6G Spectrum Initiative

Open Meeting

Collaboration Model – Breakout

Chair: Bob Stewart

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5th October 2021

How did we get here? … Back in March 2021 …

From DCMS / SPF Workshop guidelines:

The Spectrum Policy Forum is making the space in one of its cluster groups ***to think really long term about the exploitation of radio spectrum*** *to support the next wave of digital services and infrastructure modernisation.*

One key starting point for the UK is a ***review of the research we have currently underway*** *in our Universities that could feed into an approach to 6G that seeks to solve critical policy problems ahead like improved spectrum efficiency, better coverage, and lower energy use.*

This guideline established the framework for this series of workshops alongside a first review of documents and ***data from relevant 'comms' RUK activity of the last few years****.*

SPF-DCMS 6G Spectrum Initiative – Five Agreed Goals

i. Widespread coverage, to prevent the manifestation of a "digital divide" and to contribute to improved health and social care outcomes and future transport ambitions.
ii. Innovation in spectrum management (eg through the use of automation and AI), spectrum efficiency and densification of spectrum sharing, particularly in the low band (sub 1GHz) and mid band (1GHz to 4GHz) frequencies suitable for mobile connectivity.
iii. Economic viability of roll-out of next generation mobile infrastructure (through enabling new service possibilities or significant cost savings).
iv. Alignment with the government's net zero targets.
v. Seamless connectivity between a "network of networks" (for example the integration of terrestrial and non-terrestrial networks) and their high security and resilience.

Three 6G Spectrum Initiative University Workshops

- 3 one day live Workshop events in May, July and Sept 2021
- Workshop event Webpages with Slides + Videos:

  Bristol: https://www.techuk.org/resource/slides-6g-technology-enablers-for-spectrum-energy-efficient-wireless-access.html

  Surrey: https://www.techuk.org/resource/slides-and-presentation-recordings-radio-access-network-techniques-for-6g.html

  Strathclyde: https://www.techuk.org/resource/slides-software-defined-radio-and-rf-sampling.html

- Expert Panel Excel Scoring Completed (Bristol, Surrey Strath)
- Expert Panel Scoring Sheet Guidance (re 3- extraordinary, 2 – significant, 1 – useful)
- Eight Recommendations shared with Govt / DCMS

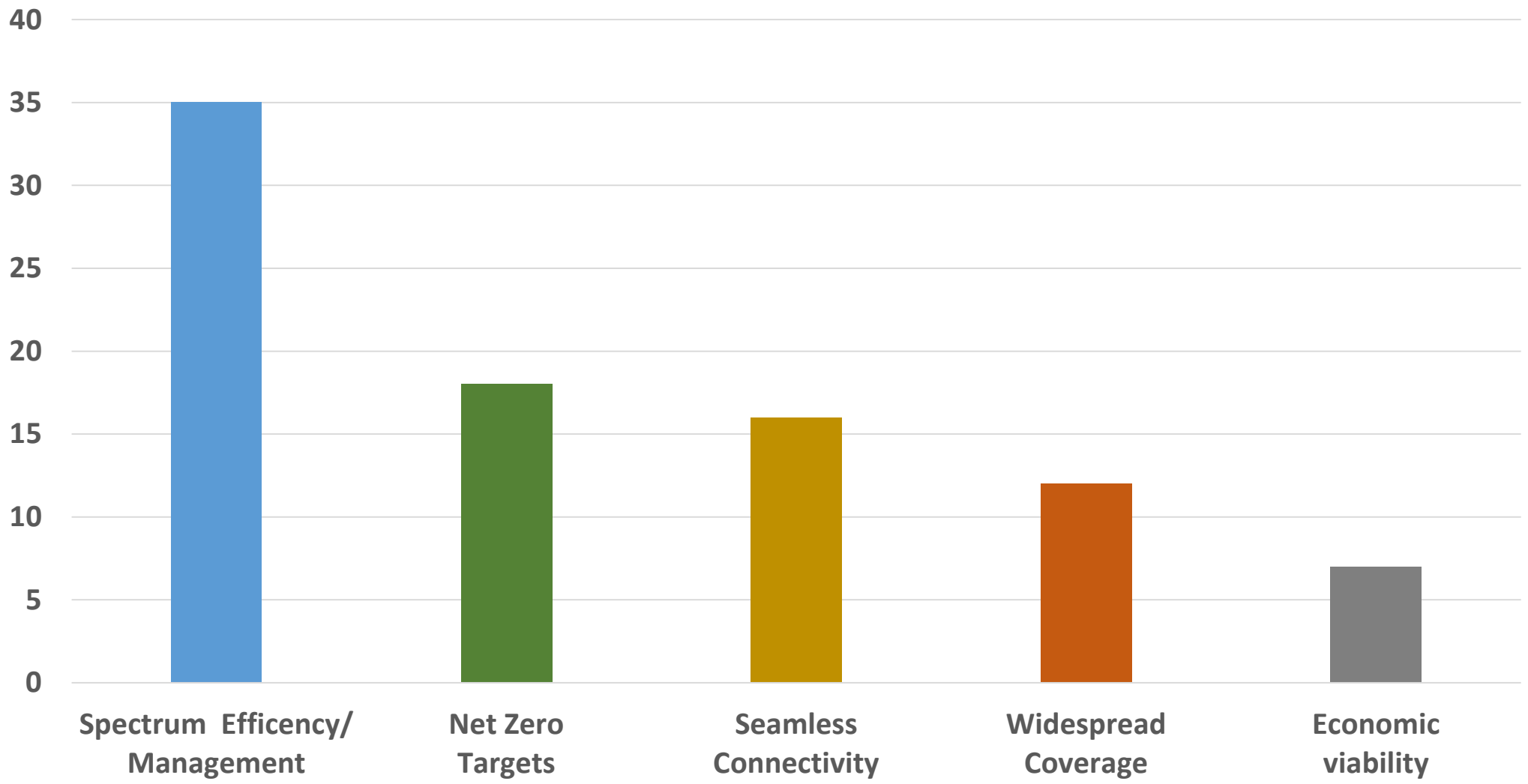
UK Universities 6G Spectrum Initiative … So far

Univ	Bristol (May)	Surrey (July)	Strath (Sept)
Edinburgh	1		
Bristol	7		2
HW	1		1
Sheffield	1		1
UCL	1		
York	1		
Lancaster	1		
Queen Mary	1		
Exeter	1		
Strath	1	1	6
Birmingham	1		
Glasgow		1	1
Leeds		1	
Public Health England		1	
UCL		1	
Durham		1	
Imperial College		1	
Kings College		1	
Surrey		8	1
Southhampton		1	1
Queens Univ Belfast		1	
Loughborough			1
Swansea			1
Sussex			1
East London			1
Liverpool			1
Total	**17**	**18**	**18**

- Initial UK Mobile/Wireless Comms R&D Audit Completed
- **26 UK Universities** presenting at 3 Workshops
- **54 UK university papers**, 3 keynotes, 4 review presentations
- More than **800+ registrations** at Bristol / Surrey / Strath
- Event attendees of more than 200 over the day of each event
- **Industry, Academia, Govt audience** + international interest
- All slides/pdfs on line at SPF TechUK location
- Presentations on line at SPF (Strath final edits just being closed
- 400 review words from authors/presenter shared
- Expert Panel – 'Scoring' review of all presentations completed
- Expert Panel overall assessment of initiative
- Draft Key Recommendations created for Govt
- SPF Cluster 2 Review Report in Draft
- Open Public Consultation with SPF Cluster 2 – Oct 5th 2021

