



BT Space R&D

Jon Wakeling

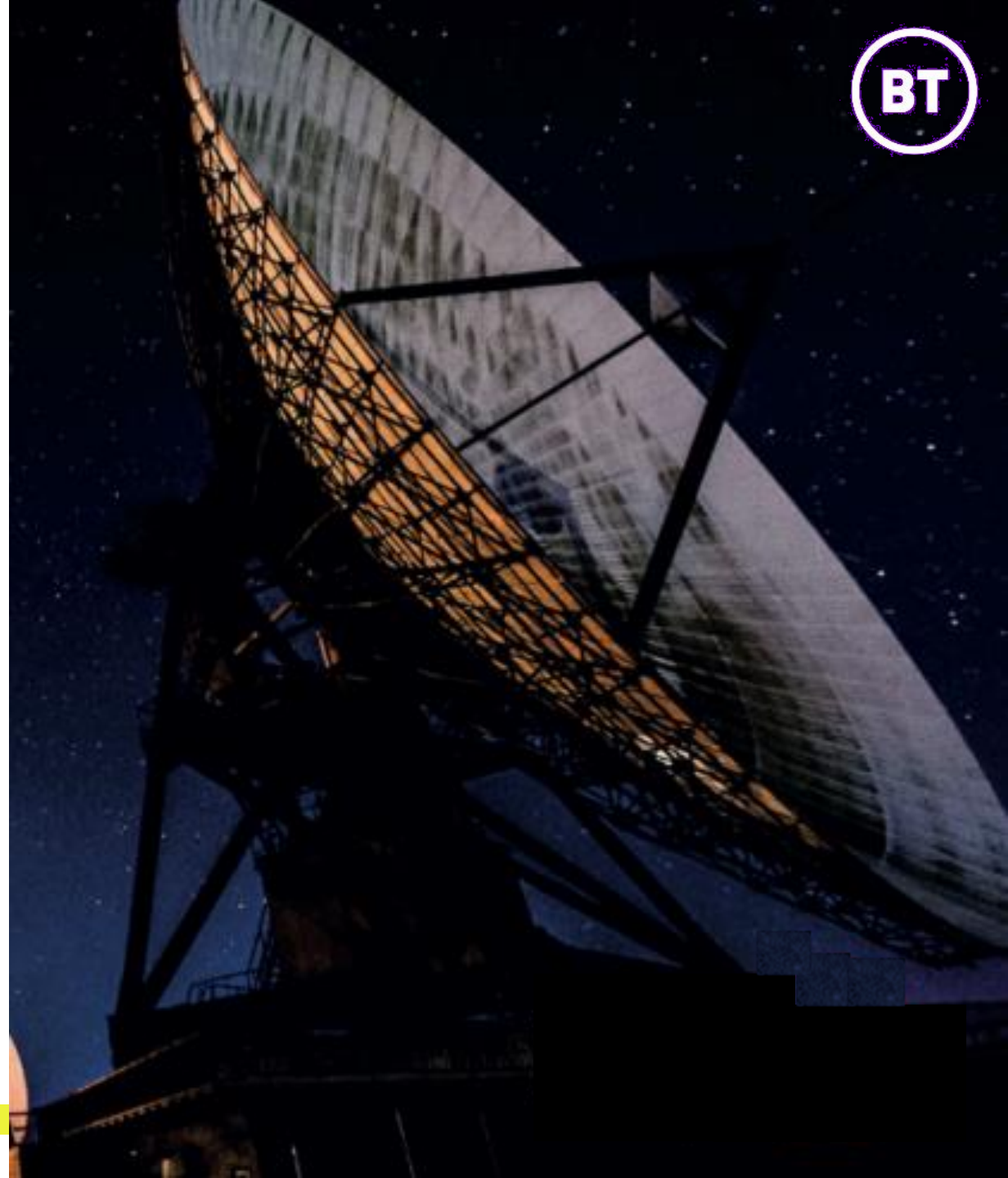
Acting Director, Fundamental Research
and IPR

BT Research and Network Strategy

Chair UKspace-techUK Satellite Telecommunications
Committee

Member of UKTIN NTN Experts Group

25th January 2024



Agenda

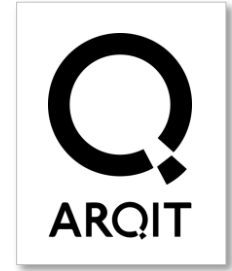
- BT's approach to space R&D
- The Adastral Park Space Lab
- BT R&D update:
 - HAPS fixed and mobile service demonstrations;
 - Satellite QKD service validation and integration;
 - Optical satellite systems.



