



SPACE NORTH™



RESILIENT COMMUNICATIONS

Globally Leading Expertise

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SPACE NORTH



Space Innovation for Global Challenges

1ST EDITION (JULY 2024)

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FOREWORD

FOREWORD



It has never been a more exciting time for the Space sector in the North of England than it is today, and it is the right time for **Space North**.

Space North was born when three of the UK's regional Space clusters – Space North East England, Space Hub Yorkshire, and the North West Space Cluster - worked together to support a major programme for the UK-Australia Space Bridge. This experience demonstrated that we had the ability to create a unique collaborative partnership to showcase the region's Resilient Communications expertise, attract inward investment and boost research and collaboration.

The growth of the communication sector and its associated fields will create high-value jobs and enable hybrid, highly effective work models. 5G and 6G technologies will greatly improve the quality of life, support AI and robotics, reduce human risk in dangerous environments, drive environmental solutions, increase biodiversity, enhance social connections, and enable new forms of smart government services.

Investment is essential to accelerate technology advancement, particularly in communication technology, which has the potential to revolutionise all industries. Communication technology facilitates high-speed data communication, information processing, and AI development. It will enhance economic growth, enable automation, connect people in urban and remote areas, secure food supply, and build resilience against climate change.

Space North is here to catalyse investment, to champion Space on the national and international stage, and to promote the exponential growth potential of the industry.

Private industry has pushed the boundaries of innovation within the Space sector like never before and have subsequently advanced research and development of the industry significantly. To become a superpower, foreign investment must be at the top of the agenda and the Space North initiative will supercharge the UK's ability to promote itself as a place to do Space business.

Industry and academia, working alongside regional government in the form of our Combined Authorities must take advantage of these Foreign Direct Investment opportunities to promote growth and harness the talent within the UK. Regional Space Clusters are key to this, as they aim to unlock the Space Sector for all and demonstrate the immense technical capability of the UK.

This guide illustrates the breadth of these capabilities across the North of England, we reveal many of the companies that have made the North their home.

We are ambitious.
We are welcoming.
We look forward to working with you.





FOREWORD

The UK Space Agency is delighted to support Space North as part of its commitment to catalyse investment, increase collaboration and boost prosperity across the country in order to build a whole-UK space ecosystem. We are empowering local space clusters to recognise the value and importance of their shared expertise. The Space North initiative brings together the North West, North East and Yorkshire regions to capitalise on their wealth of world-class capabilities, with a specific focus on resilient communications.

The UK Space Agency is investing in the UK's network of space clusters to accelerate the development of a thriving, strong, and national space ecosystem that drives sector growth and resilience. Through a series of targeted interventions, leveraging regional, national and international opportunities, and addressing local issues, we are building an environment where the UK space sector is more than the sum of its parts. In doing so, the UK is better placed to realise its ambitions as a world-leading space economy and place to do business internationally.

The UK's digital infrastructure plays a critical role in our daily lives. Resilient communications and the role of space is an increasingly important element in enabling countless aspects of day-to-day life. From safety and security on Earth and in space, to financial transactions and broadband connectivity, delivering rural healthcare services, supporting emergency services, and enabling precision farming; as our reliance on such services enabled by satellites increases, their resilience is ever more paramount and new technology will need to be developed.

The Space North area is home to a wide range of companies and organisations involved in growing the space sector. These range from newer companies such as Inotech Solutions through to more established companies such as MDA, Filtronic, Kratos, and Telespazio. It also includes universities which help drive forward research and innovation. Examples of what these organisations deliver include Satixfy which in 2023 sold its space services arm to MDA, which have since gone on to win major contract awards such as for the Telesat Lightspeed constellation. Filtronic have been pioneering the use of high frequency wavelengths in the electromagnetic spectrum (commonly referred to as Q/V bands) which are now becoming available for commercial use. Developing the technologies needed to access these wavelengths is highly specialised and with support through the UK Space Agency and ESA, Filtronic are emerging as leaders in this field.

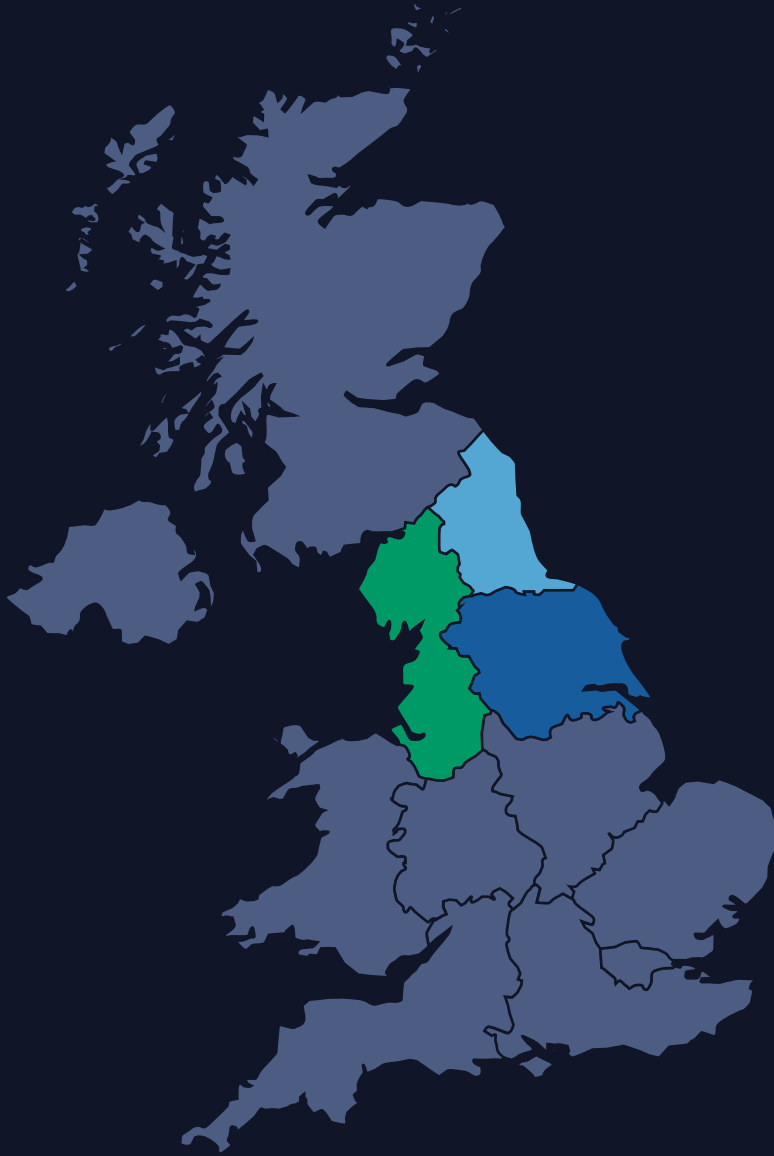
This comprehensive guide to the resilient communications sector across the north of England showcases the region's extensive capabilities and how it makes a significant contribution not only to the UK's space sector, but to our economic prosperity as a whole. It represents the first, small step in an exciting partnership between regional space clusters that have come together to take advantage of shared expertise to unlock new markets and pursue emerging opportunities.





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BACKGROUND



SPACE NORTH EAST ENGLAND

2.7M

POPULATION

8,600 km²

AREA

71

SPACE ORGANISATIONS

27

RESILIENT COMMS ORGS

1,300+

PEOPLE EMPLOYED

26

RESILIENT RESEARCH ORGS

SPACE HUB YORKSHIRE

5.5M

POPULATION

15,600 km²

AREA

87

SPACE ORGANISATIONS

54

RESILIENT COMMS ORGS

1,800+

PEOPLE EMPLOYED

27

RESILIENT RESEARCH ORGS

THE NORTH WEST SPACE CLUSTER

7.5M

POPULATION

14,100 km²

AREA

124

SPACE ORGANISATIONS

29

RESILIENT COMMS ORGS

2,800+

PEOPLE EMPLOYED

31

RESILIENT RESEARCH ORGS



BACKGROUND

“Space North” is a unique collaboration between three UK regional Space clusters based in the North of England - **Space Hub Yorkshire**, the **North West Space Cluster**, and **Space North East England** - who have joined forces to harness their complementary expertise and capabilities. With nearly **6,000 employees spread across 280 space-related organisations**, the region thrives on its diverse strengths, with capabilities including advanced manufacturing, robotics, cybersecurity, optical communications, and environmental technologies. Amidst these domains, “Resilient Communications” emerges as a particularly unique centre of expertise.

“Resilient Communications refer to the capacity of a communication system to maintain its functionality, adapt, and recover quickly in the face of disruptions, challenges, or adverse conditions. The goal is to ensure that communication networks and infrastructure can continue to operate effectively, even when faced with unexpected events, such as natural disasters, cyberattacks, equipment failures, or other forms of interference.”

Resilient Communications are a major part of the UK Space industry, with related applications making up [~65% \(£11.4Bn\)](#) of the industry’s contribution to national income. It is also estimated that [~18% \(£370Bn\)](#) of the national GDP is dependent on satellites, with the negative financial impact of a five-day outage amounting to [~£5.2 billion](#).

PURPOSE

This brochure is the outcome of a comprehensive capability mapping exercise of the resilient communications industry in North England, reflecting the region’s complementary expertise and collaborative efforts across public, private and academic organisations.

This report aims to highlight key actors in the region, showcasing the breadth and depth of local capabilities, and informs the foundation of Space North as well as its future strategic endeavours. The region is inherently outward-looking and this brochure shows a compelling case for stakeholders interested in the (international) growth and innovation of this dynamic sector.

Please note that entity descriptions are inevitably non-exhaustive, highlighting primarily core capabilities and/or recent developments of relevant entities.

DEFINITION OF THE RESILIENT COMMUNICATIONS SECTOR

Primary classification	Manufacturing	Ground	Connectivity	Software	Services
Secondary classification	Laser/optical satcom	Ground equipment manufacturer (e.g. antennas, tracking systems, control centres)	HAPS / stratospheric	Data analytics software (incl. AI/ML)	Engineering
	Materials Manufacture (e.g. semiconductors, metal alloys, ceramics)	Ground station / data warehousing (e.g. manage reception, processing, storage, and distribution of data collected from Space)	Managed services providers	Network management	IT & Cybersecurity
	Payload manufacturer (e.g. measurement & comms systems)	Ground station operations (e.g. mobile vs. static)	QKD providers	Other software e.g. satellite control systems, data processing, simulation tools	GPS and location services
	Satellite integrator	Space weather monitoring	Vertically integrated satellite connectivity providers		Network integration and monitoring
	Satellite manufacturer		- By operating frequency		Regulatory
	Satellite subsystem or component manufacturer (e.g. RF chips / sensors)		- By type (e.g. satellite / hybrid / terrestrial)		Satellite operations
	Testing and development facilities		- By use-case (e.g. broadband / IoT / military)		Software development
			Virtual network operators		Training

NB: THE ABOVE IS A REPRESENTATION OF THE TAXONOMY APPLIED ACROSS SPACE NORTH'S RESILIENT COMMUNICATION SECTOR, FOCUSING ON COMPANIES BY PRIMARY/SECONDARY CLASSIFICATIONS. AT A HIGH LEVEL, WE HAVE APPLIED A SIMILAR TAXONOMY FOR RESPECTIVE RESEARCH ORGANISATIONS AND FACILITIES, NOTING THEIR INHERENT FOCUS ON RESEARCH AND DEVELOPMENT OVER COMMERCIAL ACTIVITIES.



As one of the UK's thirteen critical national infrastructures, Space technologies play a pivotal role in enabling Resilient Communication systems.

The satellite communications (satcom) market relies on an extensive ecosystem of technologies that enable and manage the flow of data between Earth and orbit, from manufacturing supply chains and launch providers delivering satellites to their designated specifications and positions, to intricate ground segments collecting, storing, and distributing the relayed information. Furthermore, emerging technologies like optical transmission and quantum key distribution help provide lower latencies and increase the reliability and security of communication channels, whilst value-added services and analytics empower end-users with additional and deeper insights into the satellite-collected data.

The UK Space industry income from satellite communications is [estimated to be at least £3bn](#).

Future market growth is expected to be in the double digits, driven by:

- Rapidly increasing demand for data and connectivity (volume increases offsetting price decreases), increased demand for secure and reliable communication (alternative for terrestrial infrastructure)
- Expansive LEO constellations (low latency, higher signal strength and data throughput) made possible through a reduced cost-to-orbit (launch costs), improved satellite production (e.g. in satellite design, miniaturization and cost reduction, HTS, improving inter-satellite links)
- Technological advancements (e.g. electronically steerable antennas, enhanced signal reception and flexibility, software-designed satellites)
- Dual-use demand (increasing demand for satellite-based ISR capabilities)

Space-based communications are also becoming an increasingly integral part of other advanced technologies such as IoT, (hybrid) cellular/satellite networks and autonomous vehicles – driving the need for communication systems that are resilient to cyber threats.

Space-based communication systems can provide:

- **Global Coverage:** reaching even the most remote and inaccessible areas on Earth. This ensures that communication can be established regardless of geographic barriers, or terrestrial infrastructure limitations.
- **Disaster Recovery and Emergency Response:** during natural disasters or emergencies, terrestrial communication infrastructure often gets damaged or disrupted. Satellites offer a resilient alternative by providing uninterrupted communication channels for emergency responders, enabling them to coordinate rescue efforts and provide assistance efficiently.
- **Redundancy and Backup:** Space-based communication systems serve as redundancy and backup for terrestrial networks. In case of network failures or outages on the ground, satellite communication can seamlessly take over, ensuring continuity of communication services.
- **Mobility and Flexibility:** satellites can provide communication services to mobile platforms such as ships, aircraft, and vehicles, as well as to individuals in remote locations. This mobility and flexibility are essential for various applications, including maritime communication, aviation, military operations, and disaster response.
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- **Security and Reliability:** Space-based communication systems offer secure and reliable communication channels, particularly for sensitive applications such as military operations, government communications, and financial transactions. These systems are less susceptible to interception, tampering, or sabotage compared to terrestrial networks.
- **Broadband Connectivity:** with the advancement of satellite technology, modern communication satellites can provide high-speed broadband connectivity to users worldwide, including in rural and underserved areas where terrestrial infrastructure is lacking.
- **Future Expansion and Innovation:** Space technology continues to evolve, with ongoing advancements in satellite design, propulsion systems, and communication protocols. These advancements pave the way for future innovations in resilient communication systems, including the deployment of large constellations of small satellites and the integration of Space-based networks with terrestrial infrastructure.



Resilient Communication systems offer benefits across various sectors, due to their ability to maintain connectivity and functionality in adverse conditions:



Emergency Services and Disaster Management: critical for emergency services and disaster management. They ensure that first responders can communicate effectively during crises, coordinate rescue efforts, and provide timely assistance to affected populations, even when terrestrial infrastructure is damaged or overwhelmed.



Healthcare: enabling remote patient monitoring, telemedicine consultations, and real-time data exchange between healthcare providers. These systems enhance patient care, especially in rural and underserved areas where access to medical facilities may be limited.



Transportation and Logistics: essential for the transportation and logistics industry to track shipments, manage fleets, and ensure the safety and efficiency of operations. They provide real-time information on routes, weather conditions, and vehicle status, enabling companies to optimize logistics processes and respond promptly to disruptions.



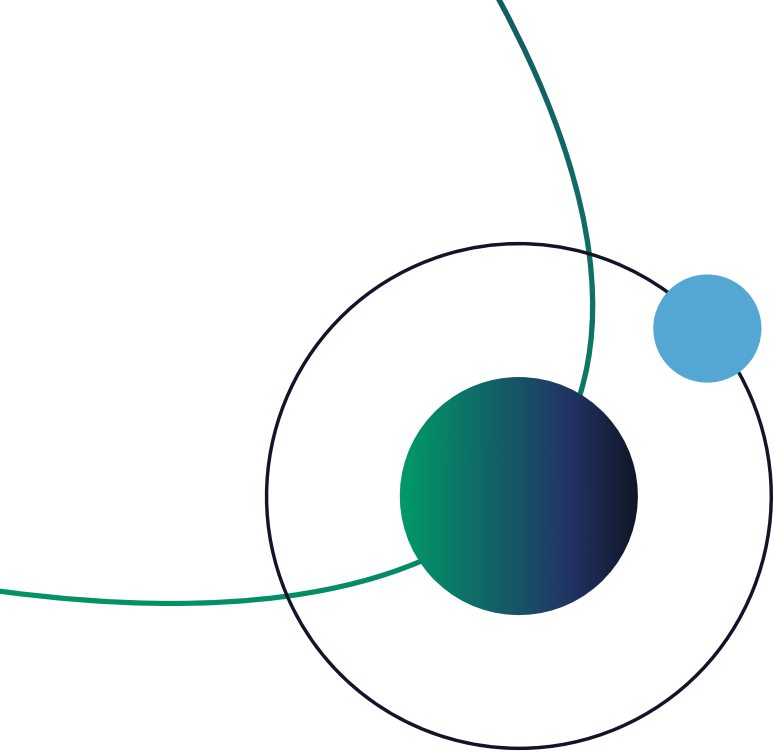
Smart Cities: the backbone of smart city initiatives by enabling the integration of various IoT devices, sensors, and data analytics platforms. These systems facilitate real-time monitoring and management of urban infrastructure, including transportation networks, energy grids, waste management systems, and public services. They improve operational efficiency, enhance public safety, and optimise resource utilisation, thereby creating more sustainable and liveable urban environments.