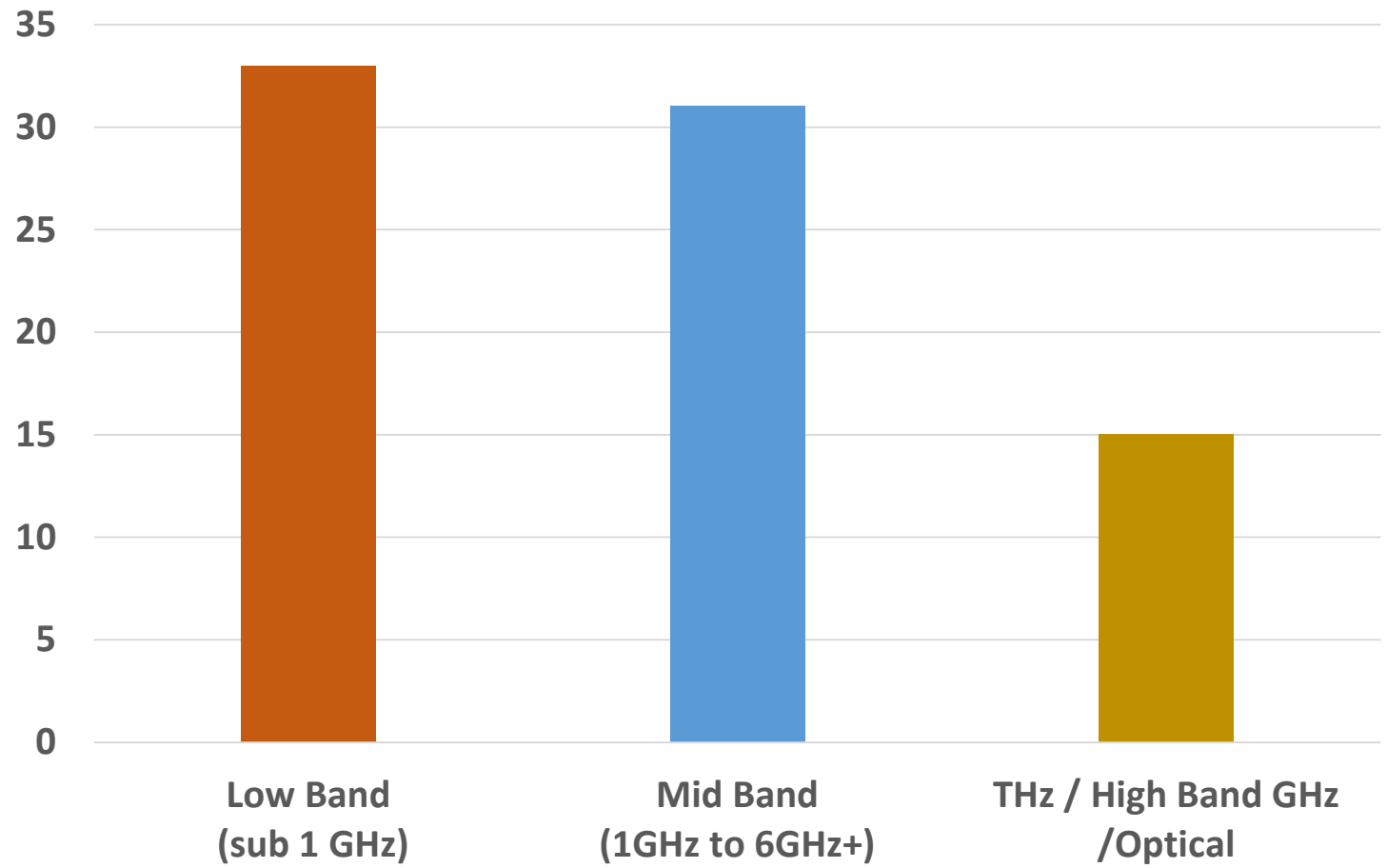
Topics Related to Five Goals

Work will often cover more than one goal.



Which Mobile Bands Featured?

Work can be relevant to more than one band.



Public Consultation – Live 1st Oct to 15th Oct

https://www.techuk.org/resource/public-consultation-on-recommendations-to-government-on-how-to-harness-the-potential-of-6g.html

Industry views 04 Oct 2021

Share this page

Public Consultation: On recommendations to government on how to harness the potential of 6G

Led by UK SPF | Start date: 4 October 2021 | Deadline: 12:00 noon on Friday 15 October 2021

Following three university-led 6G Spectrum Initiative workshops* an expert panel have created a list of recommendations that can be found in section 3 of the document below.**

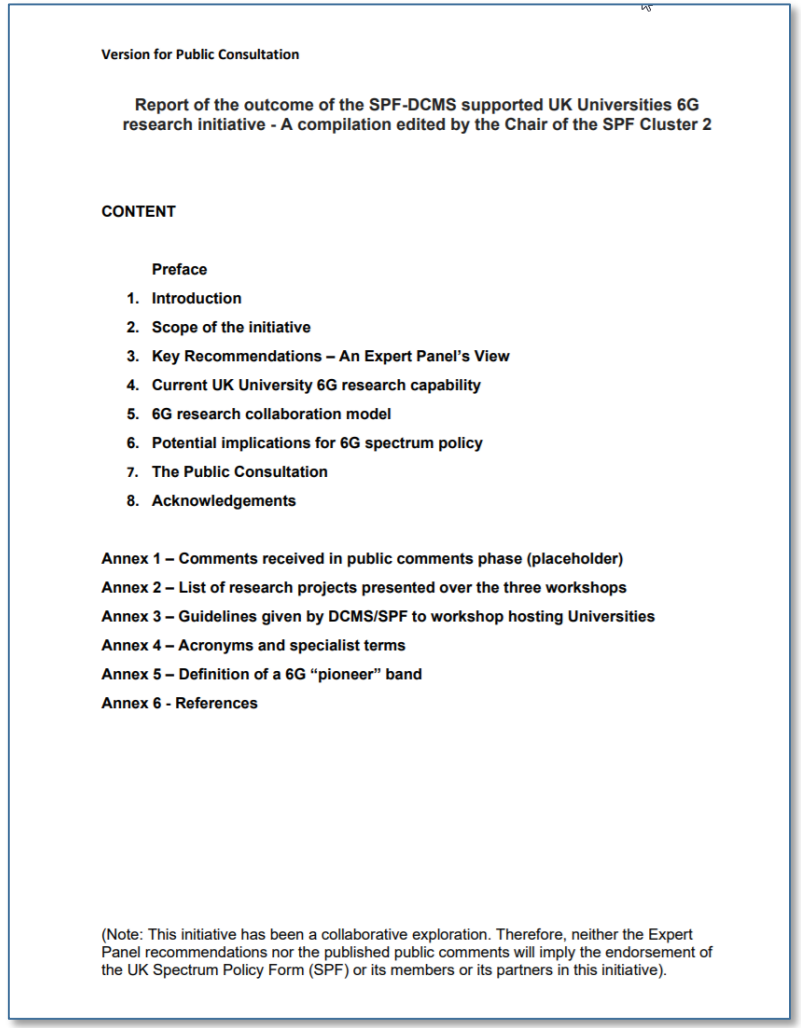
Specifically, relating to 6G, we want to ensure that we have captured any potential research gaps, and any potential spectrum policy implications.

uk spectrum policy forum

Therefore, the UK Spectrum Policy Forum (SPF) are seeking views on the recommendations via this public consultation.

The document below also contains background information on the process plus a section on this Public Consultation, we recommend you review it – section 7.

