WM5G Application Accelerator

End of Project Report (External)

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CONTENTS

1 SCOPE OF REPORT 5
2 EXECUTIVE SUMMARY 6
3 INTRODUCTION 10
3.1 Key Objectives 10
4 PROJECT OVERVIEW 11
4.1 Background 11
4.2 5PRING 12
4.3 5PRING Programme Offering 13
4.4 Facilities 15
4.5 Technologies 16
4.6 Innovation Programmes 18
4.7 Commercial Network Rollout 20
5 PROJECT RESULTS 21
5.1 Project Outputs & Outcomes 21
5.1.1 Summary 21
5.1.2 The Numbers 21
5.2 Participant Data 22
5.3 Technology 24
5.3.1 Key Insights 24
5.3.2 Performance 26
5.3.2.1 Throughput 26
5.3.2.2 Latency 27
5.3.3 Benefits 27
5.3.4 Security 29
5.3.4.1 Security Approach 29
5.3.4.2 Key Takeaways 29
6 PROJECT IMPACT 30
6.1 Outputs & Outcomes 30
7 KEY LESSONS LEARNED 32
7.1 Key Drivers 32
7.2 Top 5 Key Lessons 32
7.3 COVID 19 Impacts 33

7.4 Other Impacts 34
7.4.1 Virgin Media and O2 Joint Venture 34
7.4.2 Commercial Network Delays 34
7.5 Sustainability 34
7.6 What Would We Do Differently? 35
8 END OF PROGRAMME ACTIONS 36
8.1 Financial Requirements 36
8.2 Benefits Realisation 36
8.3 State aid and spend compliance 36
REFERENCES 37
GLOSSARY 38
ACRONYMS 40
APPENDIX A – LESSONS LEARNED 41
Top 5 Key Lessons 41
APPENDIX B – INNOVATION PROGRAMMES 47

1 SCOPE OF REPORT

The scope of this End of Project report for the West-Midlands 5G (WM5G) Application Accelerator Workstream is to outline the project and the key benefits provided against the original objectives, highlighting insight gained, successes and associated lessons learnt that could be applied to other projects similar in nature.

2 EXECUTIVE SUMMARY

The emergence of 5PRING

5PRING, the brand name for the WM5G's 5G Application Accelerator (5GAA) Project, was officially launched on 27th March 2020.

5PRING comprised of three 5G accelerator centres (hubs) that were open to all and enabled Start-ups and Small and Medium Size Enterprises (SMEs), to learn about and engage with 5G technologies to grow and develop new products/services with suitable technical and business support. The aim was to accelerate the take-up of 5G and realise the associated benefits.

Despite the many challenges encountered by the project caused by the COVID 19 pandemic, not least businesses needing to focus on survival (impacting the number of organisations attending the programme) or social-distancing rules (preventing access to the 5GAA facilities), the project was still able to deliver its key strategic objectives.

This achievement is down to efforts of the 5PRING Consortium - Virgin Media O2 (VM02)/ Telefonica UK Ltd – Lead partner; Deloitte; Digital Catapult; Wayra, and WM5G, each organisation working tirelessly in a collaborative manner to address challenges head on.

The project and its success could not have been made possible without the support of our funding partners: Department of Culture, Media & Sport (DCMS); European Regional Development Fund (ERDF)/Midland Engine; Getting Building Fund (GBF); Greater Birmingham and Solihull Local Enterprise Partnership (GBS-LEP); West Midlands Combined Authority (WMCA) and Wolverhampton Towns Fund.

Outputs & Outcomes

Over the course of the past two years, the WM5G 5GAA Project has helped put the West Midlands on the map as the place to be for 5G Innovation and expertise:

- Analysis of the country's core city regions found the West Midlands has the largest spread of up-and-coming tech strengths, as well as the highest number of companies developing new tech, surpassing the volume of expertise in both Greater Manchester and Leeds City Region respectively (digitalbirmingham.co.uk, 2021) [1].
- In Tech & Creative specifically, a deep dive identified the West Midlands as the most established out-of-capital destination for the industry, with the largest number of companies in 10 out of a total 13 specialisms, including digital transformation; gaming; immersive tech; process automation and software development.

5PRING has helped to create these industries of the future by enabling businesses and public sector organisations to access dedicated facilities to experience 5G and work out the benefits it could deliver – via our 5PRING 5G innovation centres in Birmingham, Coventry and Wolverhampton.

After initially struggling with participant registrations, 5PRING pivoted Innovation Programmes to be demand-side challenge-owner lead, each one themed around a specific

[1] London Economics and Glass.ai

market (Green Agenda, Construction, Smart Cities, Manufacturing, Transport and Events). The impact on applications was significant, with the long-term programmes being oversubscribed.

Initial 5PRING participant survey data [2] shows that the intervention has:

- Increased awareness of 5G technology and its benefits by engaging with circa 500 businesses, 96% of which reported that they had gained greater knowledge and understanding of the technology and the benefits for their own organisation. It is these organisations that will go forward and innovate with new technologies to help deliver a thriving ecosystem in the West Midlands and beyond.
- Assisted businesses to validate the application of 5G & IoT technology in 80 Use Cases aimed at addressing real-world challenges.
- Assisted Supply side businesses to progress 75 products & services towards commercial availability over the coming months.
- Increased likelihood of organisations adopting 5G technology (driving both demand and supply), with 84% of demand-side organisations reporting a likely increase in commitment to adopt new products or services reliant on 5G, and 94% of supply-side businesses reporting a likely increase in commitment to commercialise new 5G based products or services, both as a consequence of participating in one of the long term Innovation Programmes.

Access to Private 5G network facilities

5PRING has, in addition to technical expertise, provided organisations with access to a state-of-the-art Private 5G Testbed. The Standalone (SA) network delivered a maximum throughput of circa 900 Mbps in the DL direction, and circa 100 Mbps in the uplink. Whilst DL performance reached expectation, UL performance was slightly lower than expected.

Reasons for reduced UL performance included:

- Devices used in performance testing, incorporated antennas that supported 4R (4x receive) in the DL but only 2T (2x transmit) in the UL. The associated chipset in the devices did not support more than 64 QAM. Both limitations restricted the ability to allocate more data throughput capacity in the UL direction (from device to network).
- The 5G frame structure design of air interface link (between device and network). Traditionally cellular network frame structure has been designed to accommodate higher data rates on DL, however with the dramatic growth in IoT applications, Infrastructure Vendors and Network Operators need to ensure the right balance of UL vs DL resource allocation over the air interface to support both downlink and uplink resource intensive applications.

[2] Survey data received by 31/3/22 (project closure date). Additional feedback anticipated through future communication with participants.

Ability to unlock the power of complementary Technologies

The Innovation Programmes have also demonstrated how 5G can unlock opportunities and benefits associated with other key technologies, including (re § 5.3.1 Key Insights):

- Extended Reality (AR/VR/MR) – Low latency of 5G making it possible to offload elements of XR processing and functionality to the network edge.
- Robotics - Reliability and low-latency of 5G when combined with MEC (Multi-access Edge Compute) providing necessary connectivity and processing for robots / drones to interact with their environment in real-time.
- Computer Vision - Low-latency and high bandwidth of 5G ideal for computer vision applications requiring a huge amount of image data to be transmitted to the cloud for processing and reporting in real-time.
- Internet of Things – Capacity to support large number of connected devices in a given area, including low-power wide-area network (LP-WAN) technologies (e.g. NB-IoT and LTE-M) ideal for IoT type applications.

Accelerated roll-out of Commercial 5G network services in the West-Midlands

Telefonica UK/VM02 has also, as part of this project, accelerated their roll-out of Commercial 5G services across the West Midlands (Birmingham, Wolverhampton and Coventry & Warwickshire), thus contributing to the West Midlands being recognised as the best 5G connected region in the country (Umlaut, 2021).

Impact of COVID 19

5PRING was launched one day after COVID 19 lockdown measures legally came into force due to the global pandemic. It was not immune to the impacts of COVID and facilities remained largely out of bounds due to social distancing. Programmes needed to be delivered in a predominately virtual manner throughout the lifetime of the project and new and innovative ways of providing remote access to test bed facilities needed to be found.

Another consequence of COVID was the lower than expended ratio of participants from West Midlands vs elsewhere (34% vs target of 50% businesses on the 3-month Innovation Programmes had a presence in the West Midlands). Reasons for this included:

- Local businesses like many across the country being focused on more immediate impacts of the crisis (resulting in fewer SMEs from across the region having the time / resources to participate on the programme).
- The need to pivot to online delivery (opening the reach of the programme and interest from many more businesses from out of region).

Despite lower attendance from local organisations, exposing the 5PRING Programme to businesses from out of region helped position the West Midlands at the forefront of 5G innovation in the UK.

5PRING Sustainability

At the outset of the 5prinG programme, there was a collective stated intention by the Consortia to reach commercial sustainability by March 2022 (i.e., when DCMS funding ended), this objective was underpinned by the Consortia's 5yr business plan.

However, despite the concerted efforts of all stakeholders, commercial sustainability has not been achieved for a number of reasons including, but not limited to, impact of the pandemic.

The impact on the economy, businesses and society in general was profound and 5PRING was no different. Businesses in target markets were 'running lean', they were distracted, in many cases dealing with day-to-day survival in a very challenging climate. Priorities changed; finances put under strain with investment budgets directed elsewhere, and organisations in a number of key market verticals where 5G will play a significant role (such as Healthcare,) had little time and resources to engage with 5PRING (ref § 7.5 Sustainability for more details).

No additional funding has been secured to sustain the 5PRING facilities beyond the original project end date.