Defence and Security: indispensable for defence and security operations, providing military forces, law enforcement agencies, and homeland security personnel with secure and reliable communication channels. These systems support command and control functions, intelligence gathering, surveillance, reconnaissance, and situational awareness activities. They enable swift response to threats, rapid deployment of resources, and effective coordination among personnel in dynamic and high-stakes environments, enhancing national security and safeguarding public safety.



Education and Remote Learning: enabling remote learning and distance education initiatives by providing students and educators with access to digital learning resources, virtual classrooms, and interactive online platforms. They bridge the gap between traditional and remote learning environments, expanding educational opportunities and promoting lifelong learning.



109

RESILIENT COMMUNICATION COMPANIES

96

RESEARCH ORGANISATIONS



Agriculture and Rural Development:

supporting agricultural productivity and rural development by providing farmers with access to weather forecasts, market information, and agricultural best practices. They facilitate precision farming techniques, crop monitoring, and livestock management, helping farmers improve yields, reduce costs, and enhance sustainability.



Utilities and Infrastructure: crucial to managing critical infrastructure such as power grids, water distribution networks, and transportation systems. They enable remote monitoring, control, and maintenance of infrastructure assets, helping to minimize downtime, prevent failures, and improve overall reliability.



Government and Public Services:

support of government agencies and public services in delivering essential services to citizens, including law enforcement, public safety, education, and civic engagement. They facilitate communication between government agencies, emergency responders, and the public, fostering transparency, accountability, and effective governance.



Business Continuity and Enterprise

Operations: vital for ensuring business continuity and maintaining productivity in commercial enterprises. They enable seamless communication and collaboration among employees, customers, and partners, regardless of location or external disruptions, thereby safeguarding operations and minimizing financial losses.



In the North of England's long established tradition of innovation and collaboration, 'Space North' has convened to support further advancements in research and commercialisation that contribute to sustainable prosperity.



RESONANCE

This brochure was created together with Resonance, a global provider of data & market intelligence on emerging technology industries. The remainder of this brochure contains an extensive overview of our joint capability mapping exercise, and aims to inform you of the wide range of Space North's capabilities in the Resilient Communications sector.

Disclaimer: These materials have been prepared by Resonance for general informational purposes only, and they are not intended to be, and should not be construed as, financial, legal, or other advice. In preparing these materials, Resonance has assumed and relied upon the accuracy and completeness of any publicly available information and of any other information made available to Resonance by any third parties, as of 29 February 2024, and Resonance has not assumed responsibility for independent verification of such information. Subsequent developments may affect the information set out in this document, and Resonance assumes no responsibility for updating or revising these materials.



03

EXECUTIVE SUMMARY



SPACE NORTH CAPABILITIES

Space North boasts, among others:

- **A strong manufacturing sector adept at producing high-performance materials, tailored for Space-based applications.**

Companies in the region offer extensive capabilities in producing structural materials, semiconductors, ceramics for optical technologies, antennas, electronics, radio frequency (RF) components, and satellite complete payloads. They are supported by a plethora of local research organisations, including the National Graphene Institute, the National Nuclear Laboratory and the Henry Royce Institute, as well as numerous academic centres specialised in materials development, instrumentation, and manufacturing processes.
- **Pioneering expertise in optical applications,** exemplified by its contributions to prestigious and complex projects such as the Hubble and James Webb telescopes. Universities like Durham and Northumbria stand out as academic leaders in this field, driving research and innovation. Major defence contractors like Leonardo, Lockheed Martin, and Raytheon are making substantial R&D investments in the area, particularly in wireless satellite charging and optical inter-satellite links. Emerging quantum-based solutions, such as those developed by start-up Aegiq, are further poised to revolutionise satellite optical communications and add more unique capabilities to the region.
- **A variety of connectivity integrators facilitating access to communication networks and data across sectors,** with a particular emphasis on maritime, transport, and logistics. Complementing this ecosystem are research organisations such as Lancaster's Communication Systems Research Group and universities across the region, including Bradford, Durham, Lancaster, Leeds, Liverpool, Newcastle, Northumbria, Sheffield, and York, renowned for their contributions to electronics and satellite communications research.
- **Leading cybersecurity and IT infrastructure.**

Space North benefits from the expertise of major public organisations like GCHQ in Manchester, the MoD/GCHQ 'National Cyber Force' in Lancashire, and cybersecurity clusters like CyberNorth, as well as RAF facilities with leading cybersecurity capabilities. Universities within the region, including Durham University, Manchester Metropolitan University, University of Huddersfield, Newcastle University, Northumbria University, University of Sunderland, Teesside University, University of Central Lancashire, and Lancaster University, conduct cutting-edge research in cybersecurity, ensuring the resilience and security of communication networks.

CASE STUDY



Filtronic: Pioneering RF, Microwave, and mmWave Solutions

North East-based Filtronic is a designer and manufacturer of advanced radio frequency (RF), microwave, and millimeter-wave (mmWave) components and subsystems for mission-critical communication networks. With over four decades in the industry, the company's award-winning solutions address a variety of complex use cases, including telecommunications infrastructure, aerospace and defence, Space, test & measurement, quantum computing, and critical communications.

These vital technologies form the backbone of resilient communication systems, enabling seamless data transmission and connectivity across a wide range of applications, including satellite communications, radar systems, and telecommunications.

Radio frequency ("RF") design is a complex and fast developing engineering discipline. [...] [Filtronic's] ability to undertake rapid cutting-edge edge high-frequency RF design, and subsequently scale the manufacturing of mmWave products, enables customers to maximise performance and optimise communication networks. This combination of technical competence and agility is a significant competitive advantage for customers in the telecommunication and LEO Space markets.

– Nat Edington, CEO, Filtronic

As one of the few independent companies in the UK with expertise in Monolithic Microwave Integrated Circuit (MMIC) design, RF hardware design, and RF manufacturing, Filtronic occupies

a unique niche within the nation's Space tech ecosystem. This vertically integrated approach allows the company to control the design, development, and production processes, ensuring quality and performance.

Strategic Partnerships

Filtronic recently announced a strategic partnership with industry giant SpaceX, including a strategic investment and several high-value orders (£16 million) for E-band Solid State Power Amplifiers (SSPA), scheduled for delivery in 2025.

SpaceX has committed to ongoing orders for the next five years to ensure Filtronic remains a key part of its supply chain, supporting the continued deployment of the Starlink constellation. The two companies will also collaborate on developing and delivering products across multiple frequency bands for the Starlink platform.

Born and Bred in Northern England

Founded at Leeds University by Professor David Rhodes, Filtronic is one of the largest companies to spin out of a UK University. The company maintains its deep ties to Northern England with an HQ based in Sedgefield and facilities in Leeds and Manchester.

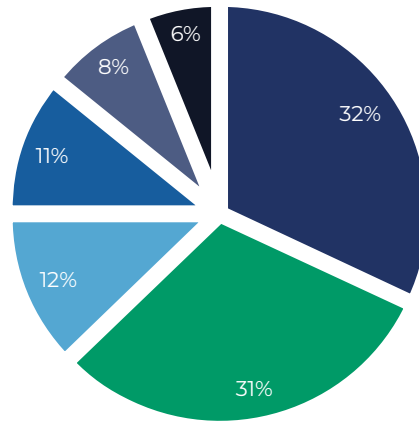
Filtronic's strategic roadmap positions the company to effectively capitalise on commercial government initiatives. By aligning with national government investment priorities, including defence, sovereign supply chains, and space (with a focus on LEO constellations), Filtronic is well-placed to leverage these opportunities for growth and development.

INDUSTRIAL CAPABILITIES

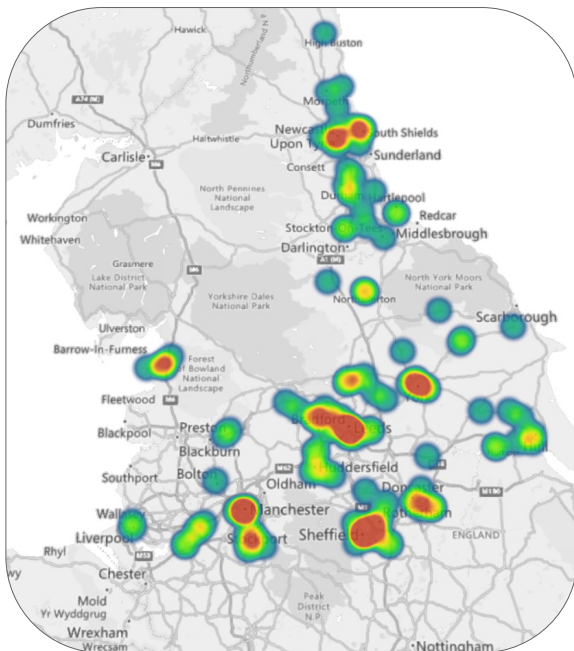
Leveraging proprietary data, desk-based research, and direct interviews with key stakeholders, this report is based on a comprehensive overview of **110 Resilient Communication companies** across the North of England.

Out of the 110 Resilient Comms companies, the largest group are satellite subsystem and/or component manufacturers (31%). Ground equipment manufacturers are the second largest category (12%), followed closely by IT & Cybersecurity (11%), network integration & monitoring service providers (8%) and engineering firms (6%).

RESILIENT COMMUNICATIONS COMPANIES



- OTHER (32%)
- SATELLIE SUBSYSTEM AND/OR COMPONENT MANUFACTURERS (31%)
- GROUND EQUIPMENT MANUFACTURERS (12%)
- IT & CYBERSECURITY (11%)
- NETWORK INTEGRATION & MONITORING SERVICE PROVIDERS (8%)
- ENGINEERING FIRMS (6%)



SPACE NORTH HOTSPOTS
(BY NO. OF COMPANIES)

Significant “hotspots” of commercial activity exist across Durham, Leeds, Manchester, Sheffield, Newcastle and Lancaster – as outlined in the below heatmaps.

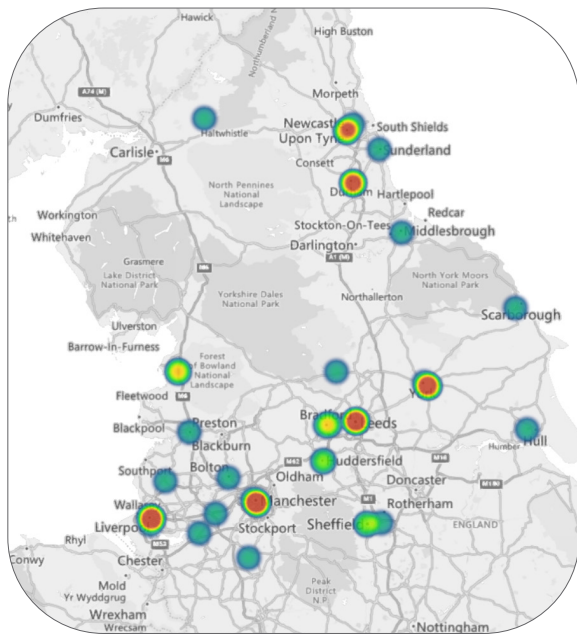
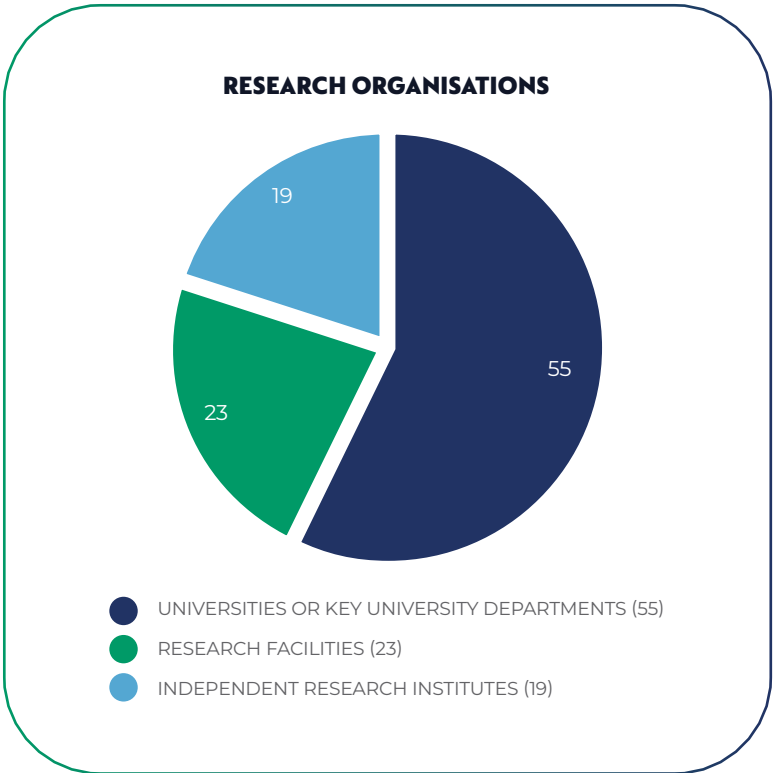
Crucially, we note that 61% of all companies are part of international businesses, including industry giants such as BAE Systems, Honeywell, Lockheed Martin, Jacobs, Kratos Communications, MDA, Northrop Grumman, Raytheon UK, Teledyne, and Telespazio UK, underscoring Space North’s outward-looking focus and global nature.

RESEARCH CAPABILITIES

In addition to the thriving private ecosystem, Space North benefits from the presence of at least **97 research organisations that contribute significantly to the advancement of resilient communications.**

These academic institutions serve as hubs of innovation, offering access to cutting-edge research, specialised training programs, and a significant talent pool that can meet the demands of the sector.

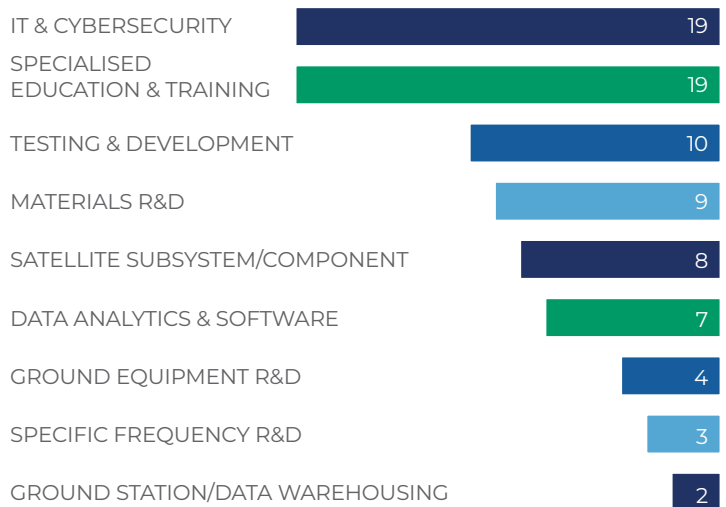
The 97 research organisations identified include 55 universities or key university departments (with relevant Resilient Comms capabilities), 23 research facilities, and 19 independent research institutes.



SPACE NORTH HOTSPOTS
(BY NO. OF RESEARCH ENTITIES)

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.

They also include respective focus areas on cybersecurity (19), education & training (19), testing facilities (10), advanced materials R&D (9), satellite subsystems (8), data analytics software (7), and ground stations and equipment (4). Other organisations include those focused on business support, RF and optical communications, HAPS, QKD and best practice engineering.





04

LOCAL CAPABILITIES

PART 1: COMPANIES

Resilient Communications Companies by Primary Classification



Source: Resonance

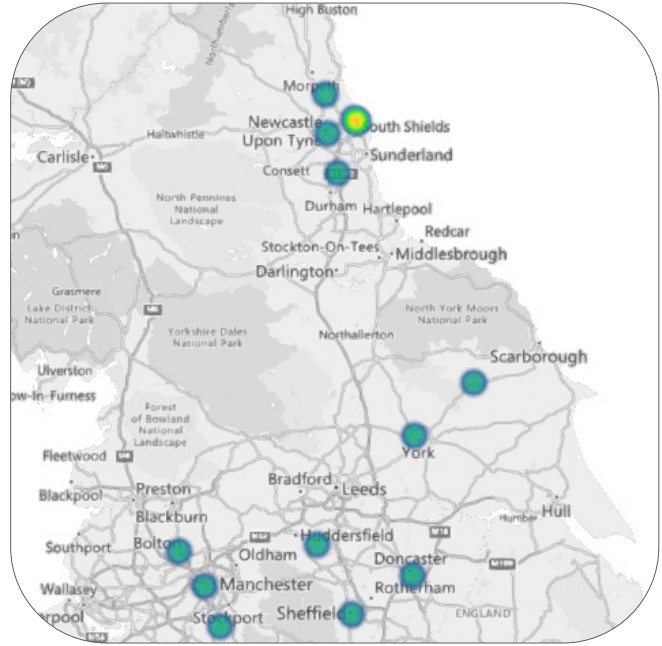
NB: THE ABOVE CLASSIFICATIONS ARE INHERENTLY A SIMPLIFICATION, AIMED TO BROADLY CATEGORISE KEY CAPABILITIES IN THE SPACE NORTH REGION. MANY COMPANIES DEPICTED ABOVE HAVING BUSINESS ACTIVITIES ACROSS MULTIPLE SEGMENTS.