Report on on Outcome of SPF-DCMS Support UK Universities Research Initiative



Version for Public Consultation

Report of the outcome of the SPF-DCMS supported UK Universities 6G research initiative - A compilation edited by the Chair of the SPF Cluster 2

CONTENT

(Note: This initiative has been a collaborative exploration. Therefore, neither the Expert Panel recommendations nor the published public comments will imply the endorsement of the UK Spectrum Policy Form (SPF) or its members or its partners in this initiative).

Collaboration Model - *Expert Panel - Recommendation 3 & 4*

*3. The government should take action that would secure **critical mass** of research activity and be **globally competitive**, thus enabling the UK to be an attractive and leading partner in **international collaborations**.*

*An **additional government funding of £25 million** per year for 6G spectrum related research would be an excellent investment as there are few better opportunities for matching known long-term national mobile and wireless infrastructure problems with UK research excellence to create and supply solutions.*

4. The government should make participation in an approved ***"collaboration model"*** a condition of 6G research grants to Universities. This should enable government, Ofcom, the Mobile Network Operators, and relevant industries to systematically engage with the 6G research community, other service providers to advise in setting research strategic directions within the five goals, and mentor individual research projects of mutual interest. The model also needs international collaboration to be forged with countries sharing the same goals.

History! Collaboration through the G's (2G to 6G)

UK R&D collaborative programmes for academic, university, govt collaboration:

- **Mobile VCE** (Mobile Virtual Centre of Excellence, 1996 – 2G)
- **Innovate-UK** Projects (industry led R&D)
- **DCMS** 5G Testbed and Trials
- **EPSRC** Prosperity Partnerships for Industry/Academia
- Engineering **Doctorates**, EngD Centres
- EPSRC & Other CDTs - **Centres for Doctoral Training**
- **Catapults** (e.g. Digital, SatApps)
- University **Alignment/Associations** and Clustering
- Core R&D and Membership Centre – **5GIC** (Surrey)

UK Universities 6G Collaboration Model Options

Option 1:
One University become the UK 6G Centre of Excellence and research teams relocate to that one centre.

Option 2:
Three or so Universities with complementary expertise form a partnership and become a hub of a UK 6G Centre of Excellence that manage research clusters of a wider number of research associates (other universities) and partners focussing on the same topic.

Option 3:
Research distributed across unlimited number of Universities (20 more, and perhaps the current status quo).

Collaboration Model - Strawman Ideas 1.0

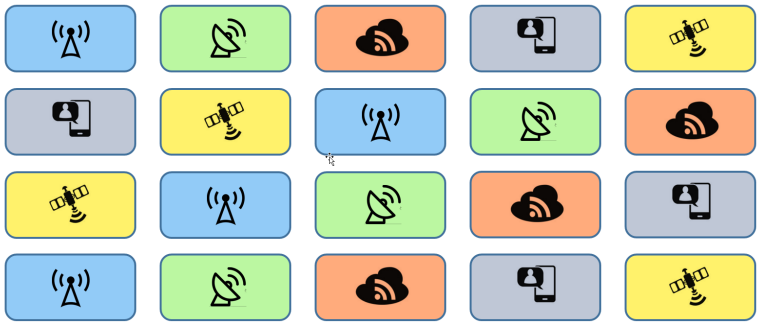
- £25m per year in first three years (this is 10+ year endeavour)
- 3 focussed/themed hubs at £8.3m per year
- UK Wide Participation – integrating the excellent momentum in UK Univs
- Mobile Industry tier 1s, SME, Ofcom, Govt Partnership for the UK
- Advisory Board – Engaged and dynamic
- Funding Board – Empowered and rapid response mode
- Internationalisation Strategies
- Complementary and additional to EPSRC/UKRI / InnovateUK
- Supporting UK Telecommunications Diversification Strategy

One 6G Hub - £8.3m per annum (Three Hubs £25m / year)

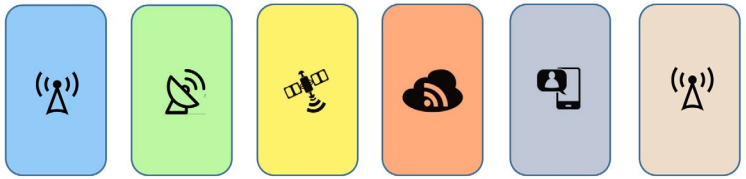
Category	Staffing Levels	Roles
Leadership		6G Spectrum Initiative Director Lead Academic *Industry* Professor R&D Industry Liaison Manager
Engineering		Core R&D Engineering Champions
Management		Hub Programme Manager Administration & Secretarial Contracts and Process
Overheads		Estates, facilities, technicians, finance, services): Residual cost @ *80% FEC* (full economic costing) on technical positions

Hub Core Staff: £1,021,520

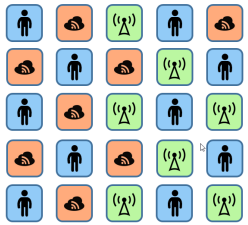
6G Hub National Technology Infrastructure: £1,000,000



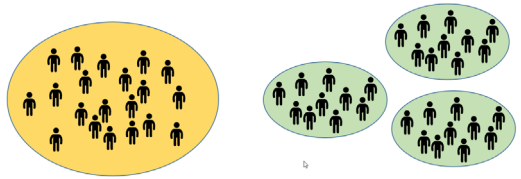
6G Technology Partner Programmes, £3,000,000



6G Infrastructure / Lab / Showcase Facilities: £1,800,000

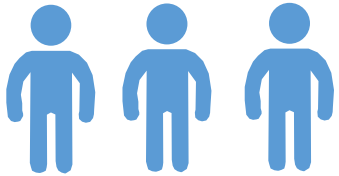
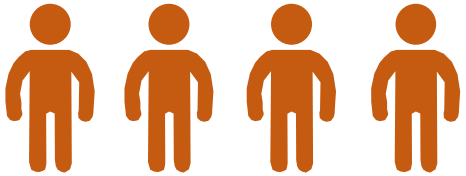


Mobile Industry / SMEs Matched Funding Pot: £1,425,000



National Events / Workshops: £88,000

£25m / year – Three Hubs @ £8.3m / year?

Category	Staffing Levels	Roles	Per Annum
Leadership		6G Spectrum Initiative Director Lead Academic *Industry* Professor R&D Industry Liaison Manager	**£288,200**
Engineering		Core R&D Engineering Champions	**£235,800**
Management		Hub Programme Manager Administration & Secretarial Contracts and Process	**£248,900**
Overheads		Estates, facilities, technicians, finance, services): Residual cost @ *80% FEC* (full economic costing) on technical positions	**£248,900**

£1,021,520 per annum

UK Universities Technology Partner Programme

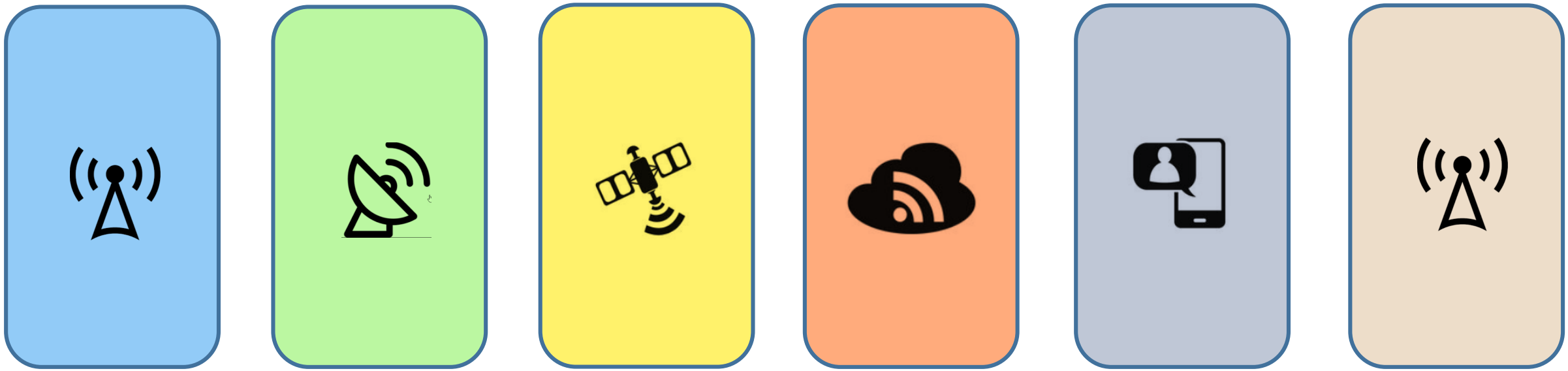
20 UK University Technology Partner Projects & Programmes @ £150,000 annum.