BT's approach to space R&D



So much going on in space!



BT's commitment to Space R&D

BT Space Strategy Pillars



UK National Space Strategy Ten Point Plan – Highest Impact Opportunities

	1. Provide A Stronger Downstream Voice	2. Proactively Collaborate Across the Space Ecosystem	3. Explore New Technologies	4. Develop Thought Leadership In Convergence	5. Foster Disruptive Thinking	6. Leverage Our Research Capabilities
1. Capture the European market in commercial small satellite launch						
2. Fight climate change with space technology	✓	✓	✓	✓	✓	✓
3. Unleash innovation across the space sector	✓	✓	✓	✓	✓	✓
4. Expand our horizons with space science and exploration						
5. Develop our world class space clusters	✓	✓	✓	✓	✓	✓
6. Lead the global effort to make space more sustainable						
7. Improve public services with space technology	✓	✓	✓	✓	✓	✓
8. Deliver the UK Defence Space Portfolio	✓	✓	✓	✓	✓	✓
9. Upskill and inspire our future space workforce	✓	✓	✓	✓	✓	✓
10. Use space to modernise and transform our transport system	✓	✓	✓	✓	✓	✓

BT's commitment to Space R&D

UK National Space Strategy Ten Point Plan – Highest Impact Opportunities



















































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8. Deliver the UK Defence Space Portfolio
9. Upskill and inspire our future space workforce
10. Use space to modernise and transform our transport system



BT Space Strategy		Foster Disruptive Thinking		6. Leverage Our Research Capabilities	
1. Provide A Stronger Downstream	2. Proactively Collaborate				
		✓	✓		✓
		✓	✓		✓
					✓
		✓	✓		✓
		✓	✓		✓
		✓	✓		✓
		✓	✓		✓
		✓	✓		✓
		✓	✓		✓

<https://business.bt.com/content/dam/bt-business/pdfs/bt-space-strategy-supporting-the-growth-of-the-UK-space-economy.pdf>

BT Space R&D engagements

	Components, Subsystems, Fundamentals	Systems and Infrastructure	User Equipment	Applications & Services	Business Models	Other	
Academia	 	 					
Start-ups / New Space		    	    	        	   	 	
Established / SME		 			 		
Operators		 		 			
Primes		 					
ROs / Catalysts							

The Adastral Park Space Lab



OneWeb terminal on long-term test at Adastral
Park

R&D delivery: Adastral Park Space Lab

- 3000+ square metre compound:
 - Access controlled gates;
 - CCTV and motion detector perimeter security;
 - Comms Room;
 - Office and lab cabins;
 - Electricity substation;
 - Back-up generator.
- Connectivity:
 - Other BT labs and testbeds, e.g. 5G, SDWAN, QKD, Broadband, Future Video, Robotics & Drones etc.;
 - Innovation Martlesham company labs and testbeds;
 - Showcases;
 - Reference models;
 - External partner connections.



