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India-UK
Future Telecoms Programme

Summary
14 July 2022

"Comprehensive strategic relationship"

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4 May 2021
India-UK 2030 roadmap

12 January 2022
India-UK FTA

20 July 2020
Telecom Security Act
£250m for telecom diversification

25 October 2021
UKRI press release

The India-UK Future Telecom Programme was launched in India by the UK Foreign Secretary Liz Truss MP, the UK DCMS Minister for Media, Data and Digital Infrastructure Julia Lopez MP and Sanjeev K Varshney, Head of International Cooperation at the Department for Science and Technology (India).

22 October 2021
Telegraph

India-UK Future Telecom Programme

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- Energy Efficient Networks
- Resilient Networks
- Secure Design
- High Density Urban Deployment
- Low Density Rural Deployment

Industry consultations
180 companies 2021/22

UK delegation to
India May 2022

India delegation to UK
June 2022

OBJECTIVE
Bilateral programme
to support the FTA

Free Trade Agreement
October 2022

	RESEARCH TOPIC	RAN sharing	Hybrid networks	Direct satellite comms	Supply chain diversity	Cyber security	Optical comms	Intelligent surfaces
CONSULTATION								
Energy efficient networks		■	■				■	■
Resilient networks			■	■	■	■		
Secure design					■	■		
High density urban deployment		■	■	■			■	■
Low density rural deployment		■	■	■			■	

- Created momentum and interest to work together
- Identified R&I topics, with outline business cases and commitment from India and UK
- Identified $bn Indian companies looking to invest in UK

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UK delegation to India

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Dr Andy G Sellars
Compound Semiconductor Applications Catapult

Lizzie Brown
Compound Semiconductor Applications Catapult

Georgios Papadakis
Innovate UK

Sundeep Bhandari
National Physical Laboratory

Sir David Payne
University of Southampton

Prof Jayanta Sahu
University of Southampton

Paul Febvre
Satellite Applications Catapult

Dr Arunprakash Jayaprakash
Satellite Applications Catapult

Key dates

- 28 March, New Delhi: British High Commission officials including DIT, FCDO and UKRI
- 28 March, New Delhi: Mr Shakya, Deputy Director General, Department of Telecoms
- 29 March, New Delhi: roundtable chaired by Prof Paul Monks, Chief Scientific Advisor to BEIS
- 29 March, New Delhi: Dr Upadhyay, Executive Director, Centre for Development of Telematics (CDOT)
- 29 March, New Delhi: Dr Harjinder Kaur Talwar, President, Federation of Indian Chambers of Commerce and Industry (FICCI)
- 30 March, New Delhi: Lt Gen Kochhar, Director General, Cellular Operators Association of India (COAI)
- 1 April, Bangalore: Vivek Kimbahune, Executive Vice President, Saankyha Labs
- 1 April, Bangalore: Gnanapriya Chidambaranathan, Associate Vice President, Infosys
- 9 May, Bangalore: Dr Samuel Varghese, Project Manager, SFO Technologies
- 9 May, Bangalore: Mr Balakrishnan, General Manager, Wipro Limited
- 9 May, Bangalore: Shaju Mangalam, Head of Karnataka State Council
- 10 May, Bangalore: Vivek Kimbahune, Executive Vice President, Saankyha Labs
- 11 May, Bangalore: Krishna Moorthy K, CEO and President, India Electronics and Semiconductor Association (IESA)
- 12 May, Bangalore: Professor Hari, Executive PI for BT, Indian Institute of Science
- 13 May, Bangalore: Gnanapriya Chidambaranathan, Associate Vice President, Infosys

Indian delegation to the UK

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KT Rajan
DIT

Gaurav Setia
L&T Tech

Gnanapriya Chidambaranathan
Infosys

Anil Prakash
SIAI

Debashish Bhattacharya
Broadband India Forum

Prof K V S Hari
IISc Bangalore

Tunde Adebayo
Tata CS

Narendran Sivakumar
Tata CS

Rajeev Gambhir
SIAI

Gnanender Ventkataraju
Saankhya Labs

Rohan Gupta
British High Commission

Key dates

- 20 June, London: roundtable discussion at the Digital Catapult with DCMS and OFCOM followed by tour of the SONIC labs
- 21 June, Southampton: introduction to the Optoelectronic Research Centre and tour of the labs
- 22 June, Oxford: tour of the Harwell campus and roundtable chaired by Dr Mike Short, DIT CSA and Stuart Martin, CEO of the Satellite Applications Catapult
- 23 June, Cardiff: tour of CSA Catapult, roundtable and evening reception hosted by Secretary of State for Wales, Rt Hon Simon Hart MP