(Support existing work already identified via the initiative?)

£3,000,000 per annum

Key UK Infrastructure Facilities

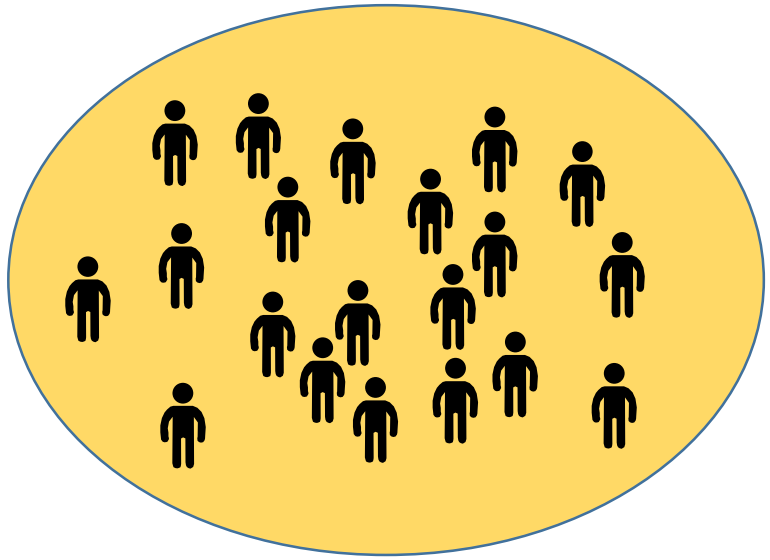
6 Key Infrastructure / Lab / Showcase Facilities at £300,000 per annum
(*Create UK showcase projects and facilities across UK Universities)*



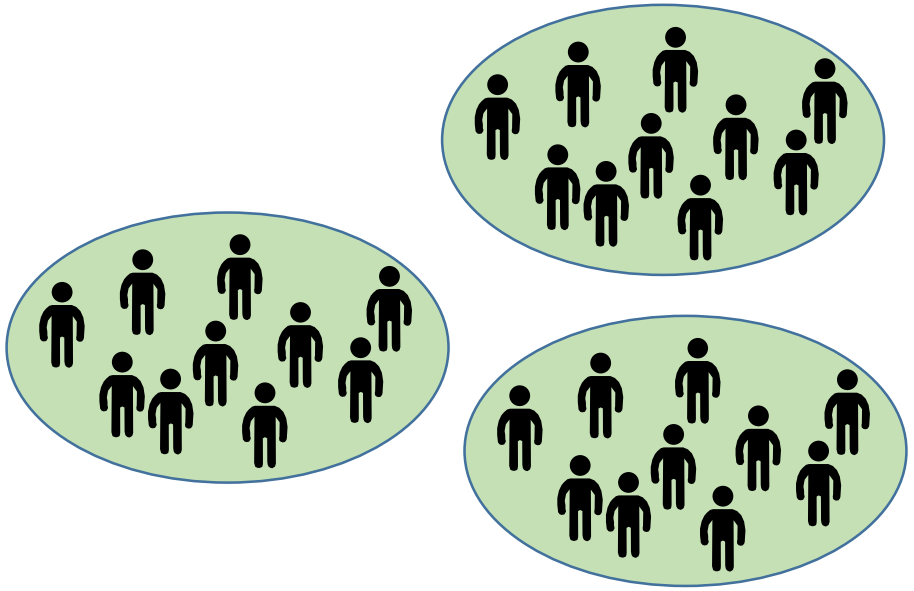
£1,800,000 per annum

National Events / Workshops / Conferences

The Workshops evidence the value of coming together with focus.
(National events, and hub events, live, showcase options and on-line)



One UK National 6G Spectrum Workshop, 300 attendees



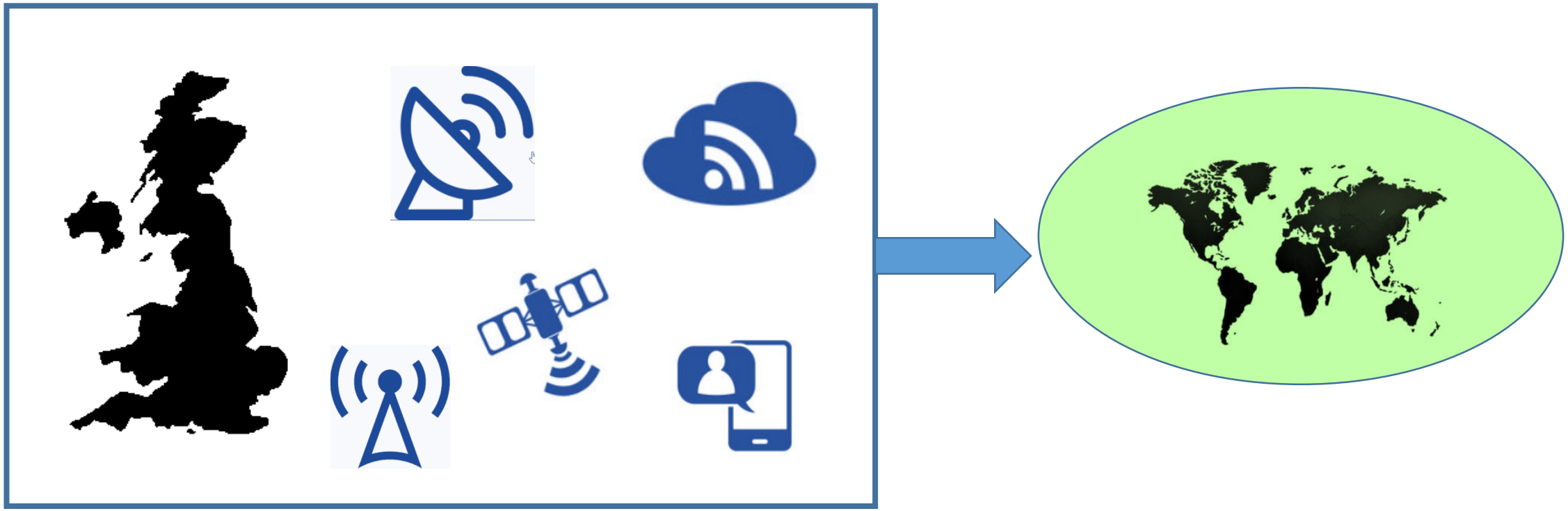
Three Hub Base Techincal Workshops, 60 attendees

£88,000 per annum

6G Hub National Technology / Infrastructure Facilities

Showcase and Collaborative Facilities/Testbeds/Demonstrators and more

(International visibility & partnership, physical existence, integrated with UK universities)

