Hybrid, Converged & Unified

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Head of Ubiquitous Connectivity

CATAPULT Satellite Applications

We work with Innovate UK

Agenda

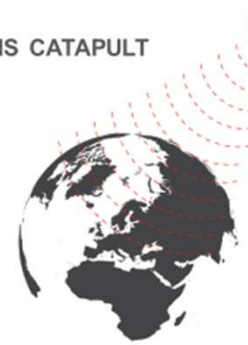
- Brief SA Catapult Intro
- Challenges and Opportunities
- Hybrid and Converged
- Unification

CATAPULT
Satellite Applications

Catapult Open

SATELLITE APPLICATIONS CATAPULT

Who are we?



An innovation and technology company transforming the way the world uses satellite technology and data.

WE HELP ORGANISATIONS GROW THEIR BUSINESS

We help organisations to use satellite applications to grow their business in the UK and internationally.

WE ARE INDEPENDENT

We bring together industry, researchers, end-users and government to explore and develop new ideas.

WE ARE GOVERNMENT BACKED

We are partly-funded by the Government and work closely with the government, space agency, innovation network and other public bodies.

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OUR MARKET FOCUS

ENERGISE | EMPOWER | ENABLE

Our strategy is to accelerate the growth of the satellite applications sector, by focusing on three themes across targeted markets.