5G Landscape

Despite the 5GAA project satisfying its strategic objectives, the drivers that underpinned the original need for an Application Accelerator have only intensified over the last two years as the roll-out of 5G continues. More and more organisations are looking to 5G connectivity to:

- Facilitate digital transformation of their businesses, addressing challenges and boosting competitiveness in the global marketplace,
- Discover new business models, products and services, to open revenue streams that are underpinned by emerging technologies (such as XR (VR/AR), AI/ML, Big Data and IoT)

5PRING was very successful at supporting Start-ups/SMEs to establish proof points (use cases and associated applications), however it should be noted that additional support (beyond relatively short 3-month interventions) is needed for those businesses wish look to scale up their propositions.

3 INTRODUCTION

3.1 Key Objectives

According to the WM5G Strategic Business Plan (WM5G Ltd, 2019) [3] the strategic objectives for the 5GAA Project were as follows:

Strategic Objectives	WM5G High Level Deliverables (by Financial Year)		
	2019-20	2020-21	2021-22
3a) Developing and testing new applications and services that use 5G capabilities; and commercial business models.	Complete participant sourcing and set-up of Application Accelerator environment and services, subject to Strategic Board approval. Applications Accelerator Project will deliver at least 4 use case demonstrations, ideally related to the first test bed projects.	At least 40 SMEs and 10 large enterprises have benefited from the 5G Application Accelerator programme. Any additional success measures for AA will be identified in year one.	At least 90 SMEs and 20 large enterprises have benefited from 5G Application Accelerator Programme. Success measures to be determined, for example, x% of the participating SMEs have secured additional private investment, or products have advanced up the RL scale.
3b) Testing early demand for 5G and related technologies.			

These strategic objectives have been mapped to the following key benefits (and associated measures)

1. Increased awareness of 5G technology and how it can potentially benefit organisations and citizens of the West Midlands and wider region.
2. Progression in development of Use-Cases and technology readiness levels (TRLs) for 5G based products and services.
3. Commitment (or intent) to commercialise new 5G based products and services (supply side).
4. Commitment (or intent) to adopt new 5G based products or services (demand side).
5. Commitment (or intent) to create new jobs requiring 5G skills.
6. Increased Revenue, Profitability, Investment attractiveness and value (CAP, shareholder value)
7. R&D expansion and Job creation

[3] Section 3.1 Table / WM5G Overarching Grant Agreement - Schedule 2 (Overarching Project Description)

4 PROJECT OVERVIEW

4.1 Background

In September 2018, West Midlands Combined Authority (WMCA) won the Department for Digital, Culture, Media & Sports (DCMS) competition to accelerate the roll out of 5G and be the lead partner of the DCMS 5G Testbeds and Trials Programme Urban Connected Communities (UCC) Project.

West Midlands 5G (WM5G) Ltd was created by WMCA (February 2019) to demonstrate the value of fifth generation (5G) mobile technology across a number of market verticals in an urban environment.

WM5G utilised 5G to make a real and positive difference to the people and businesses of the West Midlands by increasing productivity, accelerating digital adoption and improving public services. It aimed to deliver two key outcomes of the UCC Project, namely to:

- Accelerate 5G & Fiber Networks
- Test, prove and scale new 5G products and services

With these two outcomes in mind, the 5G Application Accelerator (5GAA) Project was established (along with several other 5G Testbed Projects) to create the UK's first 5G open innovation accelerator across three locations in the West Midlands (Birmingham, Wolverhampton and Coventry & Warwickshire).

Following a competitive tender exercise to select a consortium to deliver the facilities and programmes, the contract was awarded in March 2020 to a consortium of globally recognised Industry leaders, led by Telefonica UK Ltd (O2 - now Virgin Media O2):

- **Telefonica UK Ltd (O2)** - Telecommunications provider
- **Wayra** – Open Innovation Accelerator provider
- **Deloitte** - Professional Service provider
- **Digital Catapult** - Advanced Digital Technologies provider

Figure 1: Consortium Partners

'5PRING' was chosen as the brand name for 5GAA.

Figure 2: Brand Name for the 5G Application Accelerator

The facilities and programmes enabled businesses, in particular Start-ups and Small and Medium Enterprises (SME's) to engage with and improve their understanding of 5G technology and develop links and synergies between enterprises, research and development centres and the higher education sector. This in turn promotes development of the businesses increasing productivity through the through the impact of 5G on the economy.

Businesses would receive direct support in the form of webinars, panel discussions and introductory sessions, to improve knowledge and understanding of 5G and its benefits, with a proportion progressing onto long term Innovation Programmes aimed at facilitating the introduction of new to firm products and services.

The aim of the Innovation Programmes was to enable the faster identification, development and scaling of a wide range of innovative new 5G applications by supporting technological and applied research, including initiatives stimulating and facilitating productive innovation partnerships, supporting the commercialisation of new products and business processes and providing engagement opportunities for a range of organisations.

The Application Accelerator also comprised an environment that mirrored the wider Urban Connected Communities programme allowing easy access for organisations that want to get involved in large scale trials but are not quite at that point yet.

5PRING was officially launched on 27th Mar 2020 (WM5G Ltd, 2020).

4.2 5PRING

5PRING is the UK's first 5G open innovation accelerator based in the West Midlands. Its purpose is to brings together supply and demand side businesses to take 5G ideas to solve real-life challenges and work together to turn those ideas into commercially viable propositions.

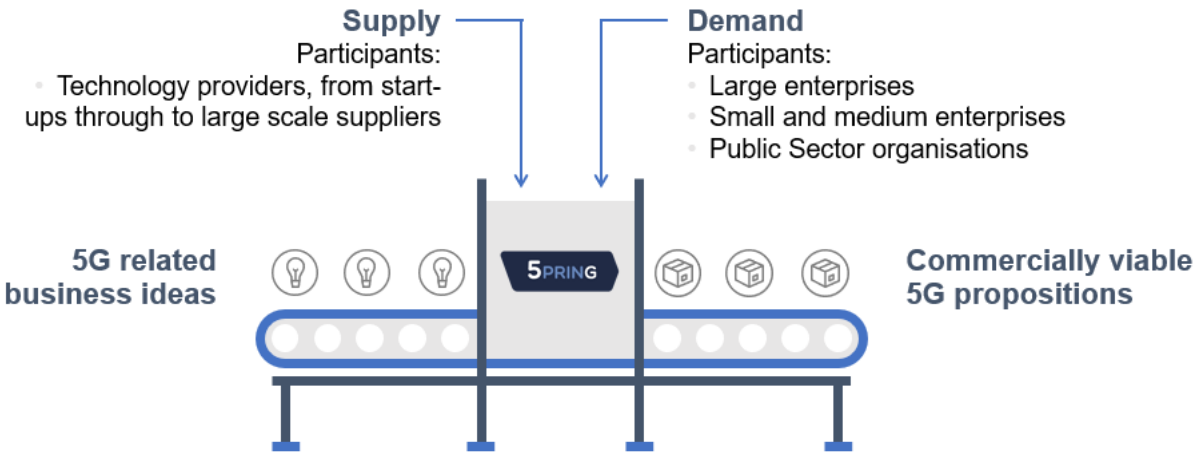

Figure 3: 5PRING Application Accelerator Model

5PRING is for many different organisation types, including:

- Start-ups
- SMEs
- Scale-ups
- Established tech vendors
- Large Enterprises
- Public Sector Organisations

5PRING supports demand side organisations by solving their business and technical challenges with 5G solutions through adopting an open-innovation business model that allows them to work with the best supply side start-ups and scale-ups.

4.3 5PRING Programme Offering

5PRING programmes are delivered by a mix of our 5G experts, business & technology coaches, external speakers and industry experts to cover a wide range of topics. Programmes are delivered via a mix of engagements; including keynote presentations, interactive workshops and 1:1 coaching to deliver a tailored experience. A range of business and tech-related topics; such as 5G technical deep-dives, lean start-up, business modelling and growth hacking strategies.

5PRING originally offered three programme types, catering to participants' differing 5G maturity and intended outcomes

1. **Educate:** One to two introductory session to help demand and the supply side participants understand 5G, its benefits and the opportunities it presents
2. **Incubate:** Two one-week intensive programmes, focused on building business cases and understanding requirements of specific 5G use cases
3. **Accelerate:** Ten-week programme to experiment with a specific use case, developing prototypes or proof of concepts (POCs) and a scaling plan

In response to initially low participation levels, due in part because of the impact COVID had on our target businesses, the Incubate and Accelerate components of the 5PRING offering were streamlined into a series of six theme-based Innovation Programmes (the short Educate events remained largely unchanged).

The redesigned Innovation Programmes format, each 3 months in duration, provided later stage (supply-side) start-ups and scale-ups the opportunity to develop innovative and ambitious 5G solutions in a collaborative manner, to address real-world challenges faced by top-tier (demand-side) organisations. 5PRING would actively seek and build partnerships with large Enterprises, LAs, LEPs and other organisations to design the challenges. These

organisations were referred to as Challenge Owners and were integral to the success of the redesigned innovation Programmes, leading to programmes being oversubscribed by businesses wishing to participate.

5PRING offers a tailored acceleration curriculum to start-ups and give them access to the state of art 5G testbeds and technical expertise. Technical and business support is provided to the start-ups through expert coaches, mentors and external speakers to support the start-ups in being able to accelerate their business growth and build prototypes that utilise 5G. In addition, start-ups have been given introductions to potential investors and customers where applicable.