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The CSA Catapult is a member of CS-Connected – the South Wales compound semiconductor cluster

www.csconnected.com

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Research topics for bilateral investment

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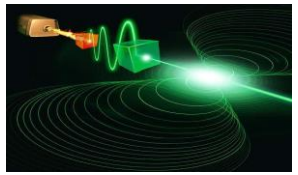
- RAN sharing
- Hybrid networks
- Direct satellite communication
- Supply chain diversification
- Cyber security
- Optical communications
- Intelligent surfaces







Project example: RAN sharing

- **Context**
- The deployment of 5G networks will require $billions of investment in radio access network (RAN) infrastructure both in India where commercial 5G has yet to be launched, in the UK where use of mmWave will require far denser networks, as well as in all other countries of the world where 5G is deployed
- At the same time energy costs for 5G networks are expected to rise substantially. 5G could "push energy from 23% of the 4G-era network TCO up to almost a third, or 32% in the 5G-era" [*in full-scale 5G deployments*] *[GSMA: https://www.gsma.com/futurenetworks/wiki/5g-era-mobile-network-cost-evolution/]*
- RAN sharing - encompassing active network components as well as sharing of passive components (such as towers) – can help reduce those costs substantially
- RAN sharing requires adaptation of network operational systems and advanced network automation
- RAN sharing is a use case of the O-RAN architecture

- **Opportunity / benefit**
- RAN sharing promises to reduce investment in building and maintaining 5G RANs in India and the UK, for public network operators and enterprises
- RAN sharing can also help reduce the energy use and hence cost and carbon footprint of 5G networks (avoiding multiple, duplicated network deployments)
- Developing RAN sharing capability would also create systems integration and software know-how that can be exported worldwide – effective RAN sharing will be of interest everywhere
- Driving RAN sharing will complement the development of O-RAN products and solutions for a global market

Project example: RAN sharing

- **Possible project parameters**
- Create a full solution stack for effective RAN sharing by assembling component subsystems
- Projects to develop software solutions for network automation in a sharing context, including configuration at the RAN level, and various degrees of sharing of active network elements and systems
- Projects looking more holistically at RAN automation – encompassing energy management, how to handle microgrid and energy storage solutions, and how to integrate renewable power
- Run tests to prove potential financial and energy/carbon savings under different deployment scenarios, as well as the operational and commercial feasibility of advanced RAN sharing, and to demonstrate that network and data security is not compromised

- **Initial steps**
- Identify network operators willing to participate in the project
- Identify developers of O-RAN technologies and virtualized core networks, and system integrators, to collaborate on full solution stacks for RAN sharing
- Identify network automation specialists
- Map available technologies and identify gaps in technologies and commercialization
- Design different sharing scenarios to focus on, in the course of software and equipment development and testing
- *Note possible links to hybrid networks, including satellite, and using automation to bring the shared 5G RAN together with other infrastructures*