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OUR TECHNOLOGY FOCUS

- UBIQUITOUS CONNECTIVITY
- GEOSPATIAL INTELLIGENCE
- ACCESS TO SPACE
- EMERGING TECHNOLOGIES

APPLICATIONS

INTEGRATION FOR A CONNECTED AND INFORMATION CENTRIC WORLD

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OUR FACILITIES


National In-Orbit Servicing Control Centre

Disruptive Innovation for Space Centre


Future Networks Development Centre at Westcott


Westcott Business Incubation Centre

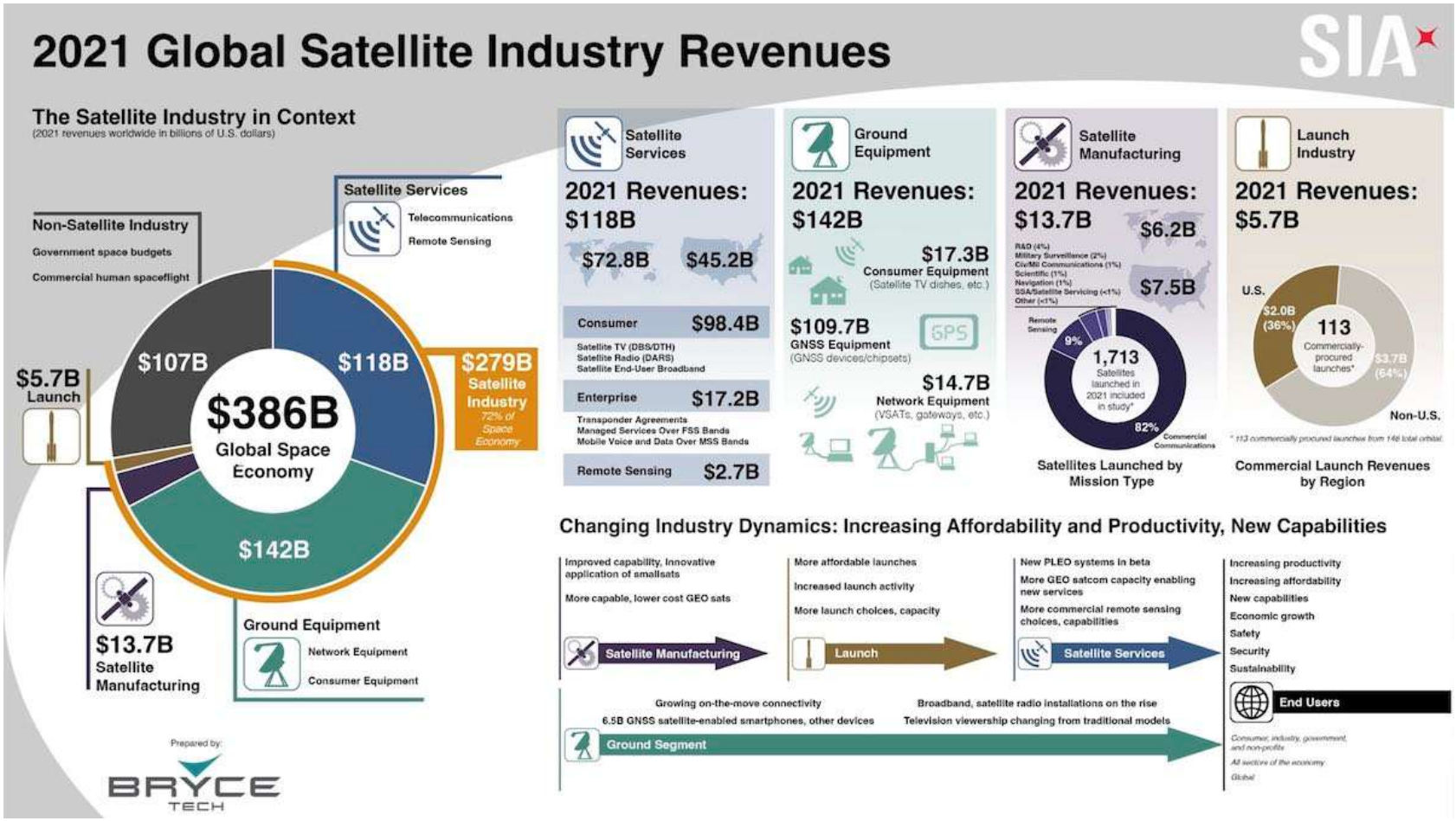

Westcott Innovation Centre


Data Facilities including CEMS and SEDAS


Far-Field Range


Goonhilly Ground Segment

We offer unique facilities designed specifically to reduce the barriers to the growth of the space sector


2021 Global Satellite Industry Revenues
SIA
The Satellite Industry in Context
(2021 revenues worldwide in billions of U.S. dollars)
Non-Satellite Industry
Government space budgets
Commercial human spaceflight
Satellite Services
Telecommunications
Remote Sensing
$107B
$118B
$279B
Satellite Industry
72% of Space Economy
$5.7B
Launch
$386B
Global Space Economy
$142B
$13.7B
Satellite Manufacturing
Ground Equipment
Network Equipment
Consumer Equipment
Prepared by:
BRYCE TECH
Satellite Services
2021 Revenues:
$118B
$72.8B
$45.2B
Consumer $98.4B
Satellite TV (DBS/DTH)
Satellite Radio (DARS)
Satellite End-User Broadband
Enterprise $17.2B
Transponder Agreements
Managed Services Over FSS Bands
Mobile Voice and Data Over MSS Bands
Remote Sensing $2.7B
Ground Equipment
2021 Revenues:
$142B
$17.3B
Consumer Equipment
(Satellite TV dishes, etc.)
$109.7B
GNSS Equipment
(GNSS devices/chipsets)
GPS
$14.7B
Network Equipment
(VSATs, gateways, etc.)
Satellite Manufacturing
2021 Revenues:
$13.7B
$6.2B
$7.5B
R&D (4%)
Military Surveillance (2%)
Civ/Mil Communications (1%)
Scientific (1%)
Navigation (1%)
SSA/Satellite Servicing (<1%)
Other (<1%)
Remote Sensing
9%
1,713
Satellites launched in 2021 included in study*
82%
Commercial Communications
Satellites Launched by Mission Type
Launch Industry
2021 Revenues:
$5.7B
U.S.
$2.0B (36%)
113
Commercially-procured launches*
$3.7B (64%)
Non-U.S.
* 113 commercially procured launches from 146 total orbital
Commercial Launch Revenues by Region
Changing Industry Dynamics: Increasing Affordability and Productivity, New Capabilities
Improved capability, innovative application of smallsats
More capable, lower cost GEO sats
Satellite Manufacturing
More affordable launches
Increased launch activity
More launch choices, capacity
Launch
New PLEO systems in beta
More GEO satcom capacity enabling new services
More commercial remote sensing choices, capabilities
Satellite Services
Increasing productivity
Increasing affordability
New capabilities
Economic growth
Safety
Security
Sustainability
End Users
Consumer, industry, government, and non-profits
All sectors of the economy
Global
Growing on-the-move connectivity
6.5B GNSS satellite-enabled smartphones, other devices
Broadband, satellite radio installations on the rise
Television viewership changing from traditional models
Ground Segment

Challenges and Opportunities

Ubiquitous Positioning, Navigation & Timing (PNT)

‘Making PNT work anywhere – outdoors, indoors, partially covered spaces’.

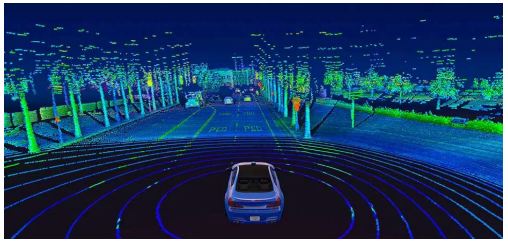
Key ITS enabling platforms are built upon GNSS services of Positioning, Navigation & Timing

- 5G/6G based positioning
- Satcom network for timing and positioning

Environment mapping

Creation and maintenance of accurate maps for large areas – including timely weather conditions

- Enabling technologies (e.g. LiDAR) requires accurate PNT services
- Spatially accurate
- Mapping from aerial imagery



Challenges and Opportunities

Ubiquitous Communication

Deploying cost effective connectivity solutions

- Rural vs urban
- Cross-Border

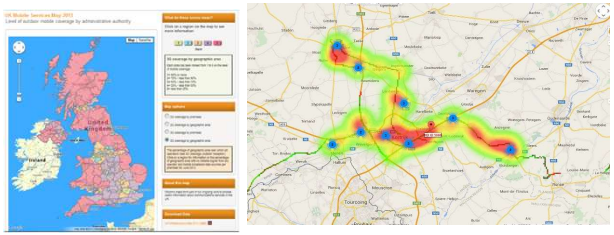
Connectivity Capacity

Elastic connectivity architecture with ability for rapid reconfiguration & prioritisation