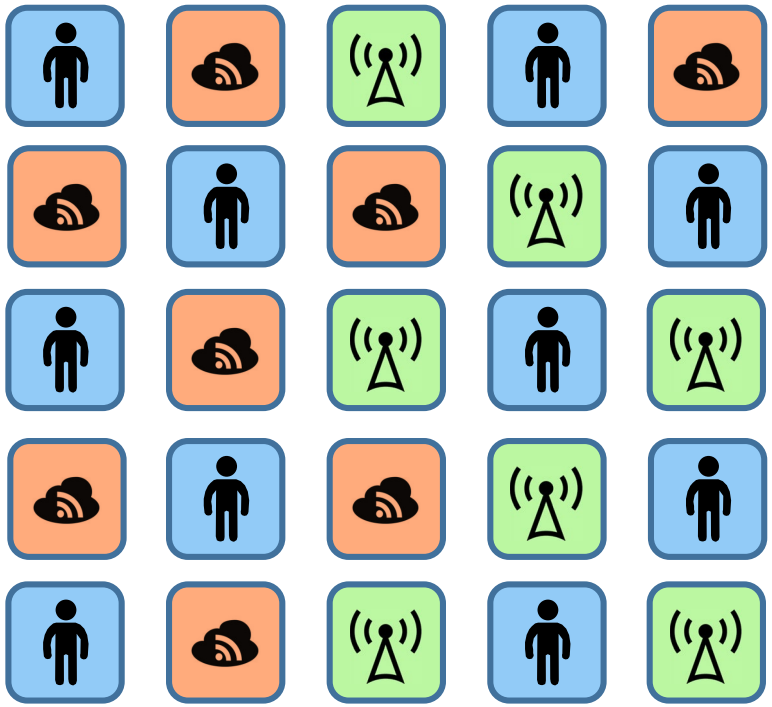


£1,000,000 per annum

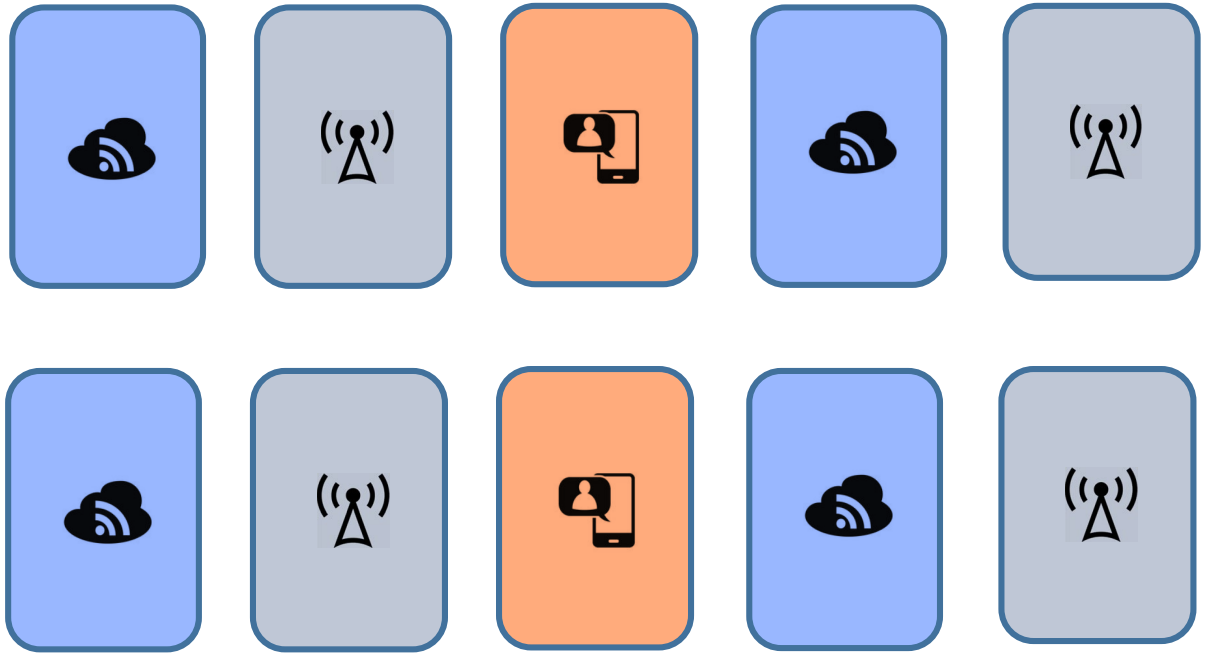
Mobile Industry / SME Matched Funding Options

Short Projects / EngD/PhD Costs / Secondments

(PhDs/EngDs/Short KTPs – Research talent training & growth <u>essential</u> for 10 year journey)



25 Industry EngDs / PhDs, £27k per annum



10 Industry SME, MNO, Ofcom Partnership Projects

£1,425,000 per annum

One 6G Hub - £8.3m per annum

Category	Staffing Levels	Roles
Leadership		6G Spectrum Initiative Director Lead Academic *Industry* Professor R&D Industry Liaison Manager
Engineering		Core R&D Engineering Champions
Management		Hub Programme Manager Administration & Secretarial Contracts and Process
Overheads	£ Univ Operational Overheads	Estates, facilities, technicians, finance, services): Residual cost @ *80% FEC* (full economic costing) on technical positions

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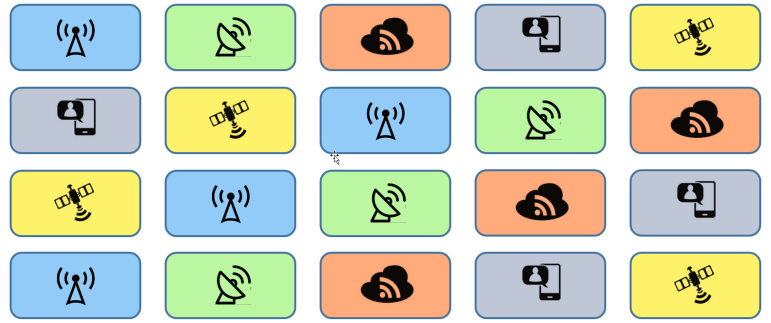
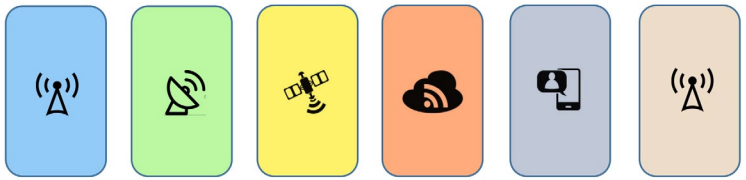
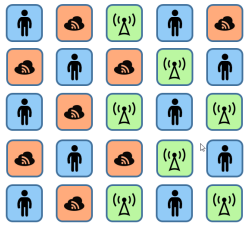


6G Technology Partner Programmes, £3,000,000



6G Infrastructure / Lab / Showcase Facilities: £1,800,000



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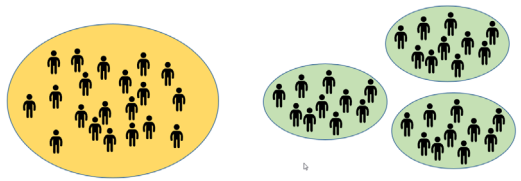
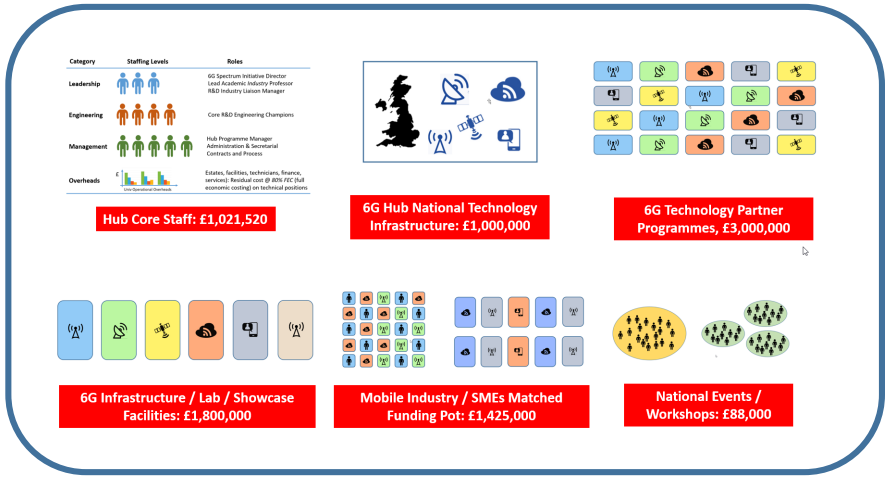