Project example: RAN sharing

- **Market size indicators**
- The global RAN market (2G-5G), excluding services, increased at a double-digit rate in 2021 to reach $40-$45 billion…. near-term projections have been revised upward – total RAN revenues are now projected to grow 5 percent in 2022…The cumulative worldwide radio access network (RAN) revenues for the 2021-2026 period are projected to approach $250 bn *[Dell Oro: https://techblog.comsoc.org/2022/02/23/ran-growth-slowed-in-4q-2021-but-full-year-ran-revenues-rose-to-40b-45b-open-ran-market-highlights/ and https://www.lightreading.com/5g/ran-growth-slows-in-4q-2021-but-still-grows-more-than-10-percent-in-2021---delloro-group/d/d-id/775542; and https://www.thefastmode.com/technology-solutions/22576-global-ran-market-on-track-to-approach-250b-says-dell-oro-group]*
- Cf. Global wireless RAN market expected to grow at a CAGR of 8.6% during 2021-2026 to reach $31.6 bn *[IndustryArc - https://www.industryarc.com/Report/15088/wireless-ran-market.html]*
- Forecast Mobile CAPEX in India is around Rs Crore 50-60,000 in FY 2022 ($660 mn to $792 mn), rising to Rs Crore 100,000-110,000 ($1.3 bn to $1.45 bn) in FY 2025, driven by the deployment of 5G *[Economic Times - https://telecom.economictimes.indiatimes.com/tele-talk/dial-down-the-stress-for-india-s-telecom-equipment-industry-to-flourish/5092] [Figures read from chart]*
- Of that, RAN spend is forecast at: Rs Crore 35-40,000 ($462 mn to $528 mn) in FY 2022, rising to Rs Crore 50,000 ($660 mn) in FY 2025; transport spend is forecast at Rs Crore 5,000 ($66 mn) in FY 2022, rising to approx. Rs Crore 40,000 ($528 mn) in FY 2025; Core spend is forecast at Rs Crore 5,000 ($66 mn) in FY 2022, rising to approx. Rs Crore 20,000 ($264 mn) in FY 2025 *[Economic Times - https://telecom.economictimes.indiatimes.com/tele-talk/dial-down-the-stress-for-india-s-telecom-equipment-industry-to-flourish/5092] [Figures read from chart]*

Project example: RAN sharing

- **Impact indicators**
- China Telecom and China Unicom, who deployed 400,000 standalone 5G base stations in a year, stated their 5G infrastructure sharing deal:
  - Reduced construction by CNY80 billion
  - Reduced OPEX by CNY8 billion per year
  - *[Mobile World Live: https://www.mobileworldlive.com/featured-content/top-three/china-operators-underline-network-sharing-savings]*
- "Network sharing will remain one of the most significant cost mitigators in the 5G-era. It can potentially deliver TCO savings of up to 40% in instances where operators share spectrum, active and passive infrastructure across the site, radio, transport and core network domains" *[GSMA: https://www.gsma.com/futurenetworks/wiki/5g-era-mobile-network-cost-evolution/]*

Project example: Hybrid networks / direct satellite communications

- **Context**
- Providing effective, resilient network coverage throughout India and the UK requires use of multiple types of network – fixed, mobile, and satellite. Those networks need to interwork seamlessly and effectively
- Deployment hurdles include not just deploying the RAN infrastructure for mobile networks, or the costs of deploying fibre locally, but also the physical and economic challenge of establishing the backhaul and transport links required to cover long geographic distances to reach rural and sparsely populated areas
- Use of satellite, integrated with terrestrial 5G networks, could speed up 5G deployment of 5G in India and UK, and improve remote coverage
- With LEO satellites offering lower cost satellite capacity, direct device-to-satellite capability has the potential improve reach into reach remote areas and improve service accessibility from mobile locations (such as vehicles, trains, boats/ships and planes)

- **Opportunity**
- UK and India investments in OneWeb offer a new satellite platform that could benefit end users and organisations in India, manufacturers in UK and India, and OneWeb itself (filling its capacity)
- Deploy satellite instead of fibre-optic cables/microwave solutions for *some* backhaul
- Leverage existing UK-India expertise in cellular/satellite NB-IoT hybrid solutions for applications such as asset tracking and transportation worldwide
- Develop cost effective, practical solutions for direct device-to-satellite connectivity, and technology for miniaturized direct device-to-satellite solutions
- In addition to fixed, mobile and satellite, hybrid infrastructure could also encompass unmanned aerial vehicles (UAVs), as well as LiFi and Free Space Optical (FSO) - other optical technologies in which UK and India companies have expertise

Project example: Hybrid networks / direct satellite communications

- **Possible project parameters**
- Demonstrator projects in India showing how satellite can be integrated with 5G in different government, military, enterprise and consumer contexts, including direct-to-satellite services from both mobile land and aerial vehicles such as UAVs
- Research into new materials, devices and designs to reduce size and costs of satellite equipment including antennas, baseband equipment, receivers, transmitters and transceivers, as well as handheld equipment for direct-to-satellite, with a clear focus on cost effective mass production
- R&D to prototype and commercialise new technologies in critical areas such as satellite tracking, amplification, beamforming, massive MIMO, RIS for 6G
- Assuring accurate position, timing and navigation (PNT) synchronization across varying networks and architectures
- Collaboration on network automation software to intelligently and automatically route traffic between satellite and 5G networks, between satellite networks, and different types of satellites to support mobility and critical communications