1.1

CONNECTIVITY


Resilient Communication solutions are the backbone of data and information transfer. Space North companies provide an infrastructure that complements terrestrial capabilities with access to satellite services, particularly via satellite terminals for maritime and logistical applications.

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.






CONNECTIVITY CAPABILITY HOTSPOTS (BY NO. OF COMPANIES) WITHIN SPACE NORTH



HIGH ALTITUDE PSEUDO SATELLITES (HAPS) / STRATOSPHERIC

	<p>Durham</p>	<p>Tao Tech builds and operates high-altitude communication platforms (HAPS) for telecoms, mapping, and observation purposes and provides the altitude launch of nano and micro Satellites. Their CHAP (Communications High Altitude Platforms) are capable of coastal monitoring, mapping data services, remote access communications stations, and humanitarian search and rescue operations.</p>
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MANAGED SERVICES PROVIDER

	<p>Huddersfield</p>	<p>ARQIVA is a supplier of national terrestrial television and radio broadcasting services in the UK. It delivers digital TV, analogue and digital radio to people in all four corners of the country. They distribute over 1,000 channels internationally using their own fibre and satellite infrastructure.</p>
	<p>York</p>	<p>Cellhire offers a range of connectivity and data solutions, including Mobile Satellite Services (MSS), M2M/IoT services, and enterprise data. The company is a reseller of Inmarsat, Iridium, and Thuraya networks. The multi-network partnership allows Cellhire to deploy tens of thousands of SIM cards remotely and provide a wide range of options to customers for devices that frequently move between different countries.</p>
	<p>Tyneside</p>	<p>Nomad Digital is a world-leading provider of passenger and fleet management solutions to the transport industry. They offer a broad solutions portfolio to both train operators and manufacturers that facilitates a significantly enhanced passenger experience with seamless connectivity, real-time journey information and onboard entertainment.</p>







MANAGED SERVICES PROVIDER

	<p>Tyneside</p>	<p>Satcom Global is a leading provider of global satellite services to the maritime, land and aero markets, and a trusted supplier of marine and offshore safety systems and engineering services. They provide voice and data solutions for users in remote locations outside terrestrial networks, and design and integrate systems ensuring safety in the most hazardous of environments.</p>
<p>Satstream Media Limited</p>	<p>Northumberland</p>	<p>Satstream Media are a software and communications company specialising in the development and operation of bespoke service platforms and applications for the mobile satellite market. Their focus is on the maritime sector, although the technology can be adapted to support other markets including land transport and aeronautical.</p>
	<p>Tyneside</p>	<p>Succorfish powers organisations with intuition using machine intelligence, enabling them to make decisions that matter. They provide fully integrated solutions, from design to deployment, that are focused on connecting users with information and insight across multiple sectors, with a particular focus on maritime and sub-sea activities.</p>
<p>TalkTalk For Everyone</p>	<p>Gateshead</p>	<p>Since the early 2000s, TalkTalk offers entertainment to the general public, offering antenna installation for telecoms and TV, as well as ground-based broadband connectivity installation.</p>



QUANTUM KEY DISTRIBUTION (QKD) PROVIDERS

	<p>Sheffield</p>	<p>Aegiq offers a portfolio of products and solutions covering frontier cybersecurity, quantum networking, quantum-enhanced sensing, and quantum computing. Aegiq services governments and global leaders in R&D, telecommunications, defence and aerospace, financial, and advanced manufacturing sectors.</p>
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SATELLITE TERMINAL SALE / INSTALLATION

	<p>Malton</p>	<p>CommScope provides advanced enterprise broadband and wireless network solutions. The company has expertise in deploying fibre and rolling out network solutions, also developing antennas and various components utilised in wireless network deployment.</p>
	<p>Wilmslow</p>	<p>GoStarLink stands at the forefront of Starlink installation services in the UK, having installed nearly 150 terminals to date.</p>
	<p>Durham</p>	<p>Inotec Solutions have developed deployable 4G and 5G integrated networks that can optimise the communication systems of critical workers on the ground, providing security, reliability, and resilience.</p>
	<p>Greater Manchester</p>	<p>NEP Connect operates Europe's largest fleet of mobile satellite uplink vehicles to suit any size of production, delivering vision, audio and talkback from sites all over the world. This includes UHD production units, HD compact uplinks, hybrid (fibre and satellite) connectivity vehicles and dual HD uplink vehicles. Notably, their AnyLive® Fiber Network connects over 240 locations, including major broadcasters and sports venues.</p>
	<p>Doncaster</p>	<p>Ninehundred Communications specialises in enabling building sites to remain inter-connected and secure, even in the most remote areas. They provide and install satellite connectivity ground equipment and devices, including broadband and satellite phones.</p>
	<p>Greater Manchester</p>	<p>As a leading internet service provider in Zimbabwe, Zodsat have set up a presence in the UK to collaborate with British connectivity companies in providing essential VSAT and High-Speed Fibre internet to connect homes, communities, and businesses across their home country.</p>

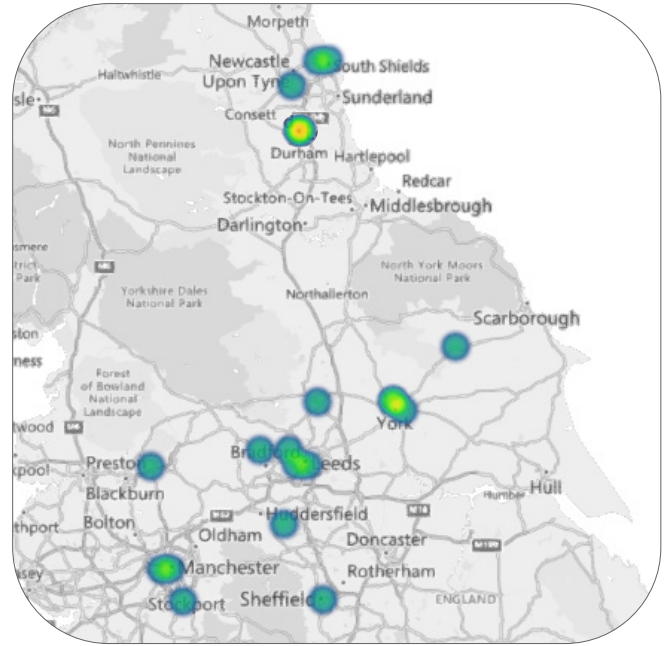
VERTICALLY INTEGRATED SATELLITE CONNECTIVITY

	<p>Northumberland</p>	<p>WEIGHTLESS.SPACE are developing low power, robust, and secure communication protocols - based on their OpenWEIGHTLESS suite optimised for ground-to-satellite connections - to enable effective transmissions with high value assets in mission critical or emergency situations. Their protocols are primarily designed for low spectrum (sub-1GHz), but also support implementations in higher frequencies like the satellite broadband spectrum.</p>
	<p>Manchester</p>	<p>MDA Digital Communications is a renowned entity in the Space industry, specialising in payload solutions for satellites. Their technology involves advanced digital signal processing, enabling more flexible and efficient satellite services. The company has also recently acquired SatixFy, a company specialising in developing advanced satellite and quasisatellite communication technology.</p>

1.2

GROUND

The ground segment of Resilient Communications infrastructure plays a pivotal role in ensuring the seamless integration and operation of satellite-based systems. Space North’s ground-based capabilities encompass a spectrum of technologies, including ground station equipment, RF sub-systems, and power amplifiers, as well as software for network simulations, operations, and monitoring.



GROUND-FOCUSED CAPABILITY HOTSPOTS (BY NO. OF COMPANIES) WITHIN SPACE NORTH

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.





GROUND EQUIPMENT MANUFACTURE

	<p>York</p>	<p>Antennas Research specialises in antenna and microwave design for satellite communications and radar. They also offer consultancy services in antenna component design, especially for research and development, prototypes and low or medium-volume manufacturing.</p>
	<p>York</p>	<p>BSC Filters is a specialist in developing microwave and RF filters. Their products include waveguide, coaxial, and dual-mode filters, designed with precision for high-frequency applications. Their filters are technically distinguished by their low insertion loss, high rejection, and temperature stability, making them ideal for satellite communication systems.</p>
	<p>Harrogate</p>	<p>Comms Design is a high-tech design and manufacturing organisation specialising in electronic products for the rail industry, including mobile base stations and radio products. Their expertise extends to a range of capabilities, including embedded and application software development, mechanical engineering design, electronic hardware design, state-of-the-art radio coverage planning and simulation, training, support and maintenance, and end-to-end product development.</p>
	<p>Malton</p>	<p>CommScope provides advanced enterprise broadband and wireless network solutions to power progress and create lasting connections. The company has expertise in deploying fibre and rolling out network solutions, as well as developing antennas and various components utilised in wireless network deployment.</p>
	<p>Sheffield</p>	<p>Curvalux provides high-capacity, long-range, and low-cost systems to reduce the cost of deployment, operations, and consumer adoption of broadband services worldwide. Their end-to-end systems operate in both licensed and unlicensed frequency bands of 2.4G and 5 to 6 GHz.</p>



GROUND EQUIPMENT MANUFACTURE

	<p>Bradford</p>	<p>Diamond Microwave manufactures compact, high-power microwave solid-state power amplifiers (SSPA) with power output ranging from 100W to 1kW and operating in specific frequency bands between 2GHz and 18GHz. The company believes its SSPA's power-to-volume ratio is one of the best in the industry, with applications such as radar, communications, medical, and routine laboratory use.</p>
	<p>Accrington</p>	<p>Global Invacom Limited is a specialist in the development and manufacturing of satellite communications equipment. Their unique product lineup includes advanced Satellite-to-IP Converters, digital stackers, and Fibre Integrated Reception Systems (FIRS), offering seamless integration of satellite, terrestrial and FM signals into a single fibre output.</p>
	<p>York</p>	<p>Hyper Sciences provides a comprehensive range of services to extend the life of ground-based communications legacy systems, offering full life cycle support and technical innovation on a global scale. They have extensive experience in HF, VHF, and satellite communications, electronic warfare and signal intelligence systems, and physical, electronic, and network security.</p>
	<p>Durham</p>	<p>Inotec Solutions have developed deployable 4G and 5G integrated networks that can optimise the communications systems of critical workers on the ground, providing security, reliability, and resilience.</p>
	<p>Tyneside</p>	<p>Kratos Communications design and manufacture antenna systems that meet the high performance, accuracy, and high reliability needs of demanding satellite tracking applications and mission-critical uplink and downlink applications. Their newly expanded portfolio includes transportable and fixed earth station antennas ranging from 2.5-meter to 18-meter in diameter, radar antennas for air traffic control and weather applications, and lines of High-Frequency (HF) and specialty antennas.</p>
	<p>Manchester</p>	<p>Milexia UK specialises in the production and distribution of RF & Microwave components, including frequency converters, low-noise amplifiers, and filters. The company also provides extensive ground equipment for downlink and uplink of satellite data across a large variety of bands.</p>
	<p>Leeds</p>	<p>Novella Satcoms was formed in 1997 and is now an established supplier of high-performance RF equipment and solutions for satellite Earth stations and CATV systems. Their product range provides full coverage up to the Ka-band and includes synthesised frequency converters, block converters, beacon tracking receivers, uplink power controllers, redundancy systems and other bespoke RF solutions.</p>
	<p>Tyneside</p>	<p>NSSL Global's expertise lies in developing, designing, and integrating solutions across networks in the maritime, energy, media, enterprise, and government sectors. From advanced communication systems to complex NavCom projects and smart logistics solutions, the company offers both hardware and software to enable connectivity in these sectors, including the use of satellite communications and location tracking.</p>

GROUND EQUIPMENT MANUFACTURE

	<p>Greater Manchester</p>	<p>POAM have years of experience supplying professional radio telescopes and tracking antennas, including the design, installation, and complete oversight of whole projects. POAM's products can be optimised for use in radio or solar astronomy, Space-based applications, radar, telemetry, or deep-space communication. Their antenna sizes start from 3m to 12m in diameter, offering full customisation based on your target applications.</p>
	<p>Sedgefield</p>	<p>Raytheon NORSS develop ground-based Low-Earth Orbit Camera sensors, known as LOCI, to routinely collect observation data on objects in LEO, including space debris, defence assets and commercial satellites. The UK Space Agency has contracted the company to help expand and improve the UK's sovereign Space domain awareness capabilities.</p>
	<p>Leeds</p>	<p>Sara's Technology provides world-class RF and microwave capabilities, offering custom engineering for a safer world. Their main expertise lies in Power Amplifiers, Filters, and RF Subsystems up to 40GHz, supplying the Defence, Aerospace, Telecom, Surveillance, and Broadcast Markets.</p>
	<p>Tyneside</p>	<p>The Aura VSAT portfolio from Satcom Global delivers high-bandwidth Ku-Band services to provide industry-leading flexibility and value for maritime broadband applications, including commercial shipping, fishing, leisure, and offshore markets.</p>

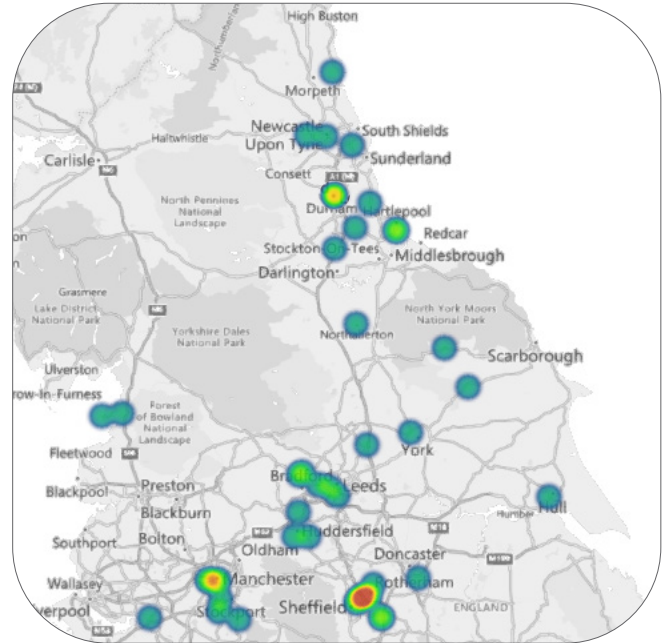
GROUND STATION OPERATION

	<p>Leeds</p>	<p>AQL specialise in providing secure, reliable wholesale access to fixed and mobile networks, with nearly 20 years of experience in streamlining B2B and B2C communications. Working across messaging, voice, data centre, connectivity and M2M & IoT, AQL securely handles millions of connectivity minutes per day via their integrated network, including a chain of satellite teleports and ground stations.</p>
	<p>Huddersfield</p>	<p>ARQIVA manages over 150 antenna and four teleports and gateways for broadcasting and dedicated networks for managing critical data and content for connected devices including smart TVs and smart meters for water, gas and electricity.</p>

1.3

MANUFACTURING





High-quality manufacturing processes ensure the reliability, durability, and performance of communication systems, contributing to their ability to withstand adverse conditions and deliver uninterrupted connectivity. Space North brings together an extensive heritage of manufacturing capabilities, leveraging expertise from industries like aerospace, automotive, and nuclear to deliver materials, components, and satellite subsystems to exceedingly high standards.







RELEVANT MANUFACTURING CAPABILITY HOTSPOTS (BY NO. OF COMPANIES) WITHIN SPACE NORTH

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.

