NTN TECHNOLOGY DEMONSTRATIONS BETWEEN THE EUROPEAN SPACE AGENCY (ECSAT, UK) AND INDIA

FACILITATED BY THE
EPSRC UK-INDIA FUTURE NETWORKS INITIATIVE
AND SUPPORTED BY
INDIAN INSTITUTE OF SCIENCE (IISc) BANGALORE
BHARAT 6G ALLIANCE
and
CENTRE FOR DEVELOPMENT OF TELEMATICS- C-DOT

Lead Facilitator: Professor Gerard Parr

g.parr@uea.ac.uk

PI- EPSRC UKI-FNI Project
https://www.ukifni.org/
Chair in Telecommunications Engineering
University of East Anglia
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g.parr@uea.ac.uk

Project Partners:-

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1. Introduction

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The UK-India Future Networks Initiative (UKI-FNI), led by the University of East Anglia in Norwich, UK and sponsored by the UK Engineering and Physical Sciences Research Council (EPSRC), has been supporting cutting-edge research into next-generation telecoms and exploring innovations in the technologies required for connectivity and services that will support the Future
Internet. The UKI-FNI project, collaborating with scientists, policy makers and engineers in UK and India, has also helped shape a joint India-UK vision for a collaborative research strategy for the future integration of terrestrial and non-terrestrial telecoms networks, covering next generation wireless communications-6G, optical, sub-sea and satellite systems. The strategy also investigates their security management in support of a range of applications and Network-enabled AI Services.

Led by Professor Gerard Parr of the University of East Anglia (UEA) in Norwich UK, the UKI-FNI project brings together leading researchers from University of Surrey (Professor Rahim Tafazolli), University of Southampton (Professor Lajos Hanzo), University College London (Professor Steve Hailes) , and King's College London (Professor Toktam Mahmoodi), alongside key partners
from the Indian Institute of Science (IISc) Bangalore (Professor Rajesh Sundaresan)
and the Indian Institute of Technology (IIT) Delhi (Professor Subrat Kar).

Part of the work of the UKI-FNI project has established links with the main Telecoms industry cluster group in India called the Bharat 6G Alliance and also the European Space Agency based in Harwell, Oxfordshire. Both the EPSRC UKI-FNI Project and the European Space Agency (ESA) have a Memorandum of Understanding with the Bharat6G Alliance team to collaborate for 5G/6G technology including Non-Terrestrial Networks. ESA's Space for 5G/6G programme forms part of the Directorate of Connectivity and Secure Communications. Sitting within ESA's Advanced Research in Telecommunications Systems (ARTES) as a strategic programme line, it is responsible for demonstrating the essential nature of satellites for 5G and 6G, working with partners to set the standards and frameworks for hybrid and downstream interoperability.

The Bharat 6G Alliance (B6GA) is a multi-stakeholder national platform established in 2023 by the Government of India under the Bharat 6G Mission to enable India's leadership in 6G telecommunications technologies. The Alliance brings together industry, startups, academia, research institutions, telecom service providers, and standards organisations. It aims to collaboratively advance research, innovation, standardisation, manufacturing, and global partnerships for 6G. It also serves as India's principal industry-academia coordination platform for shaping global 6G development and ensuring India's meaningful participation in future telecom standards.

2. Linking with European Space Agency and Nokia

In recent months, the UKI-FNI Project, European Space Agency (ESA), together with partners, have been exploring closer collaboration for the establishment of unique trials and experiments between the UK and India connecting 5G Network testbeds via Satellite Communications. In late 2025, a plan was put in place to facilitate direct links between the EPSRC UKI-FNI 5G Testbed based at IISc Bangalore and ESA's 5G/6G Hub in Harwell, UK via a satellite 5G connection.

In collaboration with C-DOT and the Bharat6G Alliance, the UKI-FNI Team also identified a further opportunity to link a remote rural village called Satnavri close to Nagpur in the centre of India to the UK via Satellite for the purposes of additional trials.