Figure 4 illustrates a typical example of an Innovation Programme Structure provided by 5PRING on e/a Innovation Programme

Figure 4: Innovation Programme Structure – Source: Wayra

Sessions would be either individual or group based

Individual

- FOLLOW UP SESSION - Monthly catch up with the Wayra team
- INVESTOR IN RESIDENCE - 1-2-1 with Investors
- EXPERT 1-2-1 with Industry leaders and field experts
- BUSINESS DEVELOPMENT SUPPORT - Identify business opportunities with challenge owners and consortium partner networks

Group

- INVESTOR DAYS – Investor sessions
- MASTERCLASS & WORKSHOPS - Business & Technical workshops to improve skills and knowledge on specific topics
- SUCCESSFUL STORIES - Successful entrepreneur case studies

- PEER REVIEW (Founder roundtables) - Monthly sessions sharing within cohort

Figure 5 outlines some of the resources and support provided to Innovation Programme participants

Figure 5: Innovation Programme Resources & Support - Source: Wayra

4.4 Facilities

As part of the project, the 5PRING consortium have created three 5PRING Hubs across the West Midlands to host Innovation Programmes and Events:

Birmingham

Innovation Birmingham Campus – iCentrium, Holt St, Birmingham, B7 4BB

Figure 6: Birmingham 5PRING Hub

Coventry & Warwickshire

University of Warwick Science Park - Riley Court, Millburn Hill Road, Coventry, CV4 7HP

Figure 7: Coventry & Warwickshire 5PRING Hub

Wolverhampton

University of Wolverhampton Science Park – Glaisher Drive, Wolverhampton, WV10 9RU

Figure 8: Wolverhampton 5PRING Hub

4.5 Technologies

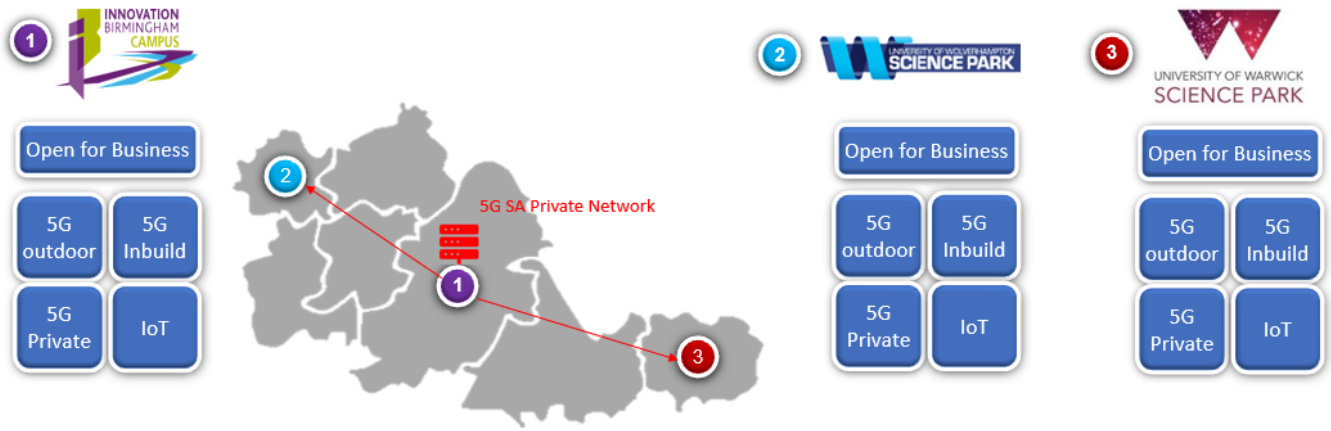

Figure 9: 5PRING Technologies

Each of the 5PRING Hubs provides participant access to cutting edge 5G and IoT Network technology.

Radio Access Elements (including ceiling mounted antennas) are installed at all three locations, with Wolverhampton and Coventry connected via 1Gbps leased line to the Core Network situated at the Birmingham Hub.

The Private 5G Test Bed is operated and maintained by Digital Catapult:

- 4G and 5G-NR (3GPP Rel. 15) Radio Access Networks operating in licensed spectrum, using a non-operational innovation and trials license granted by Ofcom
- 5G Standalone configuration (having transitioned from Non-Standalone configuration)
- Cellular IoT support (NB-IoT and LTE-M)
- Commercial-grade packet core network software with local breakout capability
- Ability to provide network slicing (through local breakout and service chaining)
- Edge computing and storage support (computational nodes available for in-network processing)
- 1Gbps internet connection (firewalled)
- Mobile user equipment (smartphones, laptops with mobile broadband dongles and tablets with cellular access, cellular IoT module) with pre- configured SIM cards
- Technical support for testbed user project integration
- Support from a 5G Technologist and Testbed Manager or 5G Innovation Program Lead with mentors and business modelling experts

4.6 Innovation Programmes

In addition to the Educate Events, 5PRING successfully delivered 6 x 3-month theme-based Innovation Programmes, the main vehicle for delivering interventions to project beneficiaries. Key to the success of the Innovation Programmes was the engagement of high-profile demand-side organisations who shaped the challenges based on their own experiences. The involvement of the Challenge Owners attracted supply-side businesses to participate, resulting in each programme being oversubscribed.

#	End Date	Theme	Location	Cohort / Challenge Owners
1	31/3/21	Green Agenda	Hybrid (Birmingham)	Cohort: 10 Supply Challenge Owners: 6 Demand ● Mott Macdonald ● O2 Sustainability Team ● Suez ● Black Country Consortium ● University of Wolverhampton ● WMCA
2	30/9/21	Construction	Hybrid (Coventry)	Cohort: 13 Supply Challenge Owners: 5 Demand ● Ferrovial ● Eurovia UK ● Galliford Try ● Clarke Telcom ● Clarke EV
3	9/12/21	Smart Cities	Hybrid (Wolverhampton)	Cohort: 17 Supply Challenge Owners: 11 Demand ● Birmingham City Council ● City of Wolverhampton Council ● Sandwell Council

				• Black Country Consortium • Coventry City Council • Coventry & Warwickshire LEP • Dudley Council • GBS LEP • Wolverhampton Homes • Swansea Bay City Deal • Walsall Council
4	6/1/22	Manufacturing	Hybrid (Birmingham)	Cohort: 11 Supply Challenge Owners: 8 Demand • BAM Nuttall • BRE • AttoCore • AE Aerospace • BAE Systems • Make UK • Denso • Celsa Group
5	10/3/22	Transport	Hybrid (Coventry)	Cohort: 14 Supply Challenge Owners: 9 Demand • HS2 • Transport for West Midlands • Port of Tyne • National Express Group • BCRRE • TfL • GoMedia • You Smart Thing • Project Centre Ltd
6	31/3/22	Events	Hybrid (Wolverhampton)	Cohort: 18 Supply Challenge Owners: 10 Demand • AEG • NEC Group • Formula 1 • O2 Arena • Koko • Indigo • Nachural • CBSO

				• Creative Technology • Coventry Venues

Table 1: 5PRING Innovation Programmes

Refer to **Appendix B** for cohort lists

4.7 Commercial Network Rollout

In addition to the strategic aims of the project, VMO2 has deployed [77] 5G live cell-sites across the region to end of March 2022. The number of sites is lower than the [115] originally targeted (due in main part because of the Government's decision that CSPs must remove telecom equipment supplied by High-Risk Vendors (such as Huawei) from their networks (gov.uk, 2020) affecting speed of roll-out. It should be noted however that VM02 have since introduced 700MHz 5G radios to complement their 3.4GHz deployments giving rise to better 5G coverage with fewer cell sites.

The split between locations is as follows:

- Birmingham: [44] cell-sites
- Coventry & Warwickshire: [17] cell-sites
- Wolverhampton [16] cell-sites

In accordance with a supplemental agreement between WM5G Ltd and VM02 / Telefonica UK (31/3/22), Telefonica UK has committed to deploy an additional [14] 5G Cell-sites (i.e. [91] in total) across the West Midlands by 31/12/22.

The split between locations will be as follows:

- Birmingham: [49] cell-sites
- Coventry & Warwickshire: [18] cell-sites
- Wolverhampton [24] cell-sites

This intervention has contributed towards the West Midlands CA region being recognised as the best 5G connected region in the country (Umlaut, 2021)

5 PROJECT RESULTS

5.1 Project Outputs & Outcomes

5.1.1 Summary

5PRING has delivered a wide range of positive and lasting outcomes for both supply and demand side organisations. Ultimately, helping to drive the adoption of 5G within several industry verticals. Partnerships were established between:

- Supply side organisations and other supply side organisations. At least four joint offerings were created through 5PRING
- Supply side organisations and demand side organisations. Over 30 advanced discussions were established with some of these already materialising into trials and PoCs
- Supply side organisations and consortium members. All organisations were integrated into Wayra's alumni network, while Deloitte and DC selectively onboarded start-ups of particular relevance to their innovation practices.

From publicly available information, supply side organisations have received nearly £7m in investment and funding since or during the completion of their relevant programmes.

5PRING was used to guide forward thinking demand side organisations who were in the process of deploying 5G testbeds. For example, BAM Nuttall and Ferrovial both gained an understanding of:

- Relevant use cases
- Key players in their market
- Technical aspects necessary to deploy and operate a private 5G network.

5PRING accelerated the 5G readiness of supply side solutions with nearly 60% of organisations on 5prinG noting an increase in the TRL for their product or solution.

For many supply side organisations, 5PRING was just their first exposure to 5G related innovation, with several going on to participate in subsequent 5G accelerators and working alongside the likes of UK5G to continue driving the adoption of 5G within industry.

5.1.2 The Numbers

As of 31/3/22 (project closure date), 5PRING delivered the following outputs across all events/programmes:

- 715 organisation interventions [4] Involving 480 unique organisations (with at least 16 being less-than 12mths old)
- 94% all organisations reported an increased awareness of the benefits of 5G to their organisation.

Regarding the Six (3-month) Innovation Programmes:

- A total 84 supply-side organisations and 49 demand-side organisations participated
- 94% supply-side organisations reported a likely increase in commitment to commercialise new 5G based products or services organisations

[4] Interventions can range from min 6hrs (attendance on short duration educate events) to 3 months (attendance on long duration Innovation Programmes).