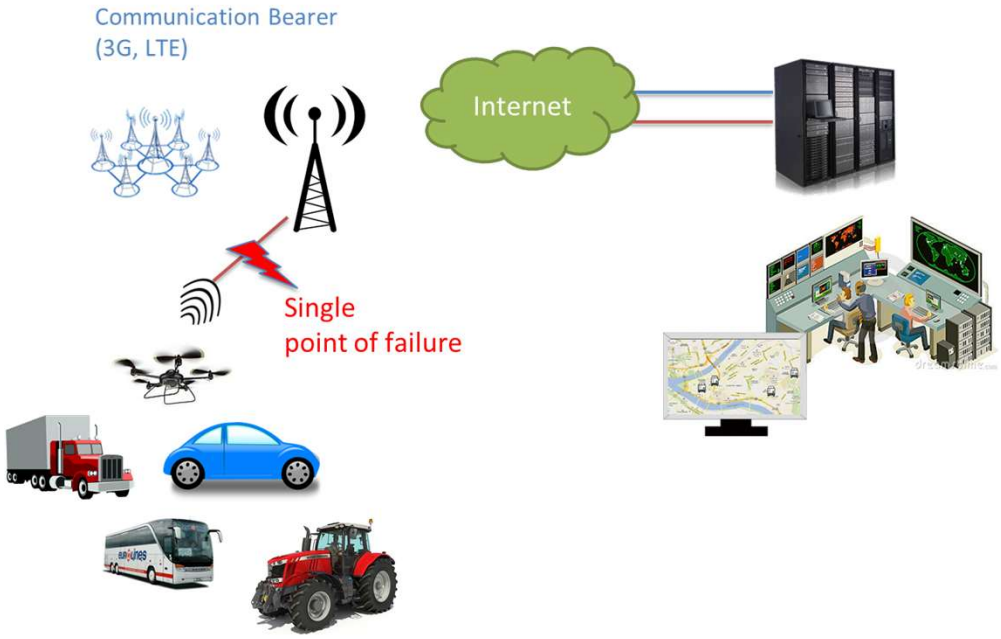
- Connected services
- Consumer demand for data (QoS expectations)

Terrestrial Networks – on its own

The deployment of terrestrial technology poses limitations and is expensive at scale – therefore not sustainable

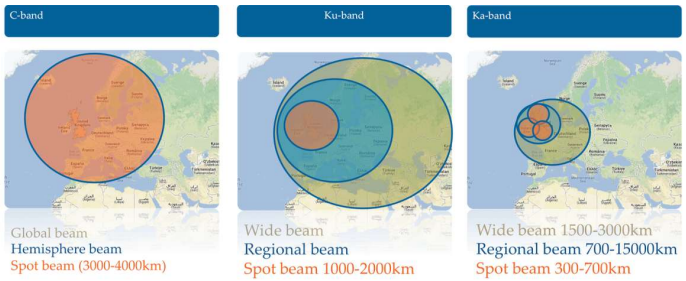


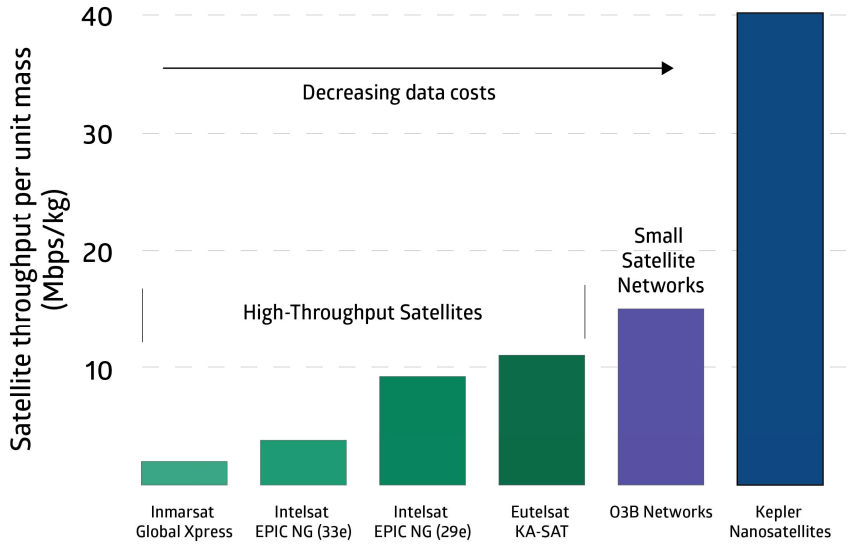
Commercial mobile network deployment focussed high usage area
(e.g. cities, busy roads)