Interestingly, the collaboration plan that was developed leveraged ESA's previous satellite demonstration experience with Nokia in Finland and their latest hi-resolution digital camera technology. The use-case identified was Telemedicine for skin-cancer detection and was conducted under strict data privacy and ethics protocols managed by ESA in Harwell, UK.

The technology from Nokia related to their Real-time eXtended Reality Multimedia (RXRM) immersive system which is AI-enhanced and satellite-adapted technology that uses 360-degree video and spatial 3D audio to provide remote, real-time monitoring of critical infrastructure, industrial environments, and telepresence. Supported by the European Space Agency (ESA) and the UK Space Agency (UKSA), it leverages 5G/6G and satellite connectivity to enable remote operation, reduce costs, and enhance safety in isolated areas.

Speaking of the collaboration between ESA and the UKI-FNI project, **Professor Gerard Parr**, **PI of the UKI-FNI** project commented:-

"*The UK-India Future Networks Initiative leverages a long track record of collaboration between the UK and India in Digital Technologies and Telecoms dating back 20 years. Interestingly, members of the current UKI-FNI team were involved in establishing the first joint Centre of Excellence in ICT between both countries. It is now well recognised that cG, Optical and Satellite Communications are strategically important to supporting the digital applications and services that the economy and wider society of India and the UK depend. The importance of Non-Terrestrial Communications has gained increasing attention in recent years where satellite connectivity can provide greater spatial coverage and Internet access across rural and remote areas, direct to hand-held devices and fixed-mobile sensors in connected vehicles, supply chain objects, etc.*

I am delighted with the support we have received from EPSRC and the amazing profile our project has gained. Our team are excited to be working with our partners in India and ESA and look forward to developing future collaborations"

Antonio Franchi – Head of 5G Strategic Programme at ESA in Oxford stated:

"This collaboration demonstrates how satellite-enabled 5G, and future cG, can seamlessly extend terrestrial networks across continents. By linking ESA's 5G/cG Hub in Harwell UK with leading Indian testbeds, we are proving the real-world value of integrated terrestrial and non-terrestrial networks, from telemedicine to smart villages, and reinforcing ESA's commitment to making satellites a core, interoperable component of future global connectivity."

Natalie Alves – 5G/6G Hub Coordinator at ESA commented:

"*The ESA 5G/cG Hub was designed to enable exactly this kind of international experimentation. Supporting live telemedicine and Smart Village demonstrations between India and the UK highlights how hybrid terrestrial-satellite networks can deliver secure, reliable connectivity for real societal impact, and we look forward to expanding these cross-border trials further.*"

In addition to the IISc Bangalore- ESA trial, the opportunity for further Telemedicine experiments was identified to also link the village of Satnavari in rural Nagpur, Maharashtra (India) to the ESA 5G/6G Hub in Harwell via Satellite. Satnavari is at the forefront of India's rural digital transformation programme and was selected under a Maharashhtra state-backed pilot project to become the nation's first '**Smart Intelligent Village'**. The initiative integrates advanced technology into daily rural life, covering agriculture, education, healthcare, governance, and finance. This project reflects a new model for holistic rural development using modern digital tools.

3. Technology Trials Demo 1- IISc Bangalore to UK

With the support and facilitation of the UKI-FNI project led by Prof Parr, ESA, Nokia and IISc Bangalore conducted a successful demonstration showcasing a telemedicine use-case. The telemedicine trial took place over an integrated satellite–5G network, connecting India and the United Kingdom. This demonstration focused on validating the feasibility of real-time, high- resolution remote medical consultation using hybrid terrestrial and non-terrestrial networks, leveraging Nokia's Real-time eXtended Reality Multimedia (RXRM) solution.