- 84% demand-side organisations reported a likely increase in commitment to adopt new 5G based products or services
- 80 new Use Cases validated
- 46 new products / services progressed towards commercial availability [5]

Follow-up Survey results indicate [6]:

- An average 8 month decrease in time to market reported per developed use case
- 67% of Supply-side organisations reporting an increase in 5G related R&D spend and 50% report an increase in revenue from 5G products or Services

Additional project output and outcome data shall be collated over the course of the next 12 months as WM5G reaches out to the 5PRING Alumni for annual update, notably:

- Job creation and safeguarded
- Investment
- Revenue

5.2 Participant Data

Based on participant survey response data [7]:

- Range of Industry Sectors represented demonstrating the widespread interest and applicability of 5G enabled products & solutions, including: Transport [17%], Construction [13%], Manufacturing [12%], Citizen Health & Wellbeing [7%], Logistics [4%].
- The majority of organisations that participated in the programme declared they were Start-ups [44%] or SMEs [40%], Large Enterprise [8%], Public Sector [6%].

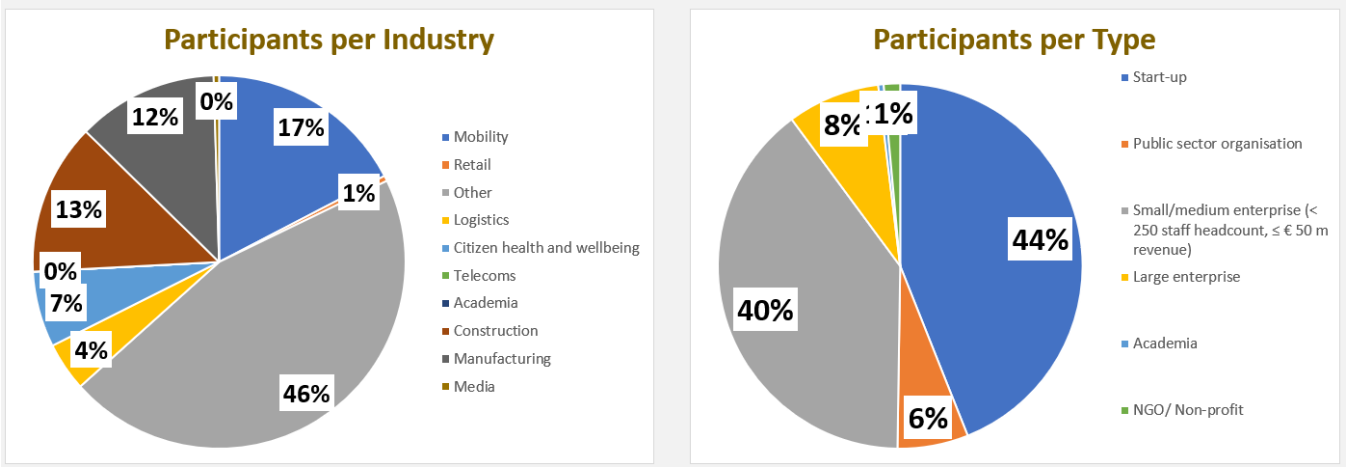

Figure 10: Participant Breakdown – Source: Deloitte

[5] Progressing by at least one TRL

[6] Results based on the first of six Innovation Programmes (i.e. Green Agenda), additional feedback anticipated through future communication with participants.

[7] Overall, the participant Survey Response Rate stands @ 54% (386/715) comprising of Educate @ 37% (178/478), Incubate @ 91% (96/105) & Accelerate programmes@ 85% (112/132).

- 34% of participants on the 3-month Innovation Programmes had a presence in the West Midlands.

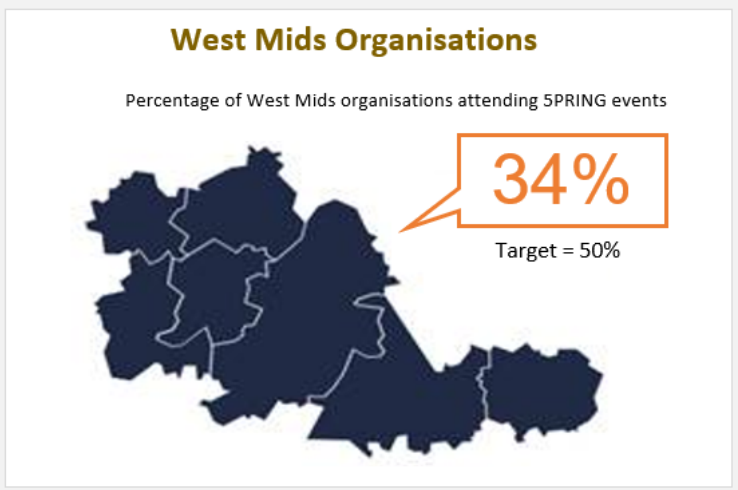

Figure 11: Percentage of participants based in West Midlands region – Source: Deloitte

- This is below overall target of 50% for the Programme, but is due in a large part to impact of COVID on the project:
    - Local businesses like many across the country were focused on more immediate impact of the crisis (fewer SMEs from across the region were able to participate on the programme)
    - Programme delivery needed to pivot to online (this opened-up programme reach and interest from out of region).
- Despite lower attendance from local organisations, exposing the 5PRING Programme to businesses from out of region, help position the West Midlands at the forefront of 5G innovation in the UK.

5.3 Technology

5.3.1 Key Insights

In-order to gain some insight as to which connection technologies are being taken up by market verticals, the type of connection technologies utilised by e/a participant were recorded on a per Innovation Programme basis (see Figure 12).

Categorisation:

- **Non-cellular based IoT technology** (IoT) – typically connected devices operating over non-licenced spectrum bands to transfer small amounts of data, consuming low power and potentially deployed in long distance from network antenna. The 5PRING Testbed supports LoRa & Sigfox technologies.
- **Cellular based IoT** (C-IoT) – like the above, but part of the 3GPP standard and operating in licenced spectrum bands. The 5PRING Testbed supports NB-IoT and LTE-M technologies

- **eMBB** - 5G Service Category for use cases requiring high throughput and supported by the 5PRING Testbed.
- **Low Latency** - 5G Service Category for use cases requiring low latency and supported by the 5PRING Testbed [8]
- **MEC** – Multi-access Edge Computing platform hosted at the edge of the network (typically close to the Radio or Data Center, as an on-premise instead of needing to send user data over the internet for processing). The 5PRING Testbed provided MEC facilities at the two satellite locations (Coventry and Wolverhampton). [9]

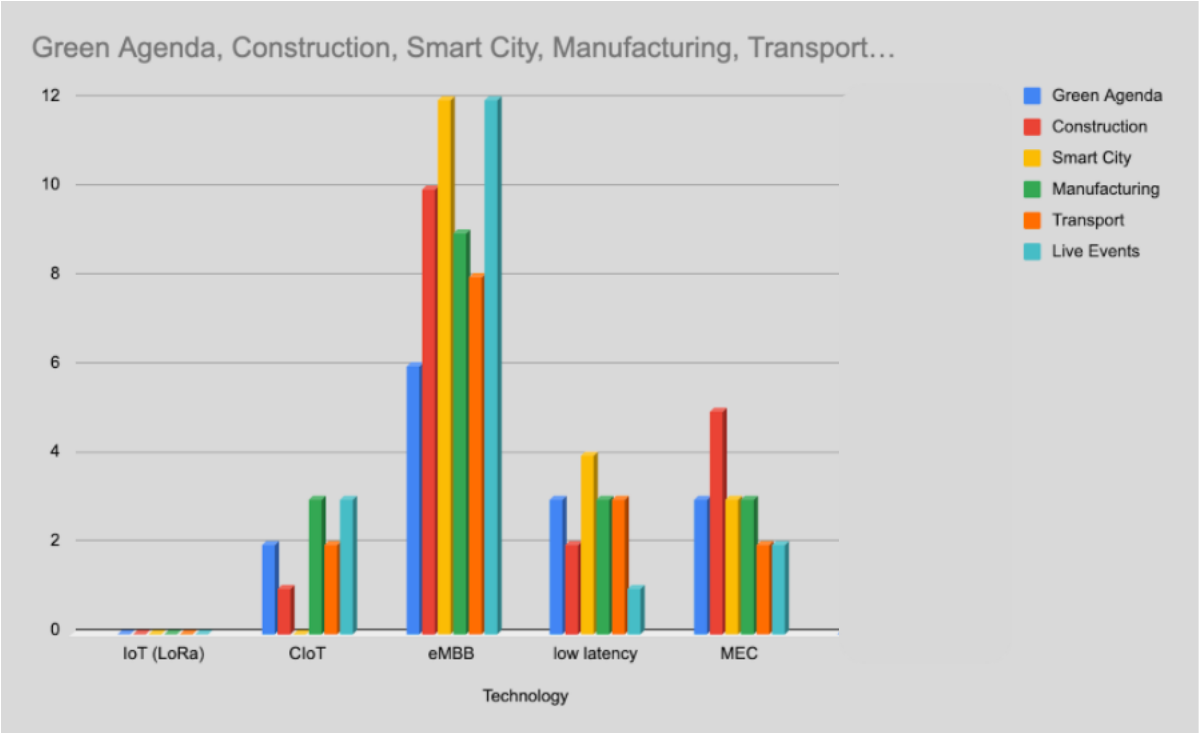

Figure 12: Adoption of Technologies per Innovation Programme – Source: Digital Catapult

Unsurprisingly, eMBB (offering high throughput) was the most widely requested service category amongst participants. What was surprising was the greater need for higher data rates in the Uplink direction (from end user device to application server in the network), as opposed to Downlink. The reason is a large proportion of participants came to 5PRING with UCs that involved the transfer of HD Video data from a camera over the 5G air interface to an Application Server hosting an AI/ML application. The need for eMBB was greatest in Smart Cities and Live Events Innovation Programmes (due to the heavy reliance on use-cases involving HQ Video content).

This may present a challenge to commercial networks. So far the 5G air interface frame structure that is specified to carry user data between the end user device and the network

[8] The 5PRING Testbed offers lower latency compared with 4G, however the full suite of uRLLC features as specified by 3GPP Rel.16/17 is not currently supported

[9] MEC was not required in Birmingham since the site hosted the full end to end network (devices, radios and Core)

radio tends to be configured by infrastructure vendors and operators with downlink (DL) traffic in mind, meaning that more radio resources are allocated to support user traffic in the direction from 5G Network to End-user device. This is fine for downlink intensive applications such as video streaming. However it can potentially reduce the amount of network resources allocated to support user traffic in the direction from End-user device to 5G network, meaning that in the case of IoT type applications such as HD Video monitoring where large amounts of data have to be continuously transmitted in the uplink (UL), performance maybe impacted.

