

# Lessons learned from first vendor engagements in SONIC Labs

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## Glossary

<b>BSS</b>	<b>Business Support System</b>
<b>CAPEX</b>	<b>Capital Expenditure</b>
<b>COTS</b>	<b>Commercial-Off-The-Shelf</b>
<b>CU</b>	<b>Centralised Unit</b>
<b>DC</b>	<b>Digital Catapult</b>
<b>DCMS</b>	<b>Department for Digital, Culture, Media &amp; Sport</b>
<b>DU</b>	<b>Distributed Unit</b>
<b>E2E</b>	<b>End-to-End</b>
<b>eCPRI</b>	<b>Enhanced Common Public Radio Interface</b>

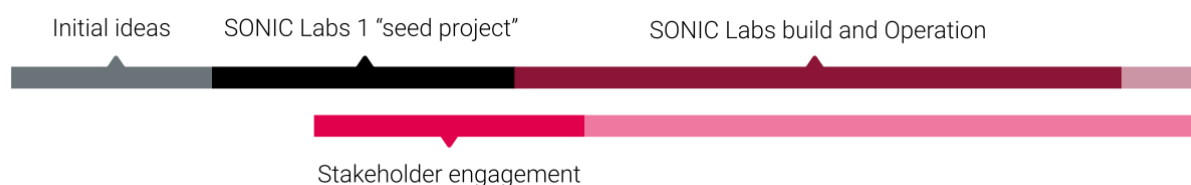
<b>FAPI</b>	<b>Functional application platform interface</b>
<b>gNB</b>	<b>gNodeB is a 3GPP-compliant implementation of the 5G-NR base station</b>
<b>NIC</b>	<b>Network interface controller</b>
<b>OPEX</b>	<b>Operational Expenditure</b>
<b>OSS</b>	<b>Operations Support Systems</b>
<b>Open RAN</b>	<b>Open Radio Access Network</b>
<b>RAN</b>	<b>Radio Access Network</b>
<b>RF</b>	<b>Radio Frequency</b>
<b>RU</b>	<b>Radio Unit</b>
<b>SA</b>	<b>Standalone</b>
<b>SONIC</b>	<b>Smart Open RAN Interoperability Centre</b>
<b>T&amp;M</b>	<b>Test and Measurement</b>
<b>TRL</b>	<b>Technology Readiness Level</b>
<b>QAM I/Q</b>	<b>Quadrature Amplitude Modulation</b>

## Purpose of this report

This report is a summary of the lessons learned during the SONIC-1 programme, with a particular focus on how these were incorporated into the design of the next phase of SONIC Labs.

It should be noted that the technical activities were largely carried out from April 2021 until around September 2021, and that the overall Open RAN ecosystem and the specific products and vendors that we worked with have improved and evolved during that period.

During this document, the overall programme is referred to as “SONIC Labs”, and the project carried out in 2021 as “SONIC-1”. The next phases of SONIC Labs beyond SONIC-1 are referred to as the next phases of SONIC Labs.



## Introduction to the SONIC programme

The SmartRAN Open Network Interoperability Centre (SONIC Labs) has been established as a joint programme between DCMS, Digital Catapult and Ofcom, as part of the DCMS' 5G Diversification Strategy. This programme is working to foster the emergence of new solutions in the telecom supply chain in the UK, focusing on multi-vendor open, disaggregated and software-centric network products, solutions and services, starting with Open RAN. With the SONIC Labs programme focussing on Open RAN and the potential for disaggregated RAN to be a game-changing technology in the diversification of the telecoms supply chain, it offers the potential to drive investment and growth for the UK telecoms industry as well as the UK economy as a whole. The SONIC Labs programme also aims to build upon the foundation of the first SONIC Labs project (SONIC-1) that took place in 2021, in driving the necessary industry learnings and conversations, as well as the technical innovations and policy environment required to achieve this.

