UKTIN

Market Research Insight Report

Artificial Intelligence

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INTRODUCTION

The UK is home to a world-leading Artificial Intelligence (AI) R&D&I community, and the adoption of cutting-edge advanced AI techniques is currently being addressed by a large cross-technology national ecosystem, with the IT and Telecommunications category making up 29.5% of deployed AI solutions across sectors. (1)

AI is expected to play an increasingly significant role enhancing the performance of future networks across application areas and for a wide range of purposes, such as improving network efficiency, increasing energy efficiency, ensuring private secure communications and optimising customer services.

With rapid technological developments taking place in the areas of both artificial intelligence and telecommunications globally, this report aims to understand the role that AI currently plays in the UK telecoms market, current public R&D&I activities and their area of focus, and the role AI may play in the future, especially as telecoms systems become more complex and interconnected.

(1) AI activity in UK businesses, UK government, 2022

INTRODUCTION

1.1 Definitions

Artificial Intelligence (AI) as a discipline can be defined in several different ways, depending on the type of underlying technology and the intended application. These definitions are not absolute and are expected to evolve with time. Nonetheless, the current capabilities of AI have been defined by various organisations and public bodies.

The Office for AI puts forward the following definition in their National AI Strategy:

> "...machines that perform tasks normally requiring human intelligence, especially when the machines learn from data how to do those tasks". (2)

Similarly, the Information Commissioner's Office considers AI to be:

> "...an umbrella term for a range of algorithm-based technologies that solve complex tasks by carrying out functions that previously required human thinking. Decisions made using AI are either fully automated, or with a 'human in the loop'". (3)

For the purposes of this report, AI in telecoms R&D&I activities are defined as projects and initiatives that aim to expand or develop the capabilities of AI in the telecoms sector, such as applications areas in wireless networks, network optimisation and efficiency, energy and security. Customer service is also an area that has significant potential innovative applications in this field, however, it is generally not the focus of R&D&I activities in the UK.

(2) National AI Strategy, Office for AI, 2021
(3) Explaining decisions made with Artificial Intelligence - Definitions, Information Commissioner's Office

1.2 Methods

The research methods for this report involved scraping web pages to obtain publicly available data, (4) including UKRI, DSIT, Horizon 2020 and CELTIC-NEXT, which detail publicly funded R&D&I activity in the telecoms sector, and curating these results to identify R&D&I that is relevant to AI in telecoms. To ensure that data is relevant and cutting-edge, the start date for data collection is 2017. (5)

Other methods include desk research, literature reviews and expert insight interviews conducted by Digital Catapult and University of Bristol as part of the UKTIN programme. The University of Bristol conducted expert interviews with four experts from four different universities.

This combined quantitative and qualitative approach was conducted with the intention of providing a snapshot in time as well as a high level, non-technical insight into pertinent academic and industrial R&D&I activities in AI in future networks and telecoms.

(4) Due to the lack of available data on private funding for R&D&I, this report focuses on publicly available data and public funding. More information on methodology and limitations may be found in Annex 1
(5) As advised by experts within Digital Catapult

1.3 Application areas for AI in Telecoms

Similar to other industries, AI has a range of current and potential applications in telecommunications, revolving around automation, decision-making, optimisation, prediction and analysis. UKTIN has identified that AI has been used in various forms in the telecoms industry since the early 2010s, in functions related to network optimisation, predictive maintenance, customer support, security and fraud prevention, revenue growth and robotic process automation. (6)

There is a distinction to be drawn between partial AI solutions (such as adding a new AI component in an existing system) and what is often referred to as 'AI-native' telecoms, where all components use AI in an interconnected manner. (7) 'AI-native' is considered to be an advanced level of AI adoption and currently the telecoms sector is at the stage of considering applications or deploying AI solutions in existing operations. Literature also suggests that AI is viewed as a major advance in automation and data analysis, with many communication service providers already either deploying AI use cases or exploring possibilities and running proof of concepts. (8)

However, several challenges remain when it comes to deploying AI solutions in the telecommunications industry, particularly in network infrastructure. Analysys Mason reports that access to high quality data is a significant challenge, and that out of 84 senior communication service provider executives surveyed worldwide, 6% considered themselves to be at the 'zero-touch automation' stage, in which AI and ML are used to automate network deployment and operation. In addition, TM Forum suggests that introducing new technologies, such as AI, while managing legacy systems is a challenge for the telecommunications sector. (9)

(6) Artificial intelligence, UKTIN
(7) Defining AI native: A key enabler for advanced intelligent telecom networks, Ericsson, 2023
(8) Accelerating the adoption of telco AI to deliver autonomous networks, Adaora Okeleke. Report by Analysys Mason, commissioned by Nokia, 2023
(9) Telcos evaluate choices on the path to becoming AI-native, Joanne Taaffe, TM Forum, 2023

1.4 General outlook for AI-related R&D&I in Telecoms

Precise data on private R&D&I is expectedly limited, as this information is commercially sensitive and access is restricted. That being said, some general data is available where individual companies have chosen to publish such information. For instance, in their 2022 Annual Report, BT Group reported spending £604 million on R&D generally speaking in the fiscal year 2022, (10) but it is not clear how much of this may have gone towards funding AI in telecoms projects.

Sector insights indicate that, generally speaking, telecoms businesses have reduced their spending in R&D from £1.4bn in 2008 to £1.03bn in 2020. (11) A report published by Imperial College London states that telecom R&D amounted to 3.8% of total UK R&D spending in 2021, and suggested that global financial conditions resulting from the Covid-19 pandemic had a role to play in this reduction of spending. This is further highlighted by the additional statement in the same report that "...despite 5G infrastructure, gigabit and satellite broadband development, there has been no remarkable growth in R&D in recent years."

However, R&D&I activities on AI are a major theme for the telecommunications sector. Korean multinational company Samsung has an established track record in AI for customer service, (12) as well as seven AI centres worldwide, one of which is in Cambridge. (13) The Samsung AI Center in Cambridge focuses on various aspects of fundamental research on AI. The Samsung R&D Institute also conducts research on AI, focusing on AI for networks. UK-headquartered operator Vodafone has a five-year plan to invest €225 million into a European Research and Development Centre in Malaga. The focus of the research centre includes "the increasing role of artificial intelligence (AI) and automatic learning in networks," as well as 5G and Open RAN. (14) In addition to large private organisations who have the expectation of having AI related telecoms activities as part of their overall portfolio, within the UK, there are industry actors focusing on AI.

(10) BT Group plc - Annual Report 2022, BT Group, 2022
(11) Sectoral Systems of Innovation and the UK's Competitiveness: The UK Telecommunications Sector, Professor Eric Yeatman, Professor Chris Tucci & Dr Marika Iivar, Imperial College London, 2023
(12) Artificial Intelligence, Samsung
(13) Samsung AI Center - Cambridge, Samsung Research. In addition, Samsung also announced a 6G networks and devices research group in 2022, one focus of which will be data intelligence
(14) Vodafone opens doors to digital future with new European R&D Centre, Vodafone, 2022

An example is network intelligence company NetAI, which provides a suite of AI-based solutions for telecoms, including energy efficiency, analytics, anomaly prediction and quality of experience. (15)

Citing a white paper by Juniper Research, TelecomTV states that AI is set to play a major role in telecom trends in 2024. Juniper Research anticipates that Tier 1 operators will seek to deploy AI into every aspect of the networks. (16) Similarly, in October 2023, TelecomTV conducted a survey of 119 individuals across the telecoms industry and related sectors which found a generally positive outlook towards AI in telecoms. When asked about how important it is to be seen as a company that has an AI strategy, 86% of respondents believe it is important to be seen to have an AI strategy (47% believing that it is "critical" and 39% stating that it is "quite important"). Furthermore, with regards to generative AI specifically, 54% responded yes to the question "do you think the use or integration of generative AI (GenAI) in your company's services or products will lead to an increase in revenues over the next year." (17)

In addition, a survey conducted by technology company Nvidia on AI in telecommunications (with 400+ telecommunication and related professionals from around the world between 2022-2023) found that while 60% expected to "optimize operations with AI" and 65% "agreed that AI is important to their company's success (based on a seven point scale)," generally speaking investment in AI seems to be low. (18) The report goes on to note that 50% of respondents for 2022 reported spending less than $1m on AI. The survey report states that 30% of respondents "...agreed that their companies have the capability and knowledge to move an AI project from research to production". (19) This underscores the importance of R&D&I activity in AI in telecoms for the sector.

(15) Net AI
(16) AI to dominate telecom trends in 2024 – report, TelecomTV, 2023
(17) DSP Leaders Report - Telecom's Take on AI, TelecomTV, 2023
(18) State of AI in Telecom 2023, Nvidia, 2023
(19) State of AI in Telecom 2023, Nvidia, 2023

It is also worth highlighting that partnerships emerge as an important focus when developing AI solutions and conducting R&D&I activities in AI in telecoms. In the AI-Native Telco Summit run by TelecomTV in October 2023, 72% answered "work with partners to develop new AI capabilities" to the question "how can telcos best leverage AI innovation to improve operational efficiency and develop new service". (20) Similarly, the survey conducted by Nvidia also found that partnerships were viewed as critical to developing AI solutions, with 47% of respondents stating that their AI solutions are co-developed with partners. (21)

What follows is an analysis of publicly-funded R&D&I activities in AI and telecoms across UKRI, DSIT, Horizon 2020 and CELTIC-NEXT, and includes both academic and industry R&D&I. Activities covered in this report range from small, medium and large-scale projects funded by UK Research and Innovation (UKRI), including fellowships and studentships, to large consortium-led projects funded by UKRI, the Department for Science, Innovation and Technology (DSIT) or Horizon 2020 and CELTIC-NEXT. (22) Generally speaking, consortium-type projects are common across public funding sources, with academia and industry working together on projects.

(20) Partnerships key to telco AI success – poll result, TelecomTV, 2023
(21) State of AI in Telecom 2023, Nvidia, 2023
(22) This report will focus on the UK partners of Horizon 2020 and CELTIC-NEXT projects

DSIT: OPEN NETWORKS R&D FUND

The Open Networks R&D Fund, an initiative from DSIT, is part of the UK's telecommunications diversification strategy. Running until April 2025, this Fund aims to build a more diverse and competitive supply market, thereby reducing the UK's reliance on the incumbent dominant industry players for mobile access network equipment.

To this end, an R&D fund worth £250m was put in place, (23) which has funded 37 R&D&I projects, as well as the SmartRAN Open Network Interoperability Centre (SONIC Labs), (24) the UK Telecoms Innovation Network (UKTIN), (25) and the UK Telecoms Lab (UKTL). (26)

The funding targets "...the security and resilience of the infrastructure that underpins" (27) telecoms. Some projects in this fund may include investigations of AI to further this aim, but AI itself is not the primary focus.