The configuration of the of the 5G air interface frame structure needs careful consideration for the type of traffic being carried.

- Predominately DL resource intensive – the frame structure needs to be configured in such a way to allocate more radio resources in downlink direction
- Predominately UL resource intensive – the frame structure needs to be configured in such a way to allocate more radio resources in uplink direction

The 5PRING 5G Testbed provided the facility to change the ratio of UL vs DL resource allocation to some degree (from up to 80/20 [DL/UL] to 50/50) depending on the application under test, but it is likely to be more difficult for commercial networks.

The requirement of the MEC was driven mainly by the same participants that requested high UL throughput performance. This group wanted to also learn about the performance of their UC when exchanging application data over a 5G link between their end-user device and an application server at the edge of the network (i.e. the on premises Virtual Machine hosted by 5PRING), vs an application server hosted in the public cloud.

Even though the UL data rate was not as high as some participants hoped for (due to the radio frame configuration restriction limiting ration of DL/UL resource allocation), it was still much higher than that delivered by 4G. The main observable benefit in this case was connection reliability provided by 5G. Some of the participants that used 5G for UL video content transmission confirmed that their cameras were on for days without noticeable interruption or intermittence. [10]

Several participants came with Augmented Reality (AR) based UCs, offering immersive real time experiences through 5G handsets or VR headsets such as Microsoft HoloLens. Low latency is key for AR & VR based applications, and participants were very keen to see the improvement in the latency offering through 5G connection, compared with that of Wi-Fi and 4G. The average latency within the Testbeds was observed to be between 10-20 ms, better than 4G (typically 40 to 100ms). The reduction improved the AR/VR user experience slightly, but further latency reductions are needed and will come with 3GPP R16/17.

There was very little demand for non-cellular IoT technologies (LoRa or SigFox). This could be down to the perception that 5PRING was a 5G and Cellular IoT facility.

[10] Due to colocation of device and network, it was difficult to determine the relative performance between a Virtual Machine (VM) acting as MEC situated closer to the device vs. the Core (in both cases, the VM was located within the same rack).

However, there was keen interest for testing UCs over 5PRING's own Cellular IoT (C-IoT) based network, with participants asking to test using the NB-IoT and LTE-M networks (in equal portions). These companies brought with them, battery operated devices to be tested over C-IoT connections with the aim of proving their C-IoT solutions and validate their application performance.

5.3.2 Performance

It should be noted that many factors affect performance, including frequency of operation (spectrum band) and bandwidth, network configuration and features and RF environment.

5.3.2.1 Throughput

5PRING's Private 5G Testbed (recently upgraded to Standalone configuration) has been demonstrated to consistently deliver up to 900 Mbps throughput in the DL direction, and ~ 100 Mbps in the uplink. Similar performance levels have been achieved at each of the three 5PRING locations.

Whilst DL performance reached expectation, UL performance was slightly lower than expected. Reasons for the reduced UL performance include:

- The devices used in performance testing, incorporated antennas that support 4R (4x receive) in the DL but only 2T (2x transmit) in the UL. The associated chipset in the devices did not support more than 64 QAM. Both limitations restricted the ability to allocate more capacity in the UL direction (from device to network). It is an important take away for both device manufacturers and vendors, because this could impact capacity and performance of the network, effecting UL throughput intensive UCs involving AI/ML processes.
- As explained in the previous section, the 5G frame structure design and the ratio 80/20 or 70/30 (DL/UL) plays a role as well in this case. Frame structure for all cellular generations was designed with higher data rate on DL in mind, with the dramatic growth in IoT that we are starting to see, Infrastructure Vendors and Network Operators need to take this challenge into account to ensure the right balance of resource allocation in DL vs UL to support both downlink and uplink resource intensive applications.

5.3.2.2 Latency

Average latency on the 5PRING 5G Testbed was 10-20 ms, and this compares favourably with that of 4G which was 40-100 ms. Whilst the 5G latency was sufficient for participant needs, it was somewhat higher than the 1ms widely marketed, however as previously stated, the testbed does not currently support the full suite of uRLLC features defined by standards, since these are based on 3GPP Rel.16 & 17 and require to be supported by the Infrastructure vendors and associated ecosystem (e.g. devices).

5.3.3 Benefits

Despite increased bandwidth being the most widely theorised benefit of 5G (i.e. faster downloads), it was not the most commonly referenced benefit from the use cases tested on the 5PRING testbed.

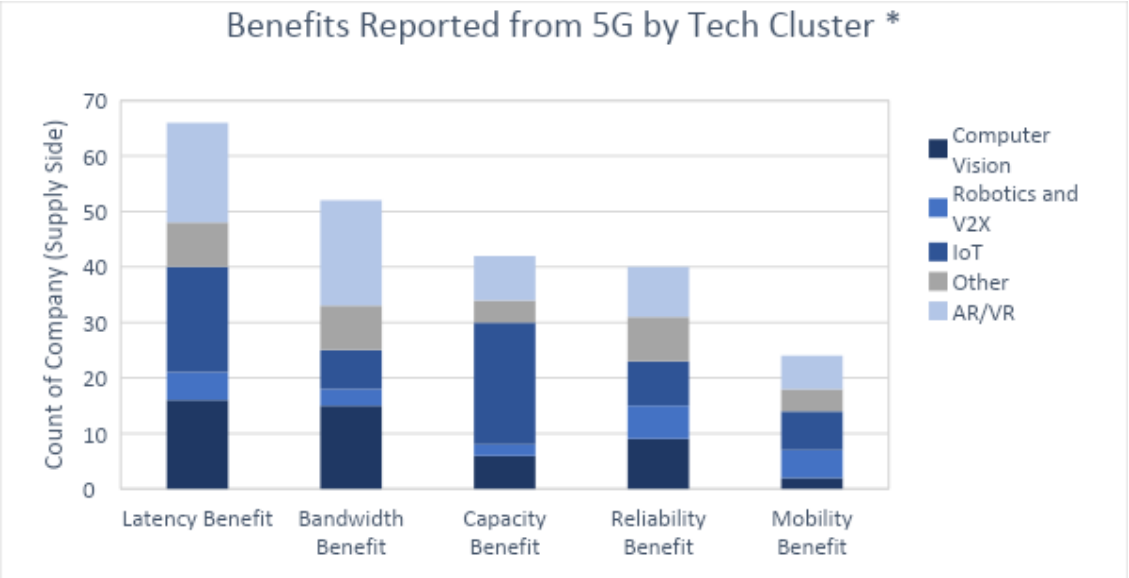

Figure 13: Benefits by Tech Cluster - Source: Digital Catapult

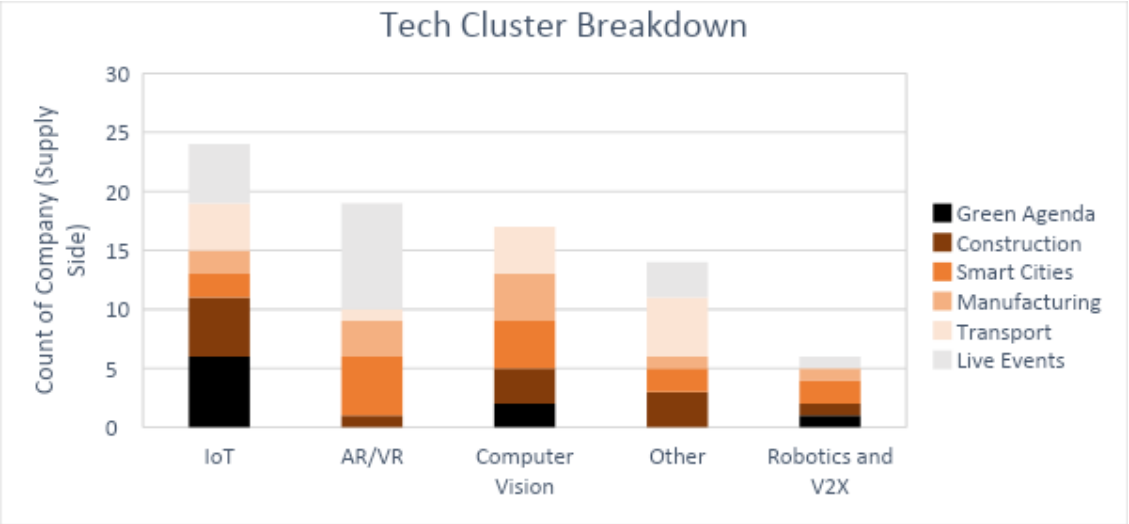

Figure 14: Tech Cluster Breakdown by Innovation Programme - Source: Digital Catapult

* Multiple 5G Benefits were reported per Use-Case

Nearly all the companies who tested reported latency improvement as the key benefit of 5G versus other wireless connectivity solutions.

- Although latency benefits of 5G are well publicised, it should be noted that 5PRING's Private 5G network is configured to 3GPP Release 15 standard, meaning that the testbed does not incorporate some key ultra-reliable low latency (uRLLC) features that are supported by 3GPP Release 16/17. Therefore, we would expect to see

further latency improvements on top of those already demonstrated by 5PRING with the advent of later standard releases and associated features.

The mobility benefit of 5G was not widely seen in the use cases tested on 5PRING, this was due to the testbed being indoor, where the range and coverage of 5G versus other wireless technologies was not a priority.

IoT based use cases were the most common technology cluster on the Programme and reflective of the market. Their relatively simple nature compared to robotics-based solutions requires less upfront investment from start-ups prior to commercialisation.