The key issues that the SONIC Labs programme aims to address are the lack of diversity in telecoms providers and a notable underrepresentation from UK vendors as a key provider of 5G access hardware and software on the global stage. This is particularly pertinent when considering that without the inclusion of High Risk Vendors in 5G deployment, only two scale vendors are deployed in national mobile network operator systems. Building the UK's ecosystem and relationships in order to assist the emergence of the UK as a leader in 5G adoption, integration and solution provision is one of the primary ways in which these issues can be addressed, so as to benefit the UK telecoms industry and overall economy in both the near future and on a long term basis.

This report will explore the lessons learned through the engagement with the vendor ecosystem in SONIC-1 and the ways in which these lessons will be applied in SONIC Labs.

## SONIC-1

The SONIC Labs programme builds upon the earlier, SONIC-1 project, a year long programme which started in November 2020, and was officially launched in June 2021, with Digital Catapult working with communications regulator Ofcom and the Department of Digital, Culture, Media and Sport (DCMS). This initial stage of the programme was established with the aim of setting up a commercially neutral and technology non-partisan OpenRAN 5G solution, in order to gain learnings and a deeper understanding of the issues and maturity of a multi-vendor disaggregated RAN solution, through investigation of the interdependencies of different vendors' OpenRAN technology building blocks.

A real-world, multi-vendor OpenRAN facility was built on top of the existing Digital Catapult 5G testbed in London, United Kingdom in this venture, which was then followed by experimentation on the testbed and dissemination of the results. The SONIC-1 project aimed to establish the following:

- Three, separate disaggregated OpenRAN 5G mobile base stations
- The inclusion of at least 2 different vendors for each building block
- The ability to enable swapping of each building block

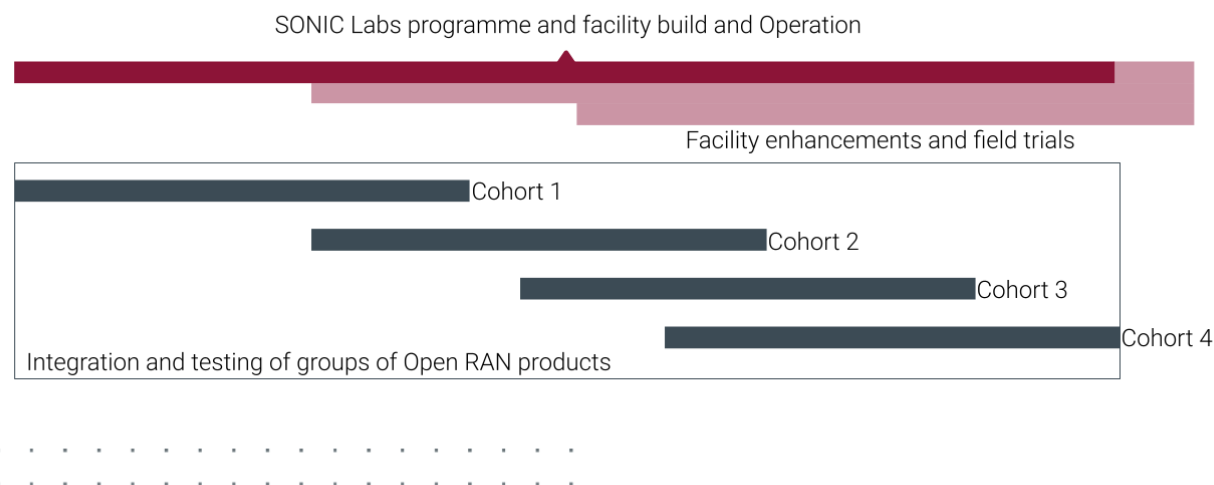
The outputs of SONIC-1 were primarily shared through events, public speaking engagements and publications, and the programme allowed Ofcom to supplement their knowledge base and insight into the technology. The events, and videos of the demonstration are available on the [Digital Catapult YouTube channel](#).

