5G INNOVATION HACKATHON 2025

WINNERS' COMPENDIUM

Winners were awarded during IMC 2025 on

📅 9 October 2025

📍 Yashobhoomi, New Delhi

Department of Telecommunications (DoT)

National Communications Academy – Technology (NCA-T), Ghaziabad

PREFACE

The 5G Innovation Hackathon 2025 marks a significant milestone in India's journey toward fostering indigenous innovation and advancing next-generation communication technologies. Conceived under the "Competition Framework" of the Department of Telecommunications (DoT), Government of India, the Hackathon was designed to provide a national platform for students, startups, and researchers to develop and demonstrate 5G-enabled solutions addressing real-world challenges.

The Hackathon was launched on 15th March 2025 and concluded on 1st October 2025, following a structured and transparent multi-stage evaluation process. During the proposal submission window from 15th March to 29th April 2025, a total of 1018 proposals were received from across 100 5G Use Case Labs established in premier academic institutions across the country. Of these, 348 proposals were shortlisted at the institutional level for the regional stage.

In the second-level evaluation, the Regional Committees reviewed these submissions and shortlisted 183 proposals for consideration by the National-level Technical Expert Evaluation Committees (TEECs). The national evaluation, which included detailed presentations by the applicants, resulted in the selection of 47 proposals. Subsequently, these 47 teams received seed funding of ₹1 lakh each to further develop their prototypes.

The final phase of the Hackathon involved detailed physical demonstrations of these 47 prototypes before two expert committees —

▷ National Communications Academy – Technology (NCA-T)- Ghaziabad (15th–19th September 2025) for Northern and Eastern region.
▷ Indian Institute of Science (IISc), Bangalore (22nd–26th September 2025) for Southern and Western region.

Following the evaluations, 3 teams were awarded in the Startup/MSME category, 4 teams in the Academia/Student category, and 4 teams were recognized for the Best Idea Award.

The 5G Innovation Hackathon 2025 exemplifies the collective vision of the Department of Telecommunications to translate research and creativity into implementable, scalable, and sustainable innovations. The active participation of the 5G Use Case Labs — established in 100 academic institutions across the country — has provided a robust ecosystem for experimentation, learning, and collaboration among academia, startups, and industry.

The Hackathon not only showcased India's talent in harnessing 5G for social and industrial transformation but also laid the groundwork for advancing toward the Bharat 6G Vision and realizing the national aspiration of "Viksit Bharat @ 2047."

This Winners' Compendium celebrates the creativity, commitment, and collaboration of all participants, mentors, and partner institutions whose efforts made this initiative a success. It stands as an inspiration for innovators across the country to continue exploring new frontiers of technology and contribute to India's leadership in global telecommunications.

National Communications Academy – Technology (NCA-T)
Department of Telecommunications, Government of India
Ghaziabad | October 2025

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भारत सरकार

DR. PEMMASANI CHANDRA SEKHAR
HON'BLE MINISTER OF STATE FOR
COMMUNICATIONS AND MINISTRY OF RURAL DEVELOPMENT
GOVERNMENT OF INDIA

MESSAGE FROM
HON'BLE MINISTER OF STATE FOR MINISTRY OF COMMUNICATIONS AND MINISTRY OF RURAL & DEVELOPMENT

It gives me immense pleasure to present this compendium featuring the winners and innovators of the 5G Innovation Hackathon 2025, an initiative of the Department of Telecommunications (DoT), Government of India.

This Hackathon reflects the remarkable energy and creativity that define India's new generation of innovators. The overwhelming participation from students, academicians, startups, and entrepreneurs across the country is a testament to the nation's growing confidence in its capability to design and build indigenous solutions for the connected future.

As India takes firm steps toward realizing its "Bharat 6G Vision," the outcomes of this Hackathon assume great significance. Each project showcased in this booklet—ranging from 5G-based emergency connectivity and remote healthcare, to AI-driven security systems, agricultural innovations, and quantum-enhanced optimization—demonstrates the transformative potential of next-generation communication technologies when combined with ingenuity and purpose.