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CCTV



Substation



Low horizon profile



Starlink terminals



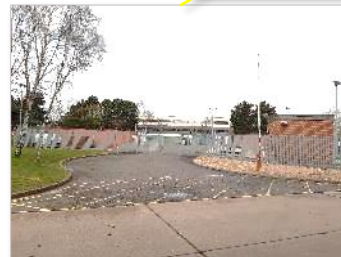
OneWeb terminal



Generator



Equipment cabins



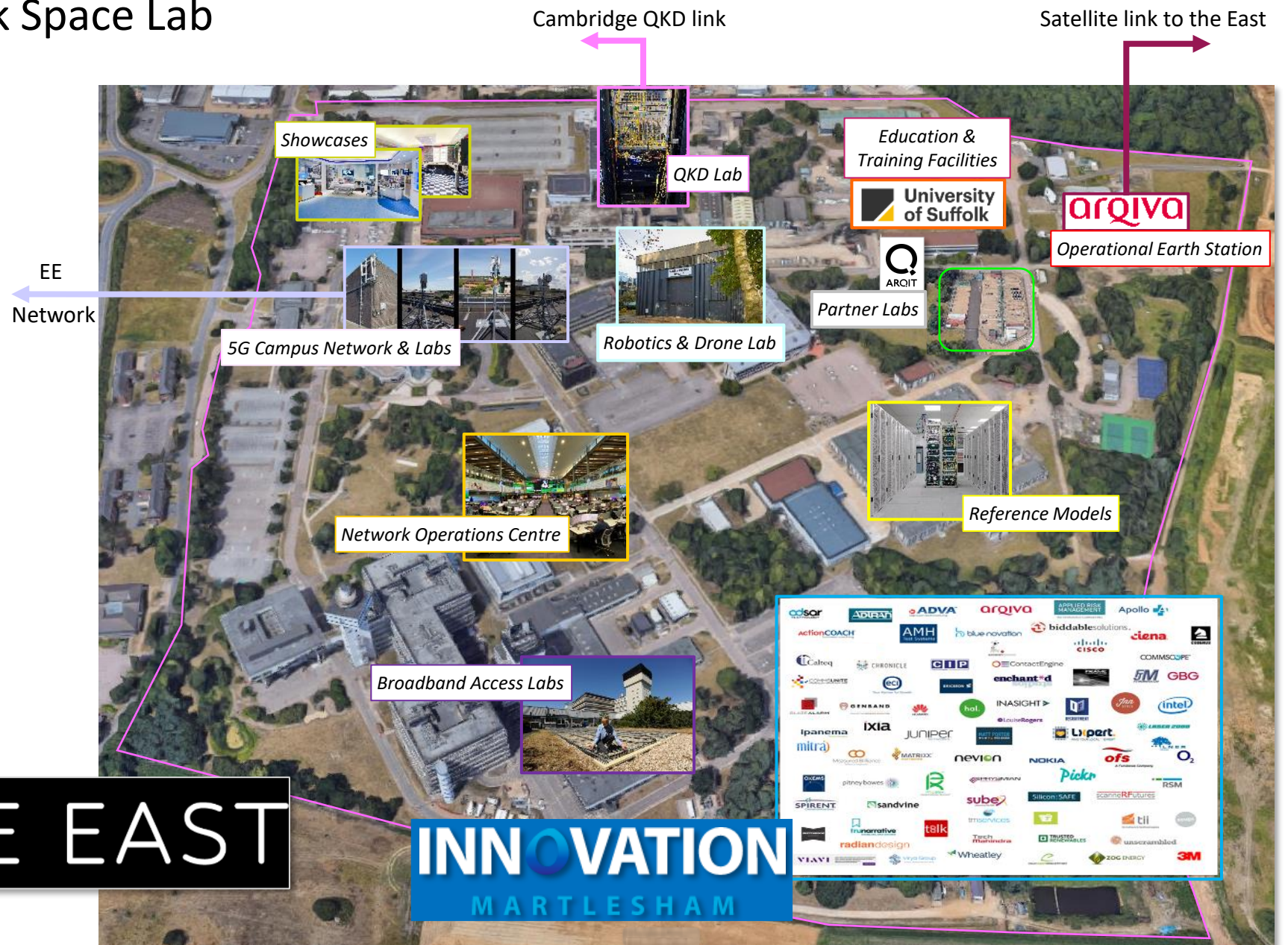
Security gates & motion detectors



Comms room

R&D delivery: Adastral Park Space Lab

- Adastral Park ecosystem:
 - 140+ companies, inc. global telecoms and ICT players;
 - Incubation services;
 - Business angels, mentors, VCs, LEP support services;
 - Networking and SIG events;
 - Lecture, conference and Expo facilities.
- Space East ecosystem:
 - Connect to regional space capabilities;
 - Focus on key regional sectors;
 - Collaborate with other national clusters.