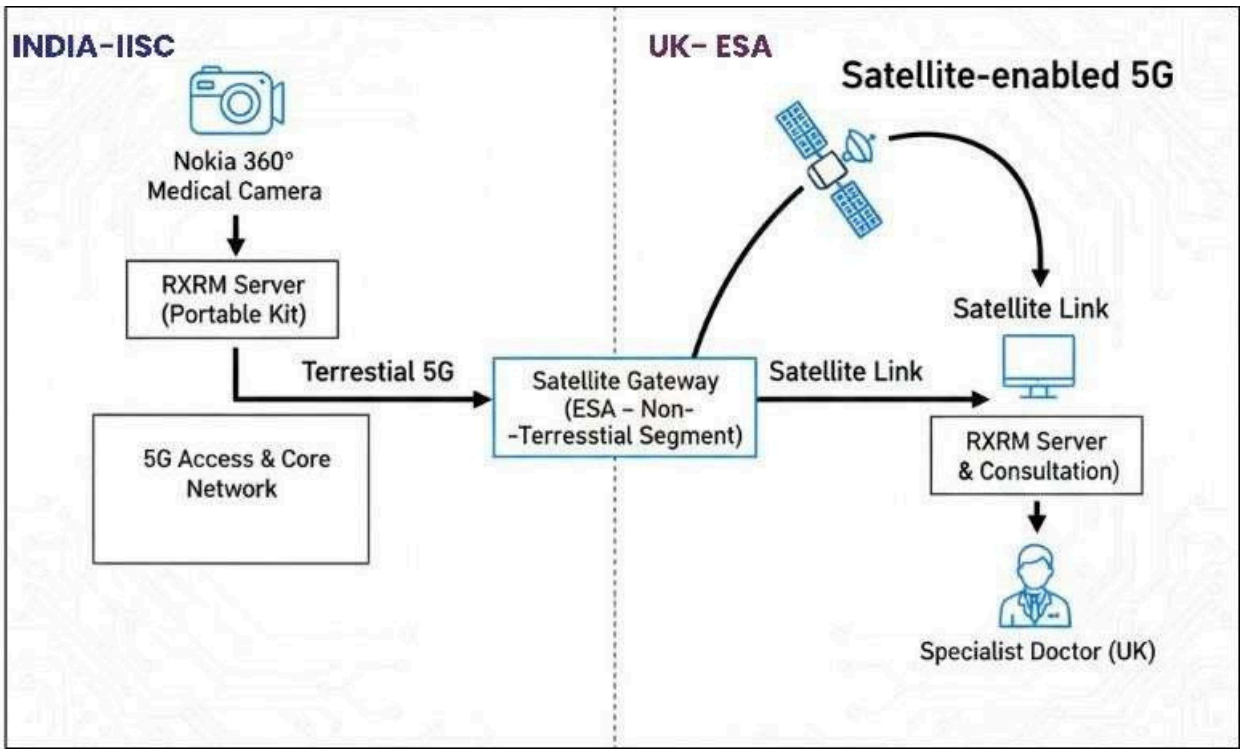

Figure 1- Basic Setup for the IISc-ESA Trials

A remote specialist doctor was located at the ESA 5G/6G Hub in Harwell in the United Kingdom. The "patient-side" setup was established at the Indian Institute of Science (IISc), Bangalore, India. The demonstration was operated over satellite-enabled 5G connectivity, enabling reliable long- distance, real-time communication. A Nokia 360° high-resolution medical camera was also deployed at the IISc site and managed by Nokia to capture and transmit live medical imaging of the patients skin supporting accurate remote assessment by the specialist doctor.

Speaking of the demonstration at IISc Bangalore **Professor Rajesh Sundaresan (Dean) and Professor Chandra Murthy** stated:

"The demonstration of remote medical tele-consultation over an integrated terrestrial and non- terrestrial (satellite) 5G network by IISc, ESA, and UKIFNI unequivocally establishes that anytime, anywhere medical assistance by the best doctors worldwide is now feasible. It is especially heartening that even demanding use cases, such as those involving a 3c0° high-resolution medical camera, work seamlessly over the integrated network. We are thrilled to see the working technology and excited to explore further use cases in the future".