- **Initial steps**
- Map the state-of-the-art for satellite solutions, the value chain, and the respective skills, expertise and project experience of UK and Indian organisations (academics; materials, component and equipment suppliers; systems integrators and service providers), and their learning in important areas, to identify possible cross-over areas, and potential for collaboration
- Introducing those with academic research facilities and personnel to commercial partners who need them (Consider funding for personnel)
- Broker introductions between UK and Indian technology providers with potential system integrators and end-users
    - Perhaps with a focus on vertical-market-oriented solutions, for instance in railway and maritime communications

Project example: Hybrid networks / direct satellite communications

- **Market size indicators**
- The global satellite communication market (equipment and services) was valued at USD 39.14 billion in 2021 and is expected to reach USD 73.72 billion by 2027; registering a CAGR of 11.45% during 2022-2027 *[Mordor Intelligence - https://www.mordorintelligence.com/industry-reports/global-satellite-communication-market]*
- *Cf:* the global satellite communication (services and equipment) market size was valued at USD 66.63 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 9.8% from 2021 to 2028 to reach $137.63 billion. Equipment > 40% of this *[Grand View Research - https://www.grandviewresearch.com/industry-analysis/satellite-communication-market; https://www.grandviewresearch.com/press-release/global-satellite-communication-market]*
- The global satellite communications equipment market is projected to grow from USD 22.0 billion in 2021 to USD 53.7 billion by 2026, at a CAGR of 19.6% *[https://www.marketsandmarkets.com/Market-Reports/satellite-communication-satcom-equipment-market-159285646.html?gclid=EAIaIQobChMInO2on8ff9gIVmuvtCh2KFAPGEAMYAyAAEgILnvD_BwE]*

- **Market size indicators**
- The global satellite communications terminal market is expected to grow from US$ 3,877.1 million in 2021 to US$ 6,030.7 million by 2028; it is estimated to grow at a CAGR of 6.5% during 2021-2028 *[The Insight Partners - https://www.businesswire.com/news/home/20220302005896/en/Satellite-Communication-Terminal-Markets-2021-2022-2028-Growing-Requirement-for-Customized-SATCOM-Solutions-Rising-Adoption-of-Portable-and-Small-SATCOM-Terminals---ResearchAndMarkets.com; https://www.digitaljournal.com/pr/satellite-communication-terminal-market-could-be-worth-us-6030-7-million-by-2028-says-the-insight-partners]*
- The hybrid-satellite cellular terminal market is projected to reach nearly $7 billion by 2031, showing a CAGR of 22.81% in 2021-2031 *[ASDReports - https://exterrajsc.com/hybrid-satellite-cellular-terminal-market-to-reach-6-9-b-by-2031/2021/09/14/]*
- UK satellite communications market (services) 2018 $3.181 bn *[Grand View Research - https://www.grandviewresearch.com/industry-analysis/satellite-communication-market]*

Project example: Hybrid networks / direct satellite communications

- **Market size indicators**
- Telecoms software and services revenue worldwide 2020: $65.8 bn, of which service design and orchestration $14.4% and network automation and orchestration 13.4% from $65.2 billion in 2019 , of which service design and orchestration $14.6% and network automation and orchestration 12.9%. Network automation and orchestration spend grew by 5.1% between 2019 and 2020 to USD8.8 billion. *[Analysys Mason - https://www.analysysmason.com/contentassets/36dc530707184faf9dc07db9f9c61d9c/analysys_mason_software_market_shares_sample_dec2021_rma09.pdf]*
- **Terminal cost trends**
- Starlink terminals cost $1500 to make each (down from $3000). Customers charged $499. *[https://markets.businessinsider.com/news/stocks/spacex-starlink-terminal-cost-spacex-gwynne-shotwell-president-2021-4]*
  - Wants to hit $250-300 but serves consumer customers *[https://www.fiercetelecom.com/telecom/spacex-s-starlink-kickstarts-a-satellite-broadband-market-could-disrupt-telecom-menon]*
- **Terminal cost trends (continued)**
- OneWeb's immediate objective is to cut the India cost of ESAs (electronically steered antenna systems) and DPAs (dual parabolic antenna systems – more expensive - used on ships and oil rigs) by at least 50% before launch in India (scheduled May 2022)
  - Currently one is $1000 – target $500-600 and the other $5000-$6000 – target $2000-2500
  - *[https://m.economictimes.com/industry/telecom/telecom-news/oneweb-in-talks-to-reduce-access-terminal-costs-says-sunil-mittal/articleshow/84130941.cms]*
- OneWeb is planning to develop a domestic satellite services and components ecosystem in India *[https://economictimes.indiatimes.com/industry/telecom/telecom-news/oneweb-to-dot-will-locally-source-develop-key-satcom-equipment-in-india/articleshow/84549237.cms?from=mdr]*
- OneWeb working on flat panel electronically-steered terminal for OneWeb- launched planned Q3 2022