BT R&D update

- HAPS fixed and mobile service demonstrations
- Satellite QKD service validation and integration
- Optical satellite systems

HAPS fixed and mobile service demonstrations



Visualisation of SPL Stratomast HAPS. Source: [Stratospheric Platforms | Affordable & Reliable Connectivity](#)

HAPS fixed & mobile service demonstrations

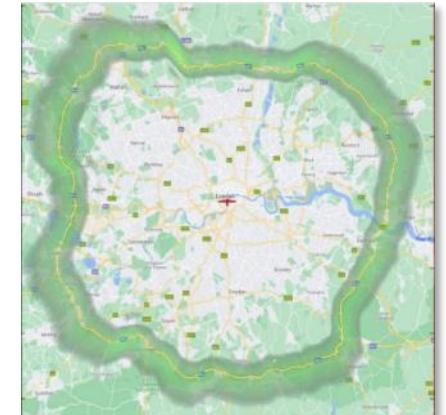
- Working with Stratospheric Platforms Ltd
- Solution:
 - Hydrogen powered autonomous aircraft:
 - Altitude c.18km;
 - Coverage 30-140km diameter;
 - 5-10 days on station.
 - Cambridge Consultants Massive MIMO antenna:
 - Modular “tiles” allow flexibility in choice of antenna size, coverage and capacity;
 - Comprises 4096 elements - contrast with 64 element antennas on the 5G network;
 - Delivers 400-600 5G cells of 1-3km diameter;
 - Supports direct-to-device connectivity.
- Commercial timeline:
 - Prototype payload in development;
 - Prototype flight platform 2025;
 - Pilot trials potentially in 2025/26.



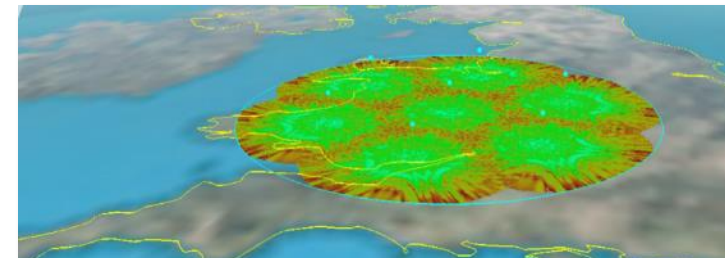
Visualisation of the Stratomast aircraft