MATERIALS MANUFACTURE

	<p>Leeds</p>	<p>Arville Textiles specialises in producing high-performance materials used in a diverse range of environments and applications. Their advanced weaving technology produces fabrics with unique properties, such as extreme temperature resistance, low outgassing, and high tensile strength, ideal for Space-based applications. The company is currently researching and developing fuselage for UAVs/HAPs aimed to be used in connectivity.</p>
	<p>Sheffield</p>	<p>Dynamic Metals sources and supplies high-grade metals. As well as cutting and supplying from their extensive stock range of titanium, stainless steels, nickel alloys, alloy steels and aluminium, they also have the relationships needed to source more exotic, 'hard to find' metals and the equipment and skills to process them on site.</p>
	<p>Sheffield</p>	<p>Forged Solutions Group Limited specialises in the design and manufacture of high-integrity forged components for the Space industry. Their offerings include advanced titanium and high-performance alloy forgings, meticulously designed with a focus on precision, durability, and adherence to stringent industry standards.</p>
	<p>Durham</p>	<p>Graphene Composites are a world leader in advanced and nano-materials research design, supporting clients to develop breakthrough solutions and enhance existing product performance with a vast network of suppliers and manufacturers. They develop composites that have similar performance as carbon-fibre composites – but with better strength to weight ratios.</p>


MATERIALS MANUFACTURE

	<p>Sheffield</p>	<p>ICD Europe specialises in the supply and distribution of high-quality metals and alloys for the Space industry, including titanium, nickel alloys, and stainless steel. ICD Europe also offers precision machining services, providing custom component production with rigorous quality control.</p>
	<p>Tyneside</p>	<p>INEX is a leading full-service compound semiconductor development and fabrication company. They have extensive in-house compound semiconductor and MEMS development and manufacturing expertise, working with customers to develop advanced gallium nitride, indium antimonide and silicon carbide based devices as well as other novel materials.</p>
	<p>Todmorden</p>	<p>Mitsubishi Chemical Advanced Materials specialises in the production of high-performance polymer solutions, including thermoplastic composites, lightweight structural components, and heat-resistant plastics. Their carbon fibre composites, in particular, have been selected and used by several satellite manufacturers.</p>
	<p>Durham</p>	<p>SEEDS is a deep-tech company specialising in researching and developing printable nanomaterials to improve the performance of battery and solar technologies. This includes printable supercapacitors that can be spray coated onto arbitrarily shaped surfaces to provide auxiliary power boosts.</p>




SATELLITE PAYLOAD MANUFACTURE

	<p>Manchester</p>	<p>MDA Digital Communications is a renowned entity in the Space industry, specialising in payload solutions for satellites. Their technology involves advanced digital signal processing, enabling more flexible and efficient satellite services. The company has also recently acquired SatixFy, a company specialising in developing advanced satellite and quasi-satellite communication technology, currently partnering with OneWeb to develop a digital, electronically steered multi-beam array (ESMA) payload.</p>
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SATELLITE INTEGRATION

	<p>Rotherham</p>	<p>Arkeik was set up in 2017, in collaboration with the University of Sheffield's Advanced Manufacturing Research Centre (AMRC), to explore how high-altitude balloons could be used to take a small payload up to an altitude, where they could be orientated and then launched into Low Earth Orbit (LEO). The company has already carried out test flights reaching 5km above sea level and is currently developing a working prototype.</p>
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SATELLITE MANUFACTURE

	<p>Northallerton</p>	<p>AmbaSat designs and builds LEO Space satellite kits, which are the foundation of a new class of 'sprite' satellites. These kits are low-cost miniature satellites used for environmental research, STEM experiments, and IoT applications. These Arduino-based DIY satellites are designed with interchangeable sensor boards, enabling customisation for specific research needs.</p>
	<p>Greater Manchester</p>	<p>Northrop Grumman supports the UK and MoD efforts with military satellite design and build via the SKYNET programme, focusing on secure communications in the field.</p>
	<p>Manchester</p>	<p>Space Systems specialise in the comprehensive design, construction, and manufacturing of AI-powered CubeSats that seamlessly integrate mobile communication, broadband, Earth observation, and IoT functionalities. Their satellite networks operate in the S, X, Ka and Ku frequency bands and rely on AI to elevate their capabilities to process and interpret data.</p>

SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Malton</p>	<p>Established in 2001, A1 Microwave is a leader in high-quality, technically advanced microwave filtering and associated products for the Satcom, Radar, Communications, Test-Equipment, Scientific and Medical markets. The company designs and manufactures filters, diplexers, couplers, combiners, adaptors and waveguide assemblies, including for build-to-print applications.</p>
	<p>Rotherham</p>	<p>AMG Alpoco is a world leader and major producer of air and gas atomised aluminium powders, aluminium alloy powders and aluminium granules for several industrial applications and Space hardware, including spacecraft structures and propulsion systems, with over 70 years of experience in the sector.</p>
	<p>Sheffield</p>	<p>Arnold Magnetic Technologies is a leading global manufacturer of high-performance permanent magnets, flexible composites, electromagnets, magnetic assemblies, and precision thin metal foils. Arnold's magnets, metals, and systems are used in high-efficiency electric motors and generators, sensors, batteries, and more.</p>
<p>aXenic</p>	<p>Durham</p>	<p>aXenic specialises in the design, development and production of optical modulators for communications and sensing, particularly in the field of satellite communications. The company's capability includes semiconductor design for GaAs and InP, packaging and test and measurement.</p>
	<p>Kingston upon Hull</p>	<p>Bollhoff Limited specialises in fastening and joining products for high-end equipment and manufacturing. The company offers unique products such as Rivnut and Helicoil, aimed at providing improved force and vibration resistance to threads in thin-walled or low-shear-strength components.</p>
	<p>Northumberland</p>	<p>Boyd Technologies specialises in creating innovative solutions for thermal management, sealing, and protection in the aerospace industry. Their products, such as custom-engineered thermal interface materials and EMI shielding, are designed with advanced material technologies and precise engineering to withstand extreme conditions in Space.</p>

SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Sheffield</p>	<p>CCPI Europe specialises in the design and manufacture of precision temperature measurement devices, specifically thermocouples and resistance temperature detectors. The company manufactures calibration and thermocouple products that are utilized in the Space industry value chain.</p>
	<p>Sheffield</p>	<p>Whether the application is for sensing an actuator position, using magnets to detect fluid flow rates, making magnetic fuel pumps, through to magnets for use in high-temperature generators, Eclipse Magnetics can design and produce products to meet their clients' requirements. Their solutions aim to provide weight reduction, miniaturisation, higher efficiency, greater holding force, improved pull versus distance, cost reduction and even reduction of rare earth material use.</p>
	<p>York</p>	<p>Edmund Optics is a leading global optical solutions provider of high-precision optical components for the Space industry, including lenses, mirrors, filters, and prisms. Their products, designed with a focus on high resolution and low distortion, are integral to imaging systems in satellites and telescopes. They have also served a variety of other markets including Life Sciences, Biomedical, Industrial Inspection, Semiconductor, R&D, and Defence since 1942.</p>
	<p>Leeds</p>	<p>Excel Precision is the UK's leading group of EDM specialists providing wire and spark erosion, which is essential in creating precision components for spacecraft. Excel Precision are approved by MT Satellite Products – PS-S415 - and are part of the group which manufactured a critical component contained with the BAPS Structure used in the Sentinel 2A Satellite.</p>
	<p>Durham</p>	<p>Filtronic is a developer and manufacturer of RF-to-mmWave components and subsystems for near-space applications. As experts in designing components for 5G XHaul, they support the industry in moving up the frequency spectrum from E-Band to W-Band and D-Band, to deliver the extra bandwidth required. In April 2024, Filtronic partnered with SpaceX to supply E-band SSPAs and develop products for Starlink's frequency bands.</p>
	<p>Heysham</p>	<p>Forsberg Services Limited is a UK-based company specialising in precision navigation solutions within the space industry. Their core expertise lies in creating and integrating GPS and GNSS systems, providing high-accuracy positioning and timing solutions. The company's technical prowess is evident in its GNSS augmentation system that enhances GPS signal reliability and accuracy.</p>
	<p>Manchester</p>	<p>Honeywell has been part of every NASA crewed Space mission for almost 60 years and has components onboard 950 satellites and counting. This includes electronics, RF components, avionics, navigation and control systems, propulsion, optical instruments, and many more.</p>
	<p>Tyneside</p>	<p>INEX is the UK's leading full-service compound semiconductor development and fabrication company. The company develops and manufactures advanced compound semiconductor and MEMS devices used in a range of applications including critical sensing systems for defence, next-generation communication systems, and high-efficiency power conversion systems for energy and e-mobility.</p>

SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Durham</p>	<p>ISOCOM specialises in the design and manufacturing of optoelectronic components for Space applications. The company's products include infrared emitters, phototransistors, and optocouplers, which are designed to operate effectively in harsh Space environments and enable high-speed data transmission.</p>
	<p>Doncaster</p>	<p>LASER Additive Solutions are developing additive manufacturing (AM) technologies for a large of industries. Their expertise lies in Laser Metal Deposition (LMD), a form of AM that enables the creation of complex geometries and lightweight structures, crucial for a variety of Space equipment.</p>
	<p>Hartlepool</p>	<p>Established in 1987, Merlin Flex (formerly Flex-Ability) has vast experience in the design, manufacture and assembly of Flexible and Flex Rigid Printed Circuit Boards. Merlin Flex is a leading global supplier of flexible interconnection systems within the defence, aerospace, medical, instrumentation, robotics, and telecoms industries.</p>
	<p>Manchester</p>	<p>Milexia UK specialises in the production and distribution of RF & Microwave components, including frequency converters, low-noise amplifiers, and filters. The company also provides extensive ground equipment for downlink and uplink of satellite data across a large variety of bands.</p>
	<p>Lancaster</p>	<p>Formed in 2009, Milliamp's team of expert engineers has vast experience in a variety of market areas – from the bespoke design of one-off equipment for extreme hi-reliability industrial environments such as aerospace, oil, gas and nuclear, to price-sensitive mass-produced consumer electronics.</p>
	<p>Manchester</p>	<p>MDA Digital Communications is a renowned entity in the Space industry, specialising in payload solutions for satellites. Their technology involves advanced digital signal processing, enabling more flexible and efficient satellite services. The company has also recently acquired SatixFy, a company specialising in developing advanced satellite and quasi-satellite communication technology. Their product suite includes silicon-based chipsets, modems, and phased array antennas, featuring proprietary SoC technology with multi-beam capability.</p>
	<p>Northallerton</p>	<p>Mowden Controls have been creating and delivering innovative, market-leading electronic solutions to customers since 1965, across a diverse product range. As a leading Contract Electronics Manufacture (CEM) in advanced manufacturing of electronics hardware, Mowden are trusted by partners at the forefront of these technologies on products including radar systems, satellite communications boards, telecommunications (inc. 5G), and subsea transmission.</p>
	<p>Durham</p>	<p>Nascent Semiconductors, a spin-out from Durham University, provide high-reliance electronic capabilities for extreme environments by fabricating devices from the Wide Band-Gap Semiconductor Silicon Carbide (SiC). Their technology offers the possibility of remote monitoring in extreme environments, enabling the Internet of Everything Everywhere (IoEE).</p>



SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Tyneside</p>	<p>Northumbria Optical Coatings was established in 1995, specialising in design and manufacture of Infrared Optical Filters and Coatings, covering the spectral range ~1.5um – 20.0um. Their filters have many applications including environmental monitoring, analysis and control of gaseous effluent, analysis of vehicle exhaust gases, ozone layer monitoring, night vision systems and Space applications.</p>
	<p>Daresbury</p>	<p>Olsen Actuators produces the world's leading range of Space-rated motor drive electronics that offer high power density and low backlash. Whether COTS, customised or fully bespoke, their motion control solutions are available with radiation-hardened components and Space-specific specifications to speed up design, testing and integration. Their products have been used on the Mars Rover and several LEO and GEO satellites.</p>
	<p>Brighouse</p>	<p>Peak Communications specialises in the design and manufacture of satellite communications equipment, including frequency converters, block upconverters, and satellite modems, all designed with advanced digital signal processing techniques and high-performance RF design. The company's innovative technology, such as the AUPC Automatic Uplink Power Control, provides essential functionality for satellite communication networks.</p>
	<p>Salford</p>	<p>Raytheon Systems contains a UK division focused on Cyber, Space, and Training. They offer distinct technologies like advanced satellite systems and integrated mission systems, designed for high functionality and resilience. The company has been involved in spaceflight since the global community set its eyes on the final frontier, with their guidance computers steering some of the first Space capsules, including Apollo 11.</p>
	<p>Huddersfield</p>	<p>Reliance Precision Engineering's products, including gears, couplings, and actuators, are designed for high performance in extreme environments, featuring low backlash, high torque, and long-life characteristics. Reliance's innovative designs have facilitated numerous Space missions, with their components being integral to the functioning of spacecraft propulsion systems, satellite positioning mechanisms, and robotic manipulators.</p>
	<p>Leeds</p>	<p>Sara's Technology provide world-class RF & Microwave capabilities, offering custom engineering for a safer world. Their main expertise lies in Power Amplifiers, Filters & RF Sub-Systems up to 40GHz, supplying Defence, Aerospace, Telecom, Surveillance and Broadcast Markets.</p>
	<p>Sheffield</p>	<p>Schaeffler are a system supplier for highly reliable special bearing applications, both in terms of the materials used and the design. In addition to the development of special bearings for turbopumps and Space systems, Schaeffler Aerospace offer complex and highly integrated bearing systems and electromechanical units including the relevant sensor systems.</p>
	<p>Leeds</p>	<p>Schunk Carbon Technology develop and manufacture high-performance carbon and ceramic materials for multiple industries, including Space. They are an experienced manufacturer of composite components with expertise in plastic matrix composites such as CFRP, GFRP, AFRP and ceramic matrix composites such as CFC, C/SiC, OFC, SiC/SiC or hybrid designs for multi-material lightweight construction.</p>

SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Bradford</p>	<p>Slipstream Engineering Design is a Digital and Microwave RF design company providing engineering services to the communication, aerospace and security industries. Slipstream Design's key areas of expertise are the design of power amplifiers, transponders, low-noise amplifiers, high-speed digital electronics and embedded controller software.</p>
	<p>Tyneside</p>	<p>Spincraft offers advanced metal forming technologies to design and manufacture cost-effective, single-source solutions for customers, with a robust experience in satellite and launch vehicle propellant tank domes. Their state-of-the-art manufacturing facilities house world-class capabilities including metal-forming, machining, heat-treating, welding, fabrication and more.</p>
	<p>Stockport</p>	<p>Founded in 1989, STI specialises in the design and manufacture of bespoke aerospace, defence and satellite communication products, having manufactured RF components and printed circuit board assemblies (PCBA) for nearly 40 years delivering to worldwide customers. Their expertise also extends to other sectors including energy and healthcare, particularly focusing on higher volume Internet of Things (IoT) products.</p>
	<p>York</p>	<p>Sylatech is a ground-breaking design and manufacturing business with a 60-year heritage of delivering precision custom engineering solutions for our customers, including waveguide assemblies for satellite communication applications. Covering S, C, X, Ku and Ka bands, their product design experience is significant across a wide-range of products and components including slotted array antennas, power dividers/combiners and rotary joints.</p>
	<p>Bradford</p>	<p>Teledyne UK provide advanced RF & Microwave solutions for the Space industry, including complex Integrated Microwave Assemblies (IMAs) and Electronic Support Measures (ESMs). Their Space-qualified RF and microwave portfolio covers frequencies from 5 MHz to Ka-band. Notably, they contributed to the Galileo satellite navigation system to provide enhanced system accuracy via high-performance oscillators</p>
	<p>Northumberland</p>	<p>TT Electronics craft tailored sensor and power management solutions to enhance precision, speed, and reliability for critical application aspects. Their customised, COTS, and MIL-spec products include innovative discrete semiconductors, microelectronics, sensors, and optoelectronics.</p>
	<p>Durham</p>	<p>VIPER RF produce a range of RF components for the satellite industry, including low-noise amplifiers, frequency converters, and synthesizers, with a frequency range of DC to 110GHz. The company has so far supplied over 10,000 monolithic microwave integrated circuits (MMIC): 10,000 to a LEO satcom mega-constellation.</p>
	<p>Huddersfield</p>	<p>Wayland Additive boast a combined 150+ years of industrial electron beam manufacturing expertise. The company was born out of a high precision engineering team with a long and distinguished pedigree in the semiconductor industry, where electron beam widths are measured in nanometers and process instabilities are unacceptable. They have previously produced parts for rocket boosters, propulsion, thermal management, and structural integrity.</p>

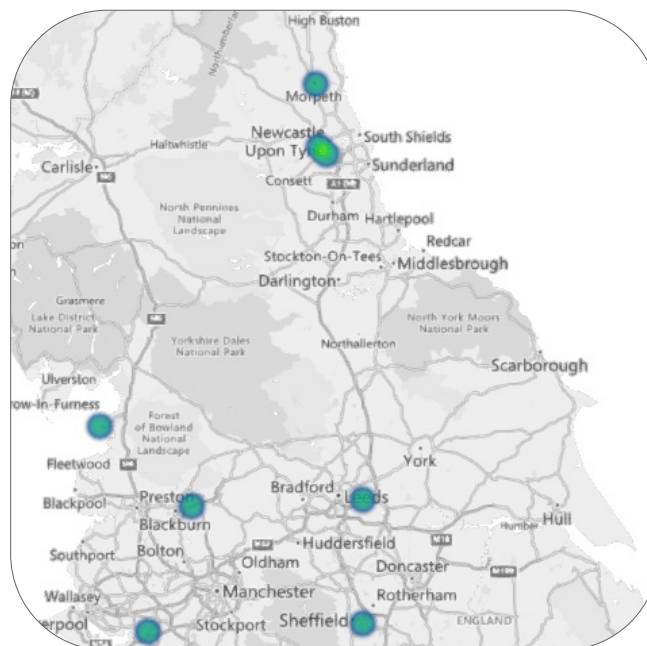
TESTING & DEVELOPMENT

	<p>Rotherham</p>	<p>Element Materials have a global network of advanced telecoms regulatory testing labs where they perform a variety of test methods for CATV and satellite equipment, including cables, connectors, splitters, amplifiers, fibre jumpers, ethernet cables, fibre-to-home products, and more. Their services include environmental simulation, mechanical testing, and non-destructive testing. From EMC requirements to environmental considerations, their labs are accredited to provide testing to a large range of standards.</p>
	<p>Birchwood</p>	<p>ESR Space redefines the limits for extreme environments and mechanism lifetimes, enabling hardware, missions and clients to achieve more. They specialise in Space and vacuum mechanisms, spacecraft systems engineering, Space tribology, and safety and risk management. Whether for consultancy activities or rapid prototyping to de-risk new ideas, they apply a wealth of heritage knowledge to help you develop devices to meet your aims and cost targets.</p>

1.4 SOFTWARE

Software plays a pivotal role in effectively managing hardware, networks, and data across all communication applications. Within Space North, companies offer robust support in these areas, particularly in bolstering geolocation services, network management, IoT, and data analytics capabilities including via artificial intelligence and machine learning expertise.