I am particularly encouraged to see that our 5G Use Case Labs, established in 100 academic institutions across the country, have become vibrant centers of experimentation and research. These labs are not just fostering technological innovation but are also nurturing a spirit of collaboration between academia, startups, and industry, laying the foundation for a self-reliant and globally competitive India in the telecom domain.

I take this opportunity to commend all the participants, mentors, and institutions who contributed to the success of this Hackathon. My heartfelt congratulations to the winners and special mention awardees whose ideas truly embody the spirit of Digital India and Atmanirbhar Bharat.

Let this compendium serve as a source of inspiration for our young innovators to continue pushing the boundaries of technology and contribute meaningfully to India's journey from 5G to 6G. I congratulate the team of National Communications Academy-Technology, Department of Telecommunications in preparing this compendium which will serve to motivate the students and start-ups working in the 5G Use Case labs across the country to think and innovate the products and help in the vision of our Honorable Prime Minister of "Viksit Bharat by the year 2047".

With visionary leadership, collective effort, and a deep sense of national purpose, India is poised not only to adopt the technologies of the future but to define them.

(DR. PEMMASANI CHANDRA SEKHAR)
HON'BLE MINISTER OF STATE FOR
MINISTRY of COMMUNICATIONS
AND MINISTRY OF RURAL DEVELOPMENT
GOVERNMENT OF INDIA

डॉ. नीरज मित्तल , भा.प्र.से.
सचिव (दूरसंचार)
दूरसंचार विभाग, भारत सरकार

DR. NEERAJ MITTAL, I.A.S.
SECRETARY (TELECOM)
DEPARTMENT OF TELECOMMUNICATIONS,
GOVERNMENT OF INDIA

MESSAGE FROM SECRETARY (T)

The 5G Innovation Hackathon 2025 stands as a testament to India's growing strength in the field of next-generation communication technologies and its deep-rooted culture of innovation. This initiative, led by the Department of Telecommunications, was envisioned as a platform to harness the collective creativity of students, researchers, startups, and enterprises from across the nation.

The Hackathon was designed not merely as a competition, but as a catalyst for transforming ideas into implementable solutions. Through multiple stages of evaluation, mentoring, and technical validation, the event encouraged participants to explore the limitless possibilities of 5G technology and beyond — from Non-Terrestrial Networks and Smart Manufacturing to Connected Healthcare, Quantum-Enhanced Optimization, and Secure Network Architectures.

What truly makes this initiative special is its strong academic-industry-government collaboration. The participation of over a hundred 5G Use Case Labs, established across premier institutions under the DoT's guidance, provided a fertile ground for experimentation and prototype development. These Labs have become vibrant centers of applied learning, nurturing innovation while bridging the gap between theoretical research and real-world deployment.

The shortlisted and winning ideas showcased in this compendium reflect the extraordinary potential of Indian innovators to address challenges that are uniquely national and simultaneously global in relevance. The spirit of inquiry, innovation, and excellence demonstrated by all participants reaffirms our commitment to build a self-reliant and globally competitive telecom ecosystem.

As India advances confidently towards the Bharat 6G Vision, initiatives like the 5G Innovation Hackathon underscore our readiness to lead in defining the technologies of tomorrow. I congratulate all the winners, mentors, and institutions whose passion and dedication made this journey possible. I also acknowledge the efforts made by National Communications Academy-Technology for providing the mentoring support to the teams of 5G Innovation Hackathon, evaluating their performance and arranging the final physical demo at NCA-T and adjudging the winners under various categories and bringing out this compendium.

This compendium is both a recognition and a reminder — that India's innovation story is accelerating, powered by its youth, guided by vision, and driven by purpose.

(Dr. Neeraj Mittal)
Secretary (Telecom)
Department of Telecommunications
Government of India

अतुल सिन्हा , महानिदेशक,
राष्ट्रीय संचार अकादमी-प्रौद्योगिकी,
गाज़ियाबाद
दूरसंचार विभाग, भारत सरकार

ATUL SINHA, DIRECTOR GENERAL
NATIONAL COMMUNICATIONS ACADEMY-
TECHNOLOGY, GHAZIABAD
DEPARTMENT OF TELECOMMUNICATIONS,
GOVERNMENT OF INDIA

MESSAGE FROM DG (NCA-T)

It gives me immense satisfaction to share this compendium of the 5G Innovation Hackathon 2025 Winners, developed with the efforts of Wireless Access division of National Communications Academy – Technology (NCA-T), Ghaziabad.