Project example: Optical communications

- **Context**
- The amounts of data being transported continue to grow. Fibre-optic networks are critical for connecting 5G base stations, for core transport networks, within data centres and for increasing broadband speeds in fixed networks
- Technology advances have dramatically increased the capabilities of fibre networks, but further advances are needed
- Both the UK and India have strong optic communications expertise (within academic and enterprise organisations), and potentially complementary skills sets and facilities

- **Opportunity**
- New advances offer the possibility to substantially increase the capabilities of fibre networks, and in doing so create technology and economic advantage for the UK and India, its manufacturers and business users. Reducing background losses in fibre networks, or the commercialisation of new multi-core fibre could offer a step change in the capacity of optic networks
- This is turn would offer the chance to create a new set of UK/India companies and industry based around production of components for multi-core fibre networks
- There is also an opportunity to diversify supply chains by pooling the capabilities of UK and India manufacturers to nurture one or more systems integrators capable of building full fibre solutions in the UK (India already has strong fibre-optic players)
- There is also an opportunity to develop the next generation of lasers and other optical components for network equipment

Project example: Optical communications

- **Possible project parameters**
- Joint R&D projects to:
  - reduce background fibre losses at different wavelengths, with new amplifiers to support those wavelengths
    - What ingredients are needed to improve amplifiers, what designs to make efficient and robust?
  - Development of multi-core fibre employing space division multiplexing, and associated amplifiers, at suitable cost
  - Development of new lasers and other optical components
- Assist India to take advantage of the UK's lab-based knowledge to make the products UK needs
- Specific joint ventures to develop the supply chain of components needed in UK and India
  - Mass manufacturing in a cost-effective way
- Open up the UK to a new system integrator by getting the various components needed for the UK made in India (with final assembly in the UK as well as India)
- **Initial steps**
- Schemes for joint UK and India R&D work, collective teams, and exchange of people (backed by funding)
- Development of working framework, IP etc
- Involvement of commercial organisations and a programme with roadmap to commercialization (move beyond proving concepts in the lab)
  - Including agreement for exclusive production in India/UK? "Only made in UK/India"
- Re: joint supply chain - map optic communications value chain, and players in it to determine what items are needed now to enable the creation of complete solutions, and to see what future technologies offer potential fruitful areas for collaboration

Project example: Optical communications

- **Market size indicators**
- The global market for optical communications and networking equipment was estimated at $18.9 billion in 2020, rising to $27.8 billion by 2025. [Markets & Markets [*https://www.marketsandmarkets.com/Market-Reports/Optical-networking-communications-market-227693036.html*]
- Within that the global market for optical fibre is estimated at $4.5 billion in 2019, rising to $9.5 to $9.7 billion by 2027/28 (9.9-10.3% CAGR depending on source) *[Fortune Business Insights - https://www.fortunebusinessinsights.com/fiber-optics-market-102904 and Verified Market Research - https://www.bloomberg.com/press-releases/2021-11-18/fiber-optics-market-size-worth-9-53-billion-globally-by-2028-at-9-9-cagr-verified-market-research]*
- *Cf.* Mordor Intelligence $9.3 bn in 2020 rising to $20.8 bn in 2026, with 14.5% CAGR *[https://www.mordorintelligence.com/industry-reports/fiber-optic-cable-market]*
- Optical fibre manufacturing in UK worth $639.9 million in 2022, 0.8% CAGR 2017-2022, expected 3.4% CAGR 2022 *[IBISWorld https://www.ibisworld.com/united-kingdom/market-size/fibre-optic-cable-manufacturing/]*
- Optical fibre cables market (spend) in India worth $881.5 million in 2019, forecast $2.1 bn by 2024, 19.7% CAGR 2019-2024 *[Research and Markets - https://www.wirecable.in/2020/08/promising-road-ahead-for-the-indian-optical-fibre-cable-industry/; https://www.businesswire.com/news/home/20191106006049/en/Indian-Optical-Fiber-Cables-Market-Analysis-Forecast-2014-2024---Rising-Investments-in-OFC-Network-Infrastructure-by-the-Indian-Government-to-Increase-Internet-Penetration---ResearchAndMarkets.com]*
- *"2020 to 2030 is the best possible decade for fibre demand".* Global demand for optical fibre cable forecast to rise 8.6% in 2021 to 2022 to 544 mn fibre km, and to rise to 634 mn fibre km in 2026. *[STL Investor Presentation Feb 22- https://www.stl.tech/pdf/STL_Investor_Presentation.pdf]*