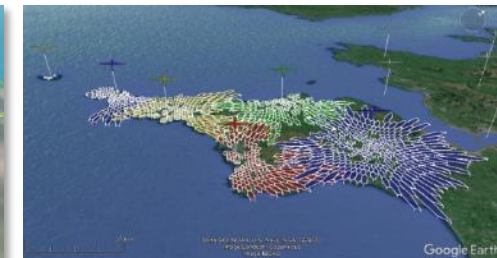
32 Tile antenna model



M25 coverage simulation



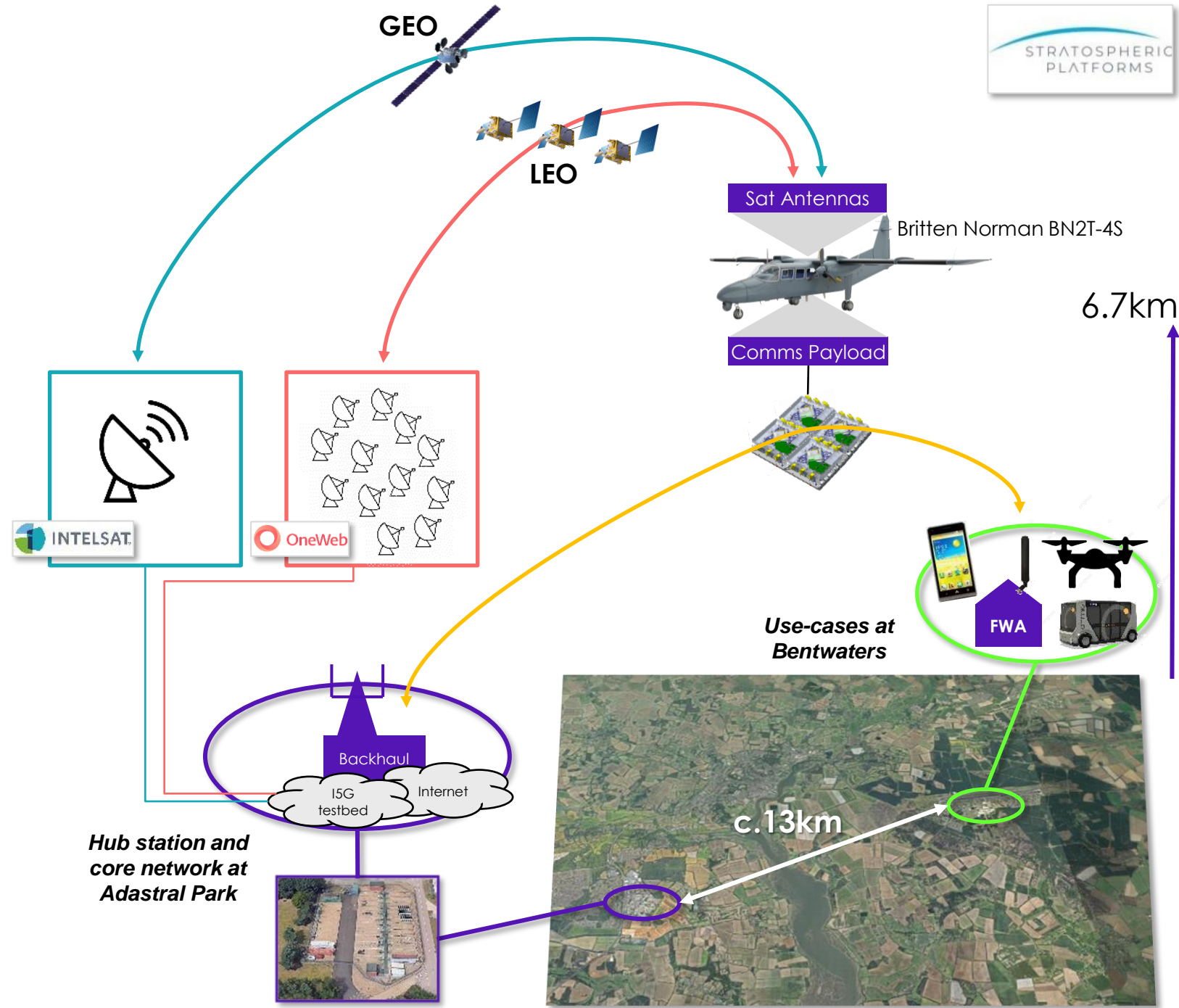
West Midlands & Wales coverage simulation



Devon & Cornwall

HAPS integration with satellites

- Recent progress:
 - Demonstrated antenna technology in operation at Adastral Park;
 - Handover from campus 5G network to HAPS payload and back.
- Potential flight demo 2024/25 of:
 - Direct backhaul to Adastral Park;
 - Backhaul via satellite:
 - Intelsat GEO;
 - OneWeb LEO.
 - 3D Network concept development.
- Use-cases to be demonstrated at Bentwaters airfield:
 - Fixed Wireless Access;
 - Mobile broadband;
 - Remote vehicle control;
 - Remote drone control.



Satellite QKD service validation and integration



Artist's impression of a SPEQTRE QKD satellite. Image: ISISpace.