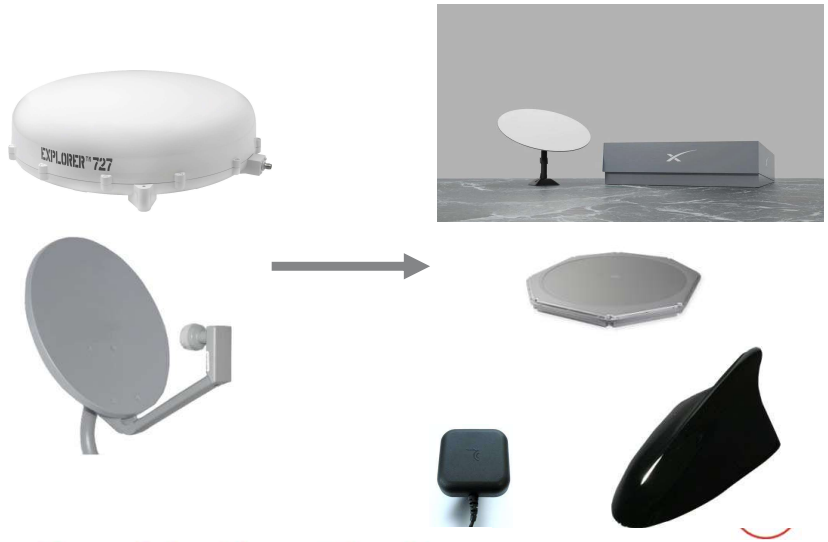


Trends in Satellite Communication

Satellite Bandwidth increasing: 1Gbps → 100Gbps
Service costs reducing: £5k → £50/month
Equipment cost reducing: £5k → £500

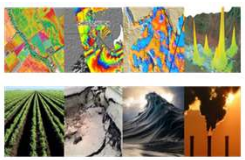






One of the biggest barriers

Holistic Approach to Key Enablers



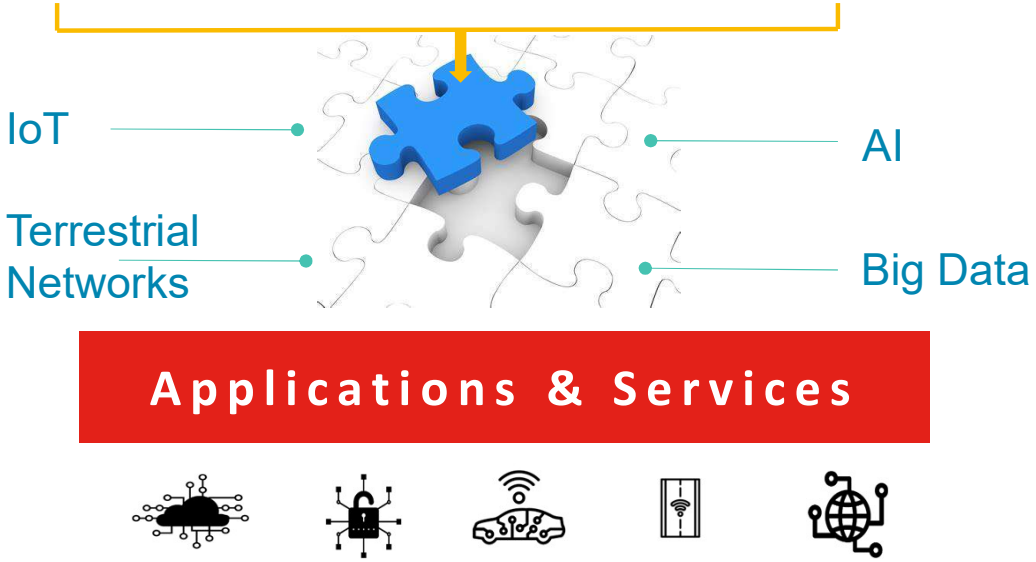
Remote Sensing

Telecommunications

PNT

Space Technologies as enablers

Combined with non-space technologies



Hybrid Approach - Emergency Services - Most critical and demanding use

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Emergency Services

ESMCP Demonstrator

Homeoffice Programme

Transition from dedicated Tetra communication network to use of commercially available mobile technology

ESMCP – the future of blue light services communications

A paradigm shift to exploit the latest technology and high bandwidth services using state of the art information systems and applications for the benefit of the emergency services.

An example of response to large scale regional and national agenda

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Connectivity Everywhere (Resilience) – Emergency Services

Always able to communicate to/from vehicle/infrastructure

Some feedback

- Bulky
- Expensive kit
- Hard to integrate

Saving lives irrespective of where you are .....

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Project - Lightbar

Innovation challenges

- Small form factor
- Cost effective
- Robust and resilient

ESA Lightbar project

- Academia and industry
- From innovation to commercialisation
- Access to early cutting-edge terminals

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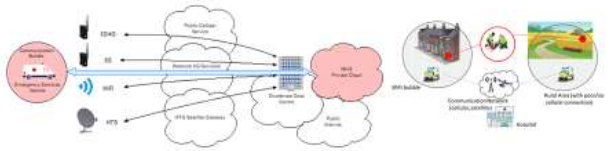
ESA - Hybrid-Connex

hybrid connex



"Connected Everywhere"

Objective – Provide on-the-road failover communications across NHS Trusts and integrated care pathways, using the latest satellite and cellular technology and a universal data system that connects and monitors the fleet.