As a key audience for developments, vendors were extensively consulted during SONIC-1 to ensure an in-depth understanding of their place in the Open RAN ecosystem, their requirements, and what they can offer to the programme goals.

## SONIC Labs

Following SONIC-1, in which seven vendors demonstrated the value of Open RAN integration, the programme will be expanded to bring through a further four groups of new Open RAN products over the next two years (2022-2024). This will also include the creation of additional physical lab environments at multiple sites including Digital Catapult and Ofcom offices, field trial locations, and enhanced test and measurement solutions. This is complemented by programmes of work to carry out interoperability experimentation between products, market engagement, and engagement with network and service providers standards and specification development, other testbeds and international activities and organisations. [Read the press release](#) and [visit the Digital Catapult website](#) to find more information about SONIC Labs.

Our activities for the next 2 years



While this report covers the lessons learned from SONIC-1, the learnings were applied to the SONIC Labs programme, providing input into the way that SONIC Labs was designed, its structure, focus and objectives.

## Engagement within the UK ecosystem

The SONIC-1 project engaged with around 90 vendors and potential vendors of Open RAN products, as well as deeper discussions with around a third of these, with further discussions taking place in SONIC Labs. In addition to this, other stakeholders were engaged with, both to gain their industry insights and to gauge interest, although SONIC-1 was particularly focused on Open RAN product vendors.

As SONIC Labs has commenced, outreach to potential vendors has been accelerated, with the team growing to support this, as well as to focus on engagement with key organisations. Interested parties should visit the [SONIC Labs web page](#) where it is possible to register interest.

From the engagements that took place during SONIC-1, the following conclusions were made, and incorporated into the next phases of SONIC Labs:

- There are a number of alternative approaches being taken for fronthaul transport architecture, and the testbed should be designed to be able to incorporate different models.
- The performance of the DU was also an area of innovation, and the activities should support different models and approaches, with testing of the performance to understand the pros and cons, this includes accelerator cards , interface cards, and different variants of front haul spec. This includes a new interface specification within the which could be another point of integration and interoperability.



- There is innovation in the component space, e.g. in silicon supporting RU and DU products, and the evolution should be tracked to identify potential new products, vendors and even approaches.
- The FAPI interface from Small Cell Forum or Split 6 fronthaul was mentioned a number of times and appears to be a further point of interoperability not originally considered, potentially bringing together new DU combinations.
- Although SONIC-1 focused on user plane connectivity and use cases, there was interest in the network control and management, and the SONIC Labs programme should be designed to give room for the network control-focused vendors (management plane), alongside complementary products and vendors, and the user plane-focused companies. This may entail separate integration activities with slightly different architectural splits.
- There are different needs and benefits for different vendors for example, some focusing on further interoperability with other products and access to testing capability, and others more focused on building confidence in the Open RAN ecosystem, others on proving or demonstrating new innovation, others on understanding the needs of the UK to help with their product roadmaps.
- There are a number of different testbeds and activities, both in the UK and internationally, and SONIC Labs should be defined in a way to maximise the value of the specific work and the ability to transfer and reuse the outputs from one activity to another.

## Participant feedback

Throughout SONIC-1, discussions were carried out with the participants, through the ongoing project delivery and through Digital Catapult support of the DCMS benefits realisation process, in addition to end of project discussions/interviews around three broad topic areas of the **overall engagement with the project**; their **technical plans and roadmap**, and **future engagement models** with SONIC Labs.

### Overall engagement

Participants expressed a positive experience of the programme, particularly with regards to both the attitude and approach of the technical team, as well as their ability to put things into place rapidly, including the other participants.

SONIC-1 was early and unusual in the approach of deploying products on platforms not controlled by the vendors, and across different, geographically separated sites, which proved harder than expected to make fully operational in the new environment. Several unexpected issues took place in moving from the vendors' internal labs to the SONIC labs, which was helpful to the vendors in that it allowed them to isolate unknown issues, making the experience useful for their product development. It was noted that the publicity and visibility obtained through the programme was



particularly helpful for their work, allowed them to demonstrate their capabilities externally, and to help them to prioritise internally.

