



# CRAFT PROSPECT

A Space Engineering Company

# Autonomy Assurance for Small Satellite EO Missions

**bright**  
ascension

**MANCHESTER**  
1824  
The University of Manchester

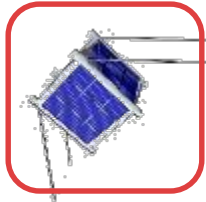
24<sup>th</sup> June 2020 Steve Greenland  
Commercial-in-Confidence

Centre for  
EO Instrumentation





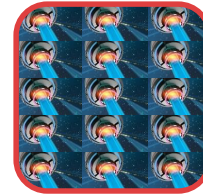
# Craft Prospect Today



Mission & System Engineering



Enabling Technologies & Services



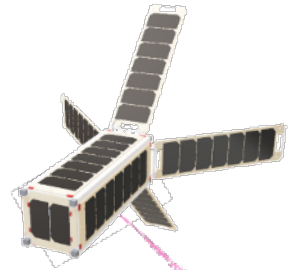
Novel Mission Applications

MISSION ARCHITECTURE

RESPONSIVE OPERATIONS



Products  
e.g. Forwards Looking Imager



QUANTUM-SECURED SERVICES

Revenue

Enables

Throughout all investing in the development of systems engineering and processes



Craft Prospect Delivers

**Smart Secure Space**



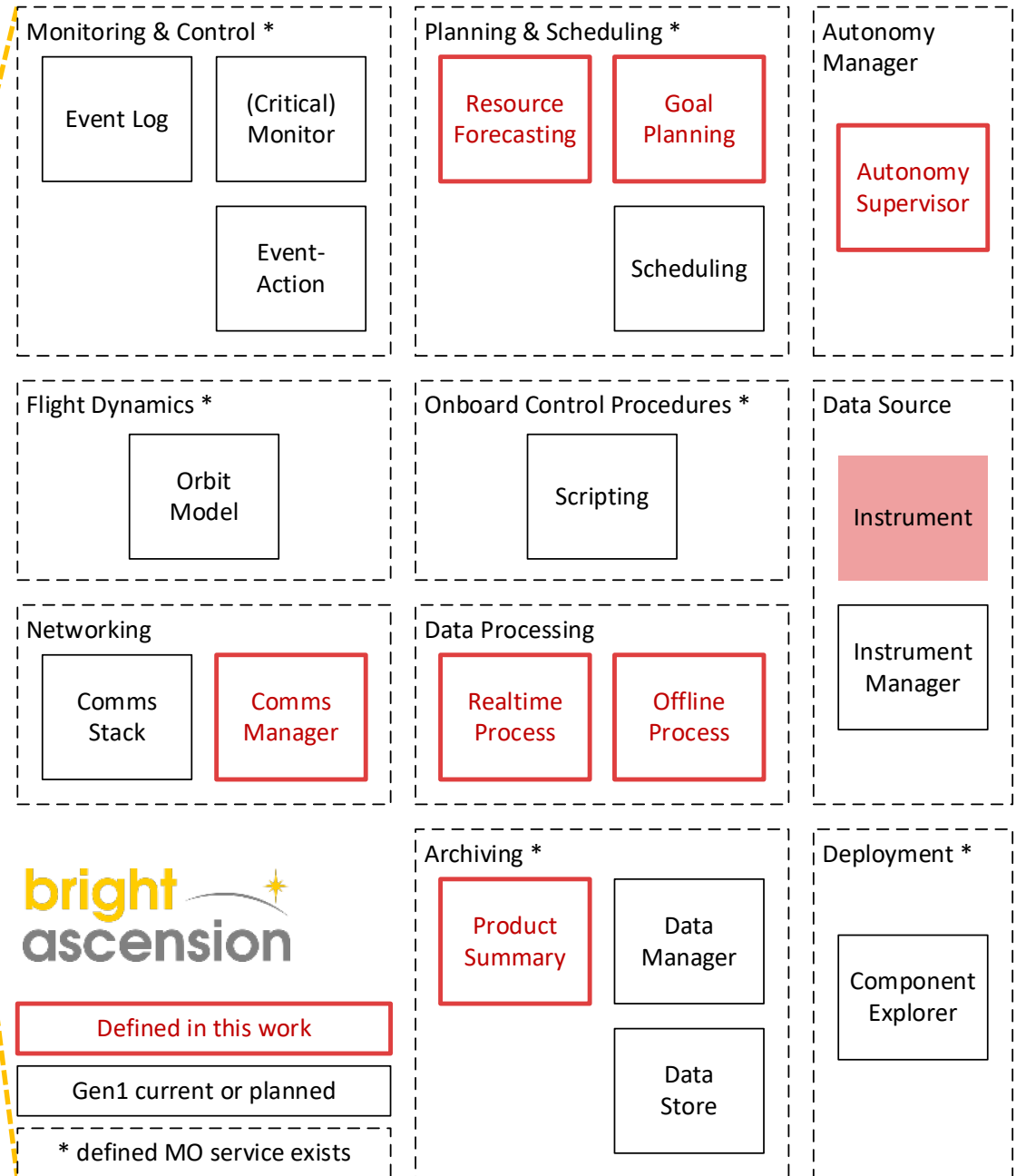
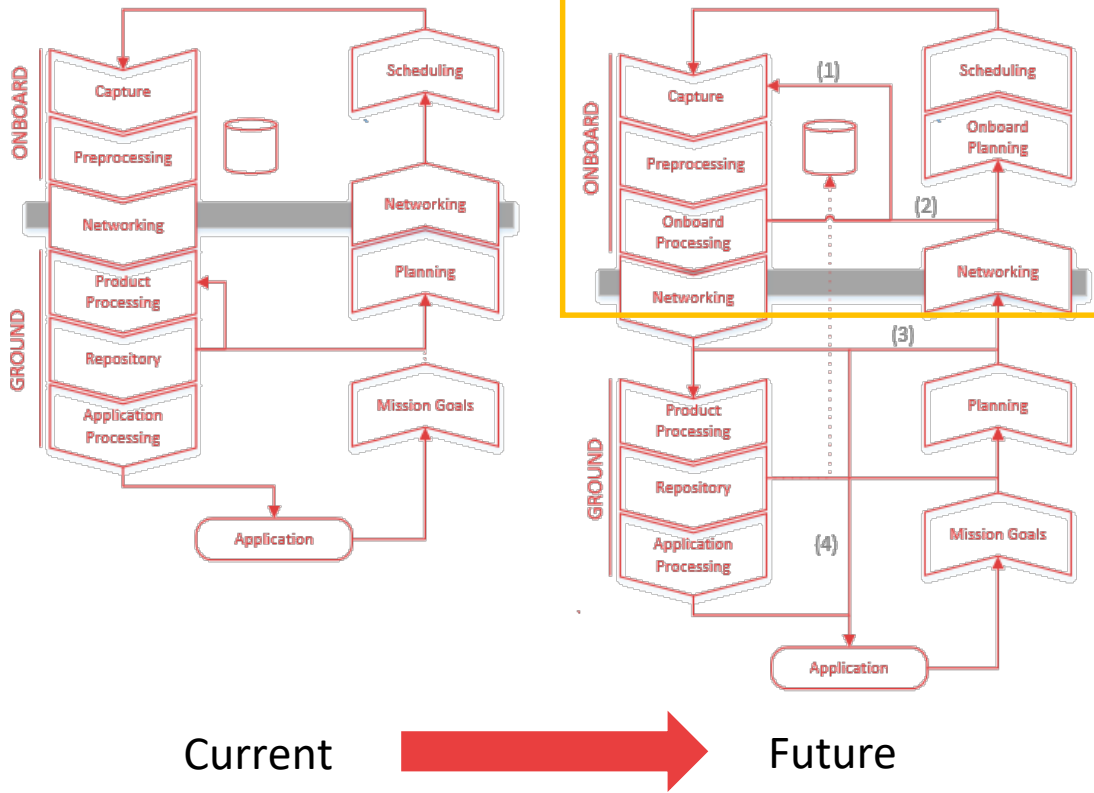
# Autonomy Assurance

- **Aim:**
  - Deliver prototype solutions, from TRL 2 to TRL 4, which satisfy end user requirements for assuring onboard autonomy in small and nanosatellite EO missions
- **Outputs:**
  - Autonomy components implemented and tested in flight heritage spacecraft software
  - System-in-loop prototypes for use cases
  - Components flight-tested on drones
  - End user data packs, providing assured autonomy for an application