Figure 2- Photo- Nokia's Real-time eXtended Reality Multimedia (RXRM) solution and a Nokia 3C0° high-resolution medical camera at IISc Bangalore

Johns Davis from Nokia Networks in Finland commented :

"It was remarkable to see how the Nokia RXRM solution with Nokia 5G 3c0 camera, connected through private 5G infrastructure and satellite links across Finland, could deliver a live medical view to a specialist in the UK. This exercise demonstrated how advanced connectivity technologies can enable real-time healthcare collaboration across continents."

4. Technology Trials Demonstration 2: Smart Village and Tele-Applications Demonstration from Satnavari (Nagpur, India) to ESA (Harwell)

As part of the collaborative activities between the Bharat 6G Alliance (B6GA) and The UKI-FNI Project, Demonstration 2 was conducted to showcase India's Smart Village deployments at Satnavri in the State of Maharashhtra. This demonstration focused on presenting multiple real-world applications running over Bharat Net Internet and 4G/5G connectivity, integrated and monitored through a centralised Common Dashboard supported by Centre for Development of Telematics (C-DOT) Research.They are designed to support the implementation of bespoke use cases such as remote healthcare, remote surgery, robotics and autonomous systems. The demonstration linked the Satnavri Common Dashboard via satellite to ESA's 5G Testbed in Oxford and highlighted how NTN connectivity can enhance access to critical services, contributing to improved quality of life and digital inclusion.

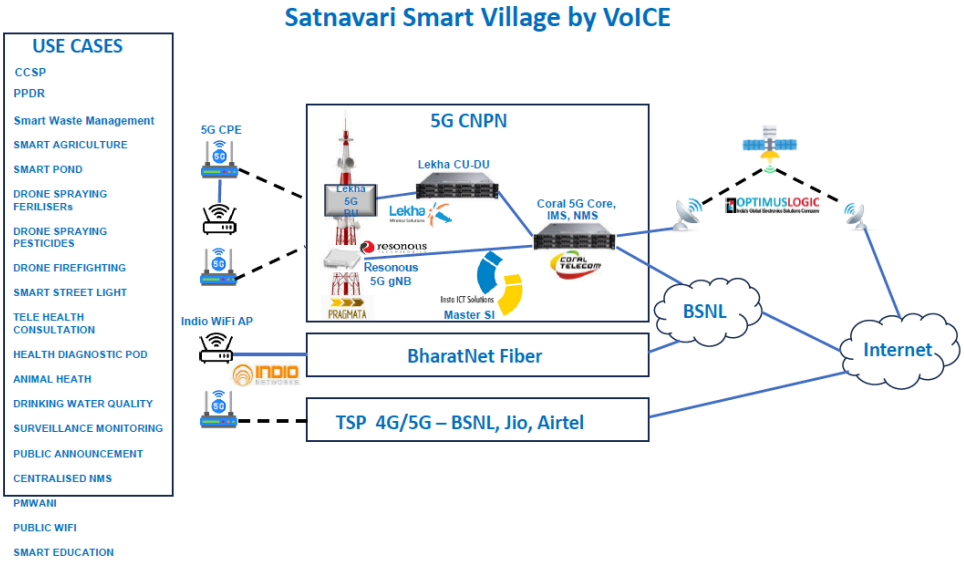

Figure 3- Smart Village Applications Portal in Satnavari

Prof. R. David Koilpillai, Chairman, Bharat 6G Alliance (B6GA) commented:

"*The successful demonstration of the Satnavari Smart Village is a landmark achievement in our journey toward ubiquitous, affordable and sustainable development of technology for societal applications. By bridging rural India with global innovation hubs like ESA Harwell, we have proven that the fusion of indigenous 5G networks, BharatNet internet connectivity and advanced satellite connectivity can dismantle the digital divide. This isn't just a technical pilot; it is a blueprint for providing secure, high-speed, and life-saving services like remote healthcare to every citizen, no matter how remote their location.*"