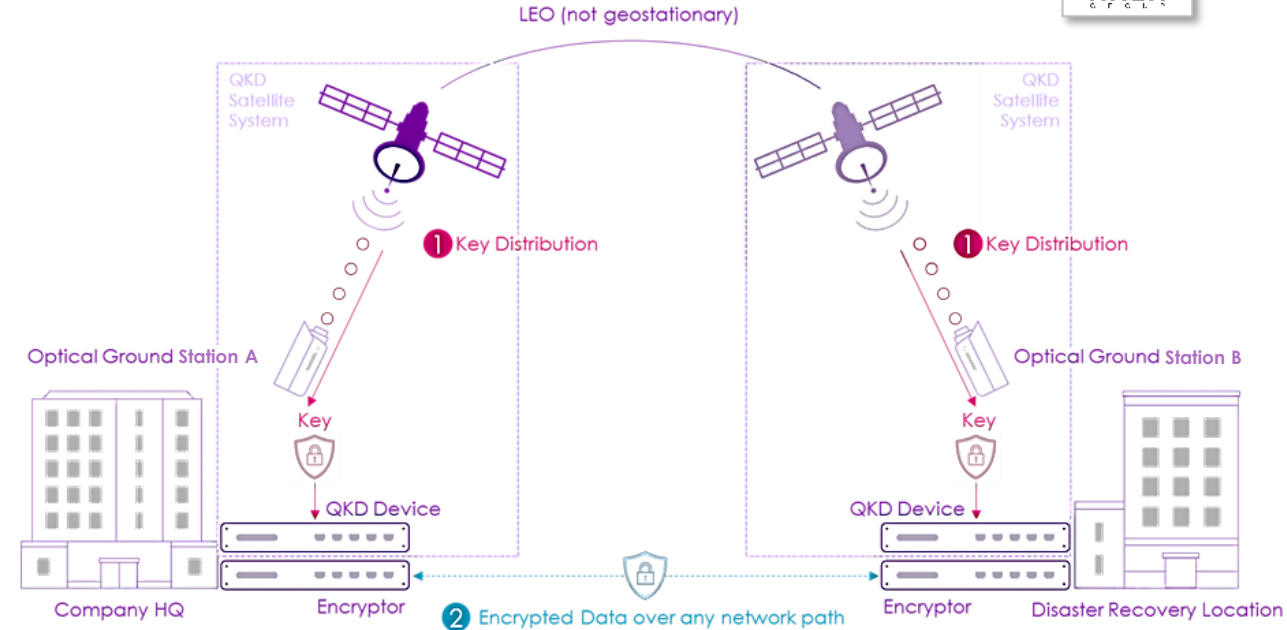
Source: [SPEQTRE: Protecting data using the 'spooky' power of quantum mechanics](#) | by Science and Technology Facilities Council (STFC) | Big Science at STFC |

[Medium](#)

Satellite QKD service validation and integration



- **ArQit: ESA QKDSat mission (launch 2025):**
 - Use-cases include: Global WAN interconnect, subsea cables; UK CNI, e.g. connecting core/metro network fibre QKD islands, remote 4/5G RAN basestations;
 - BT will deliver experimental OGS trials and demonstrations at Adastral Park in Phase 2.
- **Craft Prospect: ESA VOLT mission (launch 2026):**
 - Mission uses innovative Cubesats for service augmentation;
 - BT working on use-cases and trials.
- **Rhea Tech: new ESA proposal:**
 - Rhea proposing development of multi-platform service orchestration;
 - SpeQtral and Toshiba UK potential partners;
 - Potential UK-Singapore network.
- **Tracking other SQKD programmes, e.g.:**
 - ESA TeQuantS project (TAS leading);
 - EU-ESA SAGA mission, SES Eagle-1 satellite;
 - UK-Singapore SPEQTRE collaboration (STFC).