Project example: Supply chain diversification

- **Context**
- Economic trends have led to the consolidation of supply chains, with production of key materials and components focused in a select few geographic regions
- Recent health, transportation and geopolitical events have shown that the telecoms supply chains are at risk because of this consolidation
- Work is needed to develop new domestic capabilities (in both UK and India) and new international partnerships with friendly countries (e.g. UK and India)
- Governments in both UK and India are keen to see reinvigoration of domestic capabilities, and improvements to communications supply chain resilience

- **Opportunity**
- Opportunity to collaborate to produce key materials, components and technologies as joint projects
- Prototyping in the UK, mass manufacture in India
- Or..
- The creation of a globally competitive, joint, virtual, vertically integrated company (or partnership sharing IP) involving UK and India companies, with design and manufacturing distributed where it makes technical and commercial sense
- De-risk the supply chain in key areas
- Supply Indian and UK markets, and other countries worldwide, across a wide range of telecoms components

Project example: Supply chain diversification

- **Possible project parameters**
- Assemble consortia of companies that can build components and boxes to reduce reliance on imports from specific countries or regions
- Examples of items:
  - Semiconductors
  - Bare metal switches
  - Optical components
  - ORAN boxes – swap out components for new India-UK ones; very low cost ORAN for Indian market
- Aggregate demand from UK/India companies seeking new suppliers for similar items – to create a ready customer base for UK/India suppliers
- Collaborative project to design and create automated manufacturing capability for critical electronic components and systems

- **Initial steps**
- Seek direction from the two countries' governments about the purpose, extent and length of commitment to collaboration before projects are defined (e.g. sufficient to support fab investments?)
- Identify all elements (software, hardware,….) within the system (decompose the full network)
- Define the value chain for materials, semiconductors, components etc.
- Identify the pinch points – where is supply diversification desirable for buyers and/or government
- Work out who in UK/India either has presence/strengths in each of these areas
- Bring together buyers to quantify potential demand, match common supply needs

Project example: Supply chain diversification

- **Market size indicators**
- India telecom equipment imports: $21 bn in 2018; India telecom equipment exports: $1.2 bn 2018 *[Fierce Wireless - https://www.fiercewireless.com/tech/indian-government-spends-447m-to-propel-its-own-telecom-vendors]*
- Note: India Production Linked Incentive Scheme designed to promote Telecom and Networking Products manufacturing in India. The Union Cabinet approved $1.65 bn in production linked incentives in Oct 2021. *[https://www.ibef.org/industry/telecommunications.aspx]*
- "The PLI will offer incentives worth between 4% to 7% on incremental sales of goods manufactured in India. A company must invest over $400 million in India over four years and export goods worth $133 million annually. The scheme is likely to boost telecom equipment production worth by $32.6 billion (INR 2440 billion) and create 40,000 jobs." *[https://www.fiercewireless.com/tech/indian-government-spends-447m-to-propel-its-own-telecom-vendors]*