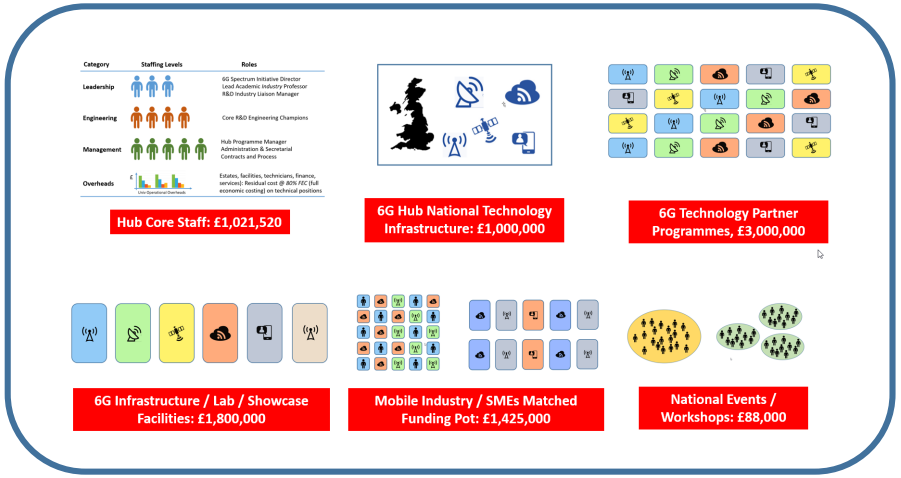
National Events / Workshops: £88,000

Three UK 6G Hub – 3 x £8.3m = £25m per annum

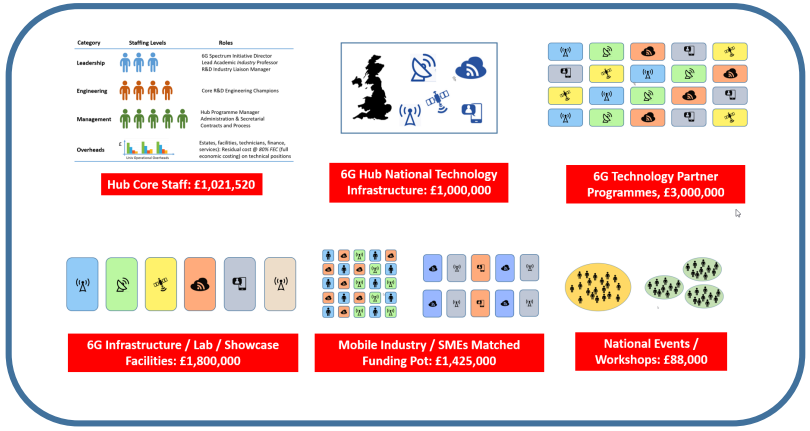
6G UK Hub 1



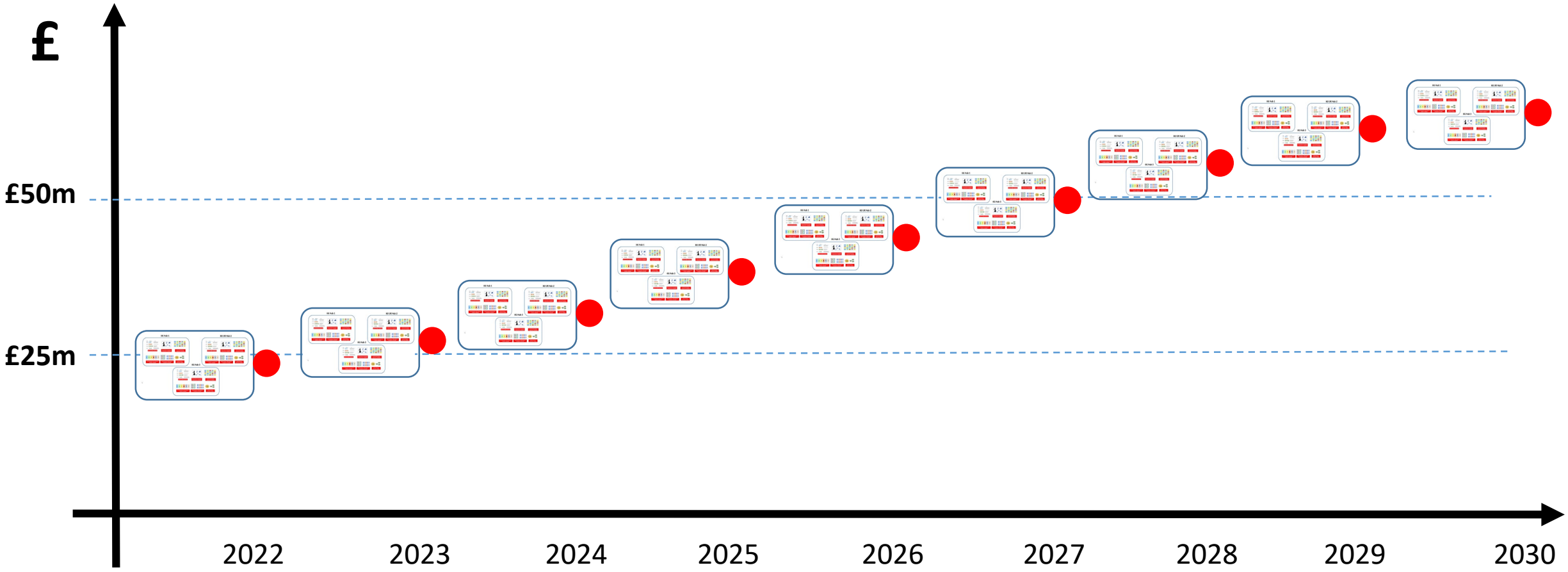
6G UK Hub 2



6G UK Hub 3



6G - For 10 Years to 2030+



Open Thoughts and Discussion … Some Prompts

- **Collaboration**, common purpose and engagement across academia, industry, and government.
- Building **advisory and partnerships** with UK regulator Ofcom and MNOs and other ‘public’ network stakeholders.
- Integrating the existing **6G relevant national activities** and capabilities.
- Running UK national **6G workshops and events** open to all partners and stakeholders.
- Supporting mutually agreed contributions to **international standard bodies**.
- Strategic and supportive strategy for UK participation in **Horizon Europe**.
- Driving **international collaboration** and building UK influence in 6G spectrum and technology.
- Creating **complementarity to EPSRC/UKRI and Innovate UK** funding portfolios on advanced communications.
- Creating a 6G **SME engagement** programmes with accessible (low cost), workable and ‘easy’ points of entry.
- Support **momentum of existing UK Univ 6G R&D** activities unearthed in the initiative workshops and more.
- Budget considerations – What could be achievable momentum and activity with proposed £25m per year?
- Supporting and dovetailing with the **UK DCMS Telecommunications Diversity Strategy**.
- Management of **IPR and licensing strategies** to support UK industry and particularly SMEs.
- Mechanisms to support both **low TRL and high TRL**, and research of both theoretical and experimental nature.
- UK 6G Testbeds and Trials – **considering ‘pioneer’ frequency bands** for the future.
- Frequency bands for 6G Spectrum Research: from **low band to terahertz to visible light**.