Satellite QKD concept



Vienna

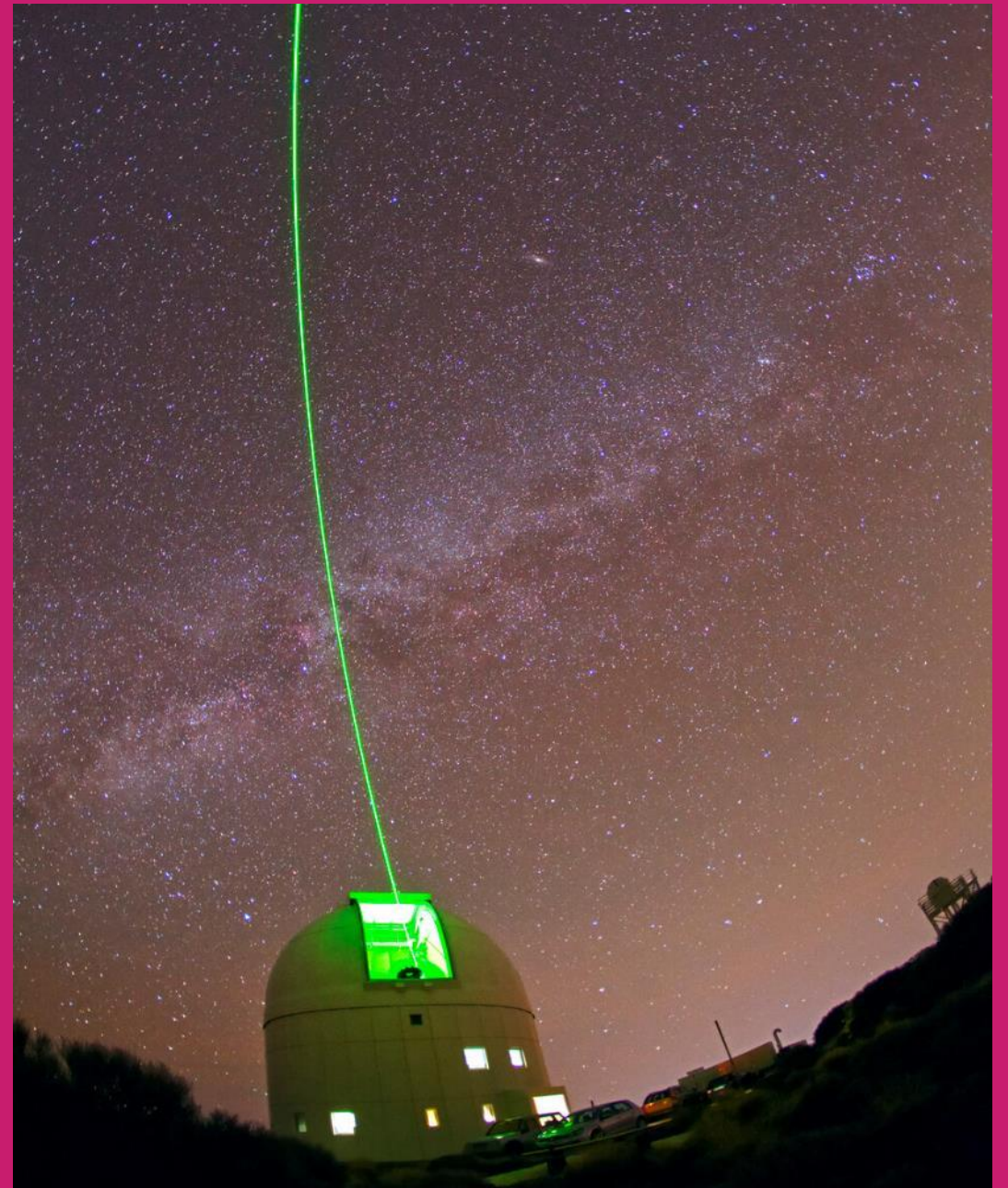
Likely experimental OGS form factor



Target commercial OGS form factors

Source: [Quantum Research — New Austrian \(austrianinformation.org\)](https://www.austrianinformation.org/en/quantum-research)

Optical satellite systems



ESA Optical Ground Station, Tenerife. Source: [ESA - ESA's site for laser and quantum links marks 25 years](#)

Optical Satellite Systems

- Proposed capability summary:
 - High speed earth-space communications using lasers;
 - Constellations with optical inter-satellite links;
 - Satellites may have compute and storage capabilities.
- Potential for new service types:
 - Massive data transfer speeds for niche applications;
 - 'Edge compute' and data centre facilities in space;
 - Distributed network architecture across terrestrial and space infrastructure for resilience, e.g. subsea cables.
- BT service opportunities:
 - In field of view or global Gbit/s or Tbit/s connections;
 - Space-based data processing or process automation;
 - Intercontinental network resilience and augmentation.
- Ground equipment:
 - Various types already exist;
 - Demonstrated operation in a rugged environment.
- ESA projects and programmes:
 - Components;
 - Networks.

*System proposers,
component and ground
equipment providers*



Target application locations

*Some free space optical
technologies have already
been developed and tested
in harsh environments*

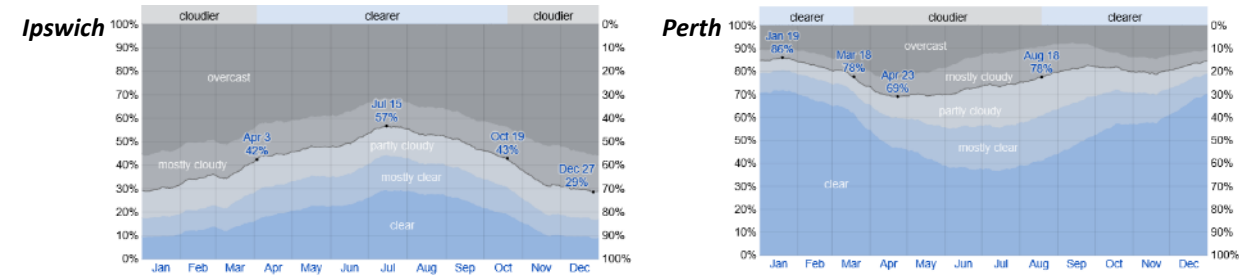


*ESA collaborative funding
programmes targeting different
system and service elements*