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.



RELEVANT SOFTWARE CAPABILITY HOTSPOTS (BY NO. OF COMPANIES) WITHIN SPACE NORTH

DATA ANALYTICS CAPABILITIES

	<p>Leeds</p>	<p>Alizent specialises in providing digital transformation solutions for many industries, focusing on automation, sensing, asset intelligence, and industrial IoT. Their technology includes the integration of advanced analytics, cloud, and industrial IoT - including satellite IoT solutions - and track more than 200k remote assets in over 40 countries.</p>
	<p>Sheffield</p>	<p>AxxonSoft develops intelligent video surveillance solutions, featuring advanced Artificial Intelligence, Neural Networks and Deep Learning technologies for multiple industrial applications. The company integrates Physical Security Information Management (PSIM) and IP Video Management Software (VMS) with CCTV and physical security products and devices, using satellite-based connectivity solutions for remote surveillance solutions.</p>
	<p>Accrington</p>	<p>Cloudbase Positioning Ltd specialises in providing Real-Time Kinematic (RTK) satellite navigation solutions within the Space industry. Their unique technology offers centimetre-level GPS positioning, a significant advancement over traditional GPS systems.</p>
	<p>Tyneside</p>	<p>MConnected uses satellite and cellular connectivity to provide asset tracking and IoT solutions worldwide, in tandem with predictive analytic algorithms to impart comprehensive asset intelligence.</p>

NETWORK MANAGEMENT

	<p>Tyneside</p>	<p>Kratos Communications specialises in providing products and services for satellite command and control, signal monitoring, and network management, including quantum communication systems and high-performance satellites. Their OpenSpace® OpsCenter™ helps unify management across ground stations in a single product. This allows for monitoring and controlling RF equipment, tracking the health of IP networks, and assuring RF signal quality. Operator full suite of software for connectivity management - signal processing, tests & simulation, and RF management.</p>
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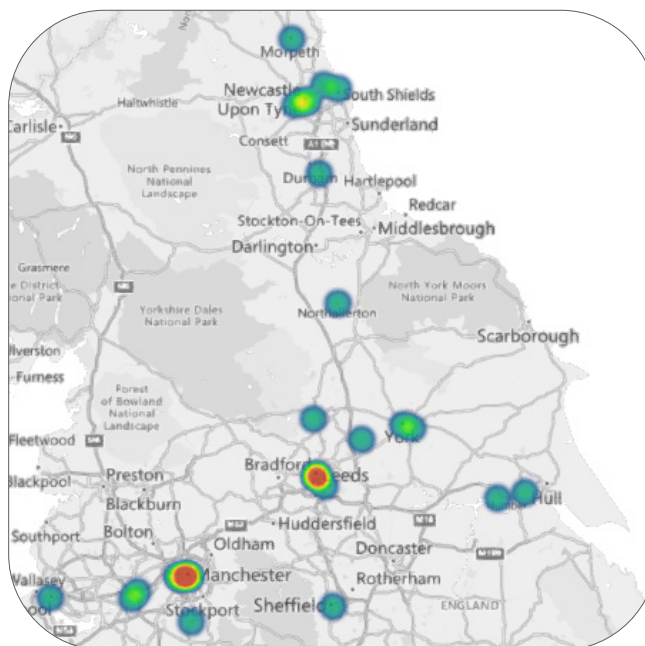
OTHER SOFTWARE

	<p>Daresbury</p>	<p>Envisage Space is a UK-based SME specialist in satellite technology and data applications, with expertise in Earth Observation and Global Navigation Satellite Service (GNSS – GPS, Galileo, etc) technologies. Their current product in development is GNSS augmentation software which enables improved GNSS performance in complex & built-up environments, such as cities.</p>
	<p>Heysham</p>	<p>Forsberg Services Limited is a UK-based company specialising in precision navigation solutions within the Space industry. Their core expertise lies in creating and integrating GPS and GNSS systems, providing high-accuracy positioning and timing solutions. The company also provide satellite and constellation orbit simulation software for the geolocation domain.</p>
	<p>Barrow-In-Furness</p>	<p>Structured Software Systems Limited (3SL) specialises in the development of Cradle, a comprehensive systems engineering toolset used in diverse industries, including the Space sector. Cradle's functionality ranges from requirements management to system design, testing, and maintenance, supporting the full system lifecycle. The tool has been utilised in significant projects like the European Space Agency's BepiColombo mission to Mercury.</p>
	<p>Tyneside</p>	<p>Telespazio UK, is a supplier of systems engineering, integration and testing, technical and operational support to numerous satellite network operators, systems integrators, service providers and equipment manufacturers operating within the Space communications domain. They are experienced in multiple orbit constellations covering GEO, MEO and LEO, and at numerous frequency bands (UHF, S, L, Ku, Ka, and X). Their domain experts extend across the full end-to-end system lifecycle, from feasibility analysis through to in-field integration and test support, as well as network simulation and management.</p>
	<p>Lancashire</p>	<p>AWOL Adventure offers a novel approach to live event photography services by integrating GNSS tagging and satcoms with proprietary AI recognition systems to rapidly deliver accurately timed and located photos to registered users.</p>

1.5 SERVICES


From network maintenance and integration services to cybersecurity, service providers play a critical role in ensuring the continuous functionality and performance of communication infrastructure. Companies in Space North have a wide array of expert consulting offerings at hand, including technological, regulatory, and educational, empowering their business to succeed.

● COMPANIES WITH DUPLICATE ENTRIES, GIVEN THEIR UNIQUE CAPABILITIES IN DIFFERENT FIELDS.






RELEVANT SERVICE PROVIDER HOTSPOTS (BY NO. OF COMPANIES) WITHIN SPACE NORTH





BUSINESS SUPPORT

	<p>Leeds</p>	<p>Xactium, recently acquired by Riskconnect, are working to bring innovative, AI-driven governance, risk management, and compliance (GRC) technologies to a global audience. Their solutions transform the way companies perceive and manage risk by integrating data, connecting events, and correlating their relationships for a clear view of how risk impacts the entire enterprise.</p>
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ENGINEERING

	<p>Leeds</p>	<p>C.P.L Precision Engineering is a Leeds-based company with over 60 years of combined experience, providing bespoke manufacturing of high-precision components and precision engineering for Space, telecoms, audio, and motorsport industries.</p>
	<p>Tyneside</p>	<p>Telespazio UK, is a long-term and trusted supplier of systems engineering, integration and testing, technical and operational support to numerous satellite network operators, systems integrators, service providers and equipment manufacturers operating within the Space communications domain. They are experienced in multiple orbit constellations covering GEO, MEO and LEO, and at numerous frequency bands (UHF, S, L, Ku, Ka, and X). Their domain experts extend across the full end-to-end system lifecycle, from feasibility analysis through to in-field integration and test support.</p>
	<p>Birchwood</p>	<p>ESR Space redefines the limits for extreme environments and mechanism lifetimes, enabling hardware, missions and clients to achieve more. They specialise in Space and vacuum mechanisms, spacecraft systems engineering, Space tribology, and safety and risk management. Whether for consultancy activities or rapid prototyping to de-risk new ideas, they apply a wealth of heritage knowledge to help you develop devices to meet your aims and cost targets.</p>




ENGINEERING

 <p>GLOBAL SPACE CONSULTING</p>	<p>Durham</p>	<p>Established in 2009, Global Space Consulting Limited (GSCL) is an independent consulting company providing engineering and procurement monitoring services for satellite and launch vehicles, launch campaigns, IOT, and in-orbit insurance, as well as full life cycle procurement and acquisition monitoring of satellite ground stations.</p>
 <p>Challenging today. Reinventing tomorrow.</p>	<p>Manchester</p>	<p>Jacobs provides a full spectrum of professional services including consulting, technical, scientific and project delivery for the government and private sector. Jacobs delivers high-end solutions for remote sensing and earth observation, intelligence gathering, communications and navigation, and Space-enabled science and exploration through its decades of experience and capabilities in scientific, engineering and technology innovation.</p>
	<p>Brough</p>	<p>Jesmond Engineering is an independent, progressive engineering design consultancy. They help customers make improvements in efficiency, safety, sustainability and profitability using innovative and quality-driven engineering design. This includes structural analyses, discrete element modelling, and computational fluid dynamics.</p>
	<p>Greater Manchester</p>	<p>Roke Manor Research, now part of Chemring Group, offer extensive consulting for comms connectivity applications, both commercial and military related, recently supporting the development of anti-spoofing methods for satcoms in collaboration with Dstl.</p>

GPS AND LOCATION SERVICES

	<p>Hull</p>	<p>Arrows has 20 years of experience in offering GPS-based vehicle tracking solutions, solution integration and consulting services to support their customers with effectively tracking their assets.</p>
	<p>York</p>	<p>Incremental is driving the smart transport revolution by exploiting the value of vehicle data across fleet assets. Their technology leverages the power of GPS data aggregation and analytics to deliver products that unlock a range of complex movement issues, connecting their clients' vehicles with the information you need to improve efficiency.</p>
	<p>St Helens</p>	<p>DriverNet allows organisations to manage their transport operations, as well as perform driver and vehicle admin from a single piece of software. Their three-in-one platform helps automate route planning and vehicle tracking whilst simplifying fleet management.</p>




IT AND CYBERSECURITY

	<p>Leeds</p>	<p>BAE Systems provides advanced, technology-led defence, aerospace and security solutions. BAE's offering ranges from state-of-the-art cyber threat detection to flight control systems that enable pilots to make better decisions and other A&D solutions.</p>
	<p>Durham</p>	<p>HiComply enables businesses to unlock market access and accelerate business growth through software that makes achieving information security simple and hassle-free.</p>
 <p>a cognizant company</p>	<p>Wilmslow</p>	<p>Mobica provide software engineering and development capabilities through Talent-as-a-Service (TaaS) to businesses to create complex, high-quality software systems, including for Space applications like satellite navigation and communication systems.</p>


IT AND CYBERSECURITY

	<p>Manchester</p>	<p>NCC Group help organisations protect their critical systems and data by taking an attacker’s point of view to ensure their services retain the “always-on” standard that consumers know and value. They deliver auditing, penetration testing, security consulting, network monitoring, data mapping and protection, and incident response services to technology, media, and telecommunications providers.</p>
	<p>Greater Manchester</p>	<p>Northrop Grumman in the UK brings modern software development approaches and blends these with a rich heritage and experience in the defence and security sectors. They are an industry leader in solutions that harness the latest in data science, machine learning, and secure cloud transformation technology, delivered at pace and scale.</p>
	<p>Salford</p>	<p>Raytheon Systems contains a UK division specialised in Cyber, Space, and Training. They offer distinct technologies like advanced satellite systems and integrated mission systems, designed for high functionality and resilience. They company has been involved in spaceflight since the global community set its eyes on the final frontier, with their guidance computers steering some of the first Space capsules, including Apollo 11.</p>
	<p>Greater Manchester</p>	<p>Roke Manor Research, now part of Chemring Group, develop a number of products for satcoms, including payload data processors, onboard software, and ground station systems, taking advantage of AI and ML processing capabilities to enhance efficiency and reduce operational costs.</p>
	<p>Durham</p>	<p>With over 20 years experience, Tekgem support manufacturing and engineering companies to protect their critical industrial automation control systems from cyber-security threats, bridging the gap between IT and OT.</p>

NETWORK INTEGRATION AND MONITORING

	<p>Tyneside</p>	<p>Telespazio UK is a long-term and trusted supplier of systems engineering, integration and testing, technical and operational support to numerous satellite network operators, systems integrators, service providers and equipment manufacturers operating within the Space communications domain. They are experienced in multiple orbit constellations covering GEO, MEO and LEO, and at numerous frequency bands (UHF, S, L, Ku, Ka, and X). Their domain experts extend across the full end-to-end system lifecycle, from feasibility analysis through to in-field integration and test support.</p>
	<p>Padgate</p>	<p>GTMaritime specialises in providing satellite connectivity within the maritime industry. Their products utilise satellite communication technologies to ensure reliable data transmission in remote maritime environments at a reduced satellite bandwidth usage, with a set of robust cyber-security features.</p>
	<p>Liverpool</p>	<p>KVH's industry-leading communications systems provide fast data speeds and reliable Internet, phone, and IoT connectivity services to maritime vessels and vehicles around the globe, including via the use of satellite connectivity. Valued by seafarers for more than 30 years, they can provide latency-free access to entertainment via up to 50 personal devices.</p>


NETWORK INTEGRATION AND MONITORING

	<p>Northumberland</p>	<p>Satstream Media are a software and communications company specialising in the development and operation of bespoke service platforms and applications for the mobile satellite market. Their focus is on the maritime sector, although the technology can be adapted to support other markets including land transport and aeronautical.</p>
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REGULATORY

	<p>Manchester</p>	<p>Fieldfisher's satellite and Space projects team includes lawyers with over 20 years of experience advising on major satellite and Space projects in the UK, Europe, and worldwide. They offer expertise in regulatory compliance, intellectual property rights, and commercial contracts within the Space sector. They work with satellite operators, Space insurers, and launch service providers, ensuring that their clients meet all legal requirements for their operations.</p>
	<p>Leeds</p>	<p>Clarion Solicitors support organisations across various industries with advice and legal council on business growth, data management, ESG (environmental, social and governance), strategy, and much more. In 2023 The Lawyer named Clarion Solicitors 'Independent Law Firm of the Year'.</p>

SOFTWARE DEVELOPMENT

	<p>Tyneside</p>	<p>Accenture (UK) specialises in providing sophisticated digital and technological solutions. Their services encompass areas like satellite technology, cloud-based data processing, and advanced analytics. Accenture's Spacecraft Digital Twin, a unique innovation, simulates spacecraft performance using AI and IoT, enabling predictive maintenance and operational efficiency.</p>
<p>INFINITYWORKS Part of Accenture</p>	<p>Manchester</p>	<p>Infinity Works Consulting, recently acquired by Accenture, specialises in providing data engineering, cloud, and digital transformation services to the Space industry. Their unique expertise lies in utilizing advanced technologies like AI and machine learning to analyse large volumes of Space data for predictive modelling and decision-making. Their cloud solutions facilitate storage and seamless access to Space data, enhancing operational efficiency.</p>

TRAINING

	<p>Northallerton</p>	<p>AmbaSat designs and builds LEO space satellite kits, which are the foundation of a new class of 'sprite' satellites. These kits are low-cost miniature satellites used for environmental research, STEM experiments, and IoT applications. These Arduino-based DIY satellites are designed with interchangeable sensor boards, enabling customisation for specific research needs.</p>
	<p>Leeds</p>	<p>CDS Defence & Security is a team of experts providing world-class defence and security consultancy in support of engineering, training and learning, and cyber security and information assurance. They have a deep understanding of Defence training and education, with many of their team having previously served in the UK military, and are experts in creating and delivering digital learning, from e-learning, animation, gamification, Augmented and Virtual Reality (AR and VR).</p>

PART 2: RESEARCH ORGANISATIONS

Resilient Communications Market Map by Primary Segments for Academic & Research Institutes



Source: Resonance

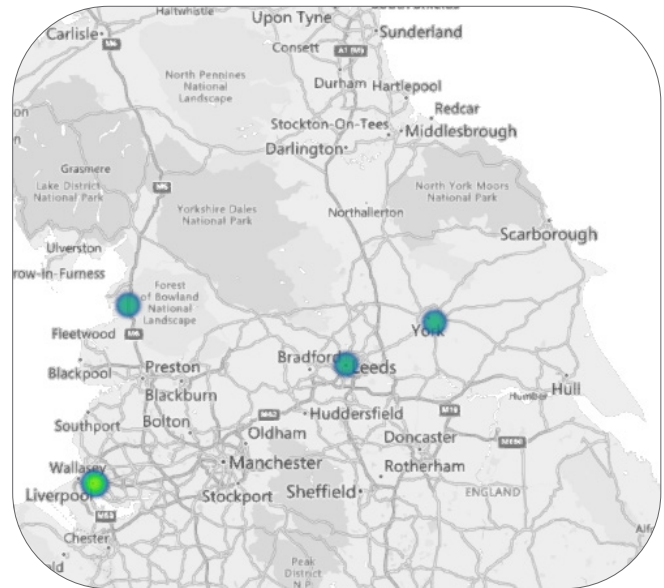
NB: THE ABOVE CLASSIFICATIONS ARE INHERENTLY A SIMPLIFICATION, AIMED TO BROADLY CATEGORISE KEY CAPABILITIES IN THE SPACE NORTH REGION. MANY ORGANISATIONS DEPICTED ABOVE HAVE RESEARCH ACTIVITIES AND/OR FACILITIES ACROSS MULTIPLE SEGMENTS.