(23)5G Supply Chain Diversification Strategy, UK Government, 2020
(24) SONIC Labs, Digital Catapult
(25) UKTIN
(26) UK Telecoms Lab, The National Physical Laboratory
(27) 5G Supply Chain Diversification Strategy, UK Government, 2020

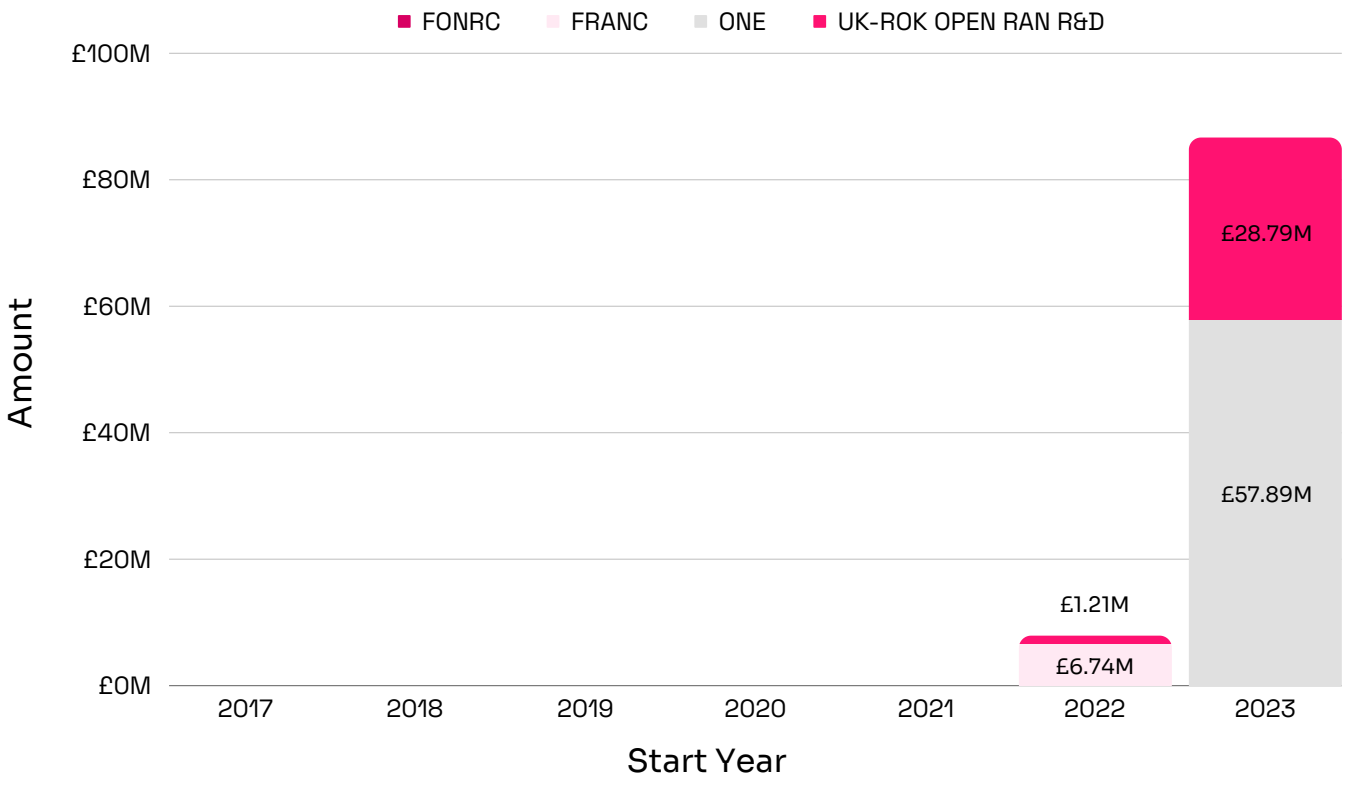
2.1 AI research in the FONRC, FRANC and ONE competitions

The R&D fund is split into three key competitions - the Future Open Networks Research Challenge (FONRC), the Future RAN Competition (FRANC), and the Open Networks Ecosystem (ONE) Competition. In addition, there is also the UK & Republic of Korea Open RAN R&D Collaboration, which has funded one project. All successful projects in these competitions are consortium-based, with a minimum of two partners. Reflecting the underlying goals of each competition, some projects are led by industry, while others are led by academia. The purpose of FONRC (28) is to facilitate universities working with relevant industry sectors (such as RAN vendors) to foster R&D&I capability, while FRANC (29) and ONE (30) are typically led by industry partners and focus on building supply chain capability.

This report identified 37 successful projects from these competitions, of which 18 are estimated to have an AI component to their R&D&I activity. (31) In terms of funding, it is estimated that £94.6m has gone towards these 18 projects with a component of AI research. Out of the £250m total, this represents 37.9%. It is, however, important to mention that the extent to which these projects focus on AI may vary, and it is also possible that projects not included in this list may focus on AI in the future or in a way that is not immediately apparent in project descriptions. Therefore, this list is presented as indicative, rather than definitive, and is intended to give an overview of the place of AI in the Open Networks R&D Fund.

(28) Future Open Networks Research Challenge, UK Government, 2022
(29) Future RAN Competition, UK Government, 2021
(30) Open Networks Research and Development Fund, UK Government, 2023
(31) For the most part, projects had AI/ML expressed in the project description. In cases where this was not explicit, expert opinion was consulted within Digital Catapult

Graphic 1: Funding allocated to Open Networks R&D Fund projects with a component of AI research (32)



The graphic represents the total amount of funding granted under each competition. It considers 18 DSIT projects with over 100 partners across all competitions for AI in Telecoms. Data credit: UK Government

In terms of funding breakdown across projects, ONE represents the largest proportion of AI-related research, with £57.9m allocated (61.2% of the total £94.6m). Of all the projects part of the ONE competition, 52.6% had a component of AI-related research. The second largest is FONRC with £28.8m allocated (30.4%), with 100% projects having an AI component. This is followed by FRANC with £6.7m allocated (7.1%), where 28.6% of the projects in the competition had an AI component. Finally, in a category of its own, the UK & Republic of Korea (ROK) Open RAN R&D Collaboration with £1.2m allocated (1.3%). (33)

(32) The year refers to the year of announcement rather than the duration of the project
(33) Table with details of funding per project in Annex 4

2.2 Projects and research themes

Open RAN (Open Radio Access Networks) is a key part of the supply chain diversification strategy, with the majority of the projects in Table 1 focusing on this. In traditional supply chain models, telecom operators worked with single suppliers across an entire mobile site, (34) whereas Open RAN offers the opportunity to increase vendor competition and diversity. As described by Juniper Networks:

> "Open RAN is an ongoing shift in mobile network architectures that enables service providers the use of non-proprietary subcomponents from a variety of vendors. …Open RAN enables programmable, intelligent, disaggregated, virtualized, and interoperable functions." (35)

With Open RAN, small, new sections of the network can be created, allowing new technologies to be integrated more easily, which could lead to increased diversification and competition. Within Open RAN, new components, including AI can be added more natively in the building blocks such as the RAN Intelligent Controller, rApps and xApps.

According to RCR Wireless News:

> “xApps and rApps are network automation tools. They maximize the radio network’s operational efficiency. …xApps and rApps provide essential control and management features and functionality.” (36)

(34) Diversification, UKTIN
(35) What is Open RAN?, Juniper Networks
(36) xApps vs. rApps: Network automation fundamentals, RCR Wireless News, 2021

Table 1: Open Networks R&D projects with a component of AI research

Project	Lead Partner	Competition	Start Year	Amount (£)
TUDOR	University of Surrey	Future Open Networks Research Challenge	2023	£12,000,000
REASON	University of Bristol	Future Open Networks Research Challenge	2023	£11,993,730
YO-RAN	University of York	Future Open Networks Research Challenge	2023	£4,795,662.16
Accelerating RAN Intelligence in 5G (ARI-5G)	Telecom Infra Project	Future RAN (FRANC)	2022	£2,377,686
O-RANOS	Cellnex Connectivity Solutions	Future RAN (FRANC)	2022	£1,937,528
Towards AI powered and secure carrier-grade Open RAN Platform	Microsoft UK	Future RAN (FRANC)	2022	£1,928,756
Energy-efficient Cloudlets for ORAN (ECORAN)	University of Leeds	Future RAN (FRANC)	2022	£492,000
One-Western O-RAN (Bath)	Telet Research (NI)	Open Networks Ecosystem	2023	£9,910,790
SCONDA (Small Cells ORAN in Dense Areas) - Glasgow	AWTG	Open Networks Ecosystem	2023	£9,123,182.58
BEACH (Worthing)	Dense Air	Open Networks Ecosystem	2023	£8,990,595
HiPer-RAN (Highly Intelligent, Highly Performing RAN)	University of Surrey	Open Networks Ecosystem	2023	£7,895,362
Cambridgeshire Open RAN Ecosystem (CORE)	Cambridgeshire County Council	Open Networks Ecosystem	2023	£6,523,645
ARIANE (Accelerating RAN Intelligence Across Network Ecosystems)	Telecom Infra Project	Open Networks Ecosystem	2023	£6,004,167.61
Reach (Blackpool)	University of York	Open Networks Ecosystem	2023	£3,144,056

Table 1: Open Networks R&D projects with a component of AI research

Project	Lead Partner	Competition	Start Year	Amount (£)
PerceptRAN: Towards maturing O-RAN based data driven RAN monitoring and control	Metaswitch Networks	Open Networks Ecosystem	2023	£2,347,827.99
Energy-efficient composable optical topologies for assembled processing (ECO-TAP)	Ultracell Networks	Open Networks Ecosystem	2023	£2,260,000
ON-SIDE (Open Network Shared Spectrum Innovation and Design Environment)	Cisco	Open Networks Ecosystem	2023	£1,694,542
Flexi-DAS	AWTG	UK & Republic of Korea Open RAN R&D Collaboration	2022	£1,211,615
Total				£94,631,145.34

This table represents the projects funded by the Open Networks R&D Fund, split according to competition type: ONE (10 projects), FRANC (4 projects), FONRC (3 projects), and the UK & ROK Open RAN R&D Collaboration (1 project). Projects are listed from the most recent to the least recent and may run across multiple years. Data credit: UK Government

Throughout all 18 DSIT projects, there were 100 partners involved across industry and academia. These projects are multi-partner consortium projects, and partners include universities, companies, local councils, Catapults and other organisations. Out of these 18 projects, the two top-funded projects have similar levels of funding.

The first, TUDOR (Towards Ubiquitous 3D Open Resilient Network), is a large consortium led by the University of Surrey's 5G/6G Innovation Centre. Working on Open RAN, TUDOR is "researching and developing open network components and their seamless interoperability in the wider RAN, core, and transport network environment and service platforms, applying them across heterogeneous networks in 5G and beyond." (37) Within the TUDOR project, AI/ML will be used for automation and network management, partially through RIC and Digital Twinning.

The second project, with similar levels of funding, is the consortium based project REASON (Realising Enabling Architectures and Solutions for Open Networks), led by University of Bristol, whose partners include three major mobile network equipment vendors, four other universities and Digital Catapult, among others. The project is adopting a Native-AI approach and will develop a "roadmap for open 6G networks" and anticipates using AI in "advanced solutions for network-edge and network-wide automation" as well as intelligent multi-access technology. (38)

The third highest-funded, ONE WORD (the Open Networks Ecosystem Western Open RAN Deployment), is a consortium led by mobile network operator Telet and aims to deploy a 5G standalone network with Open RAN in Bath, around Cardiff's Principality stadium, the Shelsley Walsh motorsport venue, and Quarry Park in Shrewsbury. Here, AI is involved in a RAN Intelligent Controller to provide "a range of management and orchestration functions on the 5G SA Open RAN through the use of xApps …, including AI techniques to improve spectrum utilisation and energy efficiency." (39)

(37) TUDOR, UKTIN
(38) REASON, University of Bristol, Faculty of Engineering
(39) One Western O-RAN (Bath), UKTIN

DSIT

A key aim for all DSIT projects is to support the diversification of the 5G supply chain, but also 5G development more generally speaking. AI/ML research underpins plans for the automation of systems, as well as enhancing network and platform efficiency, reliability and security. AI/ML solutions for power consumption and energy efficiency are also a part of several of these projects. Finally, there are also projects exploring edge computing, spectrum management, and cloud technology.

Another funded project highlighted in the interviews is an upcoming comprehensive testbed and interconnected platform that will support research from the federated Engineering and Physical Sciences Research Council (EPSRC) hubs. This may enhance collaboration as it connects labs dispersed through the UK, allowing academics to remotely access infrastructure for testing, reducing infrastructure costs. This platform also aims to permit acceleration of research and TRL advancement. While the project itself is not focused on AI applications for telecoms, the platform's terminals will contain equipment such as advanced AI-enabling edge compute, end-user equipment (e.g. AR/VR, haptic devices) and logical higher layer functions, including monitoring and intelligent control platforms, which are key enablers.

UKRI

UK Research and Innovation (UKRI) is the UK's national research and innovation body and is a key funder for both academic and industry R&D&I in telecoms. UKRI comprises Innovate UK, (40) Research England, (41) and seven research councils. To give a sense of scale, UKRI's total budget was £7.9 billion in 2022 and £8.4 billion in 2023.

Within UKRI, funding sources for academic institutions and industry differ. For academic projects (including academic leads and partners in consortium projects), the funders of the projects identified as relevant for this report are the Engineering and Physical Sciences Research Council, (42) Horizon Europe Guarantee, (43) the Future Leaders Fellowship (FLF) programme (44) and the Natural Environment Research Council (NERC). (45) For industry partners, the key funders are Innovate UK and Horizon Europe Guarantee.

A portion of the AI in telecoms research projects described below are multi-partner consortium projects. These project types have both academic and industry partners. It is important to note that funding eligibility criteria affect how funding is allocated.

(40) Innovate UK is the UK's innovation agency
(41) Research England funds and engages with English higher education providers
(42) EPSRC had a total budget of £621m in 2022 (7.9% of the total UKRI budget) and £647m in 2023 (7.7% of the total UKRI budget). See UKRI 2022-2023 - 2024-2025 budget allocations for UK Research and Innovation, UKRI, 2022
(43) Horizon Europe Guarantee is a funding category under UKRI for researchers who were unable to get their Horizon Europe funding while the UK was associating to the programme. Horizon Europe is the EU's research and funding organisation, with a budget of €95.5 billion
(44) The Future Leaders Fellowships programme is a funding scheme supporting early career researchers and innovators in academia, business or research institutions
(45) NERC, UKRI

UKRI

For example, while businesses can be eligible for Innovate UK funding, they are not eligible for EPSRC funding which is for academic researchers only. (46) This means that the same multi-partner project may receive EPSRC funding for the academic partner, and Innovate UK or Horizon Europe Guarantee funding for the industry partner.

As a result, in certain cases the same project is present in both the academic and industry table, as the project has both academic and industry partners funded by UKRI. If the project has multiple industry partners, the project also appears twice in the table.

It should be noted that in some cases, AI research is one part of a project rather than the sole focus of the research project, enabling other functionalities or applications.

(46) How to apply for research and innovation funding, UKRI

3.1 EPSRC, Horizon Europe Guarantee, FLF and NERC: Academic R&D&I

Academic research in AI has been growing continuously over the last few decades and in line with this, there is a growth in academic research projects focusing on AI applications in telecoms specifically. Insights from researchers in the field further support this, with one academic expert in industry suggesting that ”...a great amount of manuscript submissions for publication to reputable journals such as IEEE Transactions focuses on AI based solutions for telecoms’’. (47)

This reflects increasing interest in the possibilities of AI in telecommunications, as seen by the relatively small, but growing number of projects winning funding for research in recent years. In addition, the EPSRC Future Telecoms Hubs, including TITAN, (48) HASC (49) and CHEDDAR, (50) all have AI for networks as a key part of their research agenda.

The primary trends emerging from research interviews conducted for this report revolve around operational efficiency, energy efficiency, edge computing, privacy and security, and AI applications in telecommunications, particularly in the domain of wireless telecommunications. Specifically, AI in telecommunications research appears to be especially relevant in 6G projects and testbeds.

(47) Expert interview for UKTIN conducted by University of Bristol, October 2023
(48) Platform Driving The Ultimate Connectivity, University of Bristol
(49) Future communications hub in all-spectrum connectivity, University of Bristol
(50) CHEDDAR: Communications Hub For Empowering Distributed ClouD Computing Applications And Research, EPSRC

3.1.1 Funding sources

This report identifies 41 UKRI-funded projects that fall into the category of AI in telecoms R&D&I, with total funding amounting to £24m. Of UKRI's seven research councils, the EPSRC is most active in funding academic research for AI in telecommunications R&D&I, with £19.2m (79.8% of overall expenditure) spent across 32 projects.

The second largest funder of activities is the Horizon Europe Guarantee with £2.4m across 5 projects (10.2%), followed closely by the Future Leaders Fellowships programme with £2.4m (9.9%). (51)

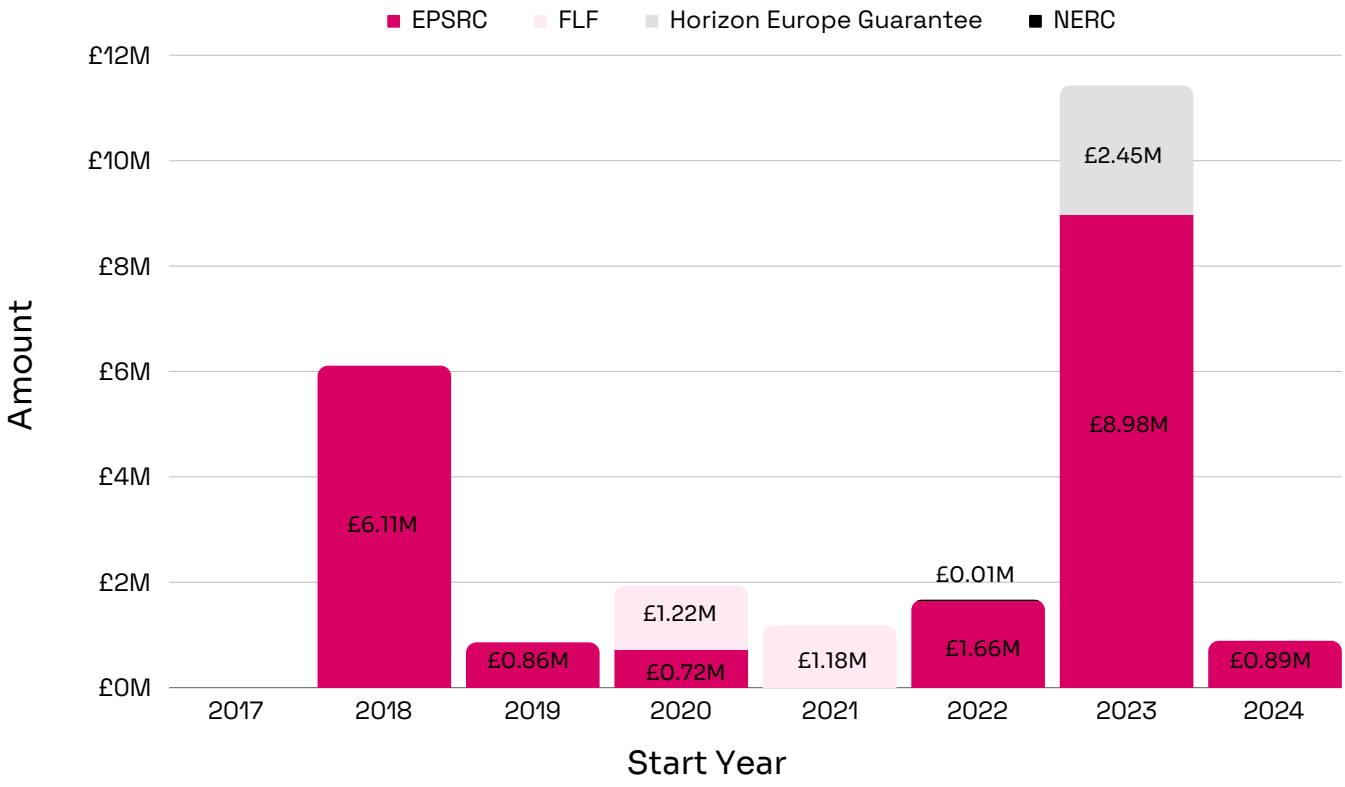
Last is NERC, which funded two projects, including a studentship with no recorded funding (as is standard) (52) and a research grant worth £11,608 (0.1%). As seen in Graphic 2, UKRI funding for academic R&D&I in this area has increased significantly in 2023. The £6.11m figure in 2018 is accounted for by the large-scale TRANSNET (53) programme (see table 2). This increase in 2023 suggests an uptick in interest on the part of the funding bodies to support AI in telecoms projects, and a corresponding uptick in these projects successfully securing funding.

Interview insights from sector experts also suggest that academic funding is primarily accessed through these three sources:

> "We don't face difficulties in securing funding, but options are limited beyond key industrial players like EPSRC and Innovate UK. We have access to Research Council funding through the EU Horizon program, which has been beneficial. Additional funding comes from impact accelerator accounts for research commercialisation, but these are the extent of funding opportunities." (54)

(51) Table with details of funding per source in Annex 6
(52) Studentships are listed as 0 for value in UKRI data. This is listed as N/A in the full table in Annex 6
(53) Transforming networks - building an intelligent optical infrastructure (TRANSNET), EPSRC
(54) Expert Interview for UKTIN conducted by University of Bristol, October 2023

Graphic 2: Funding sources for Academic AI in telecoms research year on year



The graphic represents the total amount of funding granted by UKRI under each scheme to academic AI in telecoms projects. It considers 41 different projects in total. NERC funding is labelled in yellow. Data credit: UKRI

3.1.2 Projects and R&D&I areas of focus

Since 2017, 41 research programmes have been identified in the area of AI in telecoms R&D&I. Of these, 7 have funding of over £1m. A significant proportion of this R&D&I is consortium based, led by an academic institution with industry partners. The typical scenario seen in these projects is that the academic partner leads the project, which runs for several years, although this varies.

Table 2: Top ten Academic AI in telecoms research projects

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (£)
Transforming networks - building an intelligent optical infrastructure (TRANSNET)	University College London	EPRSC	Research Grant	2018	£6,105,916
6G Sub-Terahertz Software Defined Radio Testbed	University of Sheffield	EPRSC	Research Grant	2023	£2,379,292
Platform Driving the Ultimate Connectivity	University of Strathclyde	EPRSC	Research Grant	2023	£2,030,860
Beyond Exabit Optical Communications: from new devices, via new dimensions to new	University College London	FLF	Fellowship	2020	£1,224,497
Future Millimetre Wave RF Transceiver Architectures for Communications Systems	University of Sheffield	FLF	Fellowship	2021	£1,179,053
FreeML: Engineering networked machine learning via meta-free energy minimisation	King's College London	EPRSC	Fellowship	2023	£1,061,704
AI powered micro-comb lasers: a new approach to transfer portable atomic clock accuracy in integrated photonics	Loughborough University	EPRSC	Fellowship	2023	£1,022,266
ECCS-EPSRC: NeuroComm: Brain inspired wireless communications - from theoretical foundations to implementation for 6G and beyond	King's College London	EPRSC	Research Grant	2023	£990,142
Reconfigurable intelligent surfaces 2.0 for 6G: Beyond diagonal phase shift matrices	Imperial College London	EPRSC	Research Grant	2024	£891,184
CENTRIC: Towards an AI-native, user-centric air interface for 6G networks	King's College London	Horizon Europe Guarantee	EU Funded	2023	£883,541

This table represents the ten most highly funded academic (and multi-partner) projects) that fall into the category of research in 'AI in telecoms'. These represent all of the results that were retrieved in the data scraping of the UKRI website. Projects are listed from the most recent to the least recent. The full list of 41 projects is in Annex 6. Data credit: UKRI

In terms of themes, the data shows that there is a strong focus on the possibilities of AI technologies for wireless telecommunications, in particular 5G and 6G, as well as optical infrastructure.

The highest funded research project, Transforming networks - building an intelligent optical infrastructure (TRANSNET), is a large consortium project led by University College London, the aim of which is to "create an adaptive, intelligent optical network, providing capacity when and where it is needed to transform the next-generation digital communications infrastructure". (55)

The second most highly funded project is the SDR6G+ facility, the focus of which is the development of 6G radio systems. An important part of this facility is its ability to "...produce raw data for machine learning/artificial intelligence applications used at the Physical layer". (56)

The next highest funded project, Platform Driving the Ultimate Connectivity similarly focuses on connectivity and networks. The TITAN platform in this project '...focuses on a new architecture and artificial intelligence (AI) techniques that enable the integration of multi-access technologies for a seamless end-to-end service delivery by considering advanced requirements in terms of data rate, latency, security and energy efficiency.' (57)

The key aim of these three projects is to research and develop AI tools and methodology to improve and optimise wireless technologies, particularly in relation to the future of connectivity. The focus on 6G in particular suggests that the principal investigators who obtained these grants, as well as their academic and industrial collaborators, view AI tools and methods as a core component of what will make 6G rollout possible.

(55) Transforming networks - building an intelligent optical infrastructure (TRANSNET), EPSRC
(56) 6G Sub-Terahertz Software Defined Radio Testbed, EPSRC
(57) Platform Driving The Ultimate Connectivity, University of Bristol

This was further supported by insights from industry experts, where using AI to optimise networks and make them more efficient was identified as a key area of research. One expert noted that in their telecoms research, "...the current focus is on designing architectures with embedded intelligence. This means creating architectures that seamlessly support add-on intelligence, whether integrated from the start or via plug-and-play. [Their] work also involves optimising the placement of machine learning instances near monitoring sources, considering both inference and training needs.

This approach extends beyond traditional machine learning optimisation to encompass network orchestration and AI application at the physical layer, from wireless to optical components across the telecom stack. ...[The expert is] actively researching ways to enhance network efficiency, reduce operational costs, and develop new skills for the future."

Another interviewee expressed that as part of their research so far, that they have succeeded in generating synthetic mobile network data and exploring AI applications, focusing on spectrum sharing efficiency. The interviewed expert went on to note that the primary areas that are currently being focused on in their work include troubleshooting, anomaly detection, energy efficiency, and efficient telemetry.

In addition to the focus on wireless connectivity, network efficiency and 6G, the topics of edge computing, optical fibre and photonics are also themes in other AI related projects. One such project is that of an interviewee who gave insight into their research that focuses on the exploration of AI through edge computing and native telco AI implementation, aiming to enhance network efficiency while minimising energy costs. In order to achieve their stated goal, this research focuses on cost-effective and environmentally friendly AI, leveraging contextual information for efficiency.

Another expert interviewee confirmed the ecosystem's apparent interest in these areas, sharing that their focus is on "…supporting AI through next-generation telecoms. This involves examining AI applications and their fundamental behaviours, with the goal of better understanding how communication systems can facilitate this. For example, we're exploring ways to deploy AI at the device's edge, which has limited resources and resilience, and how to develop telecom systems to compensate for these limitations."

Overall, a common thread through expert interview insights was a concern with energy efficiency and sustainable AI, with several interviewees placing this at the heart of their work.

Furthermore, it was suggested that a number of gaps in AI in telecoms research are yet to be further explored. These include:

1) the fact that research in AI for telecoms is still in early stages, and there are challenges related to risks, robustness and explainability;

2) the energy consumption of AI-based solutions such as machine learning and the gaps in terms of developing solutions to reduce energy consumption during training and ongoing training;

3) the timescales in academic research and the focus on long-term challenges, which hinders short-to-medium-term commercialisation.

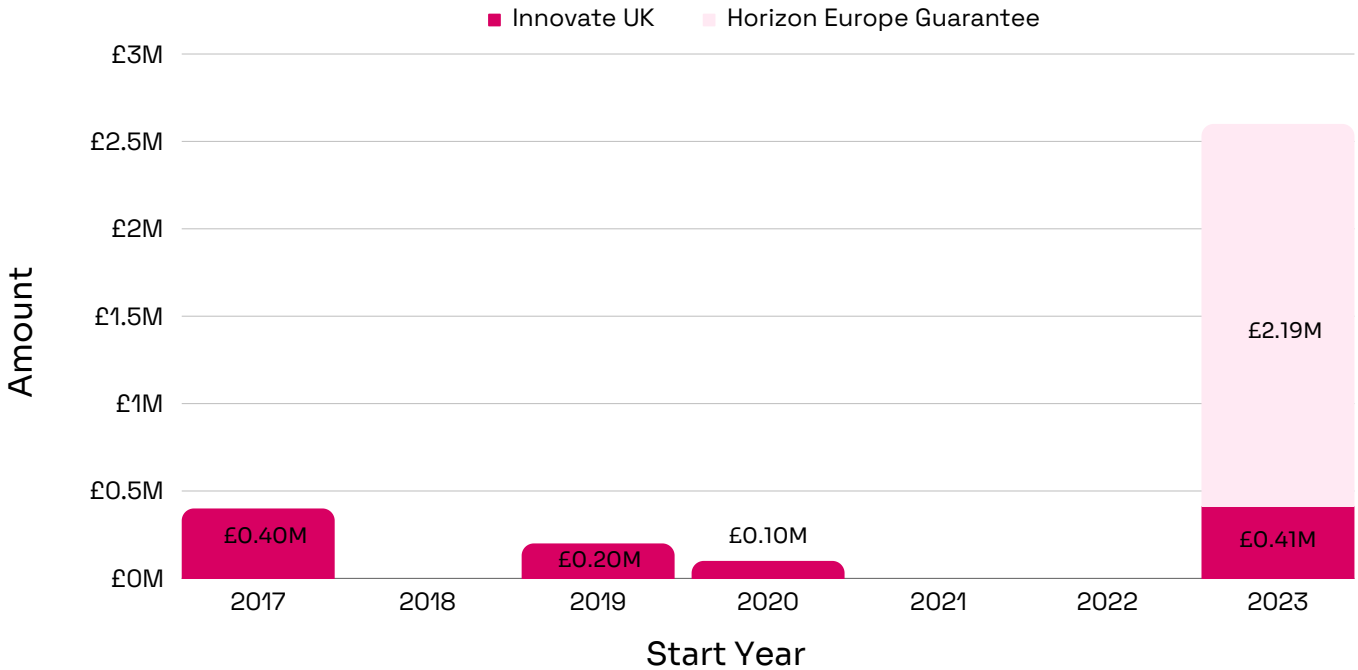
3.2 Innovate UK and Horizon Europe Guarantee: Industry R&D&I

As previously mentioned, Innovate UK (58) is the UK's innovation agency, and Horizon Europe Guarantee (59) is a UKRI funding category for researchers unable to get their Horizon Europe funding while the UK was associating to the programme. Unlike EPSRC, which is an academic funding body, both Innovate UK and Horizon Europe Guarantee fund industry partners.

3.2.1 Funding sources

Since 2017, Innovate UK and Horizon Europe Guarantee both funded R&D&I activities in AI for telecommunications, providing £3.29m in grants to non-academic entities on 13 projects. (60) Horizon Europe Guarantee provided £2.19m across 7 projects (66.49% of the total expenditure), and Innovate UK provided £1.1m across 6 projects (33.51% of the total expenditure).

Graphic 3: Innovate UK and Horizon Europe Guarantee-funded industry AI in telecoms research projects - funding amounts over time



The graphic represents the total amount of funding granted by UKRI via IUK and Horizon Europe Guarantee to industry AI in telecoms projects. It considers 13 different projects in total. Data credit: UKRI

(58) Innovate UK
(59) Horizon Europe Guarantee
(60) Table with details of funding per funding body in Annex 8

3.2.2 Projects and R&D&I areas of focus

In these industry projects, the research focus and themes parallel those of academic projects. This is not surprising, as several of these projects are part of the same R&D&I initiatives listed in the previous section on academic funding.

The focus is on leveraging AI solutions for 6G, optimising network efficiency and capacity, improving reliability and enabling low latency, as well as spectrum management and security, and making use of AI and ML to improve power usage and efficiency.

Table 3: Top 10 UKRI research projects funded of industry AI in telecoms

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (£)
Towards an AI-native, user centric air interface for 6G networks	Interdigital Europe	Horizon Europe Guarantee	EU-Funded	2023	£451,802
SNS-JU BEGREEN - Beyond 5G Artificial Intelligence assisted energy efficient Open Radio Access Network	Gigasys Solutions	Horizon Europe Guarantee	EU-Funded	2023	£443,900
Dynamic optimisation for automated real time provisioning of Cloud based and Wide-Area Networks (DO)	Aria Networks	Innovate UK	Feasibility Studies	2017	£398,082
Telecommunications and Computer Vision Convergence Tools for Research Infrastructures	Interdigital Europe	Horizon Europe Guarantee	EU-Funded	2023	£323,177
An innovative international registry for every telephone number prefix and ML service to detect if a phone number could be fraudulent	3G Telecommunications	Innovate UK	Collaborative R&D	2023	£308,180
PRogrammable AI-enabled deterministiC neTworking for 6G	Interdigital Europe	Horizon Europe Guarantee	EU-Funded	2023	£267,591
Secured and intelligent massive machine-to-machine communication for 6G	Iris Automation	Horizon Europe Guarantee	Research Grant	2023	£265,251

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (£)
BeGREEN: Beyond 5G Artificial Intelligence assisted energy efficient Open Radio Access Network	BT	Horizon Europe Guarantee	EU-Funded	2023	£238,770
IPOSEE: Intelligent and Proactive Optimisation for service-centric wireless networks	Ranplan Wireless Network Design	Horizon Europe Guarantee	Research Grant	2023	£202,179
Crowd Blackspot Intelligence for 5G Rollout (COCKPIT-5G)	Ranplan Wireless Network Design	Innovate UK	Collaborative R&D	2017	£199,918

This table represents the Horizon Europe Guarantee projects (4) and Innovate UK projects (2) that fall into the category of research in 'AI in telecoms'. These represent all the results that were retrieved in the data scraping of the UKRI website. Projects are listed from the most recent to the least recent, may run across multiple years, and may represent one section of a broader project (e.g. 'Towards an AI-native, user-centric air interface for 6G networks'). The full table of 13 projects is in Annex 8. Data credit: UKRI

The highest funded project in this table is Horizon Europe Guarantee-funded Beyond 5G Artificial Intelligence Assisted Energy Efficient Open Radio Access Network, (61) which was separated into two as two partners received funding for the same project. When combining the funding given to Gigasys Solutions and British Telecommunications, it becomes the highest funded project (£682,670).

This multi-partner, international project "...will take a holistic view to propose evolving radio networks that not only accommodate increasing traffic and services but also consider power consumption as a factor." In addition to using Multiple-Input Multiple-Output (MIMO) and Open RAN technology, the role of AI/ML in the project is to "...to provide solutions for reducing the required calculations and to recognise patterns in the system level data associated with the behaviour of the user-base and to learn the most appropriate response to this behaviour in terms of both network performance and energy consumption." (62)

(61) Beyond 5G Artificial Intelligence Assisted Energy Efficient Open Radio Access Network, European Commission, 2023
(62) BeGREEN: Beyond 5G Artificial Intelligence Assisted Energy Efficient Open Radio Access Network, UKRI. Project description is identical for both Gigasys Solutions and British Telecommunications

The second highest-funded project is 'Towards an AI-native user centric air interface for 6G networks'. This is a multi-partner European consortium project known as CENTRIC, and the sum in the table represents the value of the grant given to the industry partner captured in the UKRI data, Interdigital Europe.

The project is primarily concerned with wireless connectivity and enabling 6G use cases such as "multi-sensory holographic communications", and the proposal to leverage AI techniques "… through a top-down, modular approach to wireless connectivity that puts the users' communication needs and environmental constraints at the centre of the network stack design". The role of AI in this project is to "…create and customize tailor-made waveforms, transceivers, signaling, protocols and RRM procedures", with the end goal being to enable a "…user-centric AI Air Interface (AI-AI)". (63)

It should be noted that this project also appears in the academic table of UKRI projects above, as King's College London is one of the academic partners in the project. The third highest funded project was a feasibility study that ran from 2017-2018, and was aimed at optimising network capacity and service quality. (64)

Overall, the key themes emerging from these projects are wireless connectivity, 5G and 6G in particular, as well as network management and optimisation, and energy efficiency. In these projects, AI and ML are viewed as tools that can support these goals.

(63) Towards an AI-native user centric air interface for 6G networks (CENTRIC), UKRI
(64) Dynamic Optimisation for automated real time provisioning of Cloud based and Wide Area Networks (DO), UKRI

INTERNATIONAL FUNDS

4.1 Horizon 2020

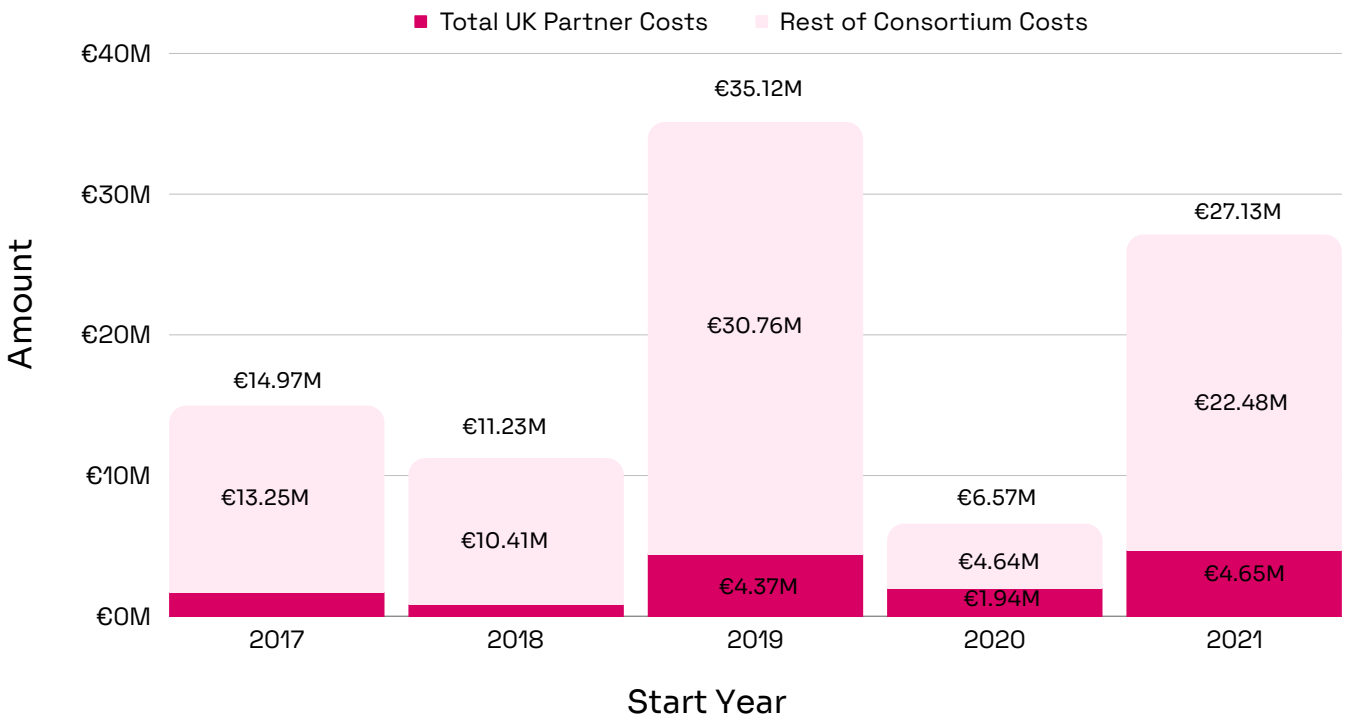
Horizon 2020 was the European Union's research and innovation funding programme, running from 2014-2020 with a budget of €80 billion. The current programme is Horizon Europe. (65) Horizon 2020 consisted of several different funding schemes, depending on the area and extent of what is eligible for funding, the reimbursement rate, the specific criteria of evaluation to qualify for funding and the use of simplified forms for costs. (66)

All the projects funded by this mechanism are developed by multiple partners across different European countries, including the UK. The report focuses only on those projects that had at least one UK partner involved, to provide more insights into the UK R&D&I AI in telecoms landscape. The schemes relevant to this report are the European Research Council Starting Grant (ERC-STG), Research and Innovation Action (RIA) and Innovation Action (IA), (67) as well as the Marie Skłodowska-Curie Actions (MSCA), including Research and Innovation Staff Exchange (RISE), Innovative Training Networks (ITN) and Individual Fellowships (IF), (68) and Standard European Fellowships (IF-EF-ST). (69)

Graphic 4 represents the total funding (70) for all H2020 projects where there was a UK partner involved (regardless of the role). These projects were funded by 7 different Horizon 2020 schemes. The total funding for UK partners amounts to €13.5m between 2017 and 2021, represented in dark pink. These was spread across 23 projects, (71) with 27 different UK partners. The amount of funding granted to UK partners as a proportion of the total project varies across years, with an average of almost 15%.

(65) Horizon 2020, European Commission
(66) Overview of Horizon 2020 funding schemes
(67) Horizon Europe - How to apply, European Commission
(68) Marie Skłodowska-Curie Actions, European Commission
(69) Marie Skłodowska-Curie Individual Fellowships 2020, European Commission
(70) Funding amounts based on reported costs by each partner involved in the project
(71) Full list of projects in Annex 9

Graphic 4: Total funding (€) for Horizon 2020 projects with at least one UK partner involved, by partner location and year

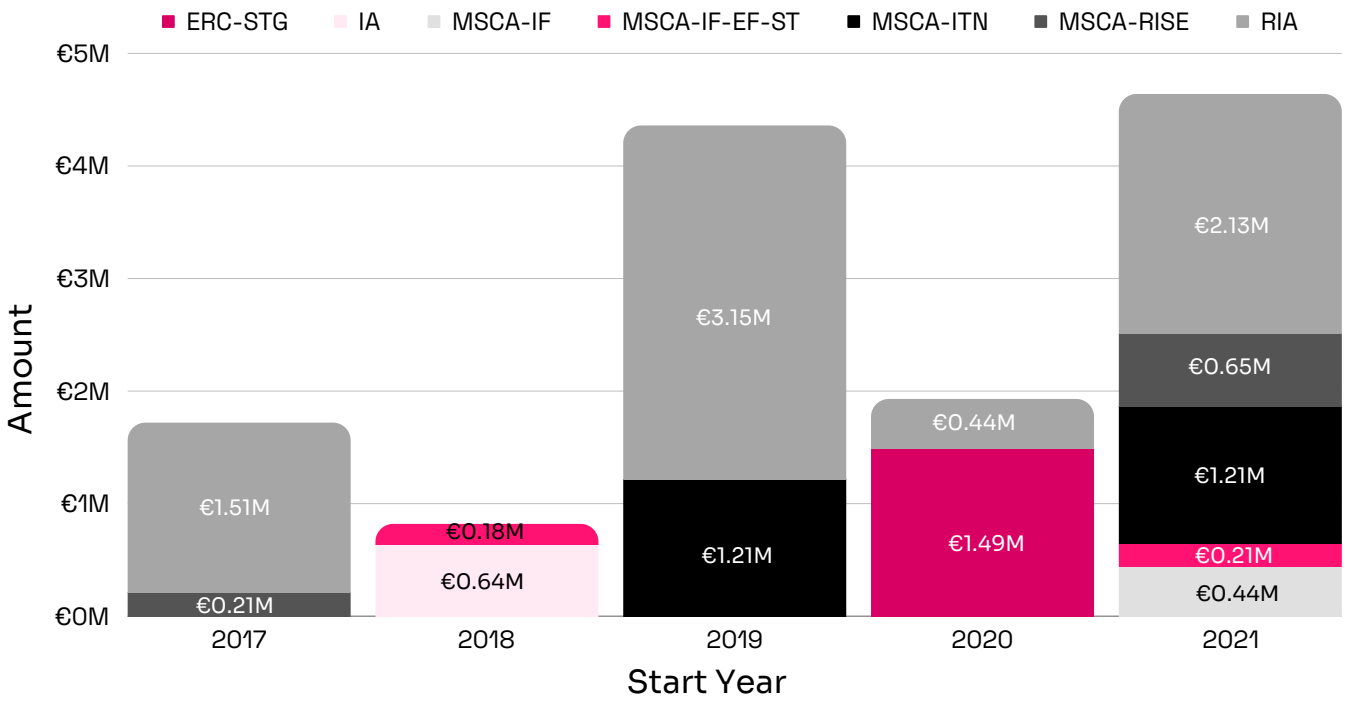


The graphic represents the total funding granted across all Horizon 2020 projects with at least one UK partner (represented by the total costs incurred by the involved partners) by start each year, indicating those where there was at least one UK partner. Each partner can take one or more roles in the development of the project (coordinator, participant or third party). Partners can take part in more than one Horizon 2020 project. The total funding of the project is represented on top of each year's bar. Data credit: European Commission (CORDIS)

This report focuses on the funding granted to UK partners under all 7 relevant schemes, as seen in graphic 5. Nonetheless, almost half of them fall under the Research & Innovation Actions (RIA). This scheme focuses on generating new knowledge or investigating the feasibility of certain technologies, products, services, etc. (72)

(72) What you need to know about Horizon 2020 calls, European Commission

Graphic 5: UK Partner's funding (€) per Year by Funding Scheme



The graphic represents total funding granted to UK partners on Horizon 2020 projects, under each relevant scheme. It considers a total of 23 projects. The total funding of these projects is represented in graphic 4. Data credit: European Commission (CORDIS)

In terms of the projects themselves, focusing on the total funding granted to UK partner(s) involved in each one, reveals that the top 10 makeup 76% of the total costs across all 23 projects with a total funding of £10.3m. It is worth noting that 20 out of the 27 UK partners involved in Horizon 2020 projects were involved in these 10, with 6 partners participating in the 5G-CLARITY project which had the highest funding.

Table 4: Top 10 projects with highest UK partners funding sorted by grant value (73)

Project Title	Funding Scheme	No of UK Partners	Total No of Partners	Start Year	Amount (€)
5G-Clarity: Beyond 5G multi-tenant private networks integrating Cellular, WiFi, and LiFi, powered by Artificial Intelligence and intent based policy	RIA	6	18	2019	2,371,595
TeLSCombe: Temporal Laser cavity solutions for micro-resonator based optical frequency	ERC-STG	2	2	2020	1,494,683
6G BRAINS: Bring reinforcement-learning into radio light network for Massive	RIA	4	15	2021	1,414,595
MOTOR5G: Mobility and Training for beyond 5G ecosystems	MSCA-ITN	1	10	2019	1,212,690
GREENEDGE: Taming the environment impact of mobile networks through GREEN EDGE computing platforms	MSCA-ITN	2	8	2021	909,517.68
SLICENET: End-to-end cognitive network slicing and slice management framework in virtualised multi-domain, multi-tenant 5G networks	RIA	1	18	2017	664,498.75
RESISTO: Resilience enhancement and risk control platform for communications infrastructure operators	IA	1	21	2018	642,813.75
DIOR: Deep intelligent optical and radio communication networks	MSCA-RISE	2	8	2021	552,000
NECOS: Novel enablers for cloud slicing	RIA	1	4	2017	523,968.75
DEDICAT 6G: Dynamic coverage extension and distributed intelligence for human centric applications with assured security, privacy and trust from 5G to 6G	RIA	1	15	2021	497,093.75

The table represents the 10 projects with higher funding granted to UK partners. One partner can be involved in more than one project. The full list of projects funded by Horizon 2020 with UK partners can be found in annex 9. Data credit: European Commission (CORDIS)

(73) More detail on the UK partners involved on each project and the costs incurred in Annex 9

4.2 CELTIC-NEXT

Active since 2018, CELTIC-NEXT is part of Eureka, an international public network for cooperation in R&D&I. Within Eureka, Eureka Clusters (74) are international communities led by industry, and composed of a wide variety of partners, both in industry and academia.

Each cluster targets specific technology areas, with CELTIC-NEXT focusing on telecommunications and Information and Communications Technology (ICT). According to the CELTIC-NEXT website, the main task of the cluster is to "...stimulate successful industry-driven collaborative European research projects" and the cluster typically has "...between 20 and 30 projects with a total budget of 100 to 300 million euros running in parallel." (75)

Out of all CELTIC-NEXT projects, 4 were identified as relevant for this report as they present an AI component. The 4 projects are listed in table 5. It is important to note that information only shows the total project budget, so it is not possible to identify real costs or which percentage was incurred by UK partners, as it was done in the previous section. Regardless of this, the focus of each project and alignment with projects funded by other means provides valuable information on research areas on AI in telecoms for the UK.

(74) Eureka Clusters Programme, CELTIC-NEXT, Eureka Cluster
(75) CELTIC-NEXT Organisation, CELTIC-NEXT, Eureka Cluster

Table 5: CELTIC-NEXT AI in telecoms projects with at least one UK partner, sorted by year

Project Title	No of UK Partners	Total No of Partners	Start Year	Amount (€)
Project Comet: Communications enabled, AI/ML based digital twins for smart city logistics and last mile applications	2	10	2024	5,280,000
Project AI-NET-ANIARA: Automation of network edge infrastructure & applications with artificial intelligence	3	20	2021	11,214,000
Project A5GARD: Achieving 5G service assurance in the residential domain	1	15	2020	4,532,710
Project AIMM: AI-enabled Massive MIMO	5	10	2020	3,167,600
Total				24,194,310

This table lists the total CELTIC-NEXT projects granted to at least one UK partner that were identified as relevant for AI in telecoms. Data credit: CELTIC-NEXT

There are 54 total partners involved across these 4 projects, with 10 UK partners across industry and academia. British Telecommunications participated in two. The total budget was over £24 M, with Project AI-NET ANIARA providing almost half of it. The main focus of that project was to improve network management by providing "intelligent network automation enablers and solutions for high-performance services deployed and operated at the network edge." (76) Next, with approximately half of the funding, project COMET focuses on 6G and enhanced remote monitoring to improve smart cities logistics and last mile applications. (77) Project A5GARD focused on telecommunications infrastructure to enable remote healthcare, while AIMM aims to incorporate AI capabilities in 5G and beyond RAN.

(76) Automation of Network edge Infrastructure & Applications with aRtificiAl intelligence, Project information
(77) Project COMET, CELTIC-NEXT, Eureka Cluster

CONCLUSION

Overall, public funding for AI in telecoms R&D&I has grown recently, in parallel with the increased interest in AI applications across industry sectors. In telecoms, AI technology is often conceptualised as an enabling technology. As seen in the projects discussed above, AI is an integral part of R&D&I initiatives in key telecoms areas, such as 5G and 6G, and Open RAN.

It is apparent that AI has important implications for telecoms. As AI and ML solutions often feature in Open RAN, AI is a significant area of research within projects supported by the £250m DSIT Open Networks R&D Fund, of which this report estimates £94.6m was spent on projects with AI R&D&I. This suggests the importance of AI in areas of strategic importance for the UK, such as Open RAN and supply chain diversification.

In research funding provided by UKRI for both academia and industry, broader topics in which AI R&D&I plays a key role include network efficiency, optimisation and capacity, as well as the automation of operational tasks. Energy efficiency, edge computing, cloud and security are also areas of focus, with the reduction of energy consumption and the acceleration of learning rates through both hardware and algorithm advancements identified as a key area by interviewed experts.

CONCLUSION

A total of £12.3m UKRI funding was allocated to AI in telecoms projects led by academic partners, and £1.6m UKRI funding was allocated to AI in telecoms projects led by industry partners (with some projects belonging to both academia and industry). The amount of funding for AI in telecoms provided by UKRI has dramatically increased over the past few years, suggesting the early stages of a key area of importance for UKRI. This overall pattern suggests that AI in telecoms R&D&I is gaining momentum.

There are similar findings when reviewing international projects and programmes when there is at least one UK partner involved. In both Horizon 2020 and Celtic Next, UK funding has steadily increased, covering similar areas such as network management, network security and sustainability with AI enabling automation and improving efficiency.

Partnerships are also a key part of AI in telecoms R&D&I. This is clearly reflected in the data for this report, with a high percentage of consortium-based projects and many multi-partner projects with both academic and industry partners. This is the case with both sources of public funding, DSIT and UKRI. Experts interviewed also confirmed the importance of partnerships, both in terms of closer collaboration between researchers and commercialisation, but also in terms of interdisciplinary collaboration across academic domains, including sensing devices, AI acceleration, silicon photonics, and analogue neural networks.

CONCLUSION

This, in conjunction with the increased expenditure in public funding in the area, some stated private funding and increased visibility of the potential use cases indicates that usage and adoption of AI in UK telecoms innovation activity will likely continue on an upward trajectory, and with the development of technology in both artificial intelligence and telecommunications as a discipline, may become standard in deployed systems.

Annex 1: Methodoloy

For this report, a combined approach was taken to provide detailed insight into some of the key UK R&D&I AI in telecoms topics, relevant to the UK ecosystem. The approach incorporated quantitative and qualitative analysis from different elements of the R&D&I ecosystem, including desk research, database analysis and web scraping from key datasets, expert interviews by the University of Bristol, and discussions between programme partners and relevant stakeholders.
In terms of quantitative analysis, a digital tool was developed, in-house by Digital Catapult, to integrate and analyse multiple data sources. While the tool is currently in the process of refining and synthesising data from a range of sources, the sources selected for this report are from the UKRI, CORDIS (Horizon 2020) and CELTIC-NEXT databases and various DSIT web pages. All data incorporated in the report is from publicly available information, and is complemented with primary and secondary research.

Data for this report was obtained in November 2023 and is therefore accurate to this point in time. The year 2017 was established as the starting point for data collection to ensure that the data is relevant and recent. In the case of AI in telecoms, this is a relatively recent development in R&D&I in the sector and there is limited data prior to 2017. DSIT research competition winners and associated project details were compiled through a mixture of web scraping and data entry from their respective government websites before being further manually evaluated and selected for their involvement in both artificial intelligence and telecommunications research. For UKRI, all combinations from two keyword lists (one for artificial intelligence and the other for telecommunications terms) as well as a list of keywords to exclude were submitted as a boolean query to the GTR-UKRI API and the results downloaded in XML format. Specific search terms were used to remove irrelevant subject areas, and the data was then manually curated over several iterations to generate reliable data sets. The CORDIS Horizon 2020 database was downloaded in its entirety and reconstructed in the tool. A co-occurrence of a subset of artificial intelligence and telecommunication terms from the European Science Vocabulary fields in the database were used to identify projects of potential relevance. These were then supplemented by a search of each project using the same keyword lists used with the UKRI API - again looking for a co-occurence of terms from both lists. The project list was then de-duplicated and filtered for at least one UK partner before being manually curated, cleaned and analysed. The CELTIC-NEXT projects were identified by a manual search for “artificial intelligence” and “AI”, and as having at least one UK partner and beginning on or after 1/1/2017. These projects were compiled using data entry. This process will be automated through web scraping in the future.

The University of Bristol conducted 4 interviews with AI in telecoms academic experts from 4 leading research Universities working in cluster V on the UKRI KEF2 database.

Annex 2: Data sources list

Dataset	Source
DSIT	FONRC ONE FRANC UK-ROK OPEN RAN R&D
UKRI	UKRI Gateway to Research
CORDIS - Horizon 2020	data.europa.eu
CELTIC-NEXT	CELTIC-NEXT

Annex 3: Limitations

This report relies on publicly available data and therefore focuses on public funding for R&D&I. Data on private company R&D&I is typically commercially sensitive and access is restricted, meaning that web scraping methods are not applicable. The data from public sources is determined by the methods described above, and is presented as an indicative snapshot of information on AI in telecoms R&D&I, rather than as a definitive and exhaustive list of projects and funding. A different methodology, specifically different keywords, may yield different results. In addition, it is not possible to precisely determine what percentage of the funds discussed are tied to AI research specifically.

Annex 4: DSIT - Open Networks R&D Fund

Total DSIT funding and number of project of AI research per competition: FONRC, FRANC and ONE

Competition	Total Grant Amount (€)	No of Projects	Percentage
Open Networks Ecosystem	57,894,168.18	10	61.18%
Future Open Networks Research Challenge	28,789,392.16	3	30.42%
Future RAN (FRANC)	6,735,970	4	7.12%
UK & Republic of Korea Open RAN R&D Collaboration	1,211,615	1	1.28%
Total	94,631,145.34	18	100.00%

Annex 5: UKRI, Horizon Europe Guarantee, FLF and NERC - Projects funded per body

Total funding and number of projects per source

Funding Body	Total Grant Amount (€)	No of Projects	Percentage
EPSRC	19,216,664	32	79.78%
Horizon Europe Guarantee	2,454,017	5	10.19%
FLF	2,403,550	2	9.98%
NERC	11,608	2	0.05%
Total	24,085,839	42	100.00%

Total funding and number of projects per funding body, per year

Annex 5: UKRI, Horizon Europe Guarantee, FLF and NERC - Projects funded per body

Total funding and number of projects per source

Funding Body	Total Grant Amount (€)	No of Projects	Percentage
EPSRC	19,216,664	32	79.78%
Horizon Europe Guarantee	2,454,017	5	10.19%
FLF	2,403,550	2	9.98%
NERC	11,608	2	0.05%
Total	24,085,839	42	100.00%

Total funding and number of projects per funding body, per year

Competition	Total Grant Amount (€)	No of Projects	Percentage	Start Year
EPSRC	891.184	1	3.70%	2024
EPSRC	8,979,774	9	37.28%	2023
Horizon Europe Guarantee	2,454,017	5	10.19%	2023
EPSRC	1,656,308	4	6.88%	2022
NERC	11,608	1	0.05%	2022
FLF	1,179,053	1	4.90%	2021
EPSRC	N/A	4	0.00%	2021
FLF	1,224,497	1	5.08%	2020
EPSRC	724,871	5	3.01%	2020
EPSRC	858,611	4	3.56%	2019
EPSRC	6,105,916	4	25.35%	2018
NERC	N/A	1	0.00%	2018
EPSRC	N/A	1	0.00%	2017
Total	24,085,839	41	100.00%	

Annex 6: UKRI, Horizon Europe Guarantee, FLF and NERC - Project list

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (€)
Reconfigurable intelligent surfaces 2.0 for 6G: Beyond diagonal phase shift	Imperial College London	EPSRC	Research Grant	2024	891,184
6G sub-terahertz software defined radio testbed	University of Sheffield	EPSRC	Research Grant	2023	2,379,292
Platform driving the ultimate connectivity	University of Strathclyde	EPSRC	Research Grant	2023	2,030,860
FreeML: Engineering networked machine learning via meta-free energy minimisation	Kings College London	EPSRC	Fellowship	2023	1,061,704
AI-powered micro-comb lasers: a new approach to transfer portable atomic clock accuracy in integrated photonics	Loughborough Unviersity	EPSRC	Fellowship	2023	1,022,266
ECCS-EPSRC: NeuorComm: Brain-inspired wireless communications	Kings College London	EPSRC	Research Grant	2023	990,142
CENTRIC: Towards AI-native, user centric air interface for 6G networks	Kings College London	Horizon Europe Guarantee	EU-funded	2023	883,541
Secured and intelligent massive machine-to-machine communication for 6G	University of Essex	Horizon Europe Guarantee	Research Grant	2023	530,502
Pervasive wireless intelligence beyond the generations	University of Southampton	EPSRC	Research Grant	2023	471,730
Scalable hybrid architecture for wireless collaborative federated learning	Queen Mary University of London	EPSRC	Research Grant	2023	445,427
Telecommunications and computer vision convergence tools for research infrastructures	Queen's University of Belfast	Horizon Europe Guarantee	EU-funded	2023	422,663
Project 101095933	University of the West of Scotland	Horizon Europe Guarantee	EU-funded	2023	407,203
Integrated waveform and intelligence: physical later solutions to sustainable 6G	Newcastle University	EPSRC	Research Grant	2023	376,856
IPOSEE: Intelligent and proactive optimisation for service-centric wireless networks	University of Sheffield	Horizon Europe Guarantee	Research Grant	2023	210,497

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (€)
Real time federated learning at the wireless edge via algorithm-hardware co-design	University of Exeter	EPSRC	Research Grant	2023	201,497
Extremely wideband optical fibre communications system	University College London	Horizon Europe Guarantee	Research Grant	2022	738,958
Smart solutions towards cellular-connected unmanned aerial vehicles system	Kings College London	EPSRC	Research Grant	2022	432,537
Towards sustainable ICT: Sparse ubiquitous networks based on reconfigurable intelligent surfaces	Queen Mary University of London	EPSRC	Research Grant	2022	282,555
Sustainable computing and communication at the Edge	Imperial College London	EPSRC	Research Grant	2022	202,258
Enabling beyond-5G industrial IOT through intelligent networking in unlicensed spectrum	University of Kent	NERC	Research Grant	2022	11,608
Future millimetre wave RF transceiver architectures for communications systems	University of Sheffield	FLF	Fellowship	2021	1,179,053
Artificial intelligence design aided photonic systems	University College London	EPSRC	Studentship	2021	N/A
Machine learning for digital twins of optical networking infrastructure	University of Cambridge	EPSRC	Studentship	2021	N/A
Machine learning techniques for communication networks	Loughborough University	EPSRC	Studentship	2021	N/A
Ultra-wideband optical fibre transmission systems	University College London	EPSRC	Studentship	2021	N/A
Beyond exabit optical communications: from new devices, via new dimensions to new systems	University College London	FLF	Fellowship	2020	1,224,497
6G Mitola Radio	University College London	EPSRC	Research Grant	2020	470,567
Edge Computing resource allocation for dynamic networks	Queens University Belfast	EPSRC	Research Grant	2020	254,304

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (9)
Location awareness accuracy improvement for full-mesh IOT networks for CAV and 5G applications	University of Cambridge	EPSRC	Studentship	2020	N/A
Physics-based machine learning for wireless communications	Imperial College London	EPSRC	Studentship	2020	N/A
Signal processing techniques for cell-free massive MIMO	Loughborough University	EPSRC	Studentship	2020	N/A
Learning to communicate: Deep learning based solutions for the physical layer of machine type communications	University College London	EPSRC	Research Grant	2019	858,611
Control, safety and security of dynamical network systems	Imperial College London	EPSRC	Studentship	2019	N/A
Optical fibre networks underpin the digital communications infrastructure	University College London	EPSRC	Studentship	2019	N/A
Signal processing and machine learning methods for wireless communications networks	Loughborough University	EPSRC	Studentship	2019	N/A
Transforming networks - building an intelligent optical infrastructure	University College London	EPSRC	Research Grant	2018	6,105,916
Artificial intelligence technologies, image and vision computing, digital signal processing	Imperial College London	EPSRC	Studentship	2018	N/A
Dynamic reconfigurable RF system for MIMO 5G applications	University of Edinburgh	NERC	Studentship	2018	N/A
Federated machine learning in edge computing	University of Exeter	EPSRC	Studentship	2018	N/A
Novel air guiding microstructured optical fibres	University of Southampton	EPSRC	Studentship	2018	N/A
Mobile edge distributed intelligence	University of Surrey	EPSRC	Studentship	2017	N/A
Total					24,085,839

Annex 7: Innovate UK and Horizon Europe Guarantee - Projects funded per body

Total funding and number of projects per funding body

Funding Body	Total Grant Amount (€)	No of Projects	Percentage
Horizon Europe Guarantee	2,192,670	7	66.49%
Innovate UK	1,105,242	6	33.51%
Total	3,297,912	13	100.00%

Total funding and number of projects per funding body, per year

Funding Body	Total Grant Amount (€)	No of Projects	Percentage	Start Year
Horizon Europe Guarantee	2,192,670	7	66.49%	2023
Innovate UK	408,104	3	12.37%	2023
Innovate UK	99,138	1	3.01%	2020
Innovate UK	199,918	1	6.06%	2019
Innovate UK	398,082	1	12.07%	2017
Total	3,297,912	13	100.00%	

Annex 8: Innovate UK and Horizon Europe Guarantee - Project list

Project Title	Organisation	Funding Body	Grant Category	Start Year	Amount (€)
Dynamic optimisation for automated real time provisioning of cloud based and wide area networks (DO)	Aria Networks	Innovate UK	Feasibility Studies	2017	398,082
Crowd blackspot intelligence for 5G rollout (COCKPIT-5G)	Ranplan Wireless Network Design	Innovate UK	Collaborative R&D	2019	199,918
RSaaS: Radio signal as a microService	Ranplan Wireless Network Design	Innovate UK	Collaborative R&D	2020	99,138
Innovative RF Awareness platform based on SDR and AI Technologies	Chakana Solutions	Innovate UK	Grant for R&D	2023	49,948
nCOMM: A wireless network for volumetric video production	Nephelie Technologies	Innovate UK	Grant for R&D	2023	49,967
IPOSEE: Intelligent and proactive optimisation for service-centric wireless networks	Ranplan Wireless Network Design	Horizon Europe Guarantee	Research Grant	2023	202,179
BeGREEN: Beyond 5G Artificial Intelligence assisted energy efficient open Radio Access Network	BT	Horizon Europe Guarantee	EU-funded	2023	238,770
Secured and intelligent massive machine-to-machine communication for 6G	Iris Automation	Horizon Europe Guarantee	Research Grant	2023	265,251
Programmable AI-enabled deterministic networking for 6G	Interdigital Europe	Horizon Europe Guarantee	EU-funded	2023	267,591
An innovative international registry for every telephone number prefix and ML service to detect if a phone number could be fraudulent	3G Telecommunications	Innovate UK	Collaborative R&D	2023	308,180
Telecommunications and computer vision convergence tools for research infrastructures	Interdigital Europe	Horizon Europe Guarantee	EU-funded	2023	323,177
SNS_JU BEGREEN - Beyond 5G Artificial Intelligence assisted energy efficient open radio access network	Gigasys Solutions	Horizon Europe Guarantee	EU-funded	2023	443,900
Towards an AI-native, user-centric air interface for 6G networks	Interdigital Europe	Horizon Europe Guarantee	EU-funded	2023	451,802
Total					3,297,912

Annex 9: Horizon 2020 projects with UK partners - sorted by year and total UK partners cost

Project Title	Funding Scheme	No of UK Partners	Total No of Partners	Start Year	Total UK Partner costs (€)
6G BRAINS: Bring Reinforcement-learning into radio light network for massive connections	RIA	4	15	2021	1,414,595
GREENEDGE: Taming the environmental impact of mobile networks through GREEN EDGE computing platforms	MSCA-ITN	2	8	2021	909,517.68
DIOR: Deep intelligent optical and radio communications networks	MSCA-RISE	2	8	2021	552,000
DEDICAT 6G: Dynamic coverage extension and distributed intelligence for human centric applications with assured security, privacy, and trust from 5G to 6G	RIA	1	15	2021	497,093.75
MENTOR: Machine learning in optical networks	MSCA-ITN	1	6	2021	303,172.56
GreenML5G: Green machine learning for 5G and beyond resource optimisation	MSCA-IF	1	1	2021	224,933.76
TeraFlow: Secured autonomic traffic management for a Tera of SDN flows	RIA	1	16	2021	222,500
IRS-THz: Intelligent reflecting surface assisted ultra-massive MIMIO THz communications for 6G	MSCA-IF-EF-ST	1	1	2021	212,933.76
MENESIS: Memristor-enabled neuromorphic system for intelligence in space	MSCA-IF	1	1	2021	212,933.76
SwiftV2X: Smart mmWave and MultiRATs for multihop vehicle-to-everything (V2X) communications in connected and autonomous vehicles	MSCA-RISE	1	6	2021	101,200
TeLSCombe: Temporal laster cavity-solutions for micro-resonator based optical frequency combs	ERC-STG	2	2	2020	1,494,683
SANCUS: analysts software scheme of uniform statistical sampling, audit and defence processes	RIA	1	16	2020	440,811.25
5G-CLARITY: Beyond 5G multi-tenant private networks integrating cellular, WiFi and LiFi, powered by artificial intelligence and intent based policy	RIA	6	18	2019	2,371,595.01
MOTOR5G: Mobility and training for beyond 5G ecosystems	MSCA-ITN	1	10	2019	1,212,690.24

Project Title	Funding Scheme	No of UK Partners	Total No of Partners	Start Year	Total UK Partner costs (€)
5GROWTH: 5G-enabled growth in vertical industries	RIA	1	25	2019	319,326.05
5G-DIVE: Edge intelligence for vertical industries	RIA	1	19	2019	309,585.30
5GZORRO: Zero-touch security and trust for ubiquitous computing and connectivity in 5G networks	RIA	1	15	2019	152,711.94
RESISTO: Resilience enhancement and risk control platform for communication infrastructure operators	IA	1	21	2018	642,813.75
ComRad: Combining MIMO radar with MU-MIMO communications, more than coesistence	MSCA-IF-EF-ST	1	1	2018	183,454.80
SLICENET: End-to-end cognitive network slicing and slice management framework in virtualised multi-domain, multi-tenant 5G networks	RIA	1	18	2017	664,498.75
NECOS: Novel enablers for cloud slicing	RIA	1	4	2017	523,968.75
RECAP: Reliable capacity provisioning and enhanced remediation for distributed cloud applications	RIA	1	10	2017	321,840
SONNET: Self-organisation towards reduced cost and energy per bit for future emerging radio technologies	MSCA-RISE	1	4	2017	211,500
TOTAL					13,500,359.11

Horizon 2020 projects with UK partners listed per UK partner - sorted by year and individual UK partner cost

Project Title	Funding Scheme	UK Partner	Start Year	UK Partner Costs (€)	Total UK Partner costs (€)
6G BRAINS: Bring Reinforcement-learning into radio light network for massive connections	RIA	Brunel University of London	2021	395,720	1,414,595
		University of West Scotland	2021	412,375	
		University of Leicester	2021	399,000	
		Viavi Solutions	2021	207,500	
GREENEDGE: Taming the environmental impact of mobile networks through GREEN EDGE computing platforms	MSCA-ITN	Imperial College London	2021	606,345.12	909,517.68
		Toshiba Europe	2021	303,172,56	
DIOR: Deep intelligent optical and radio communications networks	MSCA-RISE	Turing Intelligence Technology	2021	253,000	552,000
		University of Warwick	2021	299,000	
DEDICAT 6G: Dynamic coverage extension and distributed intelligence for human centric applications with assured security, privacy, and trust from 5G to 6G	RIA	University of Surrey	2021	497,093.75	497,093.75
MENTOR: Machine learning in optical networks	MSCA-ITN	Aston University	2021	303,172.56	303,172.56
GreenML5G: Green machine learning for 5G and beyond resource optimisation	MSCA-IF	Cranfield University	2021	224,933.76	224,933.76
TeraFlow: Secured autonomic traffic management for a Tera of SDN flows	RIA	Old Dog Consulting	2021	222,500	222,500
IRS-THz: Intelligent reflecting surface assisted ultra-massive MIMIO THz communications for 6G	MSCA-IF-EF-ST	University College London	2021	212,933.76	212,933.76

Project Title	Funding Scheme	UK Partner	Start Year	UK Partner Costs (€)	Total UK Partner costs (€)
MENESIS: Memristor-enabled neuromorphic system for intelligence in space	MSCA-IF	University of Southampton	2021	212,933.76	212,933.76
SwiftV2X: Smart mmWave and MultiRATs for multihop vehicle-to-everything (V2X) communications in connected and autonomous vehicles	MSCA-RISE	University of Surrey	2021	101,200	101,200
TeLSCombe: Temporal laster cavity-solutions for micro-resonator based optical frequency combs	ERC-STG	Loughborough University	2020	1,189,194.26	1,494,683
		University of Sussex	2020	305,488.74	
SANCUS: analysts software scheme of uniform statistical sampling, audit and defence processes	RIA	University of Lancaster	2020	440,811.25	440,811.25
5G-CLARITY: Beyond 5G multi-tenant private networks integrating cellular, WiFi and LiFi, powered by artificial intelligence and intent based policy	RIA	Gigasys Solutions	2019	389,000	2,371,595.01
		interdigital Europe	2019	420,625	
		PureLiFi	2019	396,875	
		University of Bristol	2019	605,075	
		University of Edinburgh	2019	86,699.03	
		University of Strathclyde	2019	473,320.98	
MOTOR5G: Mobility and training for beyond 5G ecosystems	MSCA-ITN	University of Huddersfield	2019	1,212,690.24	1,212,690.24
5GROWTH: 5G-enabled growth in vertical industries	RIA	Interdigital Europe	2019	319,326.05	319,326.05
5G-DIVE: Edge intelligence for vertical industries	RIA	Interdigital Europe	2019	309,585.30	309,585.30

Project Title	Funding Scheme	UK Partner	Start Year	UK Partner Costs (€)	Total UK Partner costs (€)
5GZORRO: Zero-touch security and trust for ubiquitous computing and connectivity in 5G networks	RIA	Bartr Holdings	2019	152,711.94	152,711.94
RESISTO: Resilience enhancement and risk control platform for communication infrastructure operators	IA	British Telecommunications	2018	642,813.75	642,813.75
ComRad: Combining MIMO radar with MU-MIMO communications, more than coesistence	MSCA-IF-EF-ST	University College London	2018	183,454.80	183,454.80
SLICENET: End-to-end cognitive network slicing and slice management framework in virtualised multi-domain, multi-tenant 5G networks	RIA	University of West of Scotland	2017	664,498.75	664,498.75
NECOS: Novel enablers for cloud slicing	RIA	University College London	2017	523,968.75	523,968.75
RECAP: Reliable capacity provisioning and enhanced remediation for distributed cloud applications	RIA	British Telecommunications	2017	321,840	321,840
SONNET: Self-organisation towards reduced cost and energy per bit for future emerging radio technologies	MSCA-RISE	London South Bank University	2017	211,500	211,500
TOTAL					13,500,359.11