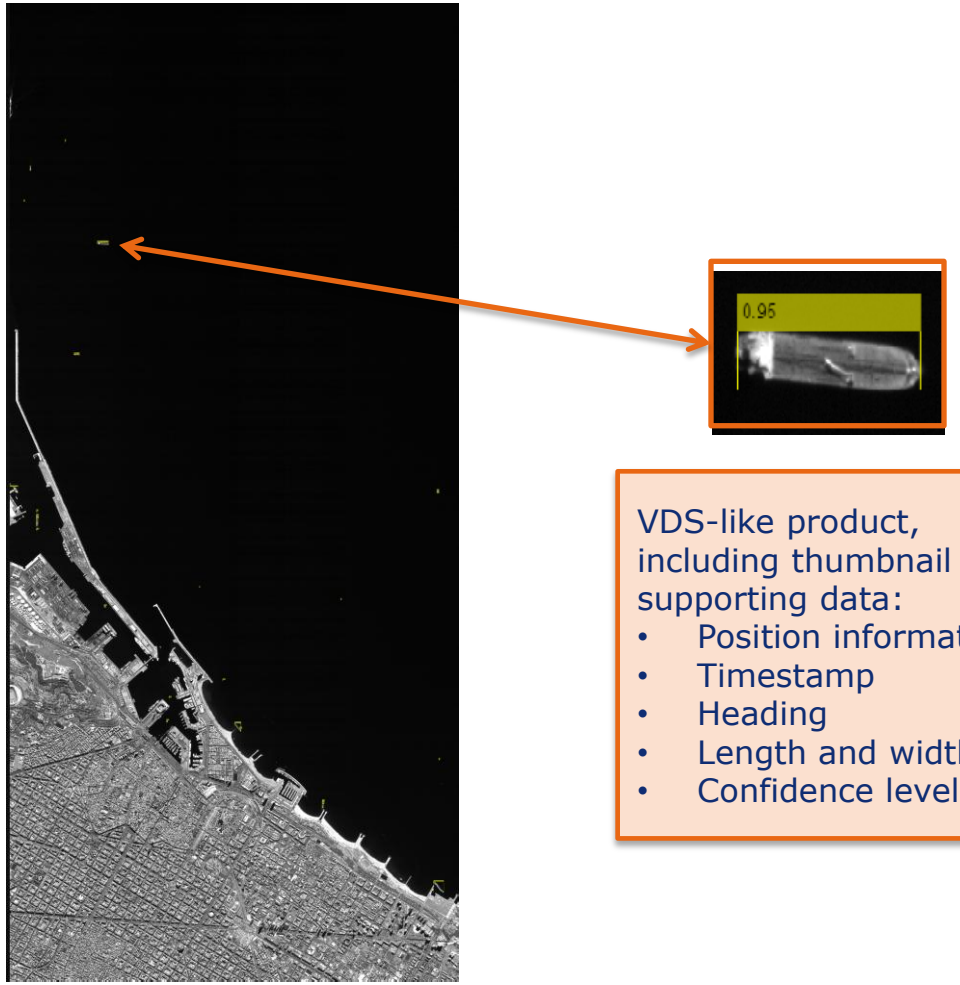
# EO-ALERT Project Results
# Ship Detection

## EMSA VDS-Like Product

### TSX Example Case



### DEIMOS-2 Example Case

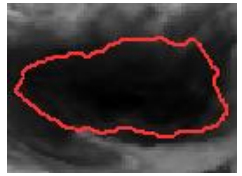



VDS-like product, including thumbnail and supporting data:

- Position information
- Timestamp
- Heading
- Length and width
- Confidence level

# EO-ALERT Project Results
# Extreme Weather Detection (Nowcasting)

## EUMETSAT Rapidly Developing Thunderstorm (RDT)-Like Product



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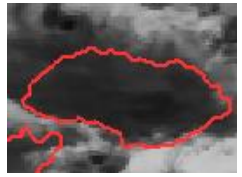
LAT 31.196908
LON 29.622436

Min Temp. -35.4
Max Temp. -24.9
…

ID 2
LAT 31.182698
LON 29.555137

Min Temp. -31.1
Max Temp. -25.3
…



ID 3
LAT 31.186459
LON 29.566574

Min Temp. -38.2
Max Temp. -25.3
…

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**The consortium is open to joint exploitation of these technologies in future EO missions**