- 5PRING was built with this in mind, as the network supports LP-WAN radio technologies (LTE-M, NB-IoT, LoRaWAN, and Sigfox).

A reasonable distribution of technology clusters across the different industry themed programmes was observed. One notable except was Innovation Programme #6 (Live Events), where there was a particularly high number of AR/VR based use cases (~50%). This is reflective of the challenges that were set on the programme, and likely influenced due to current hype surrounding the Metaverse.

5.3.4 Security

5.3.4.1 Security Approach

5PRING's approach to security comprises the following [11]:

- Identification of assets & components and the assessment of possible threats related to those elements taking into account maturity, level of impact and consequences (ref 5PRING Testbed Security Implementation Rules and Policies (Digital Catapult, 2021))
- Physical security of sites, network infrastructure and personnel (ref 5PRING Testbed Security Implementation Rules and Policies (Digital Catapult, 2021))
- Protection of user/personal and test results data (reg 5prinG Testbed Usage Rules and Policies (Digital Catapult, 2021))
- Steps taken to mitigate the threats with the focus on protecting the signalling traffic and user data over cellular media (ref 5prinG Security Policy Implementation - Audit Process (Digital Catapult, 2021))
- Defining and describing a security implementation auditing process with the focus on logging and monitoring (ref 5prinG Security Policy Implementation - Audit Process (Digital Catapult, 2021))
- Supporting the cohort members to understand the 5G security context in a sandbox environment (reg 5prinG Testbed Usage Rules and Policies (Digital Catapult, 2021))

5.3.4.2 Key Takeaways

Ensuring that participants were familiar with dos and don'ts and their responsibilities in terms of the security threats prior to onboarding to testbed (providing the 5prinG Testbed Usage Rules and Policies document), minimised issues occurring. It is believed that the

[11] Further details can be found in Digital Catapults' Security White Paper (Digital Catapult, 2022)

provision of proper security documentation and plans helped participants understand the rationale behind the security plan and associated security controls to avoid any potential security threat. The fact that there were no reports of any security problems/threats from physical or remote access demonstrated the benefit of such documentation.

Even though the three sites were connected to each other via dedicated connections with good levels of security protection in place, additional firewalls were deployed at each site providing an additional layer of protection (as opposed to being reliant on a single firewall located at the central site in Birmingham).

Choosing commercial grade products and solution for the testbed, was the right decision in terms of the security, as well as performance and reliability.

5G Testbed in a sandbox environment worked very well from the security perspective resulting in no reported security issues.

6 PROJECT IMPACT

6.1 Outputs & Outcomes

The following short-term outcomes have been achieved by the project to 31/3/22

For more detailed information please refer to Q4 FY20_21 Benefit Realisation Report (WM5G Ltd, 2022)

#	Outcome	Impact *(based on Survey response data)*	BR Metric
[1]	5G Awareness	96% of Participants (Supply/Demand) across all programmes who responded, reported an increase in overall awareness of 5G in their organisations due to their participation on the program	M31
		94% of Participants (Supply/Demand) across all programmes who responded, reported an increased awareness of the benefits of 5G.	M32
[2]	Technology Readiness	58% of Accelerate Participants (Supply) reported a TRL improvement of at least one level	M35
[3]	Commitment to Commercialise (supply orgs.) Validated Use Cases	94% of Accelerate Participants (Supply) reported a likely increase in commitment to commercialise new 5G based products or services.	M38
		73% of Accelerate Participants (Supply) report a likely increase of go-to-market readiness for new 5G based products or services.	M40
		83% of Accelerate Participants (Supply) report a decrease in time to market for new 5G based products or services.	M42*
		8 mth - average decrease in time to market per developed use case	M44*
		80 – Number of validated used cases (POC, prototype or demonstrator) (Supply/Demand)	M45/M46
[4]	Commitment to Adopt (Demand orgs.)	84% of Accelerate Participants (Demand) report a likely increase in commitment to adopt new 5G based products or services	M47
[5]	Commitment (or intent) to create new jobs	18 - Total number of newly created or safeguarded permanent FTE's in Accelerate Participant Organisations attributable to AA Intervention (Supply/Demand)	M48*
		86% of Accelerate Participants (Supply/Demand) that report newly created or safeguarded permanent FTE attributable to AA Intervention	M50*

[6]	Increased Revenue, Profitability, Investment attractiveness and value (CAP, shareholder value)	50% of Accelerate Participants (Supply) report an increase in revenue from 5G products or Services, directly attributable to AA intervention	M52*
		£102,500 - Total revenues (sales/exports) from 5G products or Services, created through AA intervention (Supply)	M53*
[7]	R&D expansion and Job creation	67% number of Accelerate Participants (Supply) report an Increase in 5G-related R&D spend, attributable to AA intervention	M64*
		£135,000 - Total Increase in 5G-related R&D spend, per Accelerate Participant organisations, directly attributable to AA intervention (Supply)	M65*

* Note the values quoted are based on a relatively small number of follow-up survey responses [6] received 12 Months after completion of first of the six Innovation Programmes (i.e.: 'Green Agenda'). Participant feedback from the remaining five Innovation Programmes will be requested going forward in-order to build a better understanding longer term impacts of such interventions.

7 KEY LESSONS LEARNED

7.1 Key Drivers

Feedback from 5PRING suggests that organisations come to an accelerator predominately for the following reasons:

Supply Side

- Networking/collaborating
- Route to market
- Access to (5G/IoT) testbed facilities
- Investment opportunities

Demand Side

- Seeking solutions to their real-world challenges
- Access to innovation/innovators

7.2 Top 5 Key Lessons

1. Ensure that the value proposition is sufficiently compelling to attract and retain participants, especially Start-ups & SMEs, that are focused on the day-to-day running of their business and have little resource to devote on other activities. Do this in part by ensuring:
    - Target audience understands clearly the proposition and the value to their business should they participate (i.e. key benefits)
    - Content is highly relevant and delivered in an interactive manner
    - Programmes is designed around key market sector themes and real-world challenges, shaped by Demand-side Challenge Owners
    - Participants have opportunity to engage with lead organisations operating in their target markets, to validate their product/solution against real-world challenges set by those organisations.
    - Sessions be conducted in groups where practicable, so that participants can benefit from each other's learnings. Working as a cohort also fosters collaboration.
    - Sufficient time for participants to complete the programme (other accelerators tend to run for 3-6mths)
2. To maximise the opportunities for participants, bring onto the Programme only those Demand-side Challenge Owners who can commit time & resource providing necessary support at time of programme and ideally opportunities to participants going forward.
3. Invest in tailored scouting with prior research on start-ups/SMEs to increase the number and quality of applications to the Programme

4. Make provision for remote access to the technology testbed, in-order to maximise utilisation of the assets and ensure participants continue to receive benefit in the event facilities become non-accessible.
5. Build in additional time contingency for when deploying new/non-commercially available cutting-edge technologies, collaborate with network integrator & infrastructure vendor (secure on-site support).

Please refer to **Appendix A** for further details.

7.3 COVID 19 Impacts

5PRING was launched on 27th March 2020, one day after COVID 19 lockdown measures legally came into force due to the pandemic. The pandemic and associated impacts demonstrated very graphically the need for capacity, reliability and availability of the nation's digital communication networks to respond to such events. It also underlined the need for rapid digital transformation of private enterprise and public services (including healthcare & transportation) alike.

The 5GAA Project was not immune to the impacts of COVID and facilities remained largely out of bounds due to social distancing:

- Businesses needed to prioritize day to day survival over longer term activities, such as new product development:
    - Reduced the number of organisations from within region able to participate in the programme
- Programmes could not be delivered f2f, having to be run instead online:
    - Increased number organisations from out of region asking to participate in the programme
    - Negative impact on the ratio of in vs out of region organisations participating on the programme, however with more organisations wishing to participate in the programme this was considered a positive for the region as it helped put the West Midlands on the map as the place to be for 5G innovation.
- Despite increased interest from out of region organisations, the original profile for number of engagements to be delivered by the programme was deemed to be no-longer achievable because of COVID. Agreement was reached to re-profile the engagement forecast distribution whilst maintaining the overall project targets.
- For the most part, participants could not physically access testbed facilities due to social distancing restrictions
    - Negative impact on user experience, limiting some key benefits of programme
    - Digital Catapult successfully introduced capability for remote access to testbed to mitigate
- Supply chain issues when ordering technology equipment leading to milestone delays
    - Impact of global chip shortages on availability of Standalone Private 5G Network Infrastructure equipment and compatible devices as part of the Private Network Upgrade [MS15]
    - Impact of infrastructure vendor staff shortages due to COVID

7.4 Other Impacts

7.4.1 Virgin Media and O2 Joint Venture

Liberty Global and Telefonica announced a 50:50 joint venture in 2020, bringing together Virgin Media and O2 (O2, 2021). Consequently, O2 has undergone an intense period of internal change whilst joint venture establishes itself. Despite every effort to maintain continuity, internal reorganisations have resulted in several staff changes on the project requiring additional time for new members to onboard.

7.4.2 Commercial Network Delays

Delays to the roll-out of O2's Commercial Network due to the impact of the Government's decision that CSPs must remove telecom equipment supplied by High-Risk Vendors (such as Huawei) from their networks (gov.uk, 2020). This edict impacted O2's original plan to utilise sites owned by another MNO in the west of the region (as part of an existing site swap arrangement), in order to provide service in those areas.

7.5 Sustainability

At the outset of the 5prinG programme, there was a collective stated intention by the Consortia to reach commercial sustainability by March 2022 (i.e., when WM5G's participation ended), this objective was underpinned by the Consortia's 5yr business plan.

The intent was for 5prinG to become self-sustaining by generating revenue through tailored sponsorship opportunities to organisations ranging from tech companies with a mature 5G offering or seeking to accelerate the adoption of 5G and drive sales for their 5G products and services, to large corporate organisations looking to deploy proof of concept projects or solve challenges to understand what 5G can do for their benefit as an end user. The Consortia also intended to offer charged for innovation services such as running bespoke hackathons, offering investor breakfast sponsorships and individual speaker series event sponsorships.