Approach

- Develop in-vehicle solution for hybrid communication as well as cloud counterpart
- Use of multiple cellular communication (including 5GNR) and Satcom

excelerate CATAPULT

vodafone

Hybrid Connectivity as a Service (HCaas) | ESA TIA

Hybrid approach – the eCall Use Case – Mass Market opportunity

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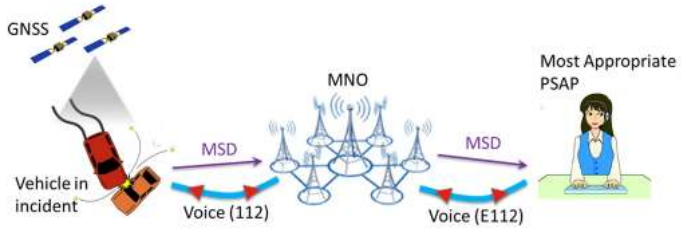
eCall service

Lets emergency services know there has been an accident



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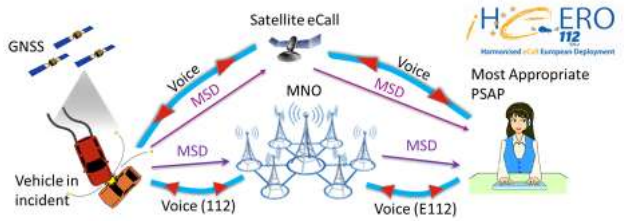
Enhancing using satellite communications

Lets emergency services know there has been an accident



I_HeERO EU funded project on eCall with >60 partners across 15 countries
Saving lives irrespective of where you are .....

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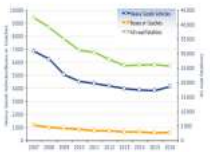
sAFE – aftermarket opportunity



CEN WG15 Standard
eCall over Satellite

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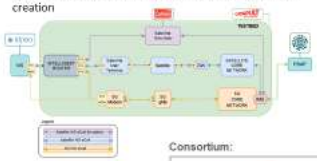
SETERIA – eCall over Satellite

UC Bid/Tech lead: Angel Almeida & Arunprakash Jayaprakash
Bid/PM person: Laura Simmons

Timeline/Duration: 18 months

Concept (from Standards):

Project aim: emulation of NG-eCall via satellite. Testbed creation



Consortium:
Lead: CATAPULT
Partners: Calnex
Ext. Service Provider:

Funder: esa
Total (EUR): 500k
SAC Value (EUR): 320k

Overall Concept

eCall is a vehicle safety feature that allows the establishment of an emergency call to the emergency services if an incident or accident happens. *eCall* system uses terrestrial networks only. This project explores the requirements of Next Generation eCall (*NG-eCall*) to be used via Satellite, enabling ubiquitous *NG-eCall*.

Technical Objective

1. **Create a testbed** for emulating NG-eCalls via satellite with PHY layer impairments (doppler, multipath, etc) and Layer 2/3 impairments (latency, jitter, packet loss, etc).
2. **Understanding** the adjustments required when using LEO/GEO satellite networks for delivering high-quality NG-eCalls with new services (e.g., video stream from vehicle).
3. **Enhancing the testbed** for routing NG-eCalls through the emulator, as well as commercial LEO satellite and private 5G networks.

Approach

- **Emulation** of PHY layer impairments, incorporating PHY high-level effects and behaviours in Layer 2/3 emulator
- **Development** of NG-eCall compatible IMS
- **Integration** of IVS, emulator, IMS and PSAP in testbed
- **Addition** of commercial satellite terminals and 5G terminals and networks, as well as an intelligent routing agent to the testbed.

Autonomous Systems – Mass Market Opportunity

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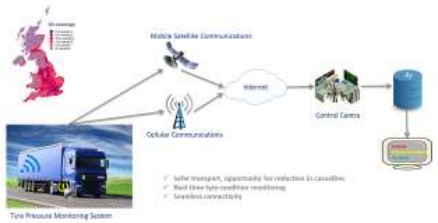
PACV (Pathway to Autonomous Vehicle)



How healthy is the lead vehicle?

Objective
Predictive maintenance of tyres using AI and remote monitoring of tyre pressure

Approach
- Use of cellular and satellite communication to relay data to AI platform
- Local alerts to driver and fleet management notification

Tructyre · University of Portsmouth · CATAPULT

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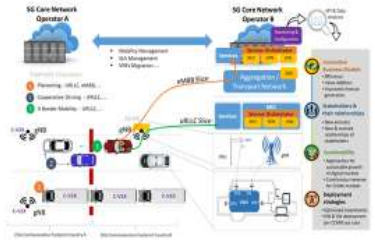
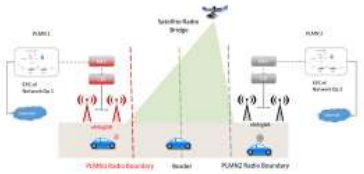
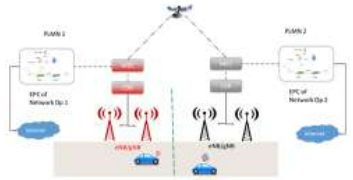
EU Project - 5G-MOBIX