# Background

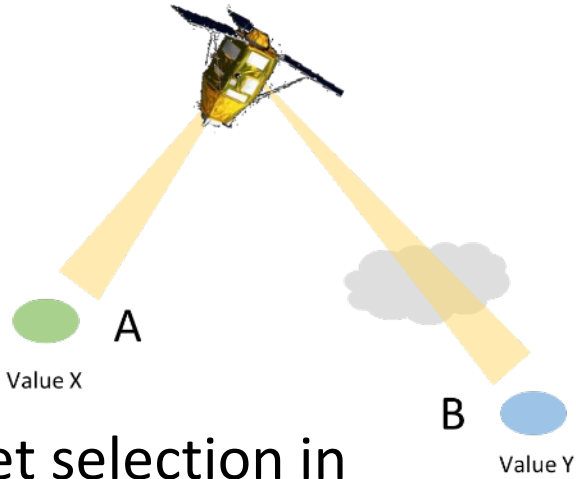
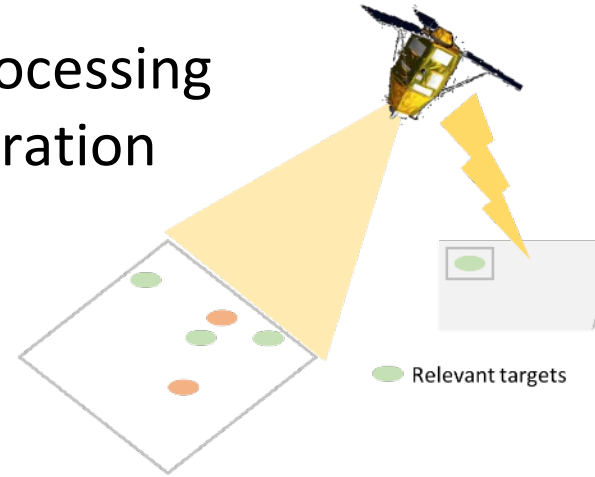






# Use Cases

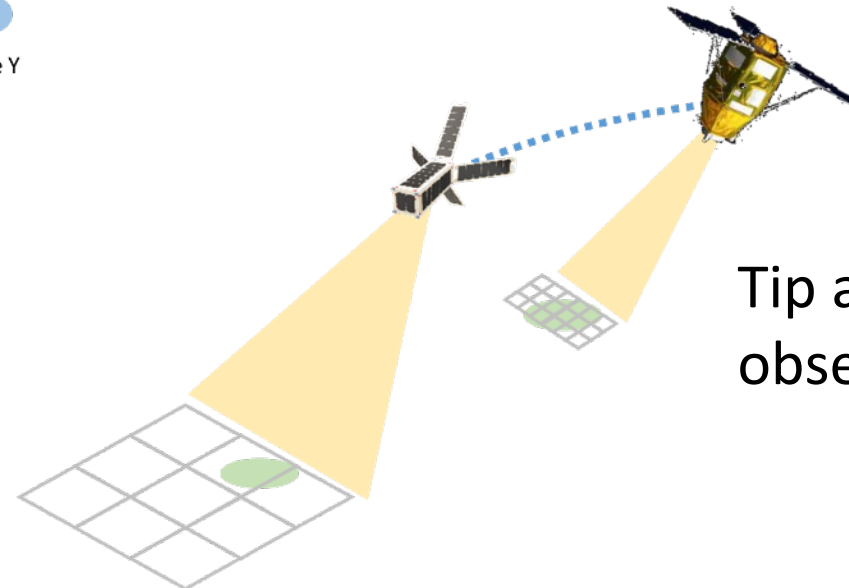
On-board data processing and product generation



Target selection in target-rich areas



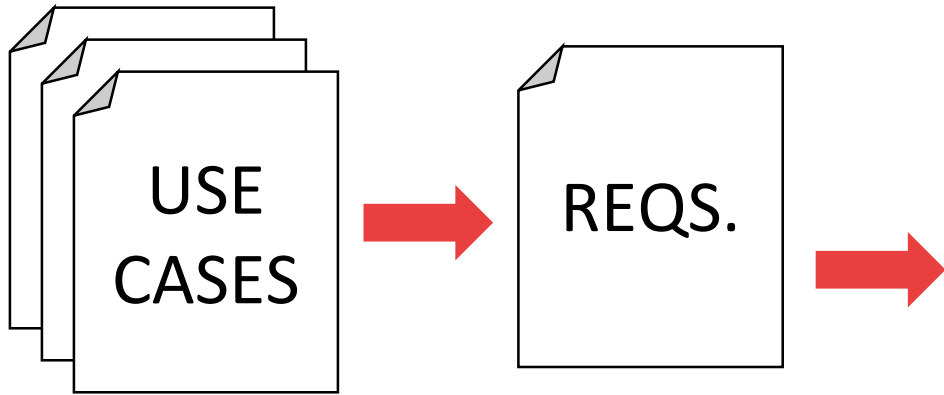
**What runtime and offline assurance processes are needed for each use case to facilitate adoption?**



Tip and cue within observation constellations

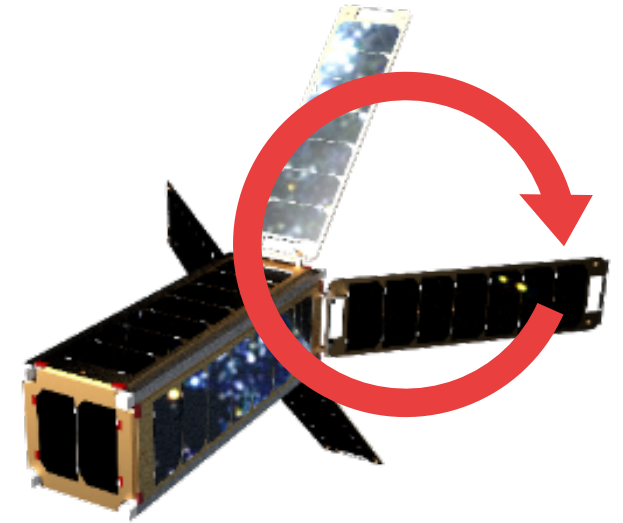


# Approach



## Flight testing

- Real-time autonomy
- Closed-loop control

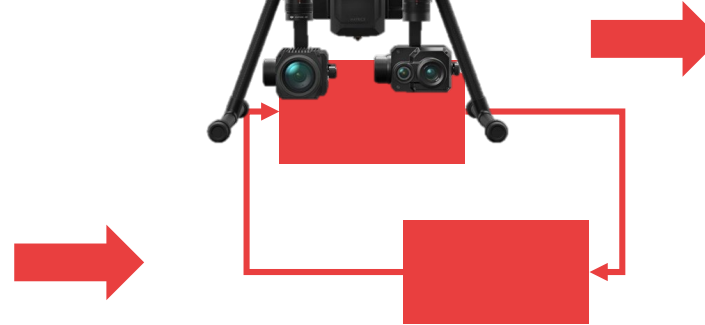
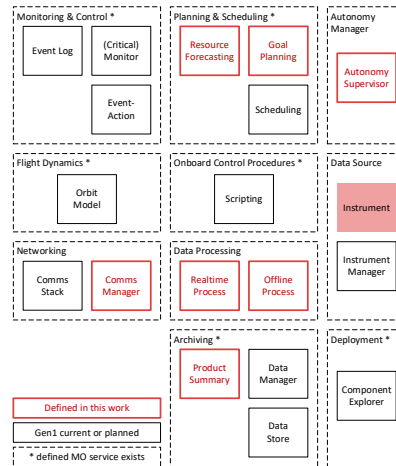
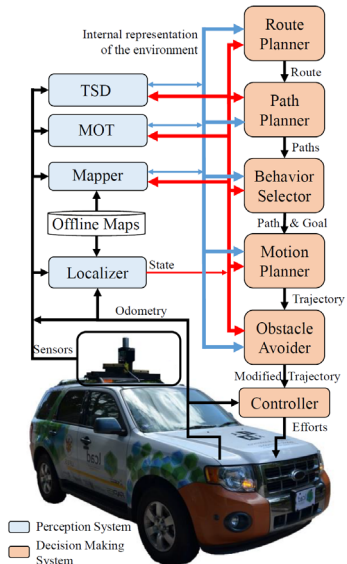


## In-orbit demonstration

- Flight/sim-tested components
- BAL SW
- Continuous testing + quality assessment
- In-orbit updates
- ROKS, Φ-Sat 1

## SIL simulation

- Bright Ascension SW
- Space-ready components
- Simulated environment







# Real-time Night-time Cloud Detection

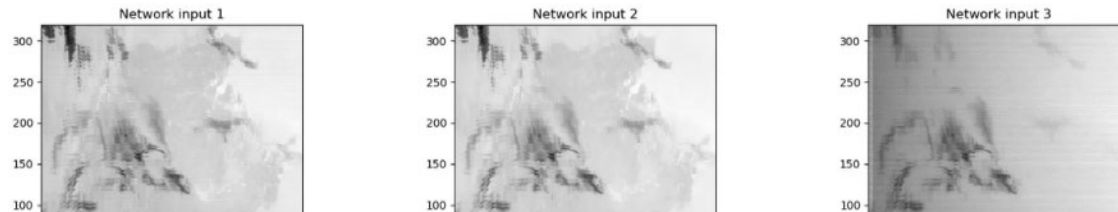
- **Aim:**
  - Develop prototype of algorithm ready for onboarding on demonstrator mission
- **Challenges**
  - Synthesise a representative dataset based on alternate image sources for the sensor flown
  - Transfer learning from existing algorithms and optimisation with the onboard processing capability
- **Outputs:**
  - Feasibility of in-orbit night-time cloud detection demonstrated
  - Demonstrated accuracy > 97% with Myriad-2 chip in the loop
  - Engagements with Cosine and ESA for in-orbit demonstrations





# Results

- 150,000 unique training images
- 15,000 unique testing images
- Accuracy >97%

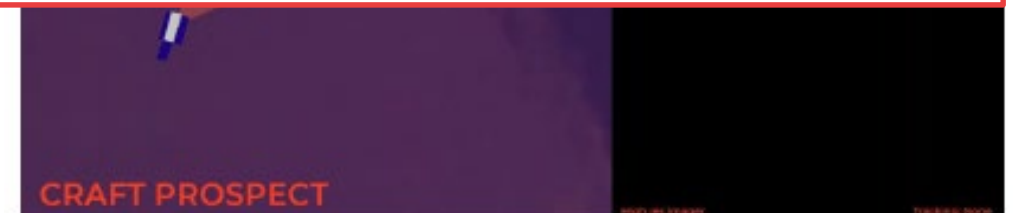
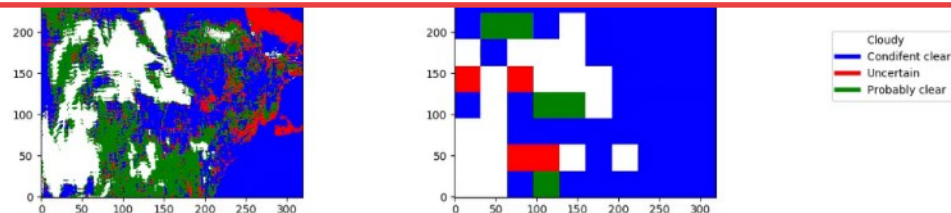


Network 3	Actual Confident clear	Actual Cloudy
Predicted Confident clear	9.6%	1.2%
Predicted Cloudy	1.6%	87.6%

97.2% accuracy  
9MB network  
68 imgs/s



## Next stop: Deployment in Space!





# What is next for us?

- Completing assurance project in Q3 2020
- In-orbit demonstrations of our work
- Flying our own in-orbit demonstrator ROKS combining quantum and AI/ML technology
- Bidding with consortium on major commercial contracts using onboard AI/ML
- Engaged with small satellite primes on integration with existing image, video and RF sensors
- ESA future looking contract: **Future Onboard Processing and Information Extraction Architectures**
  - Stakeholder Survey and Workshops Planned
  - If you want to participate and be included on the list of companies in this area, get in touch
  - [murray@craftprospect.com](mailto:murray@craftprospect.com)



University College Dublin

# Smart Secure Space

## With thanks to CEO!



[steve@craftprospect.com](mailto:steve@craftprospect.com)



[www.craftprospect.com](http://www.craftprospect.com)



[@craftprospect](https://twitter.com/craftprospect)