INSTITUTION	SPACE CLUSTER	CONNECTIVITY				GROUND			MANUFACTURING				SOFTWARE		SERVICES					
		HAPS / Stratospheric	IT & Cybersecurity	Quantum Comms R&D	Specific Frequency R&D	Equipment R&D	Ground Networks	Ground Stations & Data Warehouses	Laser/Optical Satcomms	Material R&D	Satellite Subsystems & Components	Testing and Development	Data Analytics	Other Software	Business Support	Education & Training	Engineering Support	IT & Cybersecurity	Software Development	Testing & Development
3M Buckley Innovation Centre (3M BIC)	Space Hub Yorkshire										✓									
Alan Turing Institute	Space North East											✓								
Centre for Process Innovation	Space North West													✓						✓
CyberNorth	Space North East													✓						
Durham University	Space North East		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Edge Hill University	Space North West																	✓		
GM Cyber Foundry	Space North West													✓				✓		
Henry Royce Institute	Space North West								✓		✓			✓						
Jodrell Bank	Space North West							✓												
Lancaster University	Space North West				✓	✓									✓			✓		✓
Leeds Beckett University	Space Hub Yorkshire		✓															✓		
Liverpool Hope University	Space North West	✓																		
Liverpool John Moores University	Space North West		✓			✓														
Manchester Metropolitan University	Space North West																		✓	
National Cyber Force	Space North West																		✓	
National Nuclear Laboratories	Space North West										✓									
Newcastle University	Space North East		✓	✓						✓						✓			✓	
Northumbria University	Space North East		✓	✓					✓		✓	✓	✓			✓				✓
Sci-Tech Daresbury	Space North West												✓							✓
Sheffield Hallam University	Space Hub Yorkshire														✓			✓		
Space North East England	Space North East													✓						
Teesside University	Space North East														✓	✓		✓		
University of Bolton	Space North West									✓					✓					
University of Bradford	Space Hub Yorkshire									✓			✓		✓					
University of Central Lancashire (UCLan)	Space North West		✓							✓				✓	✓	✓	✓			
University of Chester	Space North West														✓					✓
University of Huddersfield	Space Hub Yorkshire											✓			✓			✓		
University of Hull	Space Hub Yorkshire												✓		✓					
University of Leeds	Space Hub Yorkshire				✓				✓	✓		✓		✓	✓					
University of Liverpool	Space North West				✓					✓	✓				✓	✓		✓		
University of Manchester	Space North West							✓		✓		✓			✓					✓
University of Salford	Space North West						✓								✓					
University of Sheffield	Space Hub Yorkshire									✓	✓				✓			✓		
University of Sunderland	Space North East		✓												✓					
University of York	Space Hub Yorkshire	✓		✓			✓					✓			✓					
York St John University	Space Hub Yorkshire		✓												✓			✓		
Yorkshire Cyber Security Cluster	Space Hub Yorkshire																	✓		

2.1



CONNECTIVITY

Research organisations within Space North provide invaluable expertise in optimising terrestrial and satellite connectivity solutions, devising new infrastructure alternatives as well as improved communications and security protocols.



RELEVANT CONNECTIVITY RESEARCH HOTSPOTS (BY NO. OF RESEARCH ENTITIES) WITHIN SPACE NORTH



HIGH ALTITUDE PSEUDO SATELLITES (HAPS) / STRATOSPHERIC

	<p>University of York</p>	<p>The Centre for High Altitude Platform Applications (CHAPA) is developing novel uses for high-altitude platform infrastructures. It specialises in high-altitude platform applications related to wireless communications, atmospheric science research, and environmental monitoring and control for smart cities.</p>
	<p>Liverpool Hope University</p>	<p>Research capabilities at Liverpool Hope University address digital connectivity and infrastructure to bridge the global digital divide. Their key research themes cover Space, HAPS, non-terrestrial networks (NTN), connectivity/communications technologies, robotics, and leveraging AI for ICT innovation.</p>


IT AND CYBERSECURITY

	<p>University of Sunderland</p>	<p>The University of Sunderland's Applied Research in Computing (ARC) unit has domain experience from longstanding research in intelligent systems, HCI, and software engineering, with enabled expertise in application areas such as bioinformatics, health and wellbeing, creative practices, and cybersecurity.</p>
	<p>Newcastle University</p>	<p>Newcastle's Centre for Cyber Security and Resilience conducts core research in cyber security and resilience techniques, covering network nodes and systems, data warehouses and distribution, and end-user points. The research scope and techniques include AI, bio/nano systems, cyber-physical systems, financial technologies, medical systems, and society.</p>
	<p>Liverpool John Moores University</p>	<p>The Research Centre for Critical Infrastructure Computer Technology and Protection (PROTECT) investigates critical infrastructure computer technology and protection, including security to safeguard systems against cyber attacks, networking to support the systems' distributed operations, and software engineering and artificial intelligence to build autonomous capability into the systems for intelligent operations.</p>




IT AND CYBERSECURITY

 <p>Teesside University</p>	<p>Teesside University</p>	<p>Through multidisciplinary approaches, the Centre for Sustainable Engineering undertake research in areas including digitalisation, informatics, cybersecurity, automation, energy management, sustainable technologies, artificial intelligence, distributed control and social science in energy-related and construction applications. The Centre supports digital transformation and the Internet of Things (IoT) in collaboration with other researchers at Teesside, including the Software and Systems Research Group.</p>
 <p>University of Central Lancashire UCLan</p>	<p>University of Central Lancashire</p>	<p>The Cyber Solutions Centre provides provides access to UCLan's multi-disciplinary Cyber Security research and knowledge exchange activities. This includes activities undertaken in the Future Digital Technologies Institute that focus upon research related to user-centred security, communication security protocols, block chain, and usability. Activities undertaken by the Institute of Criminal, Legal and Social Justice include business cyber-resiliency, digital forensics, cybercrimes relating to identity and property crime. Activities undertaken through the Institute for Business, Enterprise and Organisational Impact include the Lancashire Cyber Eco-System Good Practice Network..</p>
 <p>LEEDS BECKETT UNIVERSITY</p>	<p>Leeds Beckett University</p>	<p>Leeds Beckett's Cybercrime and Security Innovation Centre aims to advance technical cyber security and digital forensics mechanisms and practice, and incorporate an evidence-based approach into the frontline policing of digital forensics and cybercrime investigations.</p>
 <p>Northumbria University NEWCASTLE</p>	<p>Northumbria University</p>	<p>Northumbria's 'CyberNets' research group focuses on cyber security in both wired and wireless networks. This involved the use of AI (Machine/deep learning), optimisation techniques, and adversarial learning against evasion via intrusion detection and intelligent penetration testing. The broader network systems group explores network communications protocol, UAVs and HAPs, edge computing, and 5G networks and beyond, all with the aim of creating more resilient networks.</p>
<p>Est. 1841</p> <p>YORK ST JOHN UNIVERSITY</p>	<p>York St John University</p>	<p>York St John University's Cybersecurity Research Group undertakes fundamental and applied cybersecurity research covering Network security, trust and user authentication, privacy preservation and access control, embedded system security, cybersecurity education protection of critical infrastructures, and the human aspect of cybersecurity.</p>

QUANTUM COMMUNICATIONS R&D

	<p>University of York</p>	<p>The Quantum Communications Hub's focus is on quantum secure communications and, in particular, the development and subsequent commercialisation of applications reliant on QKD, such as safe transactions. The Quantum Communications Hub brings together ten UK research-leading universities in partnership with numerous public sector bodies and several of the world's leading industrial players. The Hub is funded through the UK National Quantum Technologies Programme, a ten-year £1 billion public and private investment underpinned by the UK government. The programme aims to create a coherent government, industry and academic quantum technology community that gives the UK a world-leading position in the emerging multi-billion-pound new quantum technology markets, and to substantially enhance the value of some of the biggest UK-based industries.</p>
	<p>Durham University</p>	<p>Durham's Quantum Light and Matter (QLM) research unit draws expertise from multiple research groups with a focus on the quantum properties of atoms, molecules, and solids and their interactions with light. The university's research also includes satellite QKD.</p>
	<p>Northumbria University</p>	<p>The Quantum and Molecular Photonics Group focuses on various photonics areas, such as quantum optics, nanomanufacturing techniques, laser/maser technology, brightness-enhanced light sources, photophysical and functional properties of organic semiconductors, as well as innovative photonic devices and applications driven by structured light physics. This supports quantum information processing, portable atomic clocks and quantum radar. Additionally, masers have potential applications in quantum memories, superconducting qubits, and quantum sensors.</p>
	<p>Newcastle University</p>	<p>Newcastle's Quantum Research Group, part of the Newcastle-Durham quantum collaboration, conducts experimental and theoretical quantum research with a focus on quantum fluids, superfluidity in neutron stars, quantum optics, thermodynamics, and ultracold atomic physics.</p>

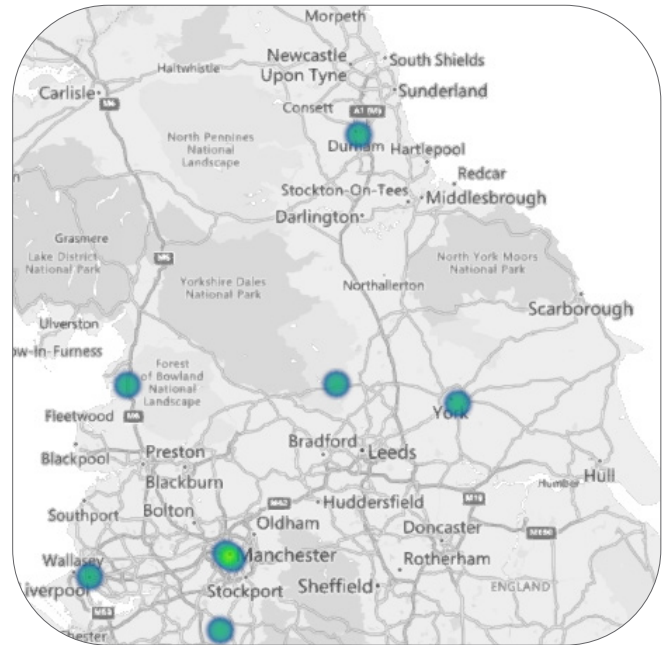
SPECIFIC FREQUENCY R&D

	<p>Lancaster University</p>	<p>Lancaster's Communication Systems Research Group focuses on the design, analysis and optimisation of future communication systems. They have a Wireless Broadband Laboratory and state-of-the-art software defined radio development facilities, providing a unique future research testbed in Future Wireless Communications, Intelligent and Cognitive Radio Technologies and Internet of Things research.</p>
	<p>University of Liverpool</p>	<p>The High-Frequency Engineering Group undertakes research in radio to terahertz frequencies, continuing the University's excellent track record in this field. The 25 researchers and PhD students in the group focus on RF engineering, EM imaging and tomography, wireless and THz devices, and wireless power transmission. The department also has the largest reverberation chamber among UK universities and an anechoic chamber.</p>
	<p>University of Leeds</p>	<p>The Pollard Institute has a history of pre-eminence in high-frequency electronics, incorporating fundamental understanding, design, modelling, and fabrication of devices, components, and subsystems from 1 GHz through to terahertz (THz) frequencies. The group is internationally recognised for research in the simulation, design, and optimization of III-V and silicon-based semiconductor devices, particularly quantum cascade lasers, quantum well photodetectors, electro-optic modulators, and quantum-dot devices.</p>

2.2

GROUND

Public institutions across Space North support the bridge between Space and terrestrial communication networks, undertaking key research in ground equipment and networks for data distribution. They also help provide additional ground station and data warehouse capacity and satellite tracking capabilities.



RELEVANT GROUND-FOCUSED RESEARCH HOTSPOTS (BY NO. OF RESEARCH ENTITIES) WITHIN SPACE NORTH




GROUND EQUIPMENT R&D

	<p>Durham University</p>	<p>The Centre for Communications Systems (CfCS) conducts extensive research on wireless systems, covering communication systems, energy-efficient buildings, on-body networks, radio imaging for medical and security applications, radar systems for monitoring the environment, and digital signal processing systems. Durham also has satellite tracking and characterisation capabilities, currently developing optical ground stations for GEO feeder links with adaptive optics capabilities in partnership with ESA.</p>
	<p>Lancaster University</p>	<p>Lancaster’s Communication Systems Research Group focuses on the design, analysis and optimisation of future communication systems. They have a Wireless Broadband Laboratory and state-of-the-art software-defined radio development facilities, providing a unique future research testbed in Future Wireless Communications, Intelligent and Cognitive Radio Technologies and Internet of Things research.</p>
	<p>Liverpool John Moores University</p>	<p>The Microelectronics Group works to develop new materials for future microelectronics industries, as well as quantum computing and hardware security of IoT. In the future, the Group intends to develop novel qualification techniques and models that will go on to become the new industry standards, as well as expand its research in Quantum Computing and Hardware Security.</p>
	<p>Liverpool John Moores University</p>	<p>The work conducted by the Sensors and Communications Group spans across new sensors for Industry 4.0 applications, medical ultrasound imaging, material characterisation, energy-efficient protocols for wireless sensor and mobile networks, sensors for system monitoring, and non-destructive testing of microelectronics.</p>

GROUND NETWORKS

 <p>University of Salford MANCHESTER</p>	<p>University of Salford</p>	<p>The Centre for Urban Processes, Resilient Infrastructure, and Sustainable Environments (UPRISE) is a multi-disciplinary research centre that looks to identify, articulate and address the challenges that cities present in the 21st century. UPRISE works across various subject areas to identify how we might design, deliver and experience cities differently, considering issues that impact at both the local and global level.</p>
 <p>Durham University</p>	<p>Durham University</p>	<p>The Institute of Hazard, Risk and Resilience (IHRR) is a world-leading research institute at Durham University, exploring multiple perspectives on infrastructure from understanding the consequences of damaged roads through to developing SMART cities to increase people's resilience to extreme events. Their recent Smart Urban Resilience project specifically aimed to understand how smart city and urban digital technologies (such as open data platforms, civic hacking, smart urban planning and others) play a role in building urban resilience by changing the ways in which citizens prepare and respond to natural disasters and emergencies.</p>
	<p>Durham University</p>	<p>The Centre for Communications Systems has been involved in radio channel measurements in the HF to mm frequency bands, measuring mobile radio channels between 300 MHz in the UHF bandwidths, but also, more recently, 5G networks. Funded by Ofcom UK and the EU, the Centre is currently studying the impact of precipitation on mm wave frequencies for short links such as building-to-building links and for outdoor and indoor environments. The University has also partnered with Queen Mary University of London and UCL in a joint research project which aims to improve mobile communications systems beyond 5G, namely via the 'Transmission Channels Measurements and Communication System Design for Future mm Wave Communications' (TRACCS) project.</p>
 <p>UNIVERSITY <i>of York</i></p>	<p>University of York</p>	<p>The York-Zhejiang Lab for Cognitive Communications and Green Radio was formed as a joint venture between the University of York, Zhejiang University, and the Centre for High Altitude Platform Applications. Its research focuses on 5G connectivity, cellular and radio networks, and more.</p>

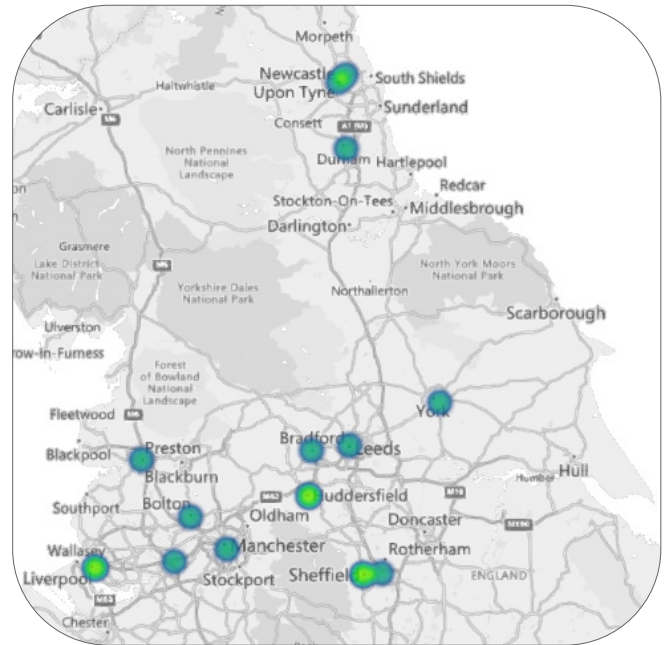
GROUND STATIONS & DATA WAREHOUSES

	<p>Macclesfield</p>	<p>Jodrell Bank Observatory hosts many radio telescopes as part of the Jodrell Bank Centre for Astrophysics at the University of Manchester. The observatory was established in 1945 by Bernard Lovell, a radio astronomer at the university, to investigate cosmic rays after his work on radar during WWII. It has since played an important role in the research of astronomy and has been heavily involved in tracking crucial satellites and Space assets.</p>
	<p>Menwith Hill Camp</p>	<p>RAF Menwith Hill provides communications and intelligence support services to the UK and USA. The site has been described as the largest electronic monitoring station in the world, containing an extensive satellite ground station and is a communications intercept and missile warning site.</p>
 <p>MANCHESTER 1824 The University of Manchester</p>	<p>University of Manchester</p>	<p>The University's satellite ground station is capable of both command uplink and data downlink on both S-band (MHz) and UHF/VHF (MHz), providing autonomous tracking capability through a programmable all-weather rotator and pass-prediction software.</p>

2.3

MANUFACTURING

The Space North region is rich in universities and public research organisations that contribute to the refinement of manufacturing techniques and the production of novel materials for communications applications. Several institutions are also undertaking the development of improved optic and electronic components and materials, alongside extensive testing facilities that are available to industrial partners.