All of the participants highlighted areas in which they had been able to learn and improve, such as that of the processes and documentation for new system setups.

A number of areas were identified as weaknesses through the work, particularly the areas of documentation, and a significant amount of manual configuration from the vendors (not unexpected at the stage of the development of some of the products) which made it difficult to replicate configurations consistently.

Some vendors noted that the testing aims could have been a bit clearer, and that there were some target testing features that could be improved in SONIC Labs.

## Technical plans and roadmap

### Testing and measurement

SONIC-1 included testing of end to end functions, and the participating vendors in this aspect of the programme saw the procurement of equipment for specific test & measurement (T&M) functions, through a transparent procurement process. Discussions into the possibility of working together on a wider basis with these vendors for equipment testing and measurement, as well as other relevant vendors have continued. Throughout the course of conversations with various vendors it was noted that testing vendors are amongst the most appropriate people to consult as they have particular insight into the ecosystem and wider market. This is due to their involvement in creating test specifications and participation in many of the testing labs around the world. As a result, their understanding of the current state of the art implementations and processes, as well as what works efficiently and what the early stage products are is particularly relevant and can inform future products. These discussions revealed a keen interest amongst all of the vendors to engage with SONIC Labs, through in a supplier capacity and partnered capacity.

### Maturity of the Open RAN specifications

Engagement with vendors throughout the course of SONIC-1 revealed an apparent lack of maturity at the time in question across the vendor landscape for Open RAN, with some of the specifications at a relatively early stage, in turn meaning that both the automation of T&M tests and implementation are at early stages. It should be noted that the end-to-end 5G testing environment is well understood, but for O-RAN specific interfaces, products are at a particularly early stage with incomplete portfolios, leading to the requirement to manually test and troubleshoot in SONIC-1. As a result of this, it has been recognised that SONIC Labs will include a significant effort to build the automation of T&M activities.



## General

During SONIC-1, the end-to-end chains improved significantly in maturity overall, but less to each individual product, and the speed for integration and for setting up the systems, both standalone and integrated. The documentation and processes for all of the deployments were improved, including the troubleshooting approaches.

One particular area of note is that the fronthaul was the most complex part technically to get running well.

## Future engagement models

All vendors consulted, both in group and individual meetings, saw the benefit that the SONIC programme could provide and have expressed their interest for SONIC Labs. Some vendors saw significant value in the swapability, in order to both increase the number of products that they can interoperate with and to increase their potential product set. Other vendors demonstrated interest in the external visibility, a key driver for their taking part to be able to show the maturity of the Open RAN ecosystem, the interoperability and deployability.

## Lessons learned

The lessons learned from the course of SONIC-1 can be categorised into technical lessons learned and engagement & innovation lessons learned.

### Technical lessons learned

The methodology of carrying out the integration and interoperability testing jointly between the vendors and the SONIC Labs team was highly valued by the participants. Whilst this is valuable and necessary for SONIC Labs operation, in order for Digital Catapult and Ofcom to get first-hand experience of the realities of the products, it was important that it was highly valued by the vendors, who expressed appreciation for having expert technical support in a new deployed environment, and also the new pairs of eyes to identify issues.

Throughout engagement, all vendors highly valued the approach to combine bench-testing (device/subsystem testing) with full end-to-end integration testing both in the lab and in a representative environment, validating the methodology used in SONIC-1.

Vendors engaged in SONIC Labs appreciated the end-to-end nature of the testing provided in the labs and the test and measurement (T&M) equipment introduced in SONIC-1 and the SONIC Labs testing regime. We identified a number of areas where additional capability would be helpful.