The Hackathon represents the spirit of collaboration, creativity, and applied innovation that forms the cornerstone of India's digital transformation journey. It has provided a vibrant platform for students, academicians, startups, and innovators from across the country to demonstrate their ability to use 5G and emerging technologies to address real-world challenges.

Through this initiative, the Department sought to strengthen the link between research, innovation, and implementation. The diversity of ideas showcased — from AI-driven healthcare and precision agriculture to quantum optimization, intelligent transport, and non-terrestrial connectivity — reflects the broad potential of India's young innovators in shaping the nation's digital future.

The 5G Use Case Labs, established in 100 premier academic institutions, have played a pivotal role in nurturing these ideas. They have become active centers for experimentation, knowledge exchange, and innovation, enabling participants to develop solutions that can be scaled across sectors.

NCA-T, as the capacity-building arm of DoT, has been privileged to facilitate knowledge dissemination, training, and coordination among these institutions. I would commend the contributions made by Shri Rajesh Gupta, Deputy Director General (Wireless Access Division) in NCA-T and Shri R P Singh and Shri Atul Joshi, Directors in WA division for mentoring the 5G Innovation Hackathon teams, evaluating their performance and arranging the demos during the final evaluations at NCA-T and providing the necessary feedback and rankings to the DoT HQs for the best ideas and winners of the 5G Hackathon during June 2025 to October 2025. We remain committed to supporting similar initiatives that bridge the gap between academic research, policy, and industrial application — laying the groundwork for India's 6G-ready ecosystem.

I extend my heartfelt congratulations to all the winners, mentors, and participating institutions for their outstanding efforts and innovative spirit. Their contributions are a testament to India's talent, determination, and technological capability.

I also take this opportunity to thank all the participants and partner organizations for their guidance, support, and trust in NCA-T's mission. May this compendium inspire more young minds to innovate fearlessly and contribute to India's emergence as a global leader in telecommunications technology.

(Atul Sinha)
Director General NCA-T
Department of Telecommunications
Government of India

राजेश गुप्ता
उप महानिदेशक (वायरलेस एक्सेस)
राष्ट्रीय संचार अकादमी-प्रौद्योगिकी ,
गाज़ियाबाद
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FOREWORD

It gives me great pleasure to present this compendium on the 5G Innovation Hackathon 2025 Winners, showcasing the creativity and determination of India's young innovators who are shaping the future of communication technology.

The Department of Telecommunications launched this Hackathon with the objective of encouraging practical, problem-driven innovation in the field of 5G and beyond. Through multiple stages of screening, mentoring, and technical evaluation, the event has brought forth some of the most promising ideas addressing challenges across diverse sectors — healthcare, agriculture, security, manufacturing, and transportation.

The success of this initiative is deeply linked with the 5G Use Case Labs established in 100 academic institutions across the country. These labs have provided the perfect ecosystem where innovation meets real-world application. It is inspiring to see how faculty and students are jointly working on ideas that will have a meaningful impact on India's technological landscape.

This compendium not only celebrates the winners but also reflects the spirit of collaboration among academia, industry, and government — the very foundation on which India's Bharat 6G Vision is being built. The innovations highlighted here exemplify how our nation's talent can drive global leadership in next-generation networks.

I convey my sincere appreciation to all participants, mentors, evaluators, and institutions whose hard work and commitment made this Hackathon a resounding success. My congratulations to the winners for their pioneering ideas, which have the potential to inspire many more innovators across the country. I also thank the DoT HQ for awarding the opportunity to NCA-T for evaluating the performance of the participating teams and physical demonstrations planned at NCA-T. The whole team of Wireless Access Division at NCA-T has been benefited directly and indirectly through the process which will help in expanding the lab facilities at NCA-T and organizing such events at NCA-T.