However, despite the concerted efforts of all stakeholders, commercial sustainability has not been achieved for a number of reasons.

5prinG was launched on 27th March 2020, one day after COVID 19 lockdown measures legally came into force due to the pandemic, and whilst it is not the sole reason for the lack of sustainability, it should be acknowledged that COVID was a significant factor. The impact on the economy, businesses and society in general was profound and 5prinG was no different. Businesses in target markets were 'running lean', they were distracted, in many cases dealing with day-to-day survival in a very challenging climate. Priorities changed; finances put under strain with investment budgets directed elsewhere, and organisations in a number of key market verticals where 5G will play a significant role (such as Healthcare,) had little time and resources to engage with 5prinG.

Onboarding demand side clients were key not just to shaping real-world challenges and attracting the start-ups and scale-ups to the innovation programmes, but also to provide the

opportunity to secure revenue generating sponsorships. However, building the necessary relationship takes a significant amount of time, and the impact of truncated project timescales, again due to COVID, reduced the time available to convert those demand slide clients and discuss commercial sponsorship opportunities.

Beyond COVID other reasons include:

- Maturity of 5G – still a very nascent market
- Huawei ban – impact of Government decision to ban Huawei products in commercial 5G network (delays widespread availability of Commercial 5G services)
- Feature availability – some key features (such as uRLLC) to enable advanced 5G use cases have yet to be supported by the ecosystem, limiting what can be demonstrated / tested to predominately high data rate (eMBB) and reduced latency related use cases, but not the full 5G potential as part of upcoming releases
- Project KPIs - the focus on achieving the required volume of interventions and the requirements for evidence collation diverted time and resources needed to cultivating demand side relationships. Whilst the consortium recognises the need for performance KPIs, in retrospect they were probably too SME/Supply side focused and the burden of evidence collation consumed a significant proportion of the resources that had been originally intended to drive demand-side interest.
- Market verticals – it may have been better to focus on fewer market segments (one or two as opposed to the six innovation programmes), allowing more time (longer programmes) to drill deeper into the challenges and solutions
- 5G accelerators – since launching 5prinG other 5G accelerators have come online creating competition in the market
- Private Indoor 5G – the concept itself is very new and still not explored fully by the vendors themselves. Vendors were less experienced troubleshooting new features and took them longer than usual to understand and resolve.

Finally, it will be the large corporates that will drive adoption; but it can take a long lead time to educate as to why they should be embracing 5G as part of their digital transformation. The view is that 5G is 'like 4G but faster'. A change of mindset is needed for organisations to understand that 5G has been designed and developed with IoT and Industry 4.0 in mind.

7.6 What Would We Do Differently?

- **Business Development** – Apply sufficient emphasis, focus and resources to BD early in the programme to ensure the right audience is reached and required number are signed-up (It was necessary for WM5G to supply additional BD support to bolster existing 5PRING resources, in order to secure participation of key demand side challenge owners).
- **Innovation Programmes** – Schedule and resource Individual innovation programmes over a longer duration (accelerator programmes typically run for 3-6mths).

8 END OF PROGRAMME ACTIONS

8.1 Financial Requirements

All claims are based upon collating & submitting the associated information/evidence to DCMS on a quarterly basis following the agreed financial principles between the respective parties i.e. DCMS and WM5G, only when the evidence is approved, grant payment is made. In the final quarter of delivery, all evidence associated with each program / project is shared with DCMS and further information is available upon request as supporting evidence.

8.2 Benefits Realisation

Throughout the delivery phase of the project, participants attending all engagements, were requested to complete online participation surveys.

The overall response rate was 54% (386 surveys /715 interventions), varying by engagement type:

- Educate (1 to 2 days): [37%]
- Incubate (2 wks): [91%]
- Accelerate (10+ wks): [85%]

With the advent of online delivery, it was very challenging to secure survey responses from participants on the short two day Educate events, however the response rate was higher the longer engagements (due to greater level of interaction over a longer period).

The survey data was used to determine Project Outputs & Outcomes:

- Please refer to § 6.1 **Outputs & Outcomes** for an overview of key Project outputs/outcomes recorded to 31/3/22.

Please refer to § 7.2 **Top 5 Key Lessons** for an overview of the key lessons learned by the Project.

Output/outcome data and lessons learned have been extracted from the **Q4 FY20_21 Benefit Realisation Report** (WM5G Ltd, 2022)

8.3 State aid and spend compliance

Workstream: AA; Project Partner: Telefonica UK Limited; State Aid/Subsidy Exception: Article 26 GBER

Please refer to email ‘For DCMS Approval - State Aid Compliance / Asset Register’ (11/4/22) for further details (Document not for general publication)

REFERENCES

(2020, July 14). Retrieved from gov.uk: https://www.gov.uk/government/news/huawei-to-be-removed-from-uk-5g-networks-by-2027#:~:text=Following%20US%20sanctions%20against%20Huawei,by%20the%20end%20of%202027.

(2021, september 21). Retrieved from digitalbirmingham.co.uk: https://digitalbirmingham.co.uk/blog/2021/09/21/west-midlands-home-to-biggest-emerging-tech-cluster-outside-london/

Digital Catapult. (2021). *5prinG Security Policy Implementation - Audit Process.* *

Digital Catapult. (2021). *5PRING Testbed Security Implementation Rules and Policies*. *

Digital Catapult. (2021). *5prinG Testbed Usage Rules and Policies.* *

Digital Catapult. (2022). *Security White Paper.*

O2. (2021, May 20). Retrieved from O2.co.uk: https://news.o2.co.uk/press-release/liberty-global-and-telefonica-welcome-final-uk-regulatory-approval-for-virgin-media-o2-joint-venture/

Umlaut. (2021, June 29). Retrieved from wm5Gg.org.uk: https://www.wm5g.org.uk/wp-content/uploads/2021/09/20210629_umlaut_WM5G_5G_Coverage_assessment.pdf

WM5G Ltd. (2019). *Strategic Business Plan (V1.0).* *

WM5G Ltd. (2020, March 27). Retrieved from WM5G.org.uk: https://5pring.org/wp-content/uploads/2020/03/WM5G-Press-Release-and-Launch-27Mar20.pdf

WM5G Ltd. (2022). *WM5G Project_Benefit Realisation FY21-22 Q4 v1.0 (Final).* *

* Internal Document (not available for publication)

GLOSSARY

Enhanced Mobile Broadband (eMBB) is one of three primary 5G New Radio (NR) use cases defined by the 3GPP. eMBB is a natural evolution to existing 4G networks that will provide faster data rates and therefore a better user experience than current mobile broadband services data-driven use cases requiring high data rates across a wide coverage area.

Massive Machine Type Communications (mMTC) is one of three primary 5G New Radio (NR) use cases defined by the 3GPP. mMTC addresses the need to support a very large number of devices in a small area, which may only send data sporadically, such as Internet of Things (IoT) use cases.

Ultra-Reliable Low Latency Communications (uRLLC) is one of three primary 5G New Radio (NR) use cases defined by the 3GPP. URLLC addresses strict requirements on latency and reliability for mission critical communications, such as remote surgery, autonomous vehicles or the Tactile Internet.
Extended reality (XR) is a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables. E.g. It includes representative forms such as augmented reality (AR), mixed reality (MR) and virtual reality (VR) and the areas interpolated among them.

ACRONYMS

3GPP	Third-Generation Partnership Programme
4G	Fourth Generation 3GPP cellular technology
5G	Fifth Generation 3GPP cellular technology
5G-CN	5G Core Network
5G-NR	5G New Radio
5GAA	5G Application Accelerator project
AI	Artificial Intelligence
AR	Augmented Reality
C-IoT	Cellular IoT
DCMS	Department of Culture, Media & Sport
DL	Downlink
eMBB	enhanced Mobile Broadband (5G Service Category)
ERDF	European Regional Development Fund
GBF	Getting Building Fund
Gbps	Giga-bit per second (data rate)
GBS-LEP	Greater Birmingham and Solihull Local Enterprise Partnership
IoT	Internet of Things
LTE	Long Term Evolution (4G)
LTE-M	LTE Category M (for machines)
MEC	Multi-access Edge Computing
ML	Machine Learning
mMTC	massive Machine Type Communications (5G Service Category)
MR	Mixed Reality
NB-IoT	Narrowband IoT
NSA	Non-Standalone 5G Network
QAM	Quadrature Amplitude Modulation
SA	Standalone 5G Network
SIM	Subscriber Identity Module
SME	Small & Medium size Enterprise
UC	Use case
UL	Uplink
uRLLC	ultra Reliable Low Latency Communications (5G Service Category)
VR	Virtual Reality
WM5G	West Midlands 5G
WMCA	West Midlands Combined Authority
XR	Extended Reality

APPENDIX A – LESSONS LEARNED

Top 5 Key Lessons

1. Ensure that the value proposition is sufficiently compelling to attract and retain participants, especially Start-ups & SMEs, that are focused on the day-to-day running of their business and have little resource to devote on other activities. Do this in part by ensuring:
    - Target audience understands clearly the proposition and the value to their business should they participate (i.e. key benefits)
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3. Invest in tailored scouting with prior research on start-ups/SMEs to increase the number and quality of applications to the Programme
4. Make provision for remote access to the technology testbed, in-order to maximise utilisation of the assets and ensure participants continue to receive benefit in the event facilities become non-accessible.
5. Build in additional time contingency for when deploying new/non-commercially available cutting-edge technologies, collaborate with network integrator & infrastructure vendor (secure on-site support).