Integration, interoperability and deployment of a 5G SA Open RAN system at both the hardware and software-level proved to be more challenging than anticipated, for example:

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- This was in part due to the migration of the products to a new environment with new people carrying it out, stressing documentation and the system setup in unexpected ways.
- Although the intent was to use commercial off the shelf equipment (COTS) there were many specific hardware requirements (including interface cards, accelerator cards and supporting firmware).
- Some of the participants highlighted the potential scale of work required to type approve all the hardware variants.
- The testbed was essentially manually set up making rework during the integration activities time consuming.
- It should be noted that this was carried out 6-9 months before the beginning of SONIC Labs, and industry has seen many improvements in the integration, and as such, it is expected that the hardware dependencies will reduce and the portfolio of suitable products will increase.

The fronthaul integration with eCPRI was particularly difficult, and the integration process required close collaboration between the DU and RU vendors and software updates.

- We believe that it is important to profile and understand the nature of eCPRI messages that pass over the fronthaul to help with the integration and also to identify implementation specific elements which could reduce the interoperability and interchangeability of products in the network.
- We also discovered two variants of the Option 7.2x fronthaul interface implemented by the vendors, Category A and Category B, which reflect different architectural choices and hardware dependencies.

### **Actions taken in the design of the next phases of SONIC Labs**

- SONIC Labs will continue the methodology to carry out joint activities on the deployment with the participants.
- Continue to include a product technical journey that integrates Open-RAN gNB systems in two stages:
  - Integration of Open-RAN gNB systems in an ideal lab scenario
  - Integration of Open-RAN gNB systems in a more realistic scenario, extending to field (outdoor/indoor) deployments
- Build as much automation into the testbed, the hardware and operating system environment and also the testing.
- Adopting a pre-integration checklist for all vendors to ensure suitable matching of products, and clarity of capabilities claimed to be implemented. Including a particular focus on the fronthaul and the Option 7.2x variants Category A and Category B.
- Ensuring that the activities and tests to be undertaken reflect the technology readiness and maturity of the products, agreed in advance.
- Making the timelines for the integration activity clearer with the associated requests for provisioning of vendor dedicated technical resources

- SONIC Labs is making provision for different types of COTS hardware and recording the dependencies vendors have on specific COTS hardware, and evolve this over time. This will be part of the exit report for every participating product/vendor, aiming to help increase the hardware portfolio.
- SONIC Labs will be expanding its test and measurement (T&M) capability, focusing on interoperability and E2E performance testing scope for tools and systems.
- SONIC Labs will include a fronthaul analyser to help accelerate the RU to DU integration over the fronthaul, and also to monitor the implementation of specific elements.
- SONIC Labs will also include test automation in scope

### **Engagement & innovation lessons learned**

SONIC-1 observed that integration required a significant amount of time and resources, and although this will improve, there are some conclusions that can be drawn:

- There was a need for one organisation to take a specific system integration role during the integration and testing.
- The resource and effort required will have an ongoing requirement and is likely to have a material impact on the overall total cost of ownership.
- There are some potential constraints on the ability for vendors to support these kinds of activities, especially the smaller vendors, particularly with other Open RAN labs being set up.

Issues with the process for the SONIC Labs activities and the integration and testing were identified, including:

- The overall journey towards a working system and then swapping elements was unclear at the outset, making prioritisation across the participants suboptimal.
- It was originally intended that the performance would be benchmarked and then improved incrementally through the programme, but the minimal level for this was not clear, making the benefits realisation process hard to measure.

The vendors had different priorities:

- For the different integration and testing activities depending on their product marketing strategy, which we had not clearly discussed at the beginning.
- The benefits for each was different, such as achieving a new integration or some test results or demonstrating the build with supporting publicity

### **Actions taken in the design of the next phases of SONIC Labs**

- SONIC Labs to now include system integrator as a specific function to be considered as part of the building of a disaggregated Open gNB. This is also intended to improve the capability and skills to spread the load from the vendors.
- The programme will seek to explore the potential economic impacts of Open RAN in terms of the resource requirements alongside the hardware and software, and develop industry advisory groups to gain input and advice on the topic.