- **Market size indicators**
- UK telecom equipment imports $20.38 bn in 2020 *[CEIC Data - https://www.ceicdata.com/en/indicator/united-kingdom/imports-telecommunication-equipment]*
- UK telecom equipment exports $5.31 bn in 2020 *[CEIC Data - https://www.ceicdata.com/en/indicator/united-kingdom/exports-telecommunication-equipment]*
- Indian telecom equipment market size: FY 2020 INR335.8 bn($4.389 bn) *[Statista - https://www.statista.com/statistics/1232421/india-telecom-equipment-market-size/]*
- India telecom equipment imports $7.23 bn 2020 (was reporting 18bn in 2016 and recent dramatic drop) *[CEIC Data - https://www.ceicdata.com/en/indicator/india/imports-telecommunication-equipment]*
- India telecom equipment exports: $3.77 bn *[CEIC Data - https://www.ceicdata.com/en/indicator/exports-telecommunication-equipment]*

Project example: Intelligent surfaces

- **Context**
- The idea of reconfigurable intelligent surfaces (RIS) is that at a physical level, a surface can be configured to scatter RF signals in a specific way to act as an antenna for transmitting or receiving signals of various frequencies
- RIS are expected to be critical for 6G using very high frequencies, particularly to enable indoor coverage
- RIS is at a very early stage of R&D – far from being commercialized. Fundamental R&D is required now in order to create the intellectual property underpinning future commercial products and solutions

- **Opportunity**
- There are opportunities for new products in green communications and IoT. There is huge market potential for IoT devices that use RIS to make them passive and unpowered (using energy harvesting)
- There is potential to develop all the components and technologies, and the manufacturing processes that would be needed to incorporate RIS into networks
- Potential for UK/India collaboration to open up market leadership, product and service opportunities

Project example: Intelligent surfaces

- **Possible project parameters**
- Testing use of semiconductors and new metamaterials for RIS
- Evaluate active vs passive RIS approaches for 6G
- Develop smart antenna concepts with RIS
- R&D into printed electronics to underpin RIS
- R&D projects to identify, test and develop new manufacturing processes
- Build test beds to evaluate technologies, approaches, and their impact on capacity, and coverage
- Evaluate applications targeted at specific use cases – e.g. vehicle antenna assemblies using RIS for satellite connectivity; or RIS for large surfaces
- Create centres of excellence; involving big companies and start-ups, as well as academic / state institutions

- **Initial steps**
- Explain what RIS can do to companies thinking about future applications for next-gen networks (cellular and satellite)
- Match those with understanding of materials, multiple semiconductor technologies, physical layer and RF engineering, system and use case design with partners that have ideas for potential commercial products and services
- Identify vertical application areas – e.g., healthcare, agriculture, smart cities, transport – where a 5G use case (involving high bandwidth and low latency) and a solution to deliver it could be developed; and then develop that use case for 6G technologies such as intelligent reflective surfaces

Project example: Intelligent surfaces

- **Market size indicators**
- The overall smart surface market is poised to exceed $100 billion by 2026…Smart surface solutions in support of 6G networks and devices will reach $16 billion by 2035 *[https://www.globenewswire.com/news-release/2022/02/04/2379174/28124/en/Global-Smart-Surface-Market-Report-2021-2026-Network-Optimization-for-5G-and-Beyond-will-Rely-Upon-the-Smart-Surfaces-Market.html]*
- https://www.prnewswire.com/news-releases/printed-electronics-for-6g-smart-surfaces-everywhere-idtechex-explores-301245841.html

Project example: Cyber security

- **Context**
- There is increasing realization that failures to protect electronic issues could lead to major security problems. IoT is proliferating, everything is connected, critical systems are monitored and controlled from the cloud. AI and automation enable increasingly sophisticated attack methods
- Current security systems are based on the premise of protecting existing systems and providing a layer of protection to paper over inherent weaknesses – point of use systems, applying patches, tools and best practices to ensure security – adding software to software to try to add security
- Software execution on hardware has been the same for decades; nothing has been done to alter known weaknesses (such buffer overflows, memory exploitation and leakage). A new approach involves altering this and 'fixing the foundations' as opposed to applying best practices and fixes - protecting systems by design
- At the same time, use of AI as well as advanced encryption can add a new layer of protection on top
- **Opportunity**
- The secure design landscape encompasses the supply chain (covered by another project topic) as well as secure design of hardware and software systems
- There is an opportunity to look at the future and devise better ways to safeguard systems, by building on existing architectures but radically updating them to be more secure
- This will in turn enable UK and India to ensure critical areas of government and enterprise are more secure
- The development of new security approaches would open up many new international export opportunities – covering everything from chips through to the systems and software using them