As India transitions from 5G to 6G, initiatives like this Hackathon will continue to play a vital role in nurturing a culture of innovation and self-reliance.

(Rajesh Gupta)
Chairman (TEEC- North and West)
for 5G Innovation Hackathon, 2025
Deputy Director General (Wireless Access)
NCA-T , Department of Telecommunications

GLIMPSES OF AWARD DISDTRIBUTION CEREMONY DURING IMC 2025

09th OCT, 2025

GLIMPSES OF
PROPOSALS EVALUATED AT TECHNOLOGY NATIONAL COMMUNICATIONS ACADEMY – GHAZIABAD

GLIMPSES OF
PROPOSALS EVALUATED
AT INDIAN INSTITUTE OF SCIENCE, BANGALORE

5G INNOVATION HACKATHON 2025

FINAL HACKATHON WINNERS

Winner/ Runner-up in Student/Academia Category

S. No.	Final/Rank	Proposal/ Project Description	Institute	Page No.
01	Winner	Drone-Based 5G Non-Terrestrial Network for Dynamic, On-Demand and Emergency Connectivity (Project ID: HAC-2025-0407).	Vellore Institute of Technology, Chennai	09
02	1st Runner Up	TouchWords : Empowering Braille Education through 5G Connectivity (Project ID: HAC-2025-0547).	Thapar Institute of Engineering and Technology	11
03	Joint 2nd Runner Up	5G-ENHANCED CRIME SCENE INVESTIGATION WITH XR & AI (Project ID: HAC-2025-1095).	National Institute of Technology, Tiruchirappalli	13
04	Joint 2nd Runner Up	Cultivating Pure Hearts, Growing Green Future (GreenHeart) (Project ID: HAC-2025-491).	University Institute of Engineering and Technology Punjab University	15

Winner / Runner-up in MSME/Startup Category

S. No.	Final/Rank	Proposal/ Project Description	Institute	Page No.
01	Winner	LifeCircuit: Hyperconnected Emergency Care Ecosystem (Project ID: HAC-2025-0997)	INDIAN INSTITUTE OF SCIENCE, Bangalore	17
02	1st Runner Up	Padmakosham IoT SecureBox: The Future of Secure Document Handling with 5G (Project ID: HAC-2025-0102)	Visvesvaraya National Institute of Technology, Nagpur	19
03	2nd runner up	Enhanced Automated Security System for Mobile Telecom Network against Cloning and unauthorised access (Project ID: HAC-2025-1426).	Malaviya National Institute of Technology Jaipur	21

Special Mention for the Best Ideas.

S. No.	Final/Rank	Proposal/ Project Description	Institute	Page No.
01	Winner	RIDE: RAN Intelligent Drift-Handling Enabler (Project ID: HAC-2025-1859)	National Institute of Technology Calicut	23
02	1st Runner Up	5G-Enabled Smart Onion Spoilage Detection and Alert System (Project ID: HAC-2025-0740)	Dr. Babasaheb Ambedkar Technological University Ionare and Savitribai Phule Pune University	25
03	Joint 2nd Runner Up	Smart Sprinkle Using 5G (Project ID: HAC-2025-0613)	National Institute of Technology Silchar	27
04	Joint 2nd Runner Up	Mentor Mitra AI: Redefining Learning Experiences with 5G and Edge AI (Project ID: HAC-2025-0864)	Jaypee Institute of Information Technology, Noida	29

◉ 1st Place: ₹5,00,000   ◉ Runner-up: ₹3,00,000   ◉ 2nd Runner-up: ₹1,50,000   ◉ Special Mentions: ₹50,000

Proposal No : HAC-2025-0407

Drone-Based 5G Non-Terrestrial Network for Dynamic, On-Demand and Emergency Connectivity

Team Leader   B Jayant

Mentor   Dr Richards Joe Stanislaus, Associate Professor, School of Electronics Engineering, VIT Chennai

Institute
Vellore Institute of Technology, Chennai

01 ▶ Problem Statement

In disaster-stricken areas, large-scale events, and remote regions, network congestion and connectivity issues pose significant challenges. Existing communication networks