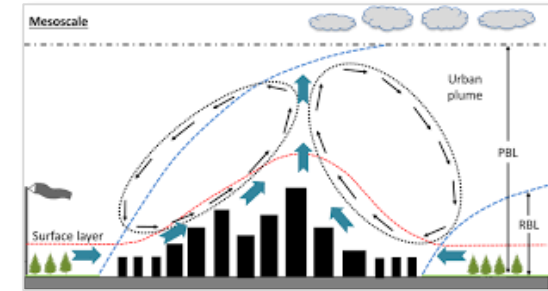
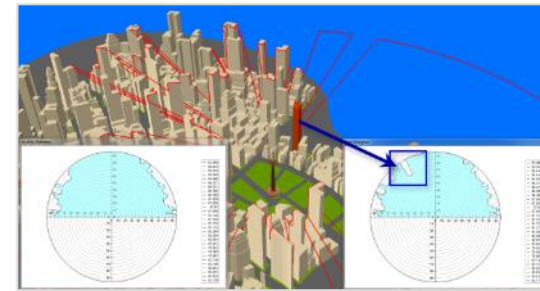


Optical Satellite Systems: service insight

- Service management will be a challenge:
 - Cloud cover varies hugely across different locations;
 - Other impairments include:
 - Particulates: sand/dust, pollution;
 - Atmospheric turbulence, especially in urban and hot environments.
 - Availability of end points do not necessarily coincide;
 - Local environmental clutter can also reduce service availability;
 - Optical channel is not necessarily as secure as you might think due to dispersion and scatter.
- Potential solutions:
 - Significant ground network infrastructure required;
 - Intermediate links, e.g. through drones or other HAPS, to convert to RF links to the ground;
 - Geography or application specific solutions likely.
- BT well positioned for exploitation:
 - World's largest global MPLS network already in place;
 - Full suite of flexible service management capabilities.

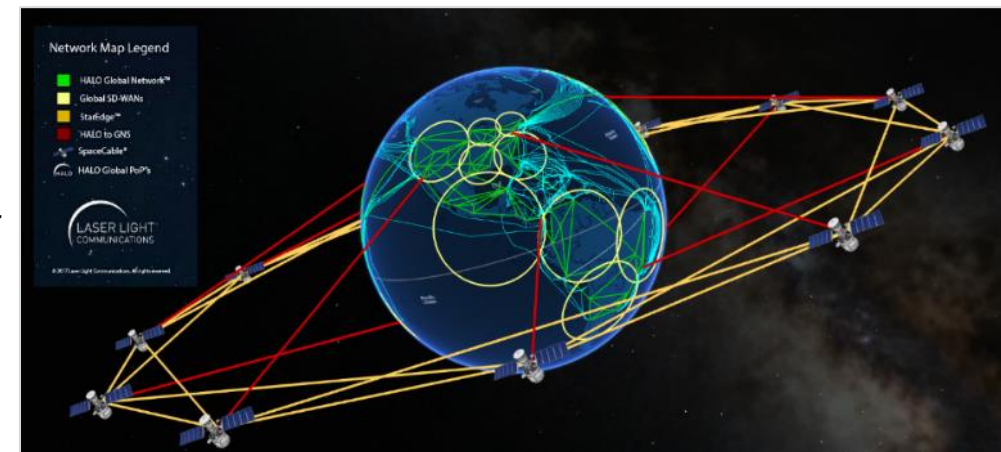


Example cloud cover variation by location and time of year



Urban locations are challenging environments due to blockage, light pollution, particulates and turbulence

System proponents recognise the need for significant supporting terrestrial infrastructure



If any of these challenging areas are of interest, please come and talk to us.
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Thank You