5 National EU test site
2 Cross-border test sites
1 S-Korean test site
1 China Trial site in Jinan (SDAS)



1. Filling coverage gaps + resilience



2. Interconnecting Edge Compute Platforms

RASR

Robotics & Automation for Soil Resilience

Funder: Innovate UK
Total: £750k
SAC Value: £190,370k

UC Bid/Tech lead: Angel Almeida
Bid/PM: Suzanne Collins / James Conning

Timeline/Duration: 36 months

Overall Concept
Accelerate the automation and standardisation of soil health sampling, monitoring and analysis to unlock soil resilience metrics, productivity gains and emerging markets by developing a cost-effective, fully autonomous robotic platform designed and tested across a range of terrains and farms whilst incorporating an agnostic 'plug and play' sensor payload.

Technical Objective
Create 5 working robotic prototypes equipped with sensors suitable for delivering commercially viable soil health, carbon, nitrogen and biodiversity data in farming environments

Approach
1. **Develop** a cost-effective, 2nd generation, fully autonomous robotic platform for monitoring soil health, biodiversity and carbon in farmland
2. **Hybrid Comms** – Transmission of data using satellite connectivity as alternative to Cellular networks (5G) if not available – Low Earth Orbit (LEO) Constellations and/or GEO satellites.

Consortium:
Lead: Partners: CATAPULT listt.io

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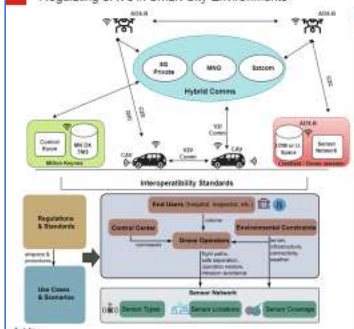
RPF

Regulating UAVs in Smart City Environments



Department for Science, Innovation & Technology

Total (GBP): 1M
SAC Value (GBP): 342k

Timeline/Duration: 17 months

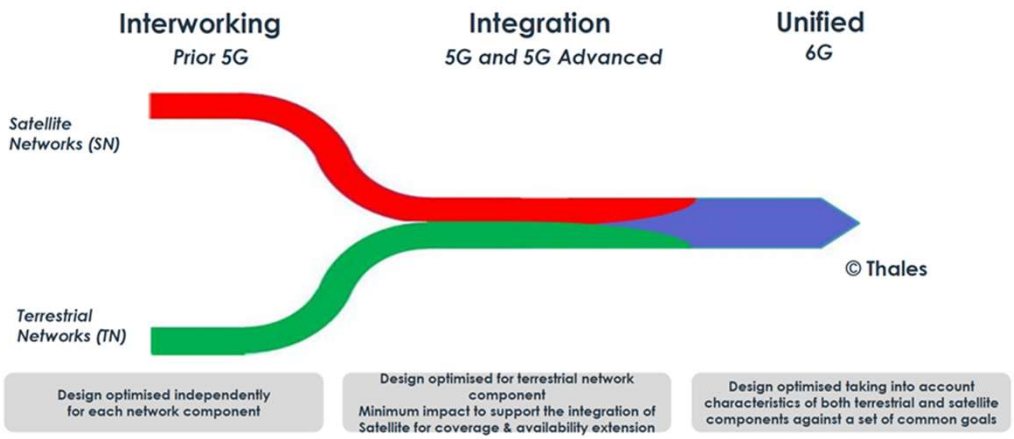
Overall Concept
To empower UK regulators and local authorities to create a regulatory environment conducive to business innovation and investment. The aim of project is to pioneer regulatory changes of Unmanned Aerial Vehicles (UAVs - Drone) by demonstrating successful and safe use cases.

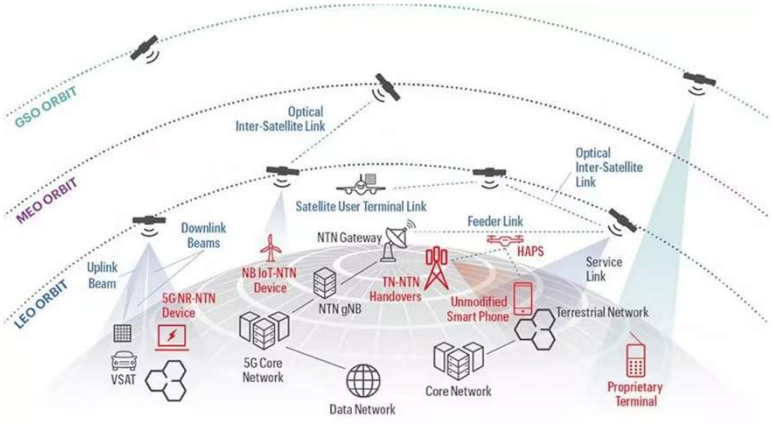
Technical Objective
Oversee 4 pre-defined scenarios of drones to achieve comprehensive urban management covering many aspects including but not limited to medical services, infrastructure inspection and emergency response and perhaps the UAV/CAV interaction proof of concept can be at the Drone port.