- SONIC Labs will seek to identify ways to reduce effort for integration, through automation and also knowledge sharing to help products be developed more “ready to go”.
- Use the pre-integration checklist to
  - Identify the optimal steps for integration, product swapping and testing for each group of vendors.
  - Identify the integration and swappability options of most interest to participating vendors to construct an activity of most value to the participants - with the highest chance of success due to internal prioritisation.
  - Identify the interfaces and integrations of most interest to vendors to help with feedback and knowledge sharing to be able to prioritise the interfaces for interoperability in the evolving Open RAN ecosystem.
- SONIC Labs has developed a comprehensive vendor technical journey that clearly specifies the swap experiments and bespoke test experiments to be performed within each activity. This is to improve the overall process and also to be clearer at the beginning with the vendors’ support required.
- Care needs to be taken to avoid excessive requirements on the vendors, and to try to automate as much as possible to lower the resource requirements.
- Design the overall programme so that there is a range and balance of different benefits, to encourage the participation of as broad a set of vendors and products as possible, and give each something useful. Our aim is to encourage different types of vendors to work together.

## Success for SONIC Labs

The time elapsed between the conclusion of the subject of this report - SONIC-1, and the following phase of the SONIC Labs programme, as well as the lessons learned from SONIC-1 has allowed for more clarity and understanding of what ‘good’ would look like in SONIC Labs, and the best ways in which to run the programme. These suggestions of what the telecoms ecosystem would evolve into in an ideal world, in part supported by SONIC Labs can be categorised into the areas of **market diversification and commercial activity, UK positioning on the global stage, and increased product development.**

### Market diversification and commercial activity

- Lowered barriers to access for new telecoms vendors
- An increased provision of a pipeline of innovative and competitive suppliers and products to UK mobile network operators, including those providing Open RAN products (hardware and software) network slicing, management and orchestration, and other relevant categories
- SONIC Labs becoming a new, national (UK) capability: a high quality provider of Open RAN performance and interoperability testing. It would be trusted by suppliers, mobile network

operators, Ofcom and other key stakeholders. A well informed position within the UK ecosystem would be established, as a national hub of industry engagement into the UK's Open RAN capabilities.

### UK positioning on the global stage

- An increased awareness in industry of UK solution providers for 5G
- Increased support of international companies to participate in the UK Open RAN market
- SONIC Labs collaboration with other international Open RAN facilities.
- Increased growth and investment in the UK telecom sector, with demonstrated support of UK players and UK based organisations to maximise their role in the supply chain.
- Strengthened 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.
- Demonstrated support of international companies to participate in the UK Open RAN market and collaboration with other international Open RAN facilities.

### Product development

- Changes in the areas of focus to address solutions relevant for the UK, and also to address emerging potential bottle-necks and areas where diversification is lacking.
- Facilitation of widespread interoperability testing and collaboration across supplier products that may not otherwise have been tested for interoperability. This would be done with a view to increase technical knowledge of Open RAN performance and interoperability across the ecosystem, and mitigating the risk of vendor lock-in in future networks.

### Next steps for SONIC Labs

SONIC-1 was particularly useful in setting the basis for understanding of the current and future ecosystem in Open RAN, their motivations, challenges and the feasibility of integrating the technologies in the most appropriate way. Whilst this initial phase was successful in a number of ways, it also revealed where there could be better ways of working, clearer communication, areas that require greater technical exploration and development, and areas that should be highlighted or looked out for in SONIC Labs so as to best reach programmatic aims and substantially contribute to the diversification of the UK 5G industry.

As work continues in the next phase of SONIC Labs, focus will be on the expansion of the programme of testing, bringing through a further four groups of new Open RAN products over the next two years. The programme's new phase will include the creation of additional physical lab environments at multiple sites including Digital Catapult and Ofcom, field trial locations and enhanced test and measurement solutions. This is complemented by programmes of work to carry

out interoperability experimentation between products, market engagement, and engagement with network and service providers standards and specification development, other testbeds and international activities and organisations.

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