Executive Vice President of C-DOT, the Indian Govt National Telecoms Lab- **Dr Dilip Krishnaswamy** commented:-

"*At C-DOT, we are on a mission to pursue cG Innovations to enable ubiquitous coverage to connect the unconnected. In this regard, we are working on non-terrestrial networking technologies with minimalistic satellite orbital configurations to serve a country and developing novel terrestrial solutions to improve coverage in connectivity-challenged areas. We are also working on platforms to provide edge services in villages to support diverse IoT data streams, and to support data fusion and AI-based solutions for such streams".*

Dr Krishnaswamy continued:

"It has been exciting to work with the UK-India FNI (Future Networks Initiative) team and the European Space Agency to enable intercontinental connectivity through space to reach remote communities in a village such as Satnavari in Maharashtra, and to enable telemedicine use-cases with live patient-doctor interactions across countries. We hope to explore additional use-cases such as tele-education and inter-community interactions across nations. Technology is taking great strides towards bridging the digital divide and to bring nations together to pursue common goals for the upliftment of society and collectively, in the UK-India FNI community and in collaboration with the ESA, we hope to make a difference in this regard."

The Smart Intelligent Village project is harnessing potential of IoT devices and Artificial Intelligence for Smart Use Cases providing services starting from passive infra and Wi-Fi mesh for RF connectivity. It will support agriculture diagnostics, irrigation management, and diagnostics for water health, cattle health, and medical for villagers C a remote medical advisory with prescriptions, providing Internet educational services to the village students. Other services relate to measuring soil health and use of drones for fertilisers C pesticide spraying. These solutions are delivered by a range of s startup and under the VoICE consortium.

Rakesh Kumar Bhartnagar, Director General of VoICE stated:

"VoICE (Voice of Indian Communication Technology Enterprises), was established in 2022 to bring together India's small, medium, and large telecom enterprises under a unified vision — to accelerate technology adoption and build a truly Atma Nirbhar (self-reliant) telecom ecosystem. In a short span, this collaborative platform has translated that vision into action.

Through indigenous 4G/ 5G and NTN technologies powered by BharatNet OFC connectivity, Satnavari village in Maharashtra has been transformed into a living model of a Smart Village. From digital governance and tele-health to connected agriculture, education, and mobility, technology is enabling measurable improvements in quality of life while fostering a sustainable rural economy aligned with the Sustainable Development Goals of the ITU and the United Nations.

The Satnavari model demonstrates that telecom-led digital transformation can increase rural incomes, reduce migration pressures on cities, and preserve the cultural fabric of our villages. I believe this scalable, inclusive framework can serve as a global template for building sustainable, technology-driven rural ecosystems."

5. Planning Ahead

At time or writing, members of the UKI-FNI Team are preparing to visit IISc Bangalore and also the Satnavari Smart Village in Maharashtra in April 2026. Whilst there, the team will explore future enhancements to the trials and experiments recently conducted to investigate issues such as systems performance, scalability and resilience . It is also expected that the team will investigate additional use-cases, e.g. use of Terrestrial and Non-Terrestrial Telecoms integration in support of Disaster Management, Environmental Monitoring as well as Secure Supply Chains. In so doing, it is hoped that lessons can be learned that can be taken back to the UK.

It is also intended that the UKI-FNI team will explore next steps in the highly successful Faculty Development Programme that was run by IISc Bangalore as part of the British Asian Trust CSR initiative with BT Group India to promote Cyber Security Skills for Women. Future technical workshops and visits will take place between UK and India during 2026 and 2027 to identify further opportunities to collaborate and learn from each other.

Acknowledgements:

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Further Information for Interested Parties (items 1-G):

1. UK-India Future Networks Initiative
   https://www.ukifni.org/
   Main Contact- Professor Gerard Parr (g.parr@uea.ac.uk)

2. ESA: ESA - Connectivity and Secure Communications

3. IISc Bangalore- EECS- https://eecs.iisc.ac.in/

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