Approach
1. System architecture design to facility connectivity and interoperability between UAV's platforms and central network.
2. Post architecture completion testing of technical and interoperability network systems before use case deployment.
3. Use of DTDC runway for testing and procuring flight operation services at Westcott.

Consortium:
Lead: Partners: SMART CITY CATAPULT HEROTECH8 NEURON

The unification

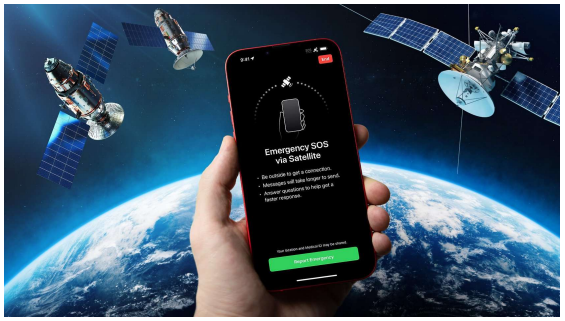


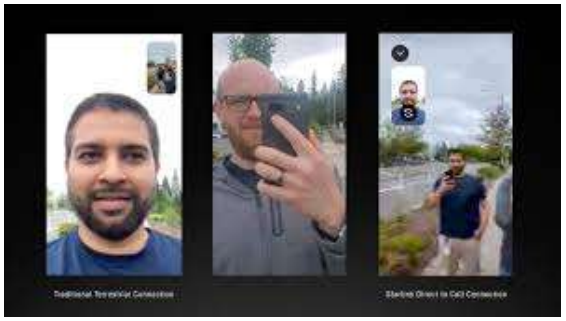


Unification key challenges

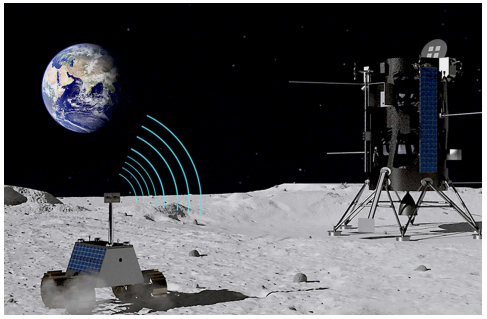
- Alignment with ETSI/3GPP
- Standardisation in the Non-Terrestrial segment
- Access devices (antenna, chipsets, software stacks)
- TN/NTN co-existence
  - Spectrum sharing (‘dynamic’? – on demand)

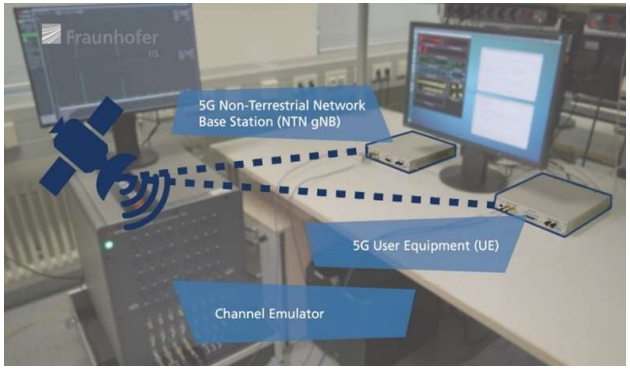
There is progress ….

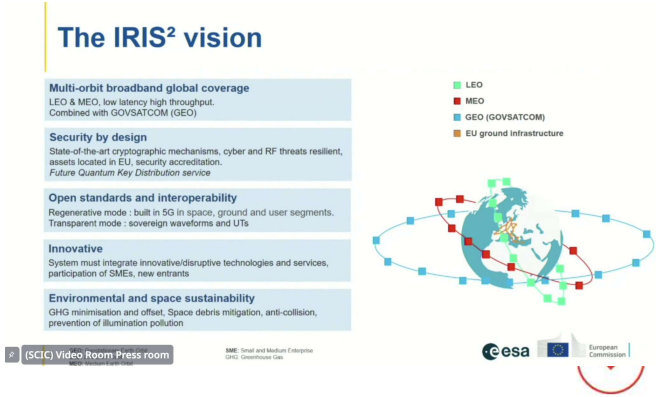




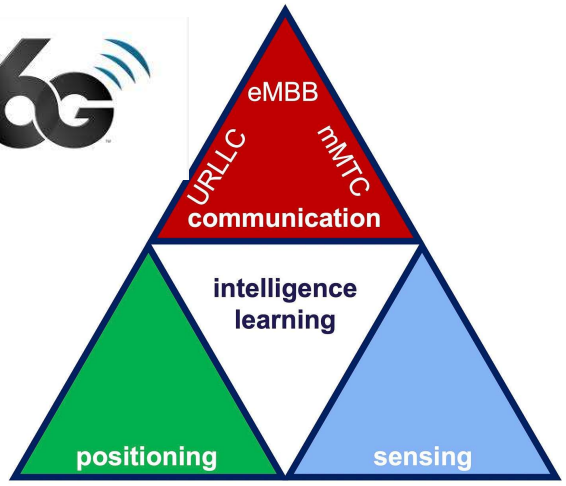
But ….