Notes

SPF/DCMS UK Universities 6G Spectrum Research Initiative

Expert Panel - Key Recommendations

The consensus view of an Expert Panel is that a 6G spectrum initiative should address at least the five goals listed below (listed in no particular order, and not precluding other goals) and incorporate them into a 6G national strategy:

- **Widespread coverage** to prevent the manifestation of a "digital divide" and to contribute to improved health and social care outcomes and future transport ambitions.
- **Innovation in spectrum management** (e.g. through the use of automation and AI), to improve spectrum efficiency and densify spectrum sharing, particularly in the low frequency, mid and mid high frequency bands suitable for mobile connectivity.
- **Economic viability** of roll-out of next generation mobile infrastructure (through enabling new service possibilities or significant cost savings).
- Alignment with the government's **net zero targets**.
- **Seamless connectivity** – a "network of networks" (for example the integration of terrestrial and non-terrestrial networks) with high security and resilience.

SPF/DCMS UK Universities 6G Spectrum Research Initiative

Expert Panel - Key Recommendations

Name	Designation	Organisation
Mark Beach	Professor & Prosperity Partnership Leader	University of Bristol
Rahim Tafazolli	Professor and Director 5G/6GIC	University of Surrey
Bob Stewart (Chair)	Professor and Lead of Strath 5G Cluster	University of Strathclyde
James Dracott	Head of ICT	EPSRC
JF Fava-Verde	Innovation Lead (Digital)	InnovateUK - UKRI
Dave Townend	Wireless Research Manager	British Telecom
David Lister	Senior R&D Manager	Vodafone
Raj Sivalingam	Head of Spectrum	DCMS
Adam Beaumont	Chair aql Group; Chair Northinvest	UK Entrepreneur
Abhaya Sumanasena	Managing Consultant	Real Wireless & Chair SPF Steering Board
Luigi Ardito	Senior Director, Government Affairs	Qualcomm & Vice-Chair SPF Steering Board
John Haine	Consultant	IoT Security Foundation
Ex Officio:		
Jo O'Riordan		UK SPF and techUK
Stephen Temple		UK SPF Cluster 2 Chair

Expert Panel Summary Final Scoring and Rating

		3 2 1 Total rated				Five Goals						Band		
REF.	Workshop Title and Main Theme	Extra- ordinary	Signficant	Useful		Spectrum Efficency	Coverage	Connectivity	Carbon net zero	Economic viability		Terrahertz/High GHz	Mid-band	Low-band
Bristol	6G: Technology Enablers for Spectrum Energy Efficient Wireless Access	20	77	63		13	2	3	3	0		5	12	10
Surrey	6G: Radio Access Network Techniques for 6G	29	74	62		14	7	6	10	3		7	12	5
Strath	6G: Software defined radio and RF Sampling	24	67	79		9	3	9	6	5		6	9	10
	TOTAL EXPERT PANEL RATINGS SCORE	73	218	204		36	12	18	19	8		18	33	25
	GLOBAL STRENGTH	15%	44%	41%										

EXPERT PANEL MEMBER VIEWS ON UK OVERALL CAPABILITY TO ADDRESS THE FIVE 6G GOALS (GIVEN THE RIGHT FUNDNG SUPPORT AND COLLABORATION MODEL)

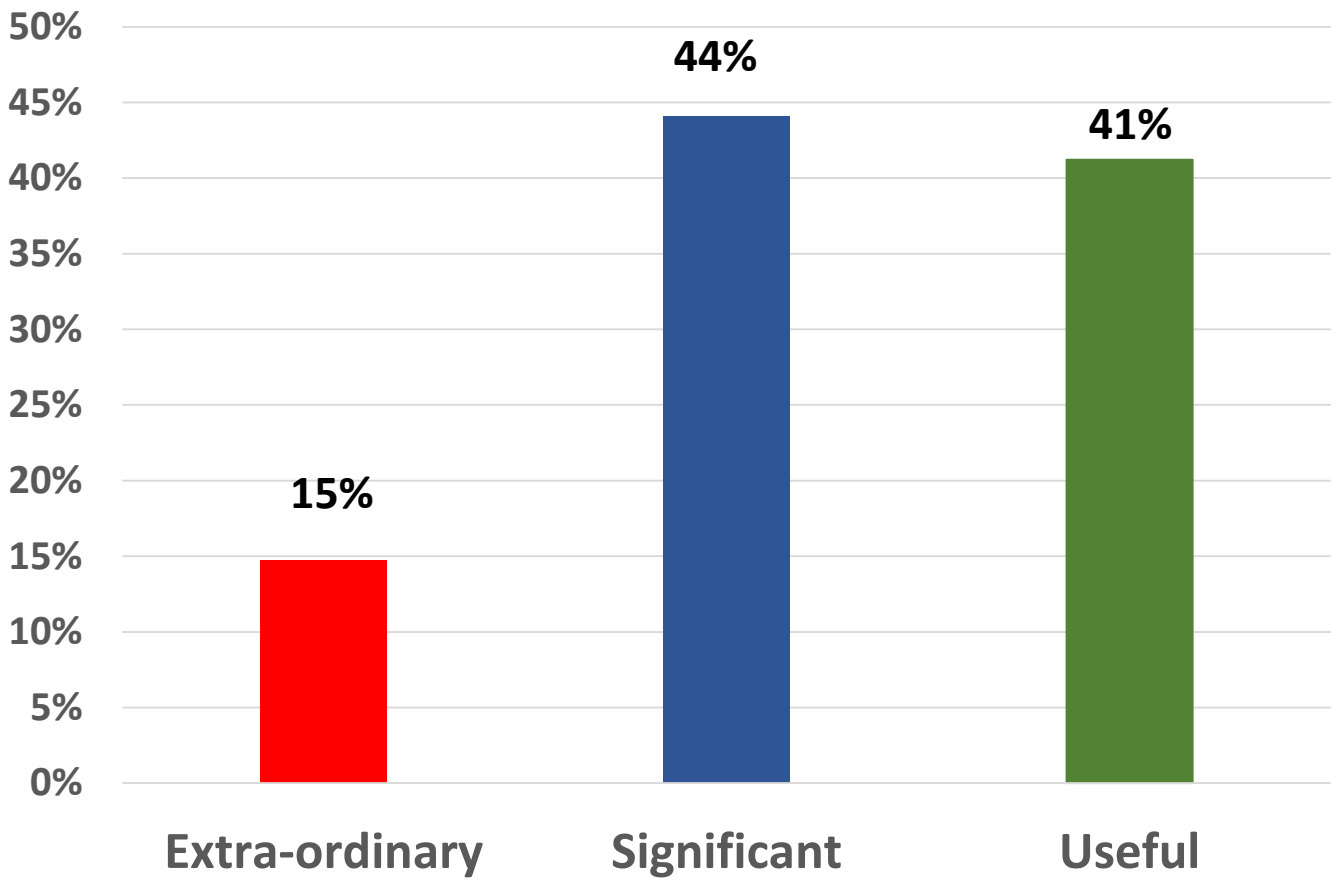
Extraordinary	Signficant	Useful
15%	44%	41%

Aggregation and averaging from Expert Panel Scoring for all workshops. Where a panel member was not experienced in a certain domain, they chose to leave blank. At least 9 (nine) panellists rated all presentations

'Low' – Sub 1GHz
'Mid' – 1GHz to 6GHz+ (but <10 GHz)

UK Universities 6G Initiative = Expert Panels Scores

Around 60% - Extraordinary and Significant – A high bar set for ‘Extraordinary’



Overall Scoring

1 Useful

Good background research but not sufficient to change the current status quo by much – may deliver a flicker of 1-2% on the ‘needle’.