Project example: Cyber security

- **Possible project parameters**
- Build on respective capabilities, such as in the areas of:
  - Secure design methodologies (such as the Morello CHERI architecture)
  - QKD for secure optical networks
  - Real-time RF signal analysis to identify and mitigate RF security threats
  - ML and AI to identify and mitigate security threats
  - Hardware root of trust (RF chipsets)
  - Accurate time and frequency measurement
- Partnerships to improve and commercialise technologies being currently developed in UK and India
- R&D projects to combine multiple innovative approaches to increase security in specific use cases
- Joint projects to demonstrate security benefits in different use cases, including analysis of impact on performance
- India/UK joint ventures to commercialise the IP

- **Initial steps**
- Understand respective approaches – is the emphasis on point of use, best practice and patches, or security by design? What is the policy and direction of travel? Are definitions aligned?
- Understand the landscape – what does each side have to offer? Where are the overlapping areas?
- What are the respective models for getting concepts from universities into spin-outs/commercial organisations?
- Agree what UK and India are willing to share
- Meetings of global experts to discuss possible areas of collaboration, followed by meetings with a wider group of potential participants, leading to…feasibility, proof of principle, and proof of concept studies.

Project example: Cyber security

- **Market size indicators**
- The global cyber security market size (hardware and services) was valued at USD 167.13 billion in 2020 and is expected to register a CAGR of 10.9% from 2021 to 2028. *[Grand View Research - https://www.grandviewresearch.com/industry-analysis/cyber-security-market]*
- The global network security market was valued at $18.48 bn in 2019 and is projected to reach $63.40 billion by 2027, registering a CAGR of 16.7% from 2020 to 2027 *[Allied Market research - https://www.alliedmarketresearch.com/network-security-market-A10606]*
- *Cf*. The global network security market size was $24.9 bn in 2020. The market is projected to grow from $27.4 bn in 2021 to $60.4 bn in 2028 at a CAGR of 12.0% *[Fortune Business Insights - https://www.fortunebusinessinsights.com/industry-reports/network-security-market-100339]*
- The worldwide market for Quantum Key Distribution (QKD) will near $1.4 billion in 2027 and then go on to around $3.4 Billion by 2030 *[Inside Quantum technology - https://www.prnewswire.com/news-releases/inside-quantum-technology-research-latest-report-projects-revenues-from-quantum-key-distribution-to-reach-almost-1-4-billion-by-2028--301444023.html]*

- **Market size indicators**
- Note: “In October 2021, Telecom Secretary Mr. K. Rajaraman inaugurated the Quantum Communication Lab at the Centre for Development of Telematics (C-DOT), Delhi, and unveiled the indigenously developed Quantum Key Distribution (QKD) solution by C-DOT. QKD can support a distance of >100 kms on standard optical fibre.” *[https://www.ibef.org/industry/telecommunications.aspx]*
- The global network encryption software / solution market is valued at around USD3bn annually, and this is growing at between 10% and 17% annually (CAGR 2019-25/26) and may reach USD5.8bn by 2026. The total includes the market for enterprise and service provider solutions (the telecom and IT end user segments account for around 40% of the total market; on-premises solutions account for around two thirds of the total (the rest is cloud-based solutions). *[Grand View Research - https://www.grandviewresearch.com/industry-analysis/encryption-software-market]*

Project example: Cyber security

- **Market size indicators**
- The Indian cybersecurity services Industry grew from USD 4.3 Bn in 2019 to USD 8.46 Bn in 2021
- Indian cybersecurity products grew from USD 740 Mn in 2019 to reach USD 1.37 Bn in 2021
- Indian cybersecurity start-ups grew from USD 740 Mn in 2019 to reach USD 1.37 Bn in 2021
- Cyber security services workforce in India in 2021: 218,000, products security workforce in India ~27000 employees.
- India cybersecurity customer spending $2.087 bn
- *[Data Security Council of India (DSCI) - https://www.dsci.in/content/india-cybersecurity-industry-2021]*

- **Market size indicators**
- UK cybersecurity industry – 46,683 employees (65% employed by companies >250 employees), 1483 firms. The sector's total annual revenue has continued to rise (by 7 per cent), reaching £8.9 billion within the most recent financial year *[UK government –*
- *https://www.gov.uk/government/news/record-year-for-uks-89bn-cyber-security-sector]*