RELEVANT MANUFACTURING RESEARCH HOTSPOTS (BY NO. OF RESEARCH ENTITIES) WITHIN SPACE NORTH

LASER / OPTICAL SATCOMMS

 <p>Durham University</p>	<p>Durham University</p>	<p>The Centre for Advanced Instrumentation (CfAI) conducts interdisciplinary applied research on Space-based telescopes, precision optics technology and applications, and free-space optical communications in collaboration with other research centres and institutes at Durham University - including the Institute for Computational Cosmology, CfCS, and the Space Research Centre (SPARC).</p>
 <p>Northumbria University NEWCASTLE</p>	<p>Northumbria University</p>	<p>The Optical Communications Research Group (OCRG) specialises in visible light communications, non-linear control systems and optical sensor research. The group has applied capability in visible light communications and organic visible light communications for data communications, indoor localisation and sensing.</p> <p>The University is also part of the Autonomous Laser Intersatellite Gigabit Network (ALIGN) mission, in collaborative partnership with Durham University, Telespazio and Lockheed Martin UK Space. Funded by the UK Space Agency for £5M, the project is set to be completed in March 2025, with the primary aim of developing CubeSats into data intensive satellite platforms, enabling a step-change in communications for future mega-constellations and Space science missions.</p>
 <p>UNIVERSITY OF LEEDS</p>	<p>University of Leeds</p>	<p>The Terahertz Electronics and Photonics Group is pioneering technologies using high frequencies and mid-infrared optoelectronic techniques, including research into probing laser dynamics and spectroscopy applications for Earth observation. The group benefits from extensive facilities in purpose-built laboratories, as well as a large array of software for modelling semiconductor band structures, waveguides, laser dynamics, and THz vibrational mode.</p>

MATERIALS R&D

 <p>UNIVERSITY OF LEEDS</p>	<p>University of Leeds</p>	<p>The Bragg Centre for Materials Research brings together advanced facilities for growth, fabrication, analysis and characterisation of materials, conducting research into various new materials for a wide range of applications, including secure and effective communication techniques.</p>
 <p>UNIVERSITY OF BRADFORD</p>	<p>University of Bradford</p>	<p>The Centre for Polymer Micro and Nano Technology (Polymer MNT) is an R&D university department focused on polymer science and engineering, with capabilities in the fields of micro and nano mouldings which enable the manufacture of new materials and compounds for various industry use cases. With strong UK and International links and supported by EPSRC over its first 11 years, the Centre focuses on advanced materials, including soft matter, nanocomposites, and biomaterials.</p>
<p>HENRY ROYCE INSTITUTE</p>	<p>Manchester</p>	<p>The Henry Royce Institute is the UK's home of advanced materials research and innovation, bringing together world-leading academics from across the UK and working closely with industry to ensure the commercialisation of fundamental research. Royce coordinates over £200 million of facilities, available to academia and industry alike.</p>
	<p>University of Bolton</p>	<p>The Institute for Materials Research and Innovation (IMRI) is a multi-disciplinary centre designed to cultivate research and innovation activities in collaboration with industry and other academic institutions. The Institute has strong applied research in materials science and engineering applications through the development of novel smart and multifunctional composite materials (fibres, fabrics, films, foams and particles) at nano/micro levels.</p>
	<p>University of Central Lancashire (UCLan)</p>	<p>The Jost Institute for Tribotechnology provides academic and industrial research covering a wide range of technologies with a primary focus on surfaces interacting in relative motion. This includes friction, wear, lubrication and interfacial interactions between solids, as well as between solids and liquids/gases. These provide a better understanding of the performance of lubricants used for mechanisms in spacecraft and the characterisation of advanced materials and coatings.</p>
	<p>University of Liverpool</p>	<p>The Leverhulme Research Centre drives a design revolution for functional materials at the atomic scale by fusing chemical knowledge with state-of-the-art computer science in a world-leading interdisciplinary team, researching new materials for antennas and structures.</p>
	<p>University of Sheffield</p>	<p>The National Epitaxy Facility plays a central role in enabling UK university research through the provision of high quality Semiconductor Epitaxy for custom designed structures and devices. The facility has also been developing expertise and capability in Droplet Epitaxy applied to quantum dot science and technology that is available to researchers and industrial customers in the UK, recently expanding from providing III-V materials and devices to include group IV epitaxy and hybrid III-V/Group IV epitaxy.</p>
 <p>The University of Manchester</p>	<p>University of Manchester</p>	<p>At 7,825 m² and £13m of world-leading equipment, the National Graphene Institute (NGI) enables academics and their industrial partners to work side-by-side on new and exciting applications of graphene and other 2D materials. The NGI is equipped with 1,500m² of class 100 and 1000 cleanrooms - which have an atmosphere more than a million times purer than air, as well as the latest technology for nanoscale and characterisation projects.</p>

SATELLITE SUBSYSTEM / COMPONENT MANUFACTURE

	<p>Huddersfield</p>	<p>3M Buckley Innovation Centre (3M BIC) has extensive additive manufacturing, design and prototyping capabilities available for industry and academic use. On the design side, they also have virtual and augmented reality capabilities, as well 2D and 3D visualisation, photogrammetry, generative design, computer-aided design (CAD), etc.</p>
	<p>University of Sheffield</p>	<p>The University of Sheffield's Advanced Manufacturing Research Centre employs about 500 highly qualified researchers and engineers to deliver Advanced Manufacturing and Autonomous Systems research for more than 125 industrial partners. The Centre's manufacturing expertise spans machining, hi-tech assembly and automation, robotics, casting, welding, additive manufacturing, composites manufacturing and structural testing across multiple high-value manufacturing sectors, including aerospace and Space.</p>
	<p>University of Sheffield</p>	<p>The Space Systems Laboratory (SSL) is involved in the design, manufacture, and operation of satellite-borne instrumentation and has a long history of involvement in high-profile Space missions. The group also conducts research in the field of experimental and theoretical Space plasma and solar physics, investigating the physical processes in the solar atmosphere.</p>
	<p>Warrington</p>	<p>The National Nuclear Laboratory (NNL) is a UK government owned and operated nuclear services technology provider covering the whole of the nuclear fuel cycle. NNL's reactor physicists are working on the next generation of gas-cooled reactors that may become the future of Space power.</p>
	<p>Northumbria University</p>	<p>The Optical Communications Research Group (OCRG) specialises in visible light communications, non-linear control systems and optical sensor research. The group is undertaking pioneering work on visible light communications and organic visible light communications (the first in the world) for data communications, indoor localisation, and sensing. OCRG collaborates with many institutions from the USA, EU, Far East, and are involved in a number of research projects, including EU projects involving more than 20 countries.</p>
	<p>Durham University</p>	<p>The University's Precision Optics Laboratory is a manufacturer of optical and micro-optical components and sub-systems used in a wide range of applications including Space and astronomical instrumentation, ophthalmic devices, and remote sensing. Their capabilities encompass errors of <50nm rms over apertures exceeding 100mm and surface roughness capabilities of typically <3nm rms and on occasion at the sub-nm level. The University has also been conducting studies on the manufacture of lightweight telescope components for satellites and free Space optical communications, used for both high bandwidth inter-satellite communications and ground station links.</p>
 <p>The University of Manchester</p>	<p>University of Manchester</p>	<p>The University's Satellite for Orbital Aerodynamics Research (SOAR) group has been partnering with Nanoracks since 2021 to build the DISCOVERER, a 3U cubesat testing different fin materials for in-orbit satellite manoeuvres, as well as atmosphere breathing electric propulsion prototypes that aim to utilise the residual atmosphere in low orbits as a propellant.</p>
	<p>University of Liverpool</p>	<p>The Solid State Electronics Research Group has a long track record of research into the test and reliability of gate dielectrics for silicon-based electronics. There is considerable activity around high-permittivity dielectrics for end-of-roadmap application, in collaboration with the Department of Engineering, materials science division which has state-of-the-art atomic layer deposition (ALD) facilities. Other work is aimed at producing very high precision passive components, particularly capacitors for medical, RF and energy harvesting applications.</p>

TESTING AND DEVELOPMENT

	<p>University of Huddersfield</p>	<p>The Centre for Precision Technologies (CPT) is a large scientific-technical centre linking measurement and production together uniquely to enable the manufacturing sector to meet the ever-increasing challenges of precision, complexity and quality whilst minimising costs. CPT is recognised as a leading research centre for the development of systems, telecommunications, and antenna research.</p>
	<p>University of York</p>	<p>Research conducted by the Communication Technologies Group deals with the design of a wide variety of communication systems, including cellular, HAPS,, wireless sensor networks and, most recently, heterogeneous systems. The Group has over 75 members of staff and a large array of testing facilities, including an electromagnetics lab with a reverberation chamber; a radio communications lab with software radio devices and an anechoic chamber.</p>
	<p>Henry Royce Institute</p>	<p>The Henry Royce Institute has a multitude of testing facilities, including a High Frequency Characterisation Suite, which includes high frequency test equipment, in particular a MVG Star Lab Antenna Measurement System (650MHZ-18GHz); and a Keysight N222A PNA Network Analyser (10 MHz to 26.5 GHz).</p>
	<p>University of Leeds</p>	<p>The Institute for Communication and Power Networks has a longstanding international reputation for communications, signal processing, control systems and instrumentation research and training. Over the last decade, there has been significant expansion into optical communications and networking, engaging with all major telecommunication companies.</p>
 <p>The University of Manchester</p>	<p>University of Manchester</p>	<p>Rarefied Orbital Aerodynamics Research (ROAR) - a ground-based facility that reproduces the atomic oxygen flux found in Very Low Earth Orbit (VLEO) to provide a deeper understanding of how materials behave in such environments. The facility is composed of a 1400L ultrahigh vacuum system capable of 10⁻⁹ to 10⁻¹¹ mbar; a hyperthermal oxygen atom generator with a flux of 10¹³ - 10¹⁵ atoms/cm²s; and ion-neutral mass spectrometers for measurement of the energy, velocity, and composition of the flow.</p>
	<p>University of Manchester</p>	<p>The University's Space environment chamber can be used for thermal vacuum cycling of small spacecraft components or 1-3U CubeSats. The system consists of a 130L vacuum chamber capable of a vacuum pressure of down to 10⁻⁵ mbar. The system also houses our thermal shroud with a range of approximately +120°C to -50°C with a test volume of 10cm x 30cm x 10cm.</p>
	<p>Durham University</p>	<p>The University operates several R&D facilities, including 7 floating optical laboratories with floating optical benches; a fibre preparation laboratory; a 24m x 10m x 6m assembly and integration laboratory with class 100,000 clean tents, as well as a separate class 100 clean room with a 30K working temperature cryogenic chamber; two other cryogenic chambers; and a 3m x 3m x 3m environmental chamber with -25°C to +40°C automated temperature control.</p>
	<p>Northumbria University</p>	<p>The Northumbria Space Technology Laboratory (NSTL) was formed in the Department of Mathematics, Physics and Electrical Engineering based on significant successful funding for Space technology research from the UK Space Agency, the Science and Technology Facilities Council, Lockheed Martin, and the Office for Students. NSTL includes all of the state-of-the-art facilities needed for developing and environmentally testing of small payloads for Space, as well as a dark room for class-4 lasers and optical system testing.</p>




2.4

SOFTWARE

Space North universities also support the advancement of software applications for Space-based resilient communications, with a particular interest and focus on using AI to improve communication spectrums, signal processing, and network usage.




DATA ANALYTICS CAPABILITIES

<p>The Alan Turing Institute</p>	<p>Newcastle-Upon-Tyne</p>	<p>The Alan Turing Institute focuses on UK priorities for the public good and supports the UK’s ambition to be a global leader in data science and AI. This leadership extends not only to science and innovation but also to public understanding and perceptions of data science and AI, as well as the national skills agenda, and leading on issues of equality, diversity and inclusion (EDI).</p>
 <p>Northumbria University NEWCASTLE</p>	<p>Northumbria University</p>	<p>The Data Science & Artificial Intelligence Group conducts theoretical and applied research in mathematical foundations of AI, deep-learning and statistical data science, including computer vision, computer graphics, visual activity and motion recognition, and natural language processing and understanding, with experts drawn from various domain areas like satellite-tech. The group lead two UK centres for doctoral training - NUData focusing on Data Intensive Science and CCAI focusing on Citizen-Centered AI.</p>
 <p>Durham University</p>	<p>Durham University</p>	<p>Durham University has data analytics and software development capabilities which span across the Institute for Data Science, the Artificial Intelligence and Human Systems Group (AIHS), and several other research groups. For resilient satcom, the university develops optical link modelling tools and algorithms for satellites.</p>
 <p>Newcastle University</p>	<p>Newcastle University</p>	<p>The Intelligent Sensing and Communications (ISC) group explores the whole spectrum of communications and digital signal processing, from underpinning theories to applications with industry partners. The group’s research comprises 3 themes: 1) Communications - including wireless, optical and underwater acoustic communications. 2) Signal Processing - including machine learning and AI, for applications in security, healthcare, environment and finance. 3) Sensor Systems - for non-destructive testing/evaluation, biomedical sensing/ imaging and environment monitoring. The University’s Intelligent Sensing Laboratory also supports signal and information processing research for multimodal data. The Lab has had breakthroughs in establishing complete mathematical proofs for nonlinear signal processing theory, which enable non-linear models for optimal signal separation and information retrieval.</p>

DATA ANALYTICS CAPABILITIES

 <p>UNIVERSITY OF LEEDS</p>	<p>University of Leeds</p>	<p>Leeds Institute for Data Analytics (LIDA) brings together over 280 researchers from all disciplines and matches them with the needs and opportunities of local organisations, opening up new opportunities to understand issues surrounding Societies, Health, and the Environment. Their projects portfolio worth over £75m spans across three key methodological data analytics areas: Statistical Data Science, Artificial Intelligence and Immersive Technologies, underpinned by leading technical infrastructure and expertise.</p>
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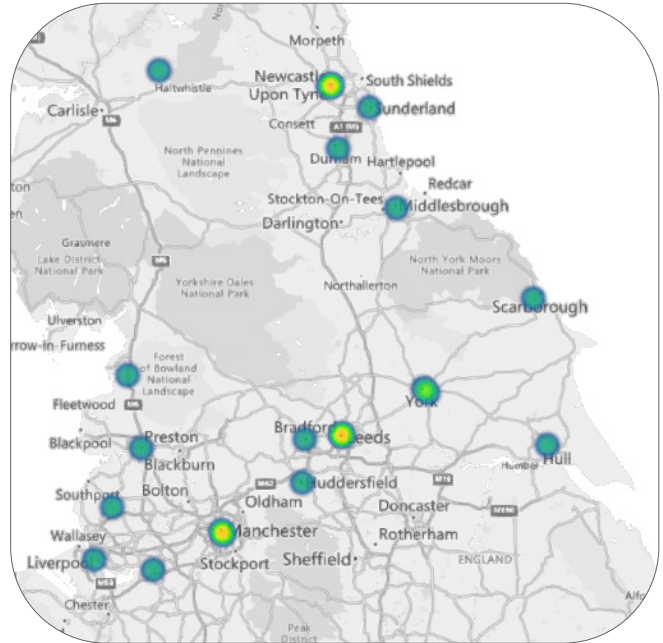
OTHER SOFTWARE

 <p>UNIVERSITY of BRADFORD The Bradford-Renduchintala Centre for Space AI</p>	<p>University of Bradford</p>	<p>Bradford-Renduchintala Centre for Space AI's expertise in satellite communications comprises four research groups with a focus across multiple research themes including: antenna; electromagnetics and radio frequency engineering; mobile, wireless and satellite communications networks and applications; and networking and performance engineering.</p>
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2.5

SERVICES

Academic and research organisations in Space North offer a comprehensive suite of services aimed at empowering industry partners to capitalise on emerging opportunities. From upskilling both current and future generations of workers to providing business and R&D facilities, companies can take advantage of a flourishing support network, especially in the area of cybersecurity.