2 Significant

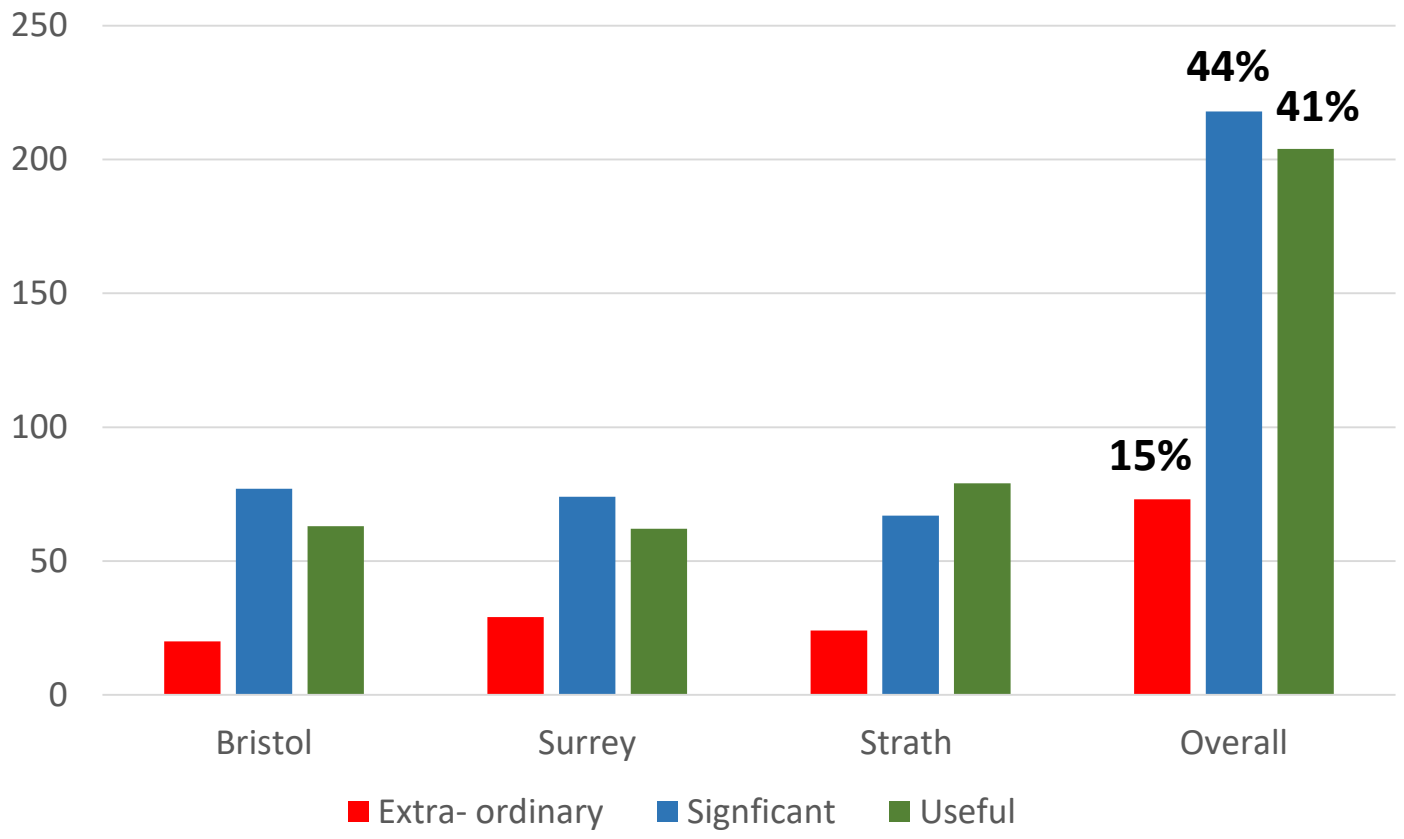
Will “move the needle” by 10 - 20% for the goal being addressed and, if successful, deliver a gain well worth the research effort.

3 Extraordinary

A transformational break-through, and moving the needle by 80 – 100%.

UK Universities 6G Spectrum Research Capability

Around 60% - Extraordinary and Significant – A high bar set for ‘Extraordinary’



Disaggregated & Overall Scoring

1 Useful

Good background research but not sufficient to change the current status quo by much – may deliver a flicker of 1-2% on the ‘needle’.

2 Significant

Will “move the needle” by 10 - 20% for the goal being addressed and, if successful, deliver a gain well worth the research effort.

3 Extraordinary

A transformational break-through, and moving the needle by 80 – 100%.

SPF/DCMS UK Universities 6G Spectrum Research Initiative

Expert Panel - Key Recommendations

Our Expert Panel's audit of current excellence of the UK University research base to address those five goals has shown that almost 60% of the research presented was rated as '*Significant and Extraordinary'* and, given the right support and focus, could propel the UK into international research leadership by solving critical next generation mobile and wireless technology problems around spectrum and coverage. The Expert Panel therefore propose the following eight key recommendations as part of a UK 6G strategy:

SPF/DCMS UK Universities 6G Spectrum Research Initiative

Expert Panel - Key Recommendations

1. The government needs to mobilise the UK's long-term research resources and capability ***now*** if the UK is to make an effective international contribution to the next technology generation upgrade of national mobile and wireless infrastructures (6G).

2. The government should set a national 6G ambition of finding solutions to the enduring mobile and wireless infrastructure problems, as specified by the five goals.

3. The government should take action that would secure critical mass of research activity and be globally competitive, thus enabling the UK to be an attractive and leading partner in international collaborations. An additional government funding of £25 million per year for 6G spectrum related research would be an excellent investment as there are few better opportunities for matching known long-term national mobile and wireless infrastructure problems with UK research excellence to create and supply solutions.

4. The government should make participation in an approved "collaboration model" a condition of 6G research grants to Universities. This should enable government, Ofcom, the Mobile Network Operators, and relevant industries to systematically engage with the 6G research community, other service providers to advise in setting research strategic directions within the five goals, and mentor individual research projects of mutual interest. The model also needs international collaboration to be forged with countries sharing the same goals.

SPF/DCMS UK Universities 6G Spectrum Research Initiative

Expert Panel - Key Recommendations

5. Later, an effective SME engagement programme with University-based 6G research has significant potential to further strengthen and diversify the UK's supply base and export of know-how and future products, in line with the government's Telecommunications Diversification Strategy. Research grants to SME's should include an element that pays for the cost of integrating their prototypes into new national 6G research and innovation multisite facilities.

6. The government should be organising a managed and coordinated national approach to efficiently and effectively take the results of relevant UK 6G research projects into global standards bodies, giving Universities, the research community, and UK SME's more impact acting collectively and taking due account of their needs.

7. 'Next generation' satellite and unmanned aerial vehicles technology needs to be on the 6G road map and associated spectrum needs considered.

8. The 6G radio frequency spectrum band choice, from low (frequency spectrum) band to terahertz, is an important consideration that will influence what 6G can deliver and where. The low and mid bands are where some of the biggest challenges will be around the five goals. Therefore, the government should have a research priority on low band and mid band frequencies research projects, and consider other frequencies that can address one or more of the above five goals in a significant way. The government should also encourage innovative ways of utilising a range of spectrum bands to achieve the above five goals.