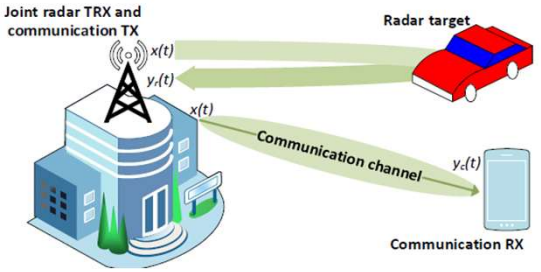






The unification – across enabling technologies – more than comms





Joint Communications and Positioning

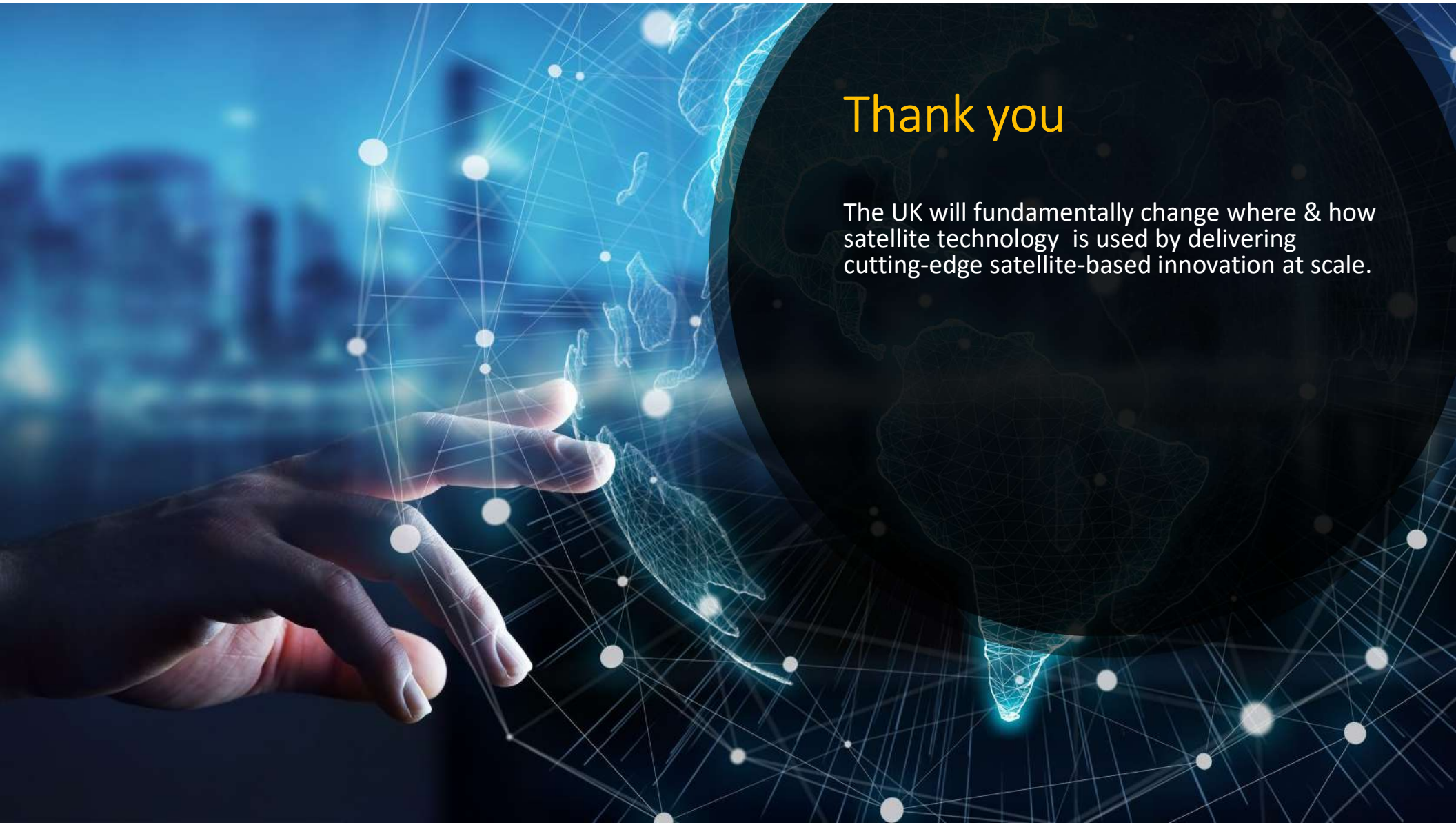
- 5G RAN based positioning
- Network assisted positioning

- Space technology complement - GNSS

Joint Communications and Sensing (Radar)

- Joint communications and Radar - Testbed demo
- Joint Radar and Comms - Waveform design,
- Joint comms and sensing for 3D environment mapping
- Joint Comms and SAR

- Space technology complement – Earth Observation


Thank you
The UK will fundamentally change where & how satellite technology is used by delivering cutting-edge satellite-based innovation at scale.