#	Title	Challenge	Impact	Resolution
1	Attracting & retaining Participants to the 5PRING Programme.	Insufficient number of participants attending/completing events in the early phase of project delivery, due in part, because organisations were more focused on business survival during the pandemic and likely considered participation in programmes such as 5PRING to be a lower priority.	The project would not deliver the required number interventions, thus putting at risk the intended outputs & outcomes (i.e. new 5G enabled products & services, jobs and economic growth)	5PRING redesigned the programme offering to make it easier to understand and more compelling for businesses to justify participation. **Simplify the offer** The programme offering was streamlined from three to two key elements: ● **Educate events** - Minimum number of hrs lowered from 12 to 6 in response to some participants (esp. start-ups/SMEs) telling us that they could only afford to be away from the business for 1 day. ● **Innovation Programmes –** 10 to 12wks duration. Note however some participants would have benefitted from the Innovation Programmes being longer (3-6mths). 5PRING needed to restrict to 3mths due to time and resource constraints. **Foster collaborative working in the Cohort** There have been several examples of joint initiatives between participants, working together to address challenges. **Theme each Innovation Programme around a market vertical**

				Each Innovation Programme (still incorporating the Incubate & Accelerate elements of the original offering) has been themed around a key market vertical where 5G is expected to play a key role (e.g. Green Agenda, Construction, Smart Cities, Manufacturing etc). By assigning each Innovation Programme with a theme an identity was created which prospective participants could connect with. It also enabled 5PRING to target audiences more effectively. **Bring Demand-Side Organisations into the process to shape real-world challenges** Critically, 5PRING has sought the participation of market leading demand side organisations in the process, to identify and specify real challenges for supply side cohort to address. **Schedule Innovation Programme themes based on first demand-Side Challenge Owner to onboard** Originally, 5PRING had many BD targets with no confirmed challenge owner or themes for programmes. The revised approach was that programmes and their themes would be allocated on a 'first come, first serve' basis and then to fill the remaining spots on the programme once the theme had been set. Generally, we found that it was hard to initially onboard a company as a demand

				side challenge owner but easier to onboard once challenges had been set and programme timelines agreed. These changes have resulted in the Innovation Programmes being oversubscribed, participants remaining on the programmes full term, and very positive short-term outcomes.
2	Selecting the right Challenge Owners for the 5PRING Programme	Whilst challenge owners from private organisations that participated in the programme, tended to have access to funding necessary to support commercial trials with the start-ups post programme, this was not the case with some public sector organisations. These organisations did not readily have the funding to progress with the commercialisation of solutions post programme, despite many promising discussions between demand and supply side.	Whilst never guaranteed, the hope from many participants was that having engaged with challenge owners on the programme and demonstrated the viability of their solution in addressing the challenge owner's challenge, that there could be future opportunities to take the proposition forward with that challenge owner.	While follow up trials and funding were not a necessity, future programmes should consider the possible funding opportunities and also procurement requirements with public sector organisations
3	Tailoring the right approach to marketing events	The levels of interest and number of registrations to the first programme was low and failed to meet 5PRING's initial targets. The initial approach was to promote the programme through online marketing, promotion in start-up slack channels and sharing the opportunity via mass email distribution. There was some direct targeting of companies within the consortium members' networks and those who were found	The project would not deliver the required number interventions, thus putting at risk the intended outputs & outcomes (i.e. new 5G enabled products & services, jobs and economic growth)	More tailored scouting has been performed with the scouting consortium members reaching out to their own contact lists where a relationship was already built. Advanced market scouting was carried out to identify companies that are good fits for the challenges and have solutions that could potentially leverage 5G. These companies were then directly targeted via email and online question submission forms where applicable. In addition, direct messages on

		through deskside research however, the focus leant towards the mass marketing approach.		LinkedIn have been used which also have a very high response rate. Overall, there has been a marked increase in the number and quality of applications to our programmes.
4	Maintaining access to testbed facilities	With the introduction of COVID 19 restrictions at the beginning of the first lock-down (Mar'21), participants on our Innovation Programmes were unable to access the Private Network Testbed facilities	Participants were not able to benefit from the private network testbed facility to validate use cases, products or solutions as part of the 5prinG programme.	5prinG (Digital Catapult) was able to pivot cohort access to the testbed from in person testing at the facility to remote testing. Participants were provisioned remote access to the testbed facility and the 5G service via VPN connection to a computing platform utilising a 5G device (CPE, Smartphone or other formfactor) connected to the Network. In some cases, participants shipped their own devices to connect to the testbed. Participants could conduct testing and monitor performance over the 5G link.
5	Sufficient time contingency when deploying new or pre-commercial technology.	Whilst Commercial 5G Networks have been deployed in the UK today, there are very few Private 5G Networks in operation. The Private 5G testbed platform used by 5PRING incorporates a state-of-the-art end-to-end network solution that is being positioned by Supplier for Enterprise market. Due to the extended list of requirements for network configurations and associated features / feature combinations, we needed for 5PRING test bed platform, it took longer than originally anticipated for the	Offering participants access to new technologies which are not yet commercially available is a key benefit of the 5PRING Accelerator Programme. Without it we ran the risk of not being able to deliver the overall benefits to participants which they joined the programme to achieve. Without due consideration for the impacted Innovation Programmes and cohort use-cases, we could find that the platform would be ether unavailable for use or not have the necessary capabilities required to test a given use-case.	Direct negotiations with the supplier allowed us access to a custom solution which was not yet commercially available. However, this made the 5PRING programme dependent on the supplier's timelines as there were no alternative hardware providers with whom these arrangements had been made. The impact of the delay was mitigated through careful planning of the remaining Innovation Programmes and more specifically when to onboard cohort

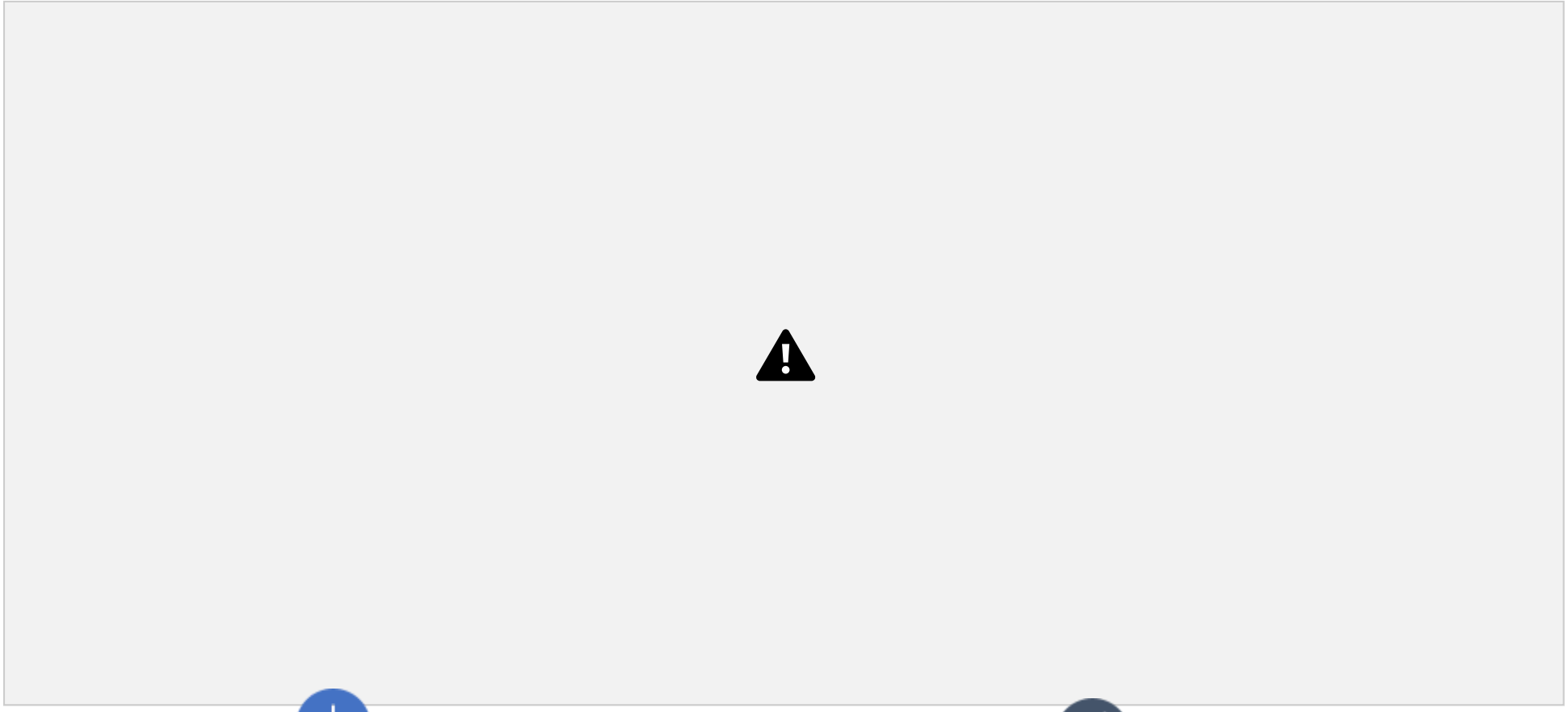
		hardware/software upgrade from 5G Non-Standalone (NSA) to Standalone (SA) network configuration. The delays were compounded by the impact of COVID o Semiconductor chip shortages impacting network equipment and device availability o Staff shortages at Infrastructure Vendor manufacturing & test facility	The overall delay upgrading from NSA to SA was 6mths	participants onto the test bed during those sessions. It should also be recognised that none of the participant testing during the delayed period required the additional capabilities (namely higher DL throughput speed) that the SA network promised. The existing NSA platform was sufficient to validate their Use Cases.

APPENDIX B – INNOVATION PROGRAMMES

For 5PRING's 3 month accelerate programmes, 84 supply side organisations and 49 demand side organisations were onboarded across 6 differently themed programmes. Each programme had its own unique set of challenges which were set by the demand side to guide which supply side solutions to onboard

Please refer to **WM5G – 5prinG Programme Outcomes v1.0** for more details (Note - this document is not for general publication)

Demand Side Organisations



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allread
EVA
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WORKFROMHUB

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