BUSINESS SUPPORT

	<p>Northumberland</p>	<p>CyberNorth spearheads the growth of a thriving cyber security ecosystem in the North East of England by creating opportunities to bring the community together, encourage progressive collaboration and to help establish the region as a centre of excellence for the cyber security sector. The CyberNorth community is made up of cyber security businesses and influencers, users of cyber security services, academia, public sector and individual innovators and thought leaders. The community provides a hub of peer led expertise, innovation potential, shared learning, sector leadership and the cluster framework facilitates a means to collaborate and connect as cyber security businesses.</p>
	<p>Manchester</p>	<p>The Greater Manchester Cyber Foundry (GMCF) offers the opportunity for small to medium enterprises to explore the development of new digital products and services. The GMCF Cyber Innovation team provides R&D services, enabling practical investigation of innovative applications of technology within a business, often leading to a software prototype. The Foundry has so far supported over 186 SMEs and helped bring over 60 new products to market.</p>
	<p>University of Leeds</p>	<p>Nexus at the University of Leeds is home to one of 11 of the Satellite Application Catapult's Space Enterprise Labs, acting as a hub for Space innovation, discussion and visualisation for the whole region. Nexus brings together business, technology and academia for events and collaboration opportunities to advance the UK's capabilities in a large variety of sectors, including AI and Space technologies.</p>
	<p>Durham</p>	<p>Space North East England brings together businesses, academia and institutions to exploit the use of satellite data, technology and applications to gain a competitive advantage in a global market. A gateway for businesses to access funding, expertise, facilities and supply chain opportunities, Space North East England offers assistance to organisations within the region via one-to-one support or an array of events.</p>

BUSINESS SUPPORT

	<p>Cumbria</p>	<p>Energus is a unique conference and training venue offering inspiring and flexible spaces with comprehensive business support and modernistic training facilities. The site is also home to several successful apprenticeship and graduate programmes, working in partnership with the National Cyber Security Centre and Nuclear Decommissioning Authority to deliver CyberFirst & Cyber security training.</p>
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DATA ANALYTICS CAPABILITIES

	<p>University of Hull</p>	<p>The Dependable Intelligent Systems Research Group has strong capabilities in synthesising software engineering and bio-inspired technologies for designing, analysing, and operating dependable intelligent systems. They exploit data analytics and AI to assess and guarantee dependability properties, including systems' safety and security, communication channels, and data repositories.</p>
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EDUCATION & TRAINING

Space North is home to several Russell Group universities, world-leading academic institutions renowned worldwide for their academic excellence. These institutions offer a diverse array of educational opportunities spanning disciplines crucial to the development of resilient communications and Space-based endeavours.





This includes but is not limited to Bachelors, Masters, and PhDs in:



- Electric, Electronic, and Avionics Systems Engineering
- Mechanical, Aeronautical, Aerospace, and Space Systems Engineering
- Computer Science, Cybersecurity, and Software Engineering
- Communications and Signal Processing
- Physics, Space Weather, and Space Situational Awareness
- Robotics and Artificial Intelligence
- Space Law and Policy
- Aerospace Medicine

The North East Space Skills and Technology Centre (NESST) at the Northumbria University is also currently in development, destined to actively work in placing the UK at the forefront of research and innovation in areas including optical satellite communications, Space weather and Space-based energy, as well as providing specialist education and training for the UK space sector. NESST is the result of a **£50 million investment** with partners including the UK Space Agency and Lockheed Martin UK Space and is expected to support the creation of over **350 jobs** and inject over **£260m** into the North East economy over the next 30 years.

ENGINEERING SUPPORT

	<p>Durham University</p>	<p>Durham's Centre for Advanced Instrumentation (CfAI) builds on its interdisciplinary applied research to provide design and development services for optical, mechanical, and software applications for the industry. So far, they have supported the development of OGS adaptive optics control, link modelling, AI, Space surveillance and tracking applications, among others.</p>
	<p>Teesside University</p>	<p>Through multidisciplinary approaches, the Centre for Sustainable Engineering undertake research in areas including digitalisation, informatics, cybersecurity, automation, energy management, sustainable technologies, artificial intelligence, distributed control and social science in energy-related and construction applications. The Centre supports digital transformation and the Internet of Things (IoT) in collaboration with other researchers at Teesside, including the Software and Systems Research Group.</p>
	<p>University of Liverpool</p>	<p>The Networks Sciences & Technologies (NeST) initiative supports and brings together several projects at the university surrounding networks across various applications, including biological, chemical, physical and digital systems, economy, social relationships and many human made complex structures such as the Internet. The NeST Software Lab is a sub-division that undertakes research and development projects in several network and connectivity issues and innovations, including wireless networks and network preservation.</p>
	<p>Northumbria University</p>	<p>Northumbria University boasts inter-disciplinary expertise in engineering research and innovation across electrical, mechanical, and construction, complemented by their Northumbria Space Technology Laboratory (NSTL) facilities. They actively engage and collaborate with industry partners across key research areas in resilient communications, including material mechanics, fluid and thermal engineering, advanced manufacturing technology (AMT) renewables, electrical power and control systems, and smart materials and surfaces.</p>

IT & CYBERSECURITY

	<p>Northallerton</p>	<p>The 90 Signals Unit, consisting of 7 different support squadrons, is based at RAF Leeming and is tasked with tactical communications and operational information for the UK's air force. They perform communications tasks to prepare, deploy, sustain and recover information services for multi-domain operations and exercises. This secures Air's cyber terrain and digital services to improve operational and corporate effectiveness with the use of technology.</p>
	<p>Durham University</p>	<p>The Artificial Intelligence and Human Systems Group (AIHS) focuses on software engineering of AI-based systems, Self-adaptive and Autonomous systems, decision-making under uncertainty, model-driven engineering (MDE), requirements engineering (RE) and Evidence-Based Software Engineering, as well as improving human-computer interactions and communications.</p>
	<p>University of Sunderland</p>	<p>The Applied Research in Computing (ARC) department has disciplinary expertise from longstanding research in Intelligent Systems, Human-computer interaction, and Software Engineering. They have had valuable impacts in the work of UK hospitals, the UK government digital service, commercial organisations (Orange, Habito) and small companies in North East England developing new approaches to user experience evaluation, machine learning, modelling for healthcare and innovation for the software sector.</p>



IT & CYBERSECURITY

 <p>Manchester Metropolitan University</p>	<p>Manchester Metropolitan University</p>	<p>Manchester Metropolitan's Centre for Advanced Computational Science advances research in five specialist areas: machine intelligence, data science, smart and secure infrastructure, human-centred computing, mathematical modelling, and flow analysis. Their work has had direct applications in defending networked computer systems, programmes, and devices from infiltration and attacks, specifically in IoT, satcom, and shared network infrastructure.</p>
 <p><i>University of</i> HUDDERSFIELD</p>	<p>University of Huddersfield</p>	<p>The Centre of Cyber Security Research focuses on addressing practical security challenges, driven by end-user needs, with a common theme of artificial intelligence and machine learning to provide technologies that can deliver security and efficiency improvements. Their research areas include identity and access control, defence and resilience, and digital forensics.</p>
 <p>Newcastle University</p>	<p>Newcastle University</p>	<p>The Centre for Cyber Security and Resilience conducts core research in network nodes and systems, data warehouses and distribution, and end-user points. Their scope and techniques include AI, bio/nano systems, cyber-physical systems, financial technologies, medical systems, and society.</p>
 <p>Edge Hill University</p>	<p>Edge Hill University</p>	<p>The Centre for Data and Complex Systems Research focuses on computer and data science, particularly smart data analytics, data representation and visualisation, cyber security, telecommunications, IoTs and other disruptive services and technologies. The group supports partners in the design, development and testing of vertical applications and services in multiple user community-driven contexts, including smart healthcare, intelligent transport, industry 4.0 and smart cities.</p>
 <p>CENTRIC Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research</p>	<p>Sheffield Hallam University</p>	<p>The Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research (CENTRIC) is a multi-disciplinary end-user focused centre of excellence offering expertise across a range of disciplines, including situational awareness and open source intelligence, cybercrime and cyberterrorism. One of the Centre's portfolio projects is 7SHIELD – developed for safety and security standards of Space systems, ground Segments and Satellite data assets - funded by the Horizon 2020 programme.</p>
<p>Est. 1841 YORK ST JOHN UNIVERSITY</p>	<p>York St John University</p>	<p>The Cybersecurity Research Group (CRG) undertakes fundamental and applied cybersecurity research covering Network security, Trust and user authentication, Privacy preservation and access control, Embedded system security, Cybersecurity education Protection of critical infrastructures, and the human aspect of Cybersecurity.</p>
 <p>LEEDS BECKETT UNIVERSITY</p>	<p>Leeds Beckett University</p>	<p>The Cybercrime and Security Innovation (CSI) Centre aims to advance technical cyber security and digital forensics mechanisms and practice and improve and incorporate an evidence-based approach into the frontline policing of digital forensics and cybercrime investigations. The centre has a close working relationship with West Yorkshire Police, working directly with the Digital Forensics Unit (DFU) and Cyber Crime Team (CCT) to investigate and improve the way cybercrime and digital evidence are processed.</p>
<p>Security Lancaster Lancaster University</p> 	<p>Lancaster University</p>	<p>As an umbrella of Lancaster's Cyber Security activities, the Lancaster Security Institute (SL) targets the broad spectrum of "useful and usable" Cyber Security with a unique "systems" perspective. SL's cross-disciplinary socio-technical research is actively complemented by policy engagement and education to deliver innovative solutions to today's complex security challenges that affect people and societies.</p>
 <p>National Cyber Force</p>	<p>Samlesbury</p>	<p>The National Cyber Force (NCF) will establish its future headquarters in Lancashire, helping to grow technology, digital and defence sectors, as well as encouraging partnerships between government, industry and universities in the region.</p>

IT & CYBERSECURITY

	<p>University of Central Lancashire</p>	<p>The Cyber Solutions Centre provides access to UCLan's multi-disciplinary Cyber Security research and knowledge exchange activities. This includes activities undertaken in the Future Digital Technologies Institute that focus upon research related to user-centred security, communication security protocols, block chain, and usability. Activities undertaken by the Institute of Criminal, Legal and Social Justice include business cyber-resiliency, digital forensics, cybercrimes relating to identity and property crime. Activities undertaken through the Institute for Business, Enterprise and Organisational Impact include the Lancashire Cyber Eco-System Good Practice Network.</p>
	<p>Northumbria University</p>	<p>Northumbria's 'CyberNets' research group focuses on cyber security in both wired and wireless networks. This involved the use of AI (Machine/deep learning), optimisation techniques, and adversarial learning against evasion via intrusion detection and intelligent penetration testing. The broader network systems group explores network communications protocol, UAVs and HAPs, edge computing, and 5G networks and beyond, all with the aim of creating more resilient networks.</p>
	<p>Brampton</p>	<p>RAF Spadeadam is the only Electronic Warfare Tactics facility in Europe where aircrews can practise manoeuvres and tactics against a variety of threats and targets that they face in contemporary warfare.</p>
	<p>Teesside University</p>	<p>Teesside University's research includes digitalisation, informatics, cybersecurity, automation, energy management, sustainable technologies, artificial intelligence, distributed control and social science in energy-related and construction applications.</p>
	<p>Yorkshire-wide</p>	<p>The Yorkshire Cyber Security Cluster works to foster and encourage skills development in the cyber security industry via several programmes and collaborations with industry. This includes the Cyber Kickstart programme which offers students of all ages, as well as adults seeking to transition their career into cyber, an opportunity to explore the industry and gain relevant qualifications to kindle their journey. The cluster also works closely with the UK Cyber Cluster Collaboration (UKC3) skills working group to deliver these programs, but also undertake national cyber skills research studies and skills surveys.</p>

SOFTWARE DEVELOPMENT

	<p>Durham University</p>	<p>Durham's Centre for Advanced Instrumentation (CfAI) builds on its interdisciplinary applied research to provide design and development services for software applications for the industry. So far, they have supported the development of OGS adaptive optics control, link modelling, AI, Space surveillance and tracking applications, among others.</p>
	<p>University of Liverpool</p>	<p>The Networks Sciences & Technologies (NeST) initiative supports and brings together several projects at the university surrounding networks across various applications, including biological, chemical, physical and digital systems, economy, social relationships and many human made complex structures such as the Internet. The NeST Software Lab is a sub-division that undertakes research and development projects in several network and connectivity issues and innovations, including wireless networks and network preservation.</p>

TESTING AND DEVELOPMENT

	<p>Durham</p>	<p>The Centre for Process Innovation (CPI) acts as a catalyst bringing together academia, businesses, government and investors to translate bright ideas and research into the marketplace. The innovation hub provides customers access to the right experts, equipment, networks, funding and more – connecting the dots for effective innovation.</p>
	<p>University of Chester</p>	<p>A multi-disciplinary team of experts from the Centre for Research into Environmental Science and Technology (CREST) works closely with SMEs to design, develop and bring new products and services to market; develop processes to save time and/or money, understand markets, and develop successful business models. The centre also has a dedicated laboratory to undertake testing and analysis on air, liquids and materials through UV-Vis spectrophotometry, XRF, and wet chemistry.</p>
	<p>Sci-Tech Daresbury</p>	<p>Sci-Tech Daresbury is an innovation hub of nearly 150 high-tech companies and over 1,300 experts. The innovation hub enables startups and scientists to accelerate growth and deliver real-world impact, by providing science infrastructure, business support, co-working Space, and laboratory Space.</p>
	<p>Durham University</p>	<p>The Durham University Space Research Centre (SPARC) is an innovation hub leveraging applied space R&D capabilities at Durham University to offer industry R&D partnerships and training. SPARC capabilities include multidisciplinary research in Space applications, novel sensors, environment modelling, machine learning, and governance and operations.</p>
	<p>Lancaster University</p>	<p>A £0.85m wireless broadband laboratory donated by Aeroflex Limited, the Wireless Broadband Laboratory uses state-of-the-art suite of test equipment to design, test and verify different protocols and algorithms for LTE-Advanced 4G wireless devices and systems.</p>
	<p>Newcastle University</p>	<p>Newcastle University's Intelligent Sensing Lab supports signal and information processing research suited to deal with multimodal data. The Lab focuses current and future smart sensor research, including multimodal (audio-video-infrared-touch-text) data processing for the next generation of artificially intelligent automated systems. The Lab has breakthroughs in establishing complete mathematical proofs for nonlinear signal processing theory, which enable non-linear models for optimal signal separation and information retrieval.</p>
	<p>Northumbria University</p>	<p>The North East Space Skills and Technology (NESST) Centre will be a state-of-the-art £50M capital facility, which will enable the advancement of the research and innovation infrastructure to support the development of Space products to mission ready status, accelerating their entry into commercial markets. This will include R&D capabilities for satellite assembly, Space readiness testing facilities for CubeSats to medium-scale satellites, specialist research facilities for optical communications research, and mission operation centre capacity.</p>
	<p>University of Central Lancashire</p>	<p>The Engineering Innovation Centre (EIC) brings together world-leading research, leading business minds and inspiring teaching in a spirit of collaboration and discovery. The EIC offers a wide-ranging portfolio of industry engagement opportunities This includes: tailored business support programmes in product design and innovation, digital manufacturing, low carbon technologies, Medtech development, and raising equity investment; technology demonstration and access to specialist facilities; Business-to-Business meeting and workshop space with high-quality meeting rooms and spaces for networking; staff upskilling via a full range of CPD and degree apprenticeships; collaborative partnerships whether through student projects, PhDs, Knowledge Transfer Partnerships and joint research bids.</p>



For more information about Space North and the opportunities within our resilient communications industry to invest, innovate or collaborate, reach out below:



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Space Hub Yorkshire
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North West Space cluster
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