SONIC Labs
2022/23 Annual Report

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Authors:

Sophie Weston, Senior Policy, Research & Engagement Manager, SONIC Labs, Digital Catapult
Rachel Hugonin, Policy and Research Analyst, Digital Catapult
Lorraine During, Lead for Research & Policy Insights, Digital Catapult
Linda Ligios, Senior Innovation Partner, Digital Catapult
Kishan Nundloll, Lead for Policy, Research & Strategic Engagement, SONIC Labs, Digital Catapult
Gary Trotman, Head of Technology Propositions, Digital Catapult

With support from:

Maria Grigorescu, Project Manager, Digital Catapult
Amrit Heer, Senior Technology Research Manager, Digital Catapult
Megan Jeapes, Marketing and Communications Manager, Digital Catapult
Zoey Chen, Policy, Research & Engagement Intern, Digital Catapult
Xhafer Krasniqi, Senior 5G Technologist, Digital Catapult

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Foreword

2022 marked the beginning of SONIC Labs – a much anticipated programme that brings together top UK and global telecoms players to partner in the development of network disaggregation, diversification and interoperability through Open RAN.

During its first year, SONIC Labs - jointly led by Digital Catapult and Ofcom, focused on interoperability in Open RAN in particular around private and indoor networks. Year two will also incorporate outdoor and public-scale networks, and future years will extend scope beyond Open RAN into wider technologies at the forefront of diverse, open and advanced communications.

It has been a remarkable year and it is inspiring to see how the impact of SONIC Labs is being felt nationally and internationally. This report shares learnings and insights from year one, which will be applied in year two. We can already see the outputs of the programme, and hear the feedback: participating vendors, policy teams and international organisations have been impressed with the number and speed of our activities. SONIC Labs is part of the collaborative and supportive environment which makes the UK an attractive market for developing and de-risking Open RAN products, building increasing confidence in Open RAN offerings and the open network ecosystem for potential adopters over time.

Cooperation with domestic and international partners who share the same goal of telecoms diversification and disaggregation has shown the strength of SONIC Labs' collaboration. From our interactions with the Future RAN Competition (FRANC) and the UK Telecoms Lab (UKTL), to hosting delegations from Japan, South Korea and Germany, amongst others, we have been able to both receive, and impart valuable insights with those at the forefront of telecoms innovation and development.

As a fitting end to year one, Digital Catapult and Ofcom were delighted to officially open the doors to the new SONIC Labs testing facilities at the inaugural showcase in March 2023. The lab, designed to provide a commercially neutral, collaborative environment for testing and integration, is the first of its kind in the UK. The event featured discussion from labs and testbeds across the globe, including those from the i14y lab in Germany, the National Telecoms and Information Administration (NTIA) in the USA, and NEC Europe. We were also pleased to have some of the vendors already involved in SONIC Labs share their learnings and insights to date with a new audience.

Following a year of huge progress on this essential project, we can be confident that the second year will build further on the facilities and success to date, as we contribute to the increasingly impressive portfolio of Digital Catapult, Ofcom, and SONIC Labs partners.

My sincere thanks go to all the partners and staff across the project who have worked diligently and passionately to build expertise across the programme and the wider ecosystem to make SONIC Labs a magnificent success so far. It has been a spectacular team effort, and I extend our gratitude to the Department for Science, Innovation and Technology (DSIT), who have played a pivotal role enabling this facility and programme.

Joe Butler
Chief Technology Officer, Digital Catapult

Executive summary

The SmartRAN Open Network Interoperability Centre (SONIC Labs) fosters the emergence of new solutions in the telecom supply chain in the UK. It focuses on multi-vendor open, disaggregated and software-centric network products and services, starting with Open RAN. Working with public and private stakeholders – including Open RAN vendors, system integrators, academia, international governmental bodies and industry bodies, as well as potential adopters of Open RAN – SONIC Labs has been at the forefront of industry, leading conversations and synthesising insights into actionable ecosystem development.

Since the beginning of the SONIC Labs programme, Ofcom and Digital Catapult have built significant momentum together, directly building upon existing infrastructure and capabilities on both sides of the partnership, through close collaboration with DSIT. This has enabled SONIC Labs and the wider telecoms ecosystem to benefit from the expertise of two world-class technology organisations and their respective areas of specialisation on this topic: Ofcom's understanding of the UK telecoms landscape and radio testing, their global reach with peer standards bodies and organisations, Digital Catapult's proficiency in delivering 5G and future telecoms-focused innovation programmes, and the engineering teams of both.

Year One at a glance

With state-of-the-art equipment housed in purpose-built labs at Digital Catapult headquarters and Ofcom headquarters in London, the programme has successfully contributed to the ongoing development of UK technical expertise and building the reputation of the UK as a place to carry out Open RAN work. In SONIC Labs we have also built many different Open RAN multi-vendor gNB systems made up of products from programme cohort participants. On a global level, SONIC Labs has built relationships with international peer labs, including i14y Lab in Germany and NTIA in the USA, both of whom have shown an interest in creating and fostering greater collaboration.

In its first year, SONIC Labs has made a significant contribution to the disaggregation and diversification in the UK and globally, by developing UK technical capabilities, supporting market readiness and allowing for a broader understanding of the industry needs. The programme is making substantial headway in demonstrating that the UK is a productive and profitable environment for international investment and global vendors.

Year One key developments and results:

- SONIC Labs is growing **the UK's open network ecosystem and supporting the building blocks for a more diversified supply chain**

- Programme participants are accessing **state-of-the-art technical facilities and Open RAN experts** to help them collaborate, develop, integrate and test their products and solutions

- SONIC Labs has established a **Strategic Advisory Board**, and three **Industry Groups bringing together core stakeholders** providing expert insights and alignment from across the ecosystem

- Several events and workshops have been held to share the insights and results, as well as specific engagements with earlier stage innovators

- SONIC Labs has worked with 13 vendors as part of SONIC-1, cohorts 1 and 2, with **32 different products**, including introducing ARM based systems

Introducing our cohorts

The first two Open RAN cohorts introduced products into SONIC Labs facilities, integrating and proving interoperability with other Open RAN solutions, and enhancing their existing business value propositions.

Cohort 1
Cohort 1 created three Open RAN systems, supported by Digital Catapult as a system integrator, resulting in:

- The selection of IS-Wireless, CableFree, Capgemini, Benetel, Phluido, Effnet

- Increased product maturity that makes integration easier, with better deployment packaging

- Improved specification of product operating parameters, demonstrating improving product maturity

- Optimisation and improvement of performance for users testing Open RAN products

Cohort 2
Cohort 2, currently in progress, focuses on system integration, exploring RAN Intelligent Controller (RIC) implementations, and investigating ARM based Open RAN implementations. Early findings include:

- The selection of ASOCS, Accelleran, Vmware, SOLID, VVDN, RadiSys, Effnet, Phluido, Cablefree

- Standardisation of their products can be valuable, with preference for a pre-validated setup prior to installation

- It would be beneficial to the wider telecoms ecosystem to have access to a communal data pool for all Open RAN vendors

- The two-step co-deployment technical journey has increased the precision of the specifications for swap and bespoke experiments to be performed within each cohort

Cohort 3
Cohort 3 began in Spring 2023, with a focus on RIC maturity and integrations to different systems.

Building momentum

Cohort participants have found access to SONIC Labs extremely valuable as a space to support vendors on their product and performance improvement journey. This has helped them to facilitate the connections they need to scale and expand their scope of operations. They have also found it highly beneficial to be part of SONIC Labs, due to its global recognition as a state-of-the-art facility, providing a neutral and open environment to test, validate and develop products, while offering a space to discuss critical issues that are not detrimental to competition.

In year two, the programme will continue the cohort activities, innovator engagements, knowledge sharing, and further support vendors to refine their product offerings by:

- Evaluating Open RAN performance, scalability and mobility/handover in an indoor environment

- Performing functional testing of Open RAN outdoor equipment

- Providing indoor and outdoor field trial environments

- Helping to understand and effectively enter the UK Open RAN ecosystem

Future cohorts, technical experiments and testing, and field trial deployments will generate more knowledge and a better understanding of the requirements and best practice. SONIC Labs' new testbed-as-infrastructure service will also allow equipment and products to evolve and mature.

£15 million

TOTAL GOVERNMENT FUNDING

22

**PARTICIPANTS
ORGANISATIONS
(SONIC-1 AND SONIC
LABS COHORTS)**

32

**OPEN RAN PRODUCTS
EXPERIMENTED WITH**

130

**STRATEGIC
ENGAGEMENTS**

14

**COUNTRIES
ENGAGED WITH**

3

**CORE INDUSTRY
GROUPS**

24

**TELECOMS
COMPANIES**

Introduction

SONIC Labs:
Driving impact and value for the UK economy

Part of the UK's national 5G Supply Chain Diversification Strategy, the SmartRAN Open Network Interoperability Centre – the SONIC Labs programme – is a groundbreaking and world-leading innovation programme and R&D facility.

It is funded by the UK Government's Department for Science, Innovation and Technology (DSIT), and co-delivered by Digital Catapult and Ofcom.

SONIC Labs was established in 2021 to accelerate the integration of new open network solutions into the UK telecoms supply chain.

This is the first annual report for the DSIT-funded SmartRAN Open Network Interoperability Centre (SONIC Labs) programme, a ground-breaking programme working to foster the emergence of new solutions to support diversification of the telecom supply chain in the UK, starting with Open RAN. This report provides an overview of the SONIC Labs programme and its successes, challenges and insights during its first full year of operation.

The global telecommunications ecosystem and supply chains are facing a range of challenges, with rapidly developing market conditions and technology trends that are transforming how the sector will operate in the near future. Fierce competition in the telecoms market, particularly between operators and between vendors, has led to multiple areas of consolidation in some parts of the telecoms supply chain. To foster innovation and the emergence of new vendors and products, the industry is working to alter the market by establishing new technical architectures and standards, as well as new methods of collaboration and co-design.

Part of the UK's national 5G Supply Chain Diversification Strategy, SONIC Labs was launched in 2021 to accelerate new open network solutions for the UK. SONIC Labs is building a commercially neutral environment for collaboration, enabling the telecoms ecosystem to test and explore the integration of multi-vendor architectures, their interoperability, and how they can develop open, disaggregated and software-centric network products, solutions and services.

WHAT IS OPEN RAN?

Open RAN is the disaggregation of the radio access network (RAN), enabling networks to be built using parts from different vendors. Network components are interconnected via interfaces that use open, standards-based, protocols for communication.

Previously, RAN had meant that telecoms operators were locked into using a single vendor across their entire network. Open RAN architecture enables telecom operators to work with multiple hardware and software suppliers, increasing diversity and allowing new market entrants and their products to be integrated into mobile networks.

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The Government's £15 million investment in SONIC Labs is helping to pave the way for diversifying the UK's telecoms market through accelerating technology development, supporting vendors and creating acceleration activities to bring in new innovators into the ecosystem.

I was lucky enough to attend the official launch, and to see it almost two years on growing and attracting global interest is a huge testament to the excellent work being done by the team here. We welcome this report which shows how the project is using its learnings from its initial year of funding to influence its activities over future years, pioneering innovation within the UK's telecoms industry.

Imran Shafi,
Digital Infrastructure Director,
Department for Science,
Innovation and Technology (DSIT)

Programme goals

Investigate value, feasibility and experimentation

This focuses on the examination of the value and feasibility of Open RAN and its subsequent relevant technologies. It also focuses on the facilitation of open interoperability in UK mobile networks, including the suitability of standards, vendor support and interpretation, and performance in practical use cases. This is expected to ultimately support policy and regulation, and improve uptake of Open RAN through learning.

Enable the Open RAN ecosystem

This goal refers to enabling and encouraging innovative vendors to participate in the UK Open RAN ecosystem in order to facilitate a more rapid path towards deployment in UK networks, and provide UK operators of all sizes with a pipeline of vendors and products to choose from.

Evaluate and explore advanced technologies

This goal focuses on building telecoms skills and expertise in the UK, by carrying out and promoting the development, integration, management and operation of open and disaggregated multi-vendor networks in both the hardware and software domains, such as Open RAN.

Expected outcomes
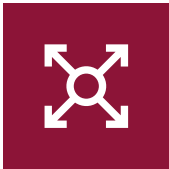
Driving market diversification and business activity around 5G and Open RAN.

This includes:

- Reducing barriers to accessing 5G networks and encouraging investment in UK telecoms
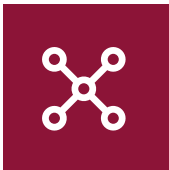
- So far, cohorts engaged in SONIC Labs have increased the provision of a pipeline of innovative and competitive suppliers offering a wide range of products to UK mobile network operators (MNOs) and other potential adopters, such as private networks. This is expected to continue, with future cohorts encouraging more UK companies to commit to Open RAN

Facilitating interoperability testing and collaboration across vendors that might otherwise not have happened.

It is expected that SONIC Labs will:

- Help the UK industry and the telecoms innovation ecosystem to build a better understanding of both the potential and reality of Open RAN, and successive relevant technologies

- Facilitate and encourage open interoperability in mobile networks

Providing global leadership for Open RAN and encouraging investment into the future of the UK's telecoms ecosystem.

This refers to:

- Supporting the UK in taking a global leadership role for the future of advanced networks and 5G and helping to establish the UK as a centre of excellence

- Encouraging global industry to engage with the UK's Open RAN capabilities and market, while accelerating and easing the way for UK MNOs to deploy Open RAN technologies in UK mobile telecoms networks by 2025

- Opening collaboration and learning pathways with other international Open RAN initiatives

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We are delighted to see the publication of the SONIC Labs annual report, the result of another year of working closely with some of the telecoms industry's leading companies. The report captures key learnings and insights that have been gathered to date and will play a vital role in informing our stakeholders on how Open RAN can support the telecoms supply chains of the future – helping to make sure they are safe, secure and open to a diverse range of suppliers.

**Lindsey Fussell, Group Director,
Networks & Communications, Ofcom**

The context for SONIC Labs

Open RAN and telecoms diversification

Open RAN and telecoms diversification

Why the SONIC Labs project was commissioned

In 2020, the National Cyber Security Centre (NCSC) issued **guidelines** recommending that the UK should avoid using equipment from high-risk vendors. This has left only two large-scale vendors with equipment suitable for the UK market: Ericsson and Nokia.

In early December 2020, the UK Government released its **5G Supply Chain Diversification Strategy**, which focuses on three areas of activity to ensure the UK is "not reliant on any single vendor and begins to realise its long-term vision for a more open and innovative market".

This involves supporting incumbent suppliers, attracting new vendors into the UK market, and accelerating open interface solutions and deployment. In support of this third priority, two lab-based interventions were announced: the establishment of a UK National Telecoms Lab (UKTL) to assess the technical performance and security of equipment, and SONIC Labs to test and demonstrate interoperable solutions.

UK telecoms diversification: the current landscape

Ensuring digital connectivity through a secure and reliable network infrastructure has become increasingly important. One way of achieving this is to accelerate the development of open interface architectures such as Open RAN, which requires the use of many open interfaces by different vendors. A more competitive 5G environment would bring more innovative and less expensive solutions to the mobile equipment market, and to facilitate this, DSIT has shared **Open RAN principles** for building open interface architecture, including:

- Open disaggregation

- Standard-based compliance and neutral testing of solutions against standards

- Demonstrated interoperability, ensuring that disaggregated components perform in a functional system that at least matches the performance and security of existing solutions

- Implementation neutrality, enabling suppliers to further innovate their products and solutions

In recent years, the UK Government, innovation bodies and telecoms industry professionals have been working towards the development of a more diverse and resilient supply chain for its telecoms market.

Amongst the organisations working to improve 5G diversification, there is a general consensus that a strong 5G ecosystem should aspire to deliver commercial Open RAN products ready for deployment and market release.
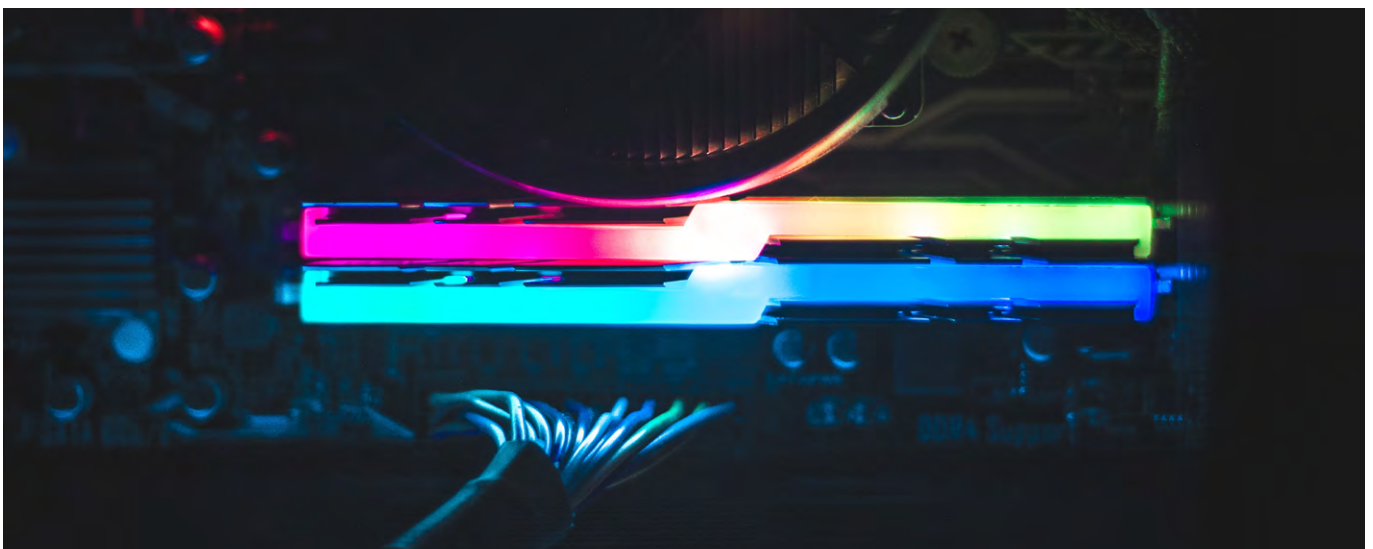
Collaboration on Open RAN

Building an open network ecosystem requires extensive collaboration between equipment vendors, product vendors, software and solution vendors, MNOs, system integrators and other relevant stakeholders, such as academics. 5G diversification stakeholders have worked to create a stimulating environment in order to foster this type of collaboration. Particular emphasis is placed on network virtualisation moving away from hardware, with network operations and functions increasingly delivered as software. Implementation of Open RAN standards is also essential for defining equipment interfaces and enabling interoperability.

To achieve success in the areas of collaboration and standards implementation, several R&D initiatives funded by DSIT are being carried out including:

The **Open Networks Research and Development Fund**, the £250 million DSIT supported programme to deliver upon the UK's 5G Supply Chain Diversification Strategy, including SONIC Labs. Initiatives under this fund include:

- The **Open Networks Ecosystem competition** offers up to £80m of funding in the next phase of the UK Open Networks Research and Development (R&D) Fund

- The **Future Ran Competition (FRANC)**, a £30m funding opportunity for initiatives developing new solutions to accelerate Open RAN deployment

- **NeutrORAN**, a public-private partnership exploring how to develop rural mobile connectivity through an Open RAN network

- **UK Telecoms Lab** (UKTL), a research facility to support the security and resilience of the telecoms industry

- The **Future Open Networks Research Challenge (FONRC)**, a £25 million fund aimed at connecting UK academics with international RAN providers to work collaboratively

The UK is also supporting the creation of interoperability testing labs through a combination of public and private funding.[1]

Through active UK support for the deployment of Open RAN products and interfaces, a national pool of UK RAN equipment vendors and service and solution providers is emerging alongside small-scale RAN deployments.[2] For example, Vodafone has committed to rolling out 2,500 Open RAN sites nationwide by 2030; BT Labs is involved in the UK Government's DSIT FRANC projects, which uses BT's Adastral Park TEAC facility; Virgin Media O2 has launched an **Open RAN neutral host in-building network** with Vilicom; and an **Open RAN** deployment is currently underway with Mavenir.

Alliances, global players and specifications

Globally, some of the industry's most visible telecoms multinationals have expressed full commitment to Open RAN and are building momentum on Open RAN activities. Samsung (South Korea), Nokia (Finland), NEC (Japan) and Fujitsu (Japan) are all working towards – and in some cases already deploying – Open RAN in UK mobile networks. A growing number of global systems integrators, such as Accenture (Ireland/USA), Capgemini (France), Rakuten Symphony (Japan), NEC (Japan) and NTT DoCoMo (Japan) are providing interoperability services for these Open RAN networks.

Similarly, international startups and chipsets manufacturers are increasing their presence in the Open RAN space, including Qualcomm (USA) and Marvell (USA) for radio and distributed unit support.

The UK is leading the way in Open RAN R&D

In 2021, a memorandum of understanding was signed by the four primary mobile network operators in the UK: Vodafone, EE, Virgin Media O2 and Three. This agreed to a decision by what was then the Department for Digital, Culture, Media and Sport (now Department for Science, Innovation and Technology) to carry 35% of UK mobile network traffic on Open RAN architectures by 2030, and to switch off public 2G and 3G networks to release spectrum for 5G.[3] Following this decision, non UK-operating MNOs Deutsche Telekom AG, Orange and Telefónica, which are all major European operators, have committed to further Open RAN deployments,[4] making Europe a key region for Open RAN rollout.

Consequently, many European industrial leaders have started conducting R&D projects and building facilities for Open RAN deployments.[5] Open Test and Integration Centres (OTICs) have sprung up across Europe for the testing and integration of Open RAN functionalities to meet different industry and end user needs.

Various parts of the UK innovation ecosystem have collaborated with international companies, gaining and sharing skills, resources and best practice with their overseas counterparts. This has demonstrated the UK's capabilities as a welcoming environment for Open RAN experimentation and investment. For example, the European 5G Centre of Excellence, which was established in 2020 in Ruislip (UK) by Japanese manufacturer NEC's Open RAN Lab[6], has engaged with several large European groups, including Telefonica, DT and Vodafone. Their objective is to test Open RAN integration and the development and validation of end-to-end solutions.

Standards, specifications and governance

Organisations covering global interests and issues such as the Telecom Infra Project (TIP) and the O-RAN Alliance aim to provide accessible certification to all. The O-RAN Alliance has over 330 members and future specifications will include collaboration with the standards company ETSI for security technical working groups. Specifications provided by the alliance enable TIP to coordinate vendors, MNOs and other international telecoms stakeholders to test, integrate, certify and run live trials for members. The organisation has so far conducted 100 trials in over 45 countries.

The Alliance is actively engaged in the UK to reshape RAN specifications that will help create a more competitive and dynamic telecoms ecosystem, as well as improve efficiency of RAN deployments and operations.[7]

Barriers and challenges to Open RAN progress

Although the concept of Open RAN appears promising, several persistent technical challenges are slowing down its adoption worldwide. Insights from early stage innovators reveal challenges such as overall hardware and software integration, interoperability and challenging security requirements. These barriers have the potential to delay, or in some cases prevent, the large-scale commercialisation of Open RAN solutions. SONIC Labs is working to address several of these challenges.

What could prevent large-scale development and adoption of Open RAN?

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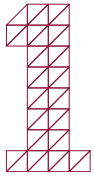
Security threats:
The increasing complexity of mobile networks has raised concerns about potential security vulnerabilities in the global 5G supply chain. Open RAN separates network components and could potentially broaden the number of threat surfaces.
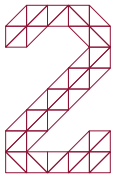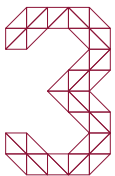
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Industry readiness:
While diversification involves new players entering the supply chain, it also requires traditional vendors to transition and innovate, and changes in what network operators do. Upgrading staff skillsets will become crucial, with more recruitment required.

3

Cost effectiveness:
Deploying Open RAN architectures could bring substantial cost savings, but will require investment, and could potentially involve systems integration and deployment delays. The question of whether the cost of Open RAN is worthwhile needs to be answered.

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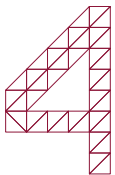
Process timescales:
The testing, validation and standards compliance of Open RAN complexities could potentially slow down the deployment of networks. Automation will help, but that will also take time and has its own issues relating to skills availability and readiness.

5
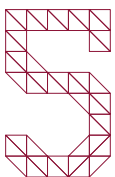
Insufficient investment in 5G infrastructure:[8]
Deploying networks that meet expected traffic demand and UK-wide deployment of basic 5G functionalities across the existing mobile network could lead to an industry investment gap of £3 billion to £5 billion by 2030. To make sure they have enough spectrum to meet 5G use on the existing network, operators will need to invest significantly in this infrastructure. This reinforces the pressing need for industry and public bodies to work together, so that investment and funding can be delivered effectively and in a timely manner.

6
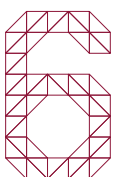
Lack of standards compliance and consistency:
Although some standards applicable to Open RAN already exist through the O-RAN Alliance and the Telecom Infra Project (TIP), there is a lack of standards compliance and consistency, resulting in widely varying results for Open RAN products in the current market.

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Industry readiness

Security threats

Cost effectiveness

RISKS TO LARGE-SCALE DEVELOPMENT AND ADOPTION OF OPEN RAN

Process timescales

Lack of compliance and consistency

Insufficient investment in 5G infrastructure

SONIC Labs overview
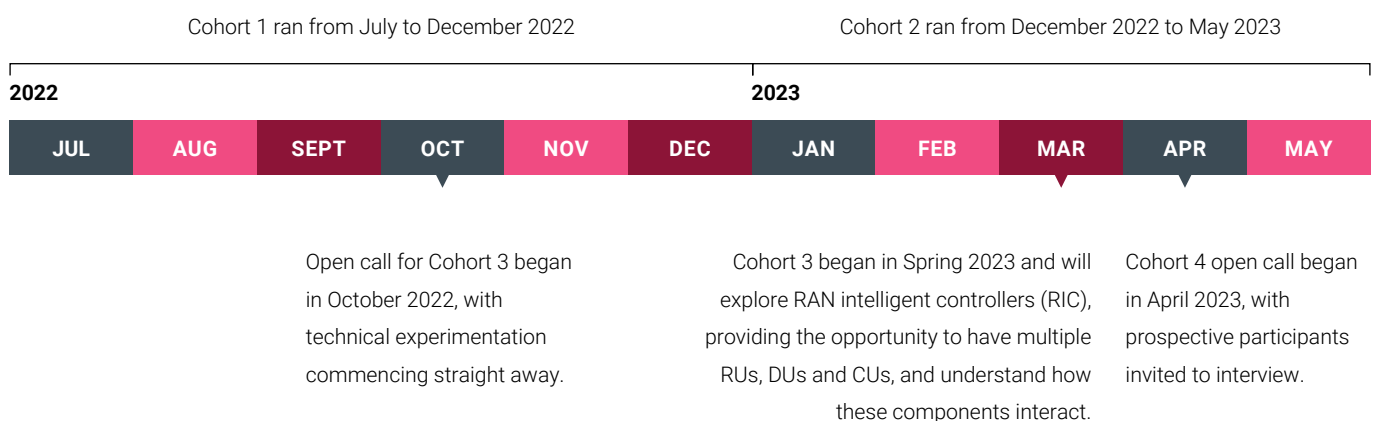
Accelerating innovation in Open RAN

Programme structure

SONIC Labs aims to foster the most suitable ecosystem in which Open RAN and further aspects of diversification can thrive, and acts as a platform from which innovators within and outside the telecom industry can explore new market opportunities.

The programme works closely with selected vendors to identify ecosystem needs, encourage knowledge sharing and disseminate findings to strategic market stakeholders and policymakers.

Phases and cohorts

SONIC Labs cohorts undertake their technical journey over the course of 7 to 9 months, taking place over two separate phases in the programme.

Cohort 1 ran from July to December 2022

Cohort 2 ran from December 2022 to May 2023

2022   **2023**

| JUL | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY |

Open call for Cohort 3 began in October 2022, with technical experimentation commencing straight away.

Cohort 3 began in Spring 2023 and will explore RAN intelligent controllers (RIC), providing the opportunity to have multiple RUs, DUs and CUs, and understand how these components interact.

Cohort 4 open call began in April 2023, with prospective participants invited to interview.

Recruitment

A pre-integration checklist was used with vendors, designed to enable technical experts to identify minimum conformance requirements. This allowed vendors the opportunity to self-certify the technology readiness levels (TRL) of their products and solutions while helping determine their readiness to perform swapability experiments.

The pre-integration checklist was implemented within a series of open calls that provided an opportunity for the SONIC Labs team to extend outreach, streamline the briefing process and outline the benefits and responsibilities for participants at an earlier stage. The checklist also helped to formalise the recruitment of cohorts, providing a fair, transparent and consistent selection process in line with SONIC Labs' objectives.

Alongside the open calls, SONIC Labs reached out directly to a large number of companies to support the aim of creating a more diversified supply chain in the UK. Engaging with these vendors through outreach gave team members an opportunity to assess the availability and maturity of companies' Open RAN products, and to capture their ambitions and motivations for joining the programme.

As well as ensuring that cohort members were aligned in their technical ambitions, the onboarding process ensured that cohort members were aligned in their technical ambitions, and introduced the programme of activities and community of practice.

Community of Practice

SONIC Labs has established a Community of Practice (CoP) to promote knowledge sharing. This supports vendors by offering a collaborative space to share expertise and learnings, encourage dialogue, and develop best practices for Open RAN deployment.

CoP sessions gather vendors' findings relating to both technical and non-technical challenges, ranging from optimal communication means to plug-and-play solutions improvement. This creates a body of knowledge based on common challenges and solutions that can be shared with the wider 5G ecosystem to raise awareness on business and product development.

Innovation workstreams: Ideate and Commercialise

Ideate

The SONIC Labs team created *Ideate* to be a core component of SONIC Labs' ecosystem development. Ideate focuses on expanding the knowledge base, reach, and networking capabilities of vendors through the following activities:

- Bringing vendors together to collaborate, gain inspiration and find potential partners in a supportive, innovative and dynamic environment, with webinars and hands-on workshops to bring new actors into the 5G ecosystem and explore new market opportunities

- Testing engagement methodologies to support new entrants into the telecoms sector, catalysing expansion of the UK supply chain beyond CU, RU, DU and RIC components

- Accelerating learning and innovation to explore solutions that take advantage of new intelligent and virtualised features of Open RAN

- Looking at Open RAN exploration of AI, network optimisation, and the market potential of the RAN intelligent controller for companies and researchers not currently operating in telecommunications. Introducing new actors is an expected benefit for vendors, for example: connecting AI/ML developers to RIC vendors and MNOs, and fostering the development of xApps and rApps that tackle new use cases such as network energy efficiency[9]

Commercialise

The *Commercialise* stream was established in order to support vendors in growing their understanding of the UK Open RAN ecosystem, and how to effectively penetrate the market with their Open RAN products. Activities in this stream include the following:

- Providing opportunities to build brand exposure and grow connections to key ecosystem partners: MNOs, testing labs and other potential end users

- Creating new connections that provide vendors with valuable insights into how to further develop their products to align with future customers' needs once interoperability testing is complete, and to provide direct contacts in potential customer organisations

- Identifying where Open RAN's end users currently sit in the adoption cycle and where targeted interventions could support users in investing more into Open RAN products

- Involving a variety of engagement methods, including webinars, roundtables, and interviews, as well as leveraging CoP sessions to give Open RAN suppliers exposure to different end users

Programme technology

In collaboration with industry-leading suppliers, the SONIC Labs team has designed, built and launched an open network technology-neutral platform to support the programme's technical activity. This platform forms the basis of the network infrastructure, and provides necessary services for the integration and interoperability activities in the programme.

SONIC Lab locations

SONIC Labs is currently distributed across three sites, with a fourth currently in development:

■
Site 1: main indoor lab environment, located in dedicated areas within the Digital Catapult office in London

■
Site 2: a satellite indoor lab environment, part of the media and network lab at Ofcom's Riverside House, London

■
Site 3: an indoor field trial location within the open office space of Digital Catapult, London

■
Site 4: an outdoor field trial location, being selected and deployed in 2023, during the programme's second year (not indicated on map)

SITE 1

Digital Catapult, London

The primary SONIC Labs site is a state-of-the-art test facility within the Digital Catapult office. Here, technical staff from Digital Catapult and participating organisations collaborate and carry out testing, as well as using the space for demos, exhibitions and on-premise seminars. Its data centre houses the common 5G infrastructure, which provides distributed computing across all sites, and hosts the network management and orchestration capability for all the Open RAN sites within SONIC Labs.

SITE 2

Ofcom, Riverside House

Approximately 3 km from Site 1, Site 2 houses a SONIC Labs Open RAN testbed, enabling newer vendors to test technology in a commercially neutral environment. As well as adding to the capacity offered by Site 1, this second site gives Ofcom experts visibility and insight into any practical issues, and enables vendors to test geographically distributed deployments.

SITE 3

Digital Catapult, London

Site 3 is designed for evaluation of deployment, scalability and manageability of Open RAN systems in a large-scale indoor environment, supporting field testing with a private 5G network for up to 30 users. It supports the deployment of open systems constituting multiple RUs, DUs, CUs and RICs. Private or non-public networks are a key deployment being targeted by the O-RAN Alliance and the wider Open RAN ecosystem, and learnings from Open RAN deployments and experimentation at Site 3 will provide useful insights and experience for planning and implementing the outdoor field trials at Site 4.

At Site 3, SONIC Labs will conduct the following experimentation and testing, assessing and verifying the following within a large-scale indoor deployment:

- Scalability of Open RAN systems by deploying multiple RU

- Operational stability of Open RAN networks

- Viability of disaggregated RAN functions/corresponding interfaces

- Constraints on the service management and orchestration (SMO) systems as Open RAN functions are scaled

- Handover in large-scale indoor Open RAN deployments

- Whether Open RAN maintains coverage and capacity KPIs (compared with best predicted performance/RF budget)

- The impact of Open RAN on end user quality of experience (QoE)

- Open RAN RIC xApps applications, such as traffic steering

- The feasibility of Open RAN in the context of shared networks deployed indoors

- The feasibility of different deployment scenarios of Open RAN networks in an indoor environment (co-located and geographically distributed RAN components)

The high-level architecture of all indoor reference network sites – network components and distribution for both 5G stand-alone (SA) and 5G non-stand-alone (NSA) – includes centralised units that are geographically distributed between all the three indoor sites, a core network hosted in the Digital Catapult London office, RAN Intelligence controllers, distributed units and radio units.

**SITE 4**

Outdoor field trial:

Site 4 is a planned site that will develop an outdoor field trial and provide a test location and infrastructure where vendors will be able to build and demonstrate their capabilities in an outdoor environment, reflecting the typical challenges seen in a real network.

It will include sub-sites of different types and sizes with overlapping coverage and enable radio equipment of different sizes, power and capability to be deployed, testing per site and network capabilities such as handovers, interference management and performance.

Pre-market engagement has been completed with mobile operators, wireless infrastructure providers, other testbeds and fixed network suppliers. The selection process has been iterative, and has been successfully concluded, with sites and frequencies identified and confirmed in an urban environment within London.

The focus of the site is in the London area, with a mixture of suburban, retail, and entertainment features. Next steps for establishment of Site 4 will entail design of the network, Open RAN vendor selection, deployment of equipment with connectivity to SONIC Labs, and making the network live for outdoor field testing.

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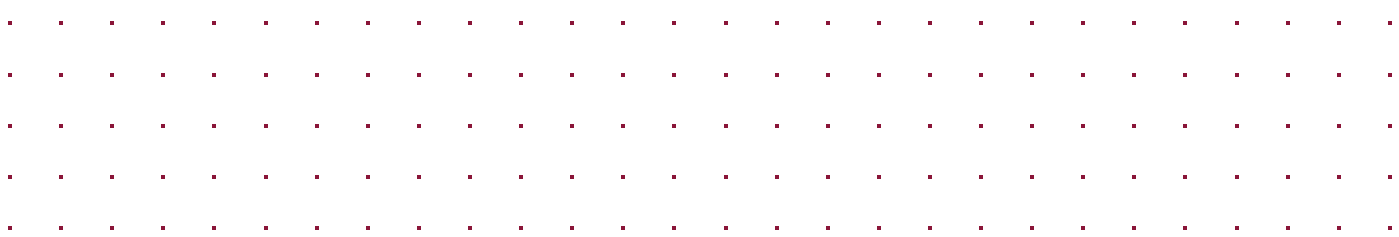
SONIC Labs is seen as a truly remarkable programme and it has been amazing to see the feedback we have received from our international partners.

The strides that the UK is making are more and more evident, and we're keen to help nurture the strong and positive international relationships we have with our like-minded partners. This has resulted in visits from delegations across the globe, with India, Japan and South Korea amongst them. We're expecting to have even more going forward, especially given the support we received at the most recent Mobile World Congress.

Kishan Nundloll, Lead for Policy, Research & Strategic Engagement, SONIC Labs, Digital Catapult
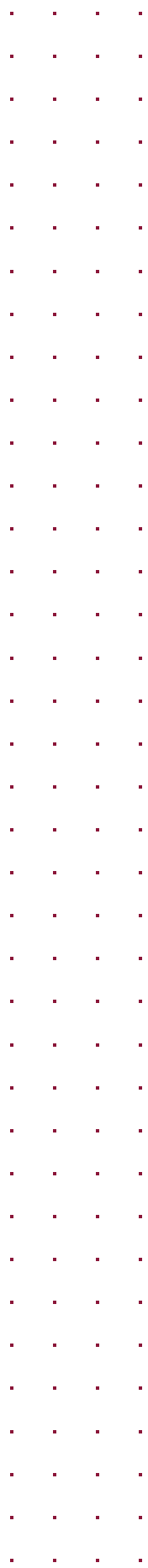
Relationship building and strategic engagement

Enabling and encouraging innovative suppliers of 5G Open RAN products to participate in the UK telecoms ecosystem is a core element of SONIC Labs. This includes development and consolidation of the programme's relationships with UK and global telecommunications ecosystems (including SONIC Labs' international counterparts) to support greater diversity in the telecoms supply chain. The SONIC Labs programme also liaises with public bodies and initiatives, including the UK Telecoms Innovation Network (UKTIN) and the National Cyber Security Centre.

New dissemination and engagement opportunities for vendors, including networking sessions and panel discussions with MNOs have contributed significantly towards the growth of the Open RAN ecosystem. Innovation events organised by SONIC Labs have also raised awareness of the RAN intelligent controller and provided a platform for RIC vendors to publicly discuss their ambitions.

Participating vendors have also been given the opportunity to learn about other initiatives, such as FRANC projects[10], with a focus on enabling vendors to foster connections with different stakeholders that could result in future partnerships.

SONIC Labs focus areas to date:

SONIC Labs continues to work with the Open RAN ecosystem to introduce new vendors into the UK ecosystem, encourage and facilitate integrations and relationships that are new, through the cohort process and engagement with vendors. Through this work the SONIC Labs team are able to support vendors bolstering participation in the UK telecoms ecosystem, improving their products - integration and testing which has identified issues with the products and interfaces, and the team has helped with fixes.

It remains paramount to build the reputation of SONIC Labs as a leading venue for Open RAN activity, and also the UK as a place for innovators to come through our work and marketing/dissemination activities, as well as sharing knowledge in bilateral discussions with other labs and policy makers.

SONIC Labs remains committed to understanding the reality of Open RAN maturity - learning vendor ambitions and aspirations through market engagement, open calls and integration activities. Ofcom is learning by taking part in the activities, and information is disseminated to the UK Government and thereafter placing the infrastructure - building the team, building labs, Industry Groups, and starting to work on field trials.

This will allow the team to explore opportunities to engage with UK companies, and innovators - early stage ideation for RIC applications and use cases. The focus technology wise, has been on indoor & private networks and the user plane primarily, with some work starting on RIC.

Strategic Advisory Board

SONIC Labs has created a Strategic Advisory Board to provide expert insight and knowledge, as well as to align with relevant key industries and UK and international initiatives. The Board advises on challenges, opportunities, technology roadmaps and capabilities relating to 5G diversification.

Membership is composed of ten public and private stakeholders from the telecoms industry, with accomplished experts offering independent advice and a dynamic perspective to benefit the wider ecosystem. Members include representatives of Open RAN vendors, system integrators, testbeds and academia, as well as potential adopters of Open RAN operators and neutral hosts:
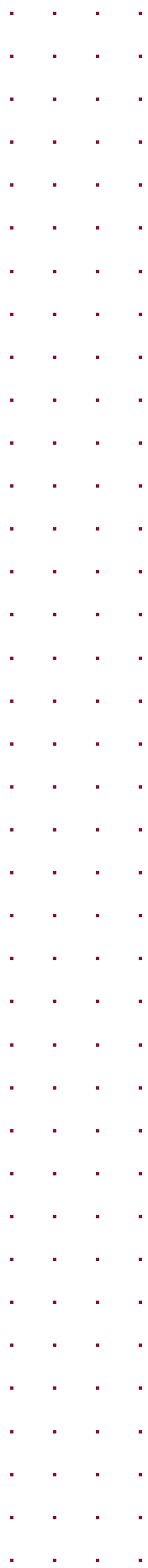
Industry Groups

Alongside the Strategic Advisory Board, SONIC Labs has created industry groups, with key telecoms stakeholders, ranging from MNOs, vendors and Open RAN testbeds to wireless infrastructure providers, academia and UK trade associations. This has enabled programme participants to draw on group experience and expertise on future network deployment across the telecoms ecosystem.

The Mobile Network Industry Group

Members of this group are Vodafone, Virgin Media O2, Three Hutchinson and EE with the group chaired by Mobile UK. As key adopters of Open RAN technology and products, SONIC Labs benefits from the invaluable insights from MNOs on new product requirements, as well as giving exposure to SONIC Labs participants.

The Wireless Infrastructure Industry Group

The wireless infrastructure, neutral host and telecoms services providers are considered future adopters of Open RAN technologies for neutral host and private networks. Members include Wireless Infrastructure Group, Cellnex, Freshwave, Ontix, Dense Air, Circet and Verizon UK.

The Testbed Industry Group

Established testbeds in the UK and overseas explore how SONIC Labs can support international companies looking to enter the UK Open RAN market. Members include a range of industry leaders such as Rakuten, NEC and BT, as well as international partners such as i14y (Germany), NTIA/ITS (USA), the Department for Home Affairs (Australia), and academics from the University of Sussex and the University of Bristol.

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The creation of industry groups has brought together core stakeholders from across the telecoms ecosystem to share their journey in the future of network deployment. This highlights how collaboration and diversity are essential for the success of open interface solutions, a key priority that SONIC Labs supports and continues to progress on.

Sophie Weston, Senior Policy, Research & Engagement Manager, SONIC Labs, Digital Catapult

Scan here to find out more.

International connections

In February 2023 SONIC Labs team members attended Mobile World Congress, and held more than 70 meetings with vendors, international governments, system integrators and telecoms labs. This enabled them to cement relationships, scout for new vendors and products, and raise the profile of the DSIT Diversification Strategy.

There has been strong external interest in the SONIC Labs work, in particular with international government-funded projects, helping DSIT to work on diversity and interoperability with like-minded nations. SONIC Labs has hosted visits from several standards bodies and international government departments, including delegations from Taiwan, Singapore, Japan, South Korea and Germany.

SONIC Labs:
the first two phases

Phase 1: SONIC-1 pilot

SONIC-1, the SONIC Labs pilot, began in November 2020 and was officially launched in June 2021 by Digital Catapult, Ofcom and DSIT, with the first group of participants in Cohort 0. Its aim was to establish the environment for a commercially neutral and technology-agnostic Open RAN 5G solution; to learn more about it and develop a deeper understanding of the issues and maturity of a multi-vendor disaggregated solution. To do this, programme partners investigated the interdependencies of different vendors' Open RAN technology building blocks.

The pilot project engaged with around 90 vendors and potential vendors of Open RAN products and fostered deeper discussions with around a third of participants. The programme team provided all cohorts with access to expert technical support and a specially deployed environment. Vendors were also given the opportunity to feed back on challenges found during experimentation, to inform best practice and benefit future cohort members and wider industry. This feedback included close collaboration to address challenges, including the integration and deployment of 5G SA Open RAN systems at hardware and software levels.

Although SONIC-1 focused on Open RAN product vendors, other stakeholders were also consulted in order to gain industry insights and to gauge interest.

SONIC-1 Vendors

Learnings from SONIC-1

Overall engagement

By accessing the network infrastructure for Open RAN being built, vendors were able to gain visibility beyond SONIC-1, enabling them to demonstrate and promote their capabilities in the marketplace. Benefiting from direct access to technical expertise also allowed them to attract new customers and garner internal support to improve processes for new system configurations.

Integration requires a significant amount of time and resources. Engagement with participating companies stressed the need for system integrators during the integration and testing process, ultimately shaping the overall total cost of ownership.

Technical plans and roadmap

Supporting vendor companies in developing their technical plans and roadmaps for deploying Open RAN meant building a better understanding of the specific test and measurement functions required for the programme. Insights on the wider ecosystem and market gathered from participating vendors – as key stakeholders shaping future products –also helped to shape the next phase, and enabled all initial vendors to engage with SONIC Labs as either a supplier or a partner.

Value propositions for future engagement models

SONIC-1 participants also contributed to future engagement models by identifying vendor value propositions. For example, swapability would increase the number of products vendors could interact with, enabling them to expand their offering. External visibility would enable them to demonstrate the maturity, interoperability and deployability of the UK Open RAN ecosystem.

Co-testing integration and interoperability

To gain first-hand experience of product maturity, SONIC-1 needed vendor test validation. Vendors found that co-testing integration and interoperability with others was extremely valuable. The combination of bench-testing (device/subsystem testing) with end-to-end integration testing and doing both in the lab and in a representative environment, provided significant added value for the participants, and validated the methodology used in the SONIC-1 pilot phase.

The operational systems in the programme, which were fully integrated end-to-end with a core network, were demonstrable soon after the programme's official launch. The three base station deployments took place in indoor real-world settings, representative of the typical vendor/integrator ecosystem that SONIC-1 would engage with in the future.

Demonstration of the value of transparency

The pilot showed that transparency around supported options, minimal conformance testing and software adaptability effectively led to better clarification of technical readiness level (TRL) definitions, helping industry manufacturers and potential future clients to assess product and system maturity.[11]

Read the rest of the SONIC-1 story

Get the detailed pilot report:

SONIC Labs - lessons learned
from the first cohort engagements

DOWNLOAD

Actions taken: designing future phases

Learnings from SONIC-1 were used to inform the next phases of the programme, including the requirements for building the future telecommunications ecosystem, and the need to be proactive in supporting market diversification, product development and UK positioning on the global stage.

Phase 2: SONIC Labs

Phase 2 of the programme - SONIC Labs, built upon the learnings gained in the pilot programme, whilst extending the programme's reach, technical capabilities and engagement.

Since the commencement of SONIC Labs in February 2022, outreach to potential vendors has been accelerated, with the team growing to support this, as well as to focus on engagement with key organisations. So far in Phase 2, the SONIC Labs programme has engaged with around 27 potential vendors of Open RAN products from the UK, as well as international vendors to form the first cohort. In addition to this, other stakeholders were engaged with, both to gain their industry insights and to gauge interest.

The selection of the open RAN vendors throughout Phase 2 cohorts has followed a process that was fair and consistent, in line with the aims of the SONIC Labs programme. These activities include pre-integration engagement, initial technical engagement, agreement on low level design and proposed swapability experimentations.

"

One of the key distinguishing features of SONIC Labs is the high level of vendor engagement it fosters. While the technical journey remains a central aspect of the programme, the knowledge-sharing spaces that vendors have built from the outset are no less important.

Through various means such as Communities of Practice, vendors have forged strong bonds not only with the programme, but also with one another. This has been vital in fostering a global community of Open RAN vendors, which is truly impressive.

Sebastian Turano,
Innovation Delivery Manager,
Digital Catapult
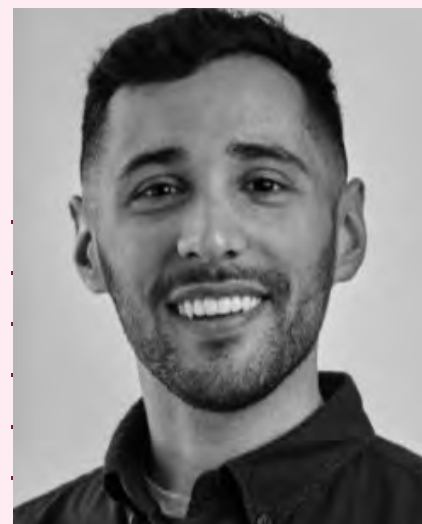
SONIC Labs Cohort 1

For Cohort 1, the programme initially engaged with 27 potential vendors of Open RAN products from the UK and internationally to form the first cohort.

Following an assessment process, six Open RAN vendors were selected to join Cohort 1:

The SONIC Labs team, with Digital Catapult as the system integrator, worked closely with the selected Cohort 1 vendors to build three Open RAN systems to be used in the SONIC Labs programme. Each system was composed of an Open RAN radio unit, distributed unit, central unit, and a Druid 5G core. The system deployments were built based on 5G standalone architecture and are geographically located at the Digital Catapult headquarters in London.

Technical development and testing activities were carried out between July 2022 and December 2022, with vendors, as well as the SONIC Labs team, noting rapid evolution of the wider Open RAN ecosystem and market within that time frame.

The technical journey throughout this cohort was broken down into a split of four months of integration and benchmarking of participants' Open RAN products, with the remaining months focused on swapping experimentation, in which products from other vendors replace existing products in order to test the integration of the formed gNodeB system.

During the first four months, participant vendors and the SONIC Labs team focused on the integration of the Open RAN gNodeB systems. Key findings from the integration phase included:
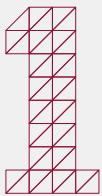
1   Integration with the 5G core was straightforward, with plug-and-play functions proving to be successful and taking one day to complete. Integration of the radio unit and the distributed unit was more rapid than anticipated, successfully being done in under one week

2   The Layer1/Layer2 logging tools were deemed by participants to be essential for testing control plane/user plane establishments.

3   The bare metal implementation of Open RAN components appeared to be more challenging to deploy and manage as opposed to containerised or virtualised implementations.

Following the integration testing, some participant vendors immediately commenced work on new software releases for future cohorts. The technical journey of Cohort 1 provided the SONIC Labs team with beneficial insights and lessons to take away in the following cohorts and in this continuous development of Open RAN.

The last two months of the cohort technical journey were dedicated to swap experimentation in which Open RAN products in the system were swapped with other Open RAN products from the same vendor or other vendors, in order to test interoperability and conduct end-to-end testing.

Two different swap experiments were conducted, using different Open RAN components from other vendors to explore the ease of integration of Open RAN components from different vendors; the ability to switch between them and interdependencies of Open RAN technology building blocks. Key takeaways from the swap experimentation included:
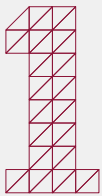
1 Product swap testing requires further time and effort, including multiple configuration changes to achieve successful integration of the whole stack.

2 Vendors noted that it would be beneficial to conduct integration and interoperability testing activities earlier in the product development lifecycle.

Throughout Cohort 1 the SONIC Labs team held recurring 'community of practice' sessions as well as 1-1 interviews with participant vendors, discussing overall engagement with the programme, participants' technical plans and roadmaps, and future plans towards energy efficiency, market perspective/commercialisation, and future engagement with the ecosystem.

Vendors in this cohort discussed the positive commercial impact and reputational support that SONIC Labs provided, enabling them to advance their business activities within the UK and developing best practices that could be beneficial to the wider telecoms ecosystem. Cohort participants were able to tap into the expertise of SONIC Labs telecoms technologists and engineers to address any technical concerns or issues along the journey.

Cohort 1 Vendors

Phluido
Phluido is a pioneer company in the fields of fronthaul technology and cellular network virtualisation from San Diego, California. The company was in charge of providing the physical layer for a Distributed Unit (DU) in Cohort 1.

Effnet
Effnet is a company based in Sweden and is dedicated to delivering 5G RAN software components to Communications Service Providers as well as for a wide variety of applications including private networks and non-terrestrial networks. They provided a Distributed Unit (DU) and a Centralised Unit (CU) to the programme and bring more than 20 years of experience in the area of research and development of efficient networking.

Benetel
Benetel is based in Dublin, Ireland, and is a company dedicated to delivering 5G ORAN Radio Units (O-RUs) to Communication Service Providers and Private Networks. They partcipated in this cohort through the provision of a radio unit.

IS-Wireless
IS-Wireless is a company based in Poland, specialising in the development of software-defined 4G and 5G mobile networks. The company has been recognised as one of a few European RAN vendors by leading telco operators in their November 2021 report "Building an Open RAN Ecosystem for Europe." IS-Wireless contributed to the programme by bringing a Centralised Unit (CU) and will bring the L2 stack, part of the Distributed Unit (DU).

CableFree
The other Radio Unit in the SONIC Labs was provided by CableFree: Wireless Excellence, a UK-based equipment vendor with a deployed base of customers in more than 80 countries. The company designs and manufactures high-performance wireless connectivity products including 5G Macro and Small Cell Radios.

Capgemini
Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. It brought its global innovation expertise to the programme, leveraging its system integration capability and Open RAN CU (Centralised Unit), DU (Distributed Unit) and RIC (RAN Intelligent Controller) solutions. This technology is essential in the development of 5G end-to-end solutions.

SONIC Labs Cohort 2

The second SONIC Labs programme cohort ran from December 2022 to May 2023, and built upon the engagement, learnings, and technological developments established in both the SONIC-1 pilot and Cohort 1. This cohort placed particular focus on system integration, the exploration of RAN intelligent controller maturity, and investigating ARM-based Open RAN implementations,

In Cohort 2 the following activities have been prioritised:

- Building programme infrastructure, including creating physical labs and industry groups

- Exploration of opportunities to engage with UK based innovators to provide early-stage ideation for RIC applications and use cases

- Focusing on indoor networks, private networks, and the user plane, and beginning work on RIC

Continuing its existing co-deployment methodology, the programme integrates Open-RAN gNodeB systems in two stages - an ideal lab scenario, and in indoor and outdoor field deployments.

Building upon the findings and advancements gained in Cohort 1, the technical process in Cohort 2 increased the precision of specifications for swap experiments performed.

Cohort 2 had two application tiers:

- **Tier 1** - for all vendors that supply and collaborate in the development and testing of their Open RAN products

- **Tier 2** - for vendors that also undertake system integrator activities for gNodeB and permutations of selected Open RAN products that involve their solutions

Nine Open RAN vendors were selected to join Cohort 2:

Of the selected companies, three are new to the UK market: VVDN (India), SOLiD (South Korea) and ASOCS (Israel).

ASOCS, Accelleran and RadiSys joined the cohort as Tier 2 vendors, playing the role of system integrators and having responsibility for end-to-end interoperability, benchmarking and swapability experimentation. In addition, these system integrators led the installation of software and firmware in the systems, as well as capturing optimisations and performance improvement measures.

Cohort 2 Vendors

Accelleran
Based in Antwerp, Belgium, Accelleran is an Open RAN pioneer, with software solutions enabling a diverse multi-vendor RAN ecosystem to create greater flexibility, efficiency and reduced costs for operators and private networks. Accelleran brought its dRAX™ platform to the SONIC Labs programme, which includes the Cloud Native CU, the RIC developer platform and systems integration capabilities to showcase interoperability and openness.

ASOCS
Based in Israel, ASOCS is empowering industrial enterprises to connect their production lines to edge applications by providing them with a cloud-based private 5G network and a scalable SaaS model. ASOCS brings a Distributed Unit (DU) and Centralised Unit (CU) to the SONIC Labs testbed.

CableFree
A latest-generation Open RAN Radio Unit for SONIC Labs Cohort 2 was provided by CableFree: Wireless Excellence, a UK-based equipment vendor with a deployed base of customers in more than 80 countries. Based in the Oxford Science Park, the company designs and manufactures high-performance wireless solutions including 5G macro and small cell radios.

Effnet
Effnet is a Swedish header compression technology and 5G network solutions company, and supplies service providers and product developers with high quality and high performance software components for a variety of products and applications, including public and private networks as well as non-terrestrial networks. Effnet joined SONIC Labs for testing and integration with RAN software components from other vendors. Effnet provided 5G DU software running on Intel and Arm platforms, integrated with 5G PHY/UL1 from third party vendors.

Phluido
Phluido is a pioneer company in the fields of fronthaul technology and cellular network virtualisation from San Diego, California. The company was in charge of providing the physical layer a Distributed Unit (DU) to the SONIC Labs programme, for deployment on ARM.

Radisys

Radisys, a global leader in open telecom solutions, enables service providers to drive disruption with new open architecture business models. Leveraging O-RAN standards for open interfaces and RAN disaggregation, multi-vendor Open RAN deployment was realised in SONIC Labs with Radisys 3GPP Rel 16 compliant CU and DU software on COTS hardware, with radio and core network from other vendors.

SOLiD Technologies

SOLiD distributed antenna system (DAS) technology and O-RAN solutions enable indoor and outdoor cellular service at many of the world's best-known and most challenging venues — from the busiest airports and subways to Fortune 500 corporate buildings, hospitals, hotels, universities, sports venues, government, industrial, and logistics facilities. SOLiD continuously innovates to deliver best-in-class modular solutions that scale to every need.

VMware

VMware offers a breadth of digital solutions that power apps, services, and experiences which enable organisations to deliver the best customer service. Having established a footprint in core telco cloud deployments globally, in recent years VMware has been expanding its capabilities to address the challenges and bring a cloud- centric approach to the RAN. VMware provided the RAN Intelligence Controller (RIC) to SONIC Labs.

VVDN

VVDN Technologies is a product engineering and manufacturing company focused on end-to-end products across several technology vertical markets. VVDN in the 5G space brings a lot of design, development, testing, cloud and manufacturing capabilities for OEMs, telcos, Test & AMP; and measurement companies. Within SONIC Labs, VVDN brought ORAN 7.2a split Radio Unit (RU). With inbuilt low physical layer functionality, small form factor, four-channel MIMO support and an integrated Omni antenna, this device can cater to the ever-growing demand for high-speed data networks.

More information on Cohort 2 will be published in the upcoming SONIC Labs: Cohort 2 Insights paper

SONIC Labs Cohort 3

Scheduled to take place between March 2023 and October 2023, Cohort 3 will focus on exploring the RIC. Four organisations are set to bring their RIC products for interoperability testing and integration.

The programme continues to evolve and extend its activities to push the capabilities of the Open RAN products, with the next activity focused on exploring outdoor focused products, as well as continuing maturity of indoor products such as testing and optimising the performance of the indoor multi-vendor systems. Field trials in indoor and outdoor environments will help to give a more realistic deployment for Open RAN systems and the maturity of the products.

The following vendors have been confirmed as participating in Cohort 3:

Cohort 3 Vendors

Accelleran
Headquartered in Antwerp, Belgium, Accelleran is an Open RAN pioneer, with software solutions enabling a diverse multi-vendor RAN ecosystem that creates greater flexibility, efficiency and reduced costs for operators and private networks. Accelleran brings the dRAX™ platform, which includes the Cloud Native CU, RAN intelligent Controller (RIC) developer platform and systems integration capabilities to the SONIC Labs programme.

Airspan Networks
Airspan Networks is a U.S.-based provider of groundbreaking, disruptive software and hardware for 5G networks, and a pioneer in end-to-end Open RAN solutions. The company has a strong R&D footprint in the UK with around 100 employees. Airspan Networks are bringing their full Open RAN solution based on the Central and Distributed Unit (CU and DU), together with the Radio Unit (RU) AV2700, an indoor small cell to SONIC Labs.

Benetel
Benetel is a leading provider of 5G Radio Unit (RU) solutions, offering a comprehensive range of RUs for both indoor and outdoor products to Communication Service Providers and Private Networks. With a proven track record of delivering high-performance, reliable and cost-effective solutions, Benetel has quickly become a trusted partner for many international partners. Benetel will provide their 5G Radio Units to cohort 3 to drive innovation and interoperability in the ecosystem.

Capgemini
Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. Capgemini will bring its global innovation expertise to the programme by leveraging its 5G portfolio capabilities, specifically its RIC (RAN Intelligent Controller) solution along with its xApps and rApps expertise. This technology is essential for developing innovative 5G use cases that can optimise RAN functioning and automate operations over radio access networks.

IS-Wireless
IS-Wireless is a company based in Poland, specialising in the development of software-defined 4G and 5G mobile networks. The company has been recognised as one of a few European RAN vendors by leading telco operators in their November 2021 report "Building an Open RAN Ecosystem for Europe". IS-Wireless is contributing to the programme by bringing a Centralised Unit (CU), part of the Distributed Unit (DU) and the RIC (RAN Intelligent Controller).

Phluido

Phluido is a pioneer company in the fields of fronthaul technology and cellular network virtualisation from San Diego, California. The company will be in charge of providing the physical layer a Distributed Unit (DU) to the SONIC Labs programme, for deployment on ARM.

RadiSys

Radisys, a global leader in open telecom solutions, enables service providers to drive disruption with new open architecture business models. Leveraging O-RAN standards for open interfaces and RAN disaggregation, multi-vendor Open RAN deployment is realised in SONIC labs with Radisys 3GPP Rel 16 compliant CU and DU software, Radisys will also play the role of the System Integrator (SI) in this phase of the programme.

VMware

VMware offers a breadth of digital solutions that powers apps, services, and experiences which enable organisations to deliver the best customer service. Having established a footprint in core telco cloud deployments globally, in recent years VMware has been expanding its capabilities to address the challenges and bring a cloud-centric approach to the RAN. VMware will bring the RAN Intelligence Controller (RIC) to SONIC Labs.

Wistron NeWeb Corporation (WNC)

Wistron NeWeb Corporation (WNC) specialises in short-/mid-/long-range communications technologies and provides solutions in network communications, network infrastructure, smart home and advanced driver-assistance systems (ADAS). WNC will bring its R1220 series radio unit (RU) and R1220 flexible vRAN solution to the SONIC Labs programme. WNC will bring its R1220 series radio unit (RU) and R1220 flexible vRAN solution to the SONIC Labs programme.

SONIC Labs
Insights and learnings to date

Engagement and innovation within the UK ecosystem

Engagement with the industry groups and the Strategic Advisory Board has been a valuable starting point for exploring innovation opportunities in line with programme objectives. Initial discussions highlighted several common themes and it has been made clear from stakeholders that SONIC Labs is viewed as a cutting-edge facility that provides an open space to discuss critical issues that are not considered detrimental to competition. Insights include the following:

- Support is required from national and international institutions to maintain momentum within the existing Open RAN ecosystem

- Support has been garnered from international labs – for example, i14y Lab and NTIA have both shown that they are keen and willing to work with SONIC Labs to create and foster greater collaboration

- Progress in the telecoms ecosystem must be supported to break down current barriers to entry, in line with work that Ofcom has undertaken

- International participants are looking to build relationships that broaden their knowledge and understanding of the UK's diversification strategy over the next 10 years

- Further expansion is needed within the UK telecoms supply chain beyond CU, RU, and DU, components. This includes a sustained focus on the RIC as one of the key enablers for third-party applications

Feedback from Cohort 1 has shown that participants appreciated the value of SONIC Labs as a space for supporting vendors in their product and performance improvement journey, and for facilitating connections helping them to scale and expand their scope of operations. Participants are keen to showcase their products, and to connect with the wider ecosystem including systems integrators, MNOs and other end users.

Ideate workshops

During the first year of the programme, SONIC Labs collaborated with a RIC vendor (VMware) and an MNO (BT) to design and deliver an educational session and innovation workshop. This targeted innovators with AI/ML expertise who were interested in exploring ideas for RIC-based applications, such as xApps and rApps.

The first Ideate event took place in October 2022 and examined the ways in which the RIC could provide opportunities for innovation to improve network efficiencies. This brought together startups and universities developing solutions using AI and ML to bring innovation to Open RAN in ways not possible with previous closed and proprietary solution ecosystems.

As well as successfully fostering connections between AI/ML experts, academia, Open RAN vendors, and mobile network operators, this event was a platform for Cohort 1 vendors to showcase their products to people external to the telecom industry. It highlighted opportunities for SONIC Labs, including the leverage of areas where the UK already has strengths such as in software development and AI. Other opportunities included examination of whether these capabilities can be translated into new offerings that take advantage of open interfaces and systems such as RIC in mobile networks.

The event also helped the SONIC Labs team to identify the type of support participants needed, such as funding, access to testbeds and mentoring.

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The RAN Intelligent Controller (RIC) is one of the most exciting innovation opportunities for startups and scaleups with AI/ML expertise to take advantage of new programmable, intelligent and interoperable functions to develop new groundbreaking applications.

Linda Ligios,
Senior Innovation Partner, Digital Catapult

Test and measurement platform

Integration complexity is increasing, in line with the growing interest in Open RAN, and the number of new vendors developing Open RAN components and interfaces. This drives the need for a higher level of certainty, performance and interoperability, which increases reliance on test and measurement (T&M) tools and the need to further develop capabilities.

The SONIC Labs technical team developed T&M capabilities that enable effective characterisation of the performance of integrated Open RANs. The team used the VIAVI Test and Measurement platform to provide comprehensive test and measurement capabilities for a wide range of test cases, and Cohort 1 participants recognised the importance of test and measurement tools for the integration-based debugging of products and of the integrated system overall.

The SONIC Labs technical team is developing an automated test process that will simplify and reduce testing time, enhancing both efficiency and repeatability. Looking forward, the challenge is expected to be determining how to automate the test process using advanced T&M platforms.

Key validations that the team will focus on future include:

- Multi-vendor interoperability tests, including the disaggregation of CU/DU components

- Interoperability testing on fronthaul, backhaul and RIC interfaces

- Individual disaggregated Open RAN tests such as O-RU, O-DU and O-CU to ensure individual disaggregated components are optimised and tested correctly

- Functional and non-functional testing on a system level

- Testing of protocols and open interfaces to ensure compliance with 3GPP and Open RAN standards specifications

- Performance monitoring of open interfaces and protocols as part of the non-functional testing

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During 2022, SONIC Labs built a programme team, established processes and underlying infrastructure, built two labs (Digital Catapult and Ofcom) and developed and ran a new participant engagement process. At the same time, we were carrying out integration and testing, and introducing new vendors to the UK market.

This was a huge amount of work undertaken in challenging times, and is a testament to the enthusiasm and expertise of everyone involved – within Digital Catapult, Ofcom, our suppliers and DSIT – and to their flexibility, supportiveness and willingness to accommodate frequent replanning and adjustment as new local and macro issues arose.

Paul Ceely,
Director, Technology Strategy,
Digital Catapult

Technical learnings

SONIC Labs Cohort 1 included testing of end-to-end functions and the participants showed their willingness to participate in the programme through a collaboration agreement and provided their hardware and software to be integrated and tested in SONIC Labs over the seven month journey.

During Cohort 1, three Open RAN systems were created. These used eight Open RAN products and three product swaps, and were deployed using 5G standalone architecture. Each system was composed of an Open RAN radio unit, distributed unit, central unit, and a 5G core.

The deployments are based on 5G Standalone Architecture, geographically located at Digital Catapult headquarters in London, with a Druid 5G core network used as well as an emulated 5G core network offered by one of the vendors. Digital Catapult played the role of the system integrator and supported all vendor participants through the technical journey.

	5GC	O - CU	O - DU		O - RU
			L2 Stack	High - PHY	
Open RAN System #1	5GC Vendor	Vendor 1	Vendor 1	Vendor 3	Vendor 4
Open RAN System #2	5GC Vendor 2	Vendor 2	Vendor 2	Vendor 3	Vendor 4
Open RAN System #3	5GC Vendor	Vendor 6	Vendor 6	Vendor 3	Vendor 4

Fig. 1 - Cohort 1 Open RAN systems[12]

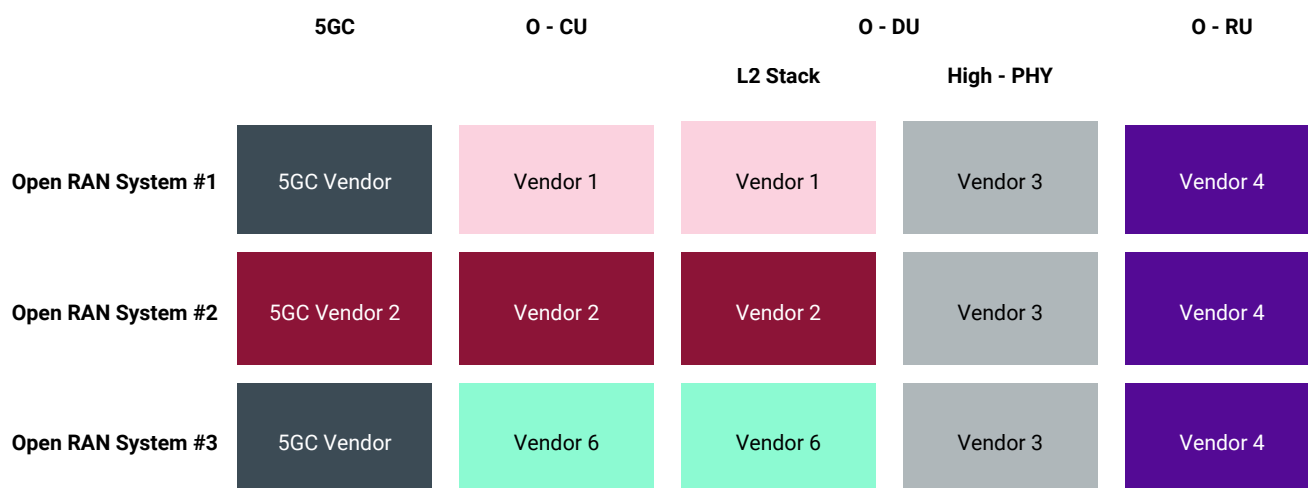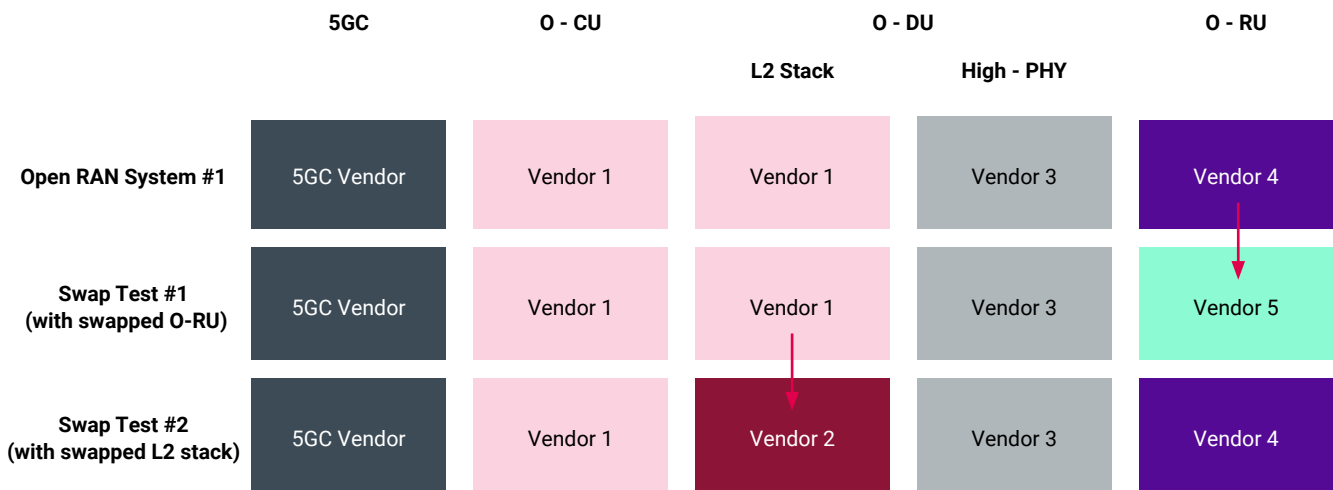|	5GC	O - CU	O - DU		O - RU
			L2 Stack	High - PHY	
Open RAN System #1	5GC Vendor	Vendor 1	Vendor 1	Vendor 3	Vendor 4
Swap Test #1 (with swapped O-RU)	5GC Vendor	Vendor 1	Vendor 1	Vendor 3	Vendor 5
Swap Test #2 (with swapped L2 stack)	5GC Vendor	Vendor 1	Vendor 2	Vendor 3	Vendor 4

Fig. 2 - Cohort 1 Swaps[13]

SONIC Labs presented the low level design (LLD) of the three Open RANs, with IOT/E2E test results, as well as the issues raised and their resolution. The high level technical findings were:

- Increased maturity of products made integration easier, with better deployment packaging

- Better specification of product operating parameters showed improving product maturity

- Performance on the user plane (data) requires further improvement and participants have continued to carry out optimisations

Further detail about technical progress in SONIC Labs to date will be available in the upcoming *Cohort 1 Insights* paper, to be published online mid-2023.

Looking forward:

SONIC Labs phase 3 and beyond

The role of SONIC Labs in future UK network diversification and disaggregation

Through collaboration, development and commercialisation, SONIC Labs has the potential to lead the Open RAN movement to attract further innovation, investment and openness to the UK telecoms space.

SONIC Labs has a vital role to play in building on the UK's existing strengths and continuing the momentum of open networks, alongside other interventions and organisations working with the UK Government's DSIT and Ofcom.

With its industry groups, the programme works to develop the UK Open RAN ecosystem by offering unique strategic and cross-industry forums to benefit UK telecoms. SONIC Labs engages and collaborates with relevant stakeholders and organisations at the forefront of the industry, building up relationships, and aligning current and future requirements and challenges with those of vendors wanting to serve the evolving UK telecoms market.

Through the open call processes and integration negotiations, SONIC Labs encourages new vendors to enter the UK Open RAN space. By widening the pool of potential actors and fostering innovation, the programme facilitates the route for vendors to work on integration with those that they have not previously worked with, leading to more interoperable systems.

Supporting the UK Government

By ensuring alignment and collaboration with key stakeholders, while leveraging technical and innovation workstreams, SONIC Labs contributes to the adoption of best practices and standards, and engaging with strategic partners will encourage the wider dissemination of learnings for UK and global policy development.

- Policy and engagement work in SONIC Labs will continue to build and maintain relations with DSIT (which is responsible for R&D and innovation), alongside digital infrastructure priorities

- SONIC Labs will also continue to closely examine the deployment of Open RAN and successive relevant technologies to help inform DSIT and Ofcom policy, programmes and regulation

SONIC Labs will also continue to support international partners in the UK Open RAN market, through collaboration and sharing of knowledge and expertise on the development and deployment of Open RAN.

Planned technical activities

Over the next year, the SONIC Labs programme will explore maturity of the solutions and be ready to start placing increased focus upon the optimisation of Open RAN deployments – network control in particular – and on their management and orchestration.

Phase 3 will explore RIC integration with different vendor Open RAN components. Selection of process vendors and external system integrators is already complete, as are definitions of Open RAN chains (such as baseline and swaps). Cohort 3 will look at further test scenarios for KPIs, with access to the new testing and measurement kit comprising Viavi E500, Keysight PBM and Nemo.

The fourth phase, Cohort 4, planned to run from July 2023 until January 2024, will seek to address mature indoor systems and the testing of outdoor equipment. Deployment of Site 4 for this will involve significant technical activity, focusing on the outdoor Open RAN field network to 5G deployment in a real and live environment. To maximise the outdoor trial test coverage, a combination of street-level and macro-based deployment would be the optimum configuration. SONIC Labs will also be building a public outdoor space disaggregated Open RAN 5G network that the programme team can start using for technical engagement activities.

Innovation and ecosystem development

The next year of the programme will support vendors to further mature their product offerings by:

- Evaluating Open RAN performance, scalability and mobility/handover in an indoor environment

- Functional testing of Open RAN outdoor equipment within a lab environment

This will accelerate UK market entry for Open RAN products with greater maturity.

Recruitment for Cohort 4 will target companies with Open RAN products at TRL6, including outdoor products that have a focus on RUs, as well as DU, CU and RIC components at a higher TRL.

SONIC Labs will continue to support the ideation of early-stage solutions to create a pool of innovative companies that can leverage Open RAN as an opportunity, while addressing supply chain diversification. Throughout 2023, a series of education and innovation activities will seed new opportunities for product development. Additionally, the team will develop a partnership framework to help innovators turn ideas into products, while offering them a testing platform.

Further research will identify UK-based startups and scaleups interested in exploring the application of artificial intelligence (AI) and machine learning (ML) in telecommunications. This will be accompanied by a call to market for all digital innovators from businesses and academia willing to take on a RIC challenge focused on energy efficiency, and develop innovative AI-based solutions to support network optimisation.

Summary of future activities and priorities:

The next year of SONIC Labs will include new activities, as well as continuing current key priorities:

- Continued engagement with commercial labs in the UK and the strengthening of relationships with international equivalents

- Continued maintenance, promotion and encouragement of innovative vendors to participate in the UK telecoms ecosystem, as well as investigate alternative options

- Collaborating with international workstreams, to better understand and facilitate their activities

- Ongoing work with industry to successfully develop new service offerings

- Continued exploration of innovation opportunities with RIC and in energy efficiency – these themes will take priority for the next version of Ideate

- Extending outreach to potential RIC challenge owners and partners

- Fostering ecosystem evolution and growth by working with innovators within and outside the telecoms domain (such as AI/ML startups and academia)

- Increasing connections between RIC vendors and app developers to explore innovation opportunities and potential collaboration

- Increasing awareness of RIC and Open RAN opportunities

Looking further ahead: future SONIC Labs plans

SONIC Labs will accelerate the route to market by providing vendors with access to bespoke business support, as well as exposure to world class commercial labs and expert market insights. This activity will include a series of specialised engagement activities, including access to potential collaborators and customers.

As technology development accelerates in the UK, vendors will explore new innovation opportunities that are aligned with the new programmable, intelligent, virtualised, and interoperable functions that Open RAN technologies bring. More emphasis will be placed on the RAN intelligent controller (RIC), which has been identified as the core element of the Open RAN disaggregation strategy and the cornerstone of Open RAN innovation. SONIC Labs will sustain ongoing engagements with communications service providers (CSPs), RIC vendors, system integrators and neutral hosts to identify the most pressing industry challenges that RIC applications can address.

Beyond the next year, SONIC Labs will explore the best ways to encourage innovation in RIC, network control, and the application of AI and ML.

Future technical activities

- **Testing other open standard network solutions** as they go through innovation maturation cycles – focusing on multi-vendor solutions requiring interoperability and integration, with a view to UK development

- Extending work on **optimisation of Open RAN deployments** (network control, management, orchestration)

- Placing an **increased focus on other elements of open interoperable software-centric networks**, such as new architectures and new network technologies beyond mobile

- **Hardware and DevOps capabilities** for edge compute support will be included in design

- Working towards building an **open standard architecture and interfaces that support multi-vendor product development and testing**, as solutions evolve in the open network space. This will involve placing a focus on the integration and interoperability of applications and features, including intelligent edge, non-cellular technologies and architectures, multi-vendor lifecycle management and workflow, and others identified in Ofcom's Technology Futures report

- Through SONIC Labs, Digital Catapult will have established a reference network infrastructure for a **multi-version Open RAN and open network testing platform**. This will be aligned with most significant international open network initiatives. Support for operational management software will also be introduced

- SONIC Labs will begin to provide **direct access and technical support for onboarding, experimenting and testing of service with Multi-Access Edge Computing (MEC) and network orchestrations** using bare metal infrastructure. The testbed will have the capability to carry and provide access to early versions of open source software from major initiatives, as well as UK and international vendors with new offers in the telecoms supply chain. Support for remote testing and measurement operations will be included

Final considerations

During its first year, SONIC Labs has made significant achievements, delivered industry firsts and contributed to the development of UK and global telecoms disaggregation.

Analysis of SONIC Labs' engagement to date shows that the programme is making substantial headway in demonstrating that the UK is a viable and profitable environment for international investment and global vendors.

In its second year, we expect SONIC Labs to do more, generating a marked positive impact for all programme partners, stakeholders and the wider telecoms community. New cohorts, technical experiments and testing will generate more knowledge and greater understanding of the requirements and likely outcomes of field trial deployments.

SONIC Labs will continue to invest in its testbed infrastructure, adding automation, evolving towards a **testbed-as-infrastructure service** to be able to offer vendors a testing journey, and it is anticipated that field trials will be closer to live/commercial deployment, enabling equipment and products to evolve and mature.

Looking further into the future, SONIC Labs will continue to make groundbreaking discoveries and achievements in telecoms interoperability, disaggregation and diversification – not only in the UK but also on a global stage. With exciting developments being made in the wider telecoms ecosystem daily, engagement and collaboration with relevant partners and stakeholders is key to maintaining the momentum of innovation, as well as for informing policy and business practices.

Balancing the depth of experience from existing industry companies with relevant learnings from newer industry players is essential for industry-leading development, and the creation of opportunities for diversification and interoperability. The SONIC Labs programme is expertly positioned to deliver this balance in the interests of achieving national telecoms ambitions.

The entire SONIC Labs team looks forward to continuing to grow impact, engagement, technological capability and global recognition for the UK as a world-leading environment for telecoms innovation.

Read more about SONIC Labs and register your interest on the SONIC Labs website.

Glossary

AI/ML	Artificial intelligence/machine learning
COP	Community of practice
CU	Centralised unit
Disaggregation	Separation of networking equipment into functional components and allowing each component to be individually deployed
DU	Distributed unit
DSIT	Department for Science, Innovation and Technology
FONRC	Future Open Networks Research Challenge
FRANC	Future Radio Access Network Competition
gNB	gNodeB: a 3GPP 5G next gen base station that supports 5G new radio
Interoperability	The ability of a product or system to work with other products or systems
IoT	Internet of things
LLD	Low level design
MNO	Mobile network operators
Ofcom	Office of Communications, the UK's communications regulator
Open RAN/O-RAN	Open radio access network, supporting interoperation between equipment from different vendors
RAN	Radio access network
RIC	RAN intelligent controller
RU	Radio unit
SmartRAN	Smart Radio Access Network
SONIC	SmartRAN Open Network Interoperability Centre
TRL	Technology readiness level[14]
UKTIN	UK Telecoms Innovation Network Competition

Footnotes

1. **https://uk5g.org/discover/supply-chain-diversification-UK-telecom/uk-open-networks-ecosystem-technology/testing-interoperability-support-UK-telecom/**

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5. **https://tecknexus.com/5g-network/current-state-of-open-ran-europe/**

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8. **The Investment Gap to Full 5G Rollout (Digital Connectivity Forum, 2022)**

9. **https://www.mobileworldlive.com/latest/revolutionize-your-energy-usage-in-the-ran-and-beyond/**

10. **https://www.gov.uk/guidance/future-ran-diversifying-the-5g-supply-chain**

11. **https://www.digicatapult.org.uk/expertise/publications/post/sonic-labs-lessons-learned-from-first-vendor-engagements/**

12. Vendors names removed due to confidentiality

13. Vendors names removed due to confidentiality

14. UKRI guidance on technology readiness levels - **https://www.ukri.org/councils/stfc/guidance-for-applicants/check-if-youre-eligible-for-funding/eligibility-of-technology-readiness-levels-trl/**

About Digital Catapult

Digital Catapult is the UK authority on advanced digital technology. Through collaboration and innovation, we accelerate industry adoption to drive growth and opportunity across the economy.

We bring together an expert and enterprising community of researchers, startups, scaleups and industry leaders to discover new ways to solve big challenges to unlock the UK's future potential. Through our specialist programmes and experimental facilities, we make sure that innovation thrives and the right solutions make it to the real world.

Our goal is to accelerate new possibilities in everything we do and for every business we partner with on the journey – breaking down barriers, de-risking innovation, opening up markets and responsibly shaping the products, services and experiences of the future.

Digital Catapult is part of the Catapult Network that supports businesses in transforming great ideas into valuable products and services. We are a network of world-leading technology and innovation centres established by Innovate UK.

About Ofcom

Ofcom is the UK regulation and competition authority for broadcasting, communications and postal industries. Ofcom has a statutory duty to represent the interests of citizens and consumers through promoting competition, encouraging innovation, and investment in relevant markets. Ofcom adopt a tech-first approach to regulation, which allows anticipation rather than reaction to emerging technologies/technology trends and an understanding of how this will impact the sectors that are regulated.

About DSIT

The Department for Science, Innovation and Technology (DSIT) is funding SONIC Labs. This UK Government department is focused on driving innovation to deliver improved public services, creating new better-paid jobs, and growing the economy.

SONIC Labs was developed to support the UK's telecom supply chain diversification strategy, which aims to accelerate the development and market readiness of interoperable network technologies.