UNDERSTANDING OUR PLANET USING AIRLINER FLEETS
NEED FOR DATA AND TELECOM SERVICES
CURRENT AND PROPOSED SOLUTIONS AND ISSUES

SATLLITES

- Manufacturing, launch & operational costs

ALTERNATIVE PLATFORMS

- Capital intensive, local/regional coverage, regulatory issues

REGULATORY ISSUES FACED DUE TO VERY BUSY AIRSPACE

SKYFLOX.EU

Ref. SFX-00-02-141118-Phi-week
NOV 2018
INACCESSIBLE AIRSPACE FOR HAPS/DRONES
MORE THAN 30,000 FLIGHTS PER DAY OVER EUROPE
SOLUTION: CREATE CONSTELLATIONS USING AIRPLANES
RE-USING THE MOST RELIABLE PLATFORM: CIVIL AIRCRAFT

ORCA
OPTICAL AND RF CONSTELLATIONS ON AIRCRAFT

HIGH REVISIT
MULTIPLE TIMES /DAY

HIGH RESOLUTION
<1 METER

EXCELLENT COVERAGE

PAYLOAD SERVICEABILITY
AND UPGRADING

LOW CAPEX & OPERATIONAL COST
ESA SUPPORTS ORCA VIA PROJECT DOCS – ‘DEMONSTRATION OF ORCA CONSTELLATION SERVICES’

PHASE 1: EVALUATE ORCA TECHNICAL, BUSINESS, AND LEGAL ASPECTS OF ORCA

<table>
<thead>
<tr>
<th>Prime Contractor</th>
<th>Airliner</th>
<th>Aircraft Certification</th>
<th>EO Marketing / Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skyflox</td>
<td>TUlfly</td>
<td>adxc</td>
<td>SIGMA GEOTECHNOLOGIE</td>
</tr>
<tr>
<td>Coordination, system architecture and design, simulations, business analysis, IPR</td>
<td>Provision of technical requirements, logistics, and access to fleet</td>
<td>Payload design, certification, and installations on aircraft</td>
<td>Customer identification and contacts, market entry strategy, multi sensor data marketing</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Data Analysis</th>
<th>Connectivity</th>
<th>Legal / Regulatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>vito</td>
<td>TNO</td>
<td>Dr. Mendes de Leon</td>
</tr>
<tr>
<td>Earth observation expertise, data processing infrastructure &amp; algorithms</td>
<td>Evaluate various real-time and non-real-time connectivity options</td>
<td>Evaluate national and EU regulatory and legal issues</td>
</tr>
</tbody>
</table>
DOCS OUTLINE ARCHITECTURE

NEAR-REAL-TIME
- Airport Connectivity

REAL-TIME
- Terrestrial network
- Satellite network
European coverage by B737-800 of TUI and Ryanair Fleet in timeframe 07-19 hours
Barcelona coverage by B737-800 of TUI and Ryanair Fleet

09:00-11:00
Near Nadir passes over city (best resolution): 23

11:00-13:00
Near Nadir passes over city (best resolution): 17

13:00-15:00
Near Nadir passes over city (best resolution): 22

15:00-17:00
Near Nadir passes over city (best resolution): 22

Simulations made with EUROCONTROL data under NDA
COVERAGE POTENTIAL
ATMOSPHERIC SENSOR COVERAGE SIMULATION EXAMPLES

Coverage by TUI Fleet B737-800s in timeframe 07-19 hours with FOV 140

DAYTIME coverage of single aircraft fleet and type (TUI Group)
FLIGHT TEST CAMPAIGN
TELECOMMUNICATIONS

- Performed with TNO – Connectivity Sub-Contractor
- Collaboration with Mobile Network Operators (T-Mobile, Tele-2)
- Validating simulations model for in-flight connectivity (with terrestrial mobile network)
- LTE tests on tarmac at Rotterdam International Airport for ground connectivity evaluations

TELCO PAYLOAD MOUNTED ON WING

FLIGHT PATH
FLIGHT TEST CAMPAIGN
EARTH OBSERVATION

- Performed with VITO – Remote Sensing Partner
- Main purpose to evaluate optical and thermal imaging with low-cost COTS equipment
- Evaluate processing and fusion of thermal/optical data
- Images co-registered and time-position-orientation tagged via GNSS /INS

EO PAYLOAD MOUNTED ON WING FLIGHT PATH
FLIGHT TEST CAMPAIGN PRODUCT EXAMPLE
EO PRODUCT: FUSED DSM - THERMAL AND VECTOR-BASED INFORMATION
PAYLOAD DESIGN AND INSTALLATION

PAYLOAD MOUNTED ON LOWER AFT FUSELAGE OF 737-800

NOTE: Design and placement of payload are the result of extensive evaluations (payload performance & certification related trade-offs) - performed by SkyfloX & Aircraft Design and Certification Ltd., in close cooperation with TUI fly The Netherlands. *Payload is baselined to be placed next to tail skid structure of aircraft (which is not part of the orca payload itself)
PERFORMANCE & APPLICATIONS
ORCA CAN SERVE MANY APPLICATIONS WITH HIGH PERFORMANCE

FLIGHT TEST CAMPAIGN, COVERAGE EVALUATIONS, AND DESIGN CONCLUSIONS
The performed work indicates that the following performance characteristics (USPs) can be realised, which prove ORCA can serve a multitude of applications (some of which are displayed below)

APPLICATIONS IN EARTH OBSERVATION*

- INSURANCE / INFRASTRUCTURE MONITORING
- RESOURCE MONITORING
- MARITIME APPLICATIONS
- DISASTER RELIEF

TELECOMMUNICATIONS*

- INTERNET OF THINGS
- AUTOMATIC IDENTIFICATION SYSTEM

*Other applications may include forest fire detection, precision farming, forestry, solar forecasting, asset tracking, meteorological, insurance, etc

** Covering 90% of the populated areas of the globe (EU, USA, SE Asia, …)

Combination of EO and Telecommunication services (e.g. EO+AIS) may open new services / markets
PILOT ACTIVITIES AND DEPLOYMENT ROADMAP

- Imaging payload/services baselined for first pilot
- Interest in deploying atmospheric sensors (pending budget availability)
Fully in line with the Space 4.0 vision, integrating multiple layers of resources
PILOT APPLICATION EXAMPLE: HIGH RESOLUTION IMAGING
WITH 5 TUI FLY 737 AIRCRAFT ONLY – COURSE OF 1 WEEK

LARGEST 4 PORTS EUROPE:
1. ROTTERDAM
2. ANTWERP
3. HAMBURG
4. AMSTERDAM

ACCOUNT FOR ±40% OF ALL EU CARGO

ROTTERDAM REVISITS: 55
ANTWERP REVISITS: 32
AMSTERDAM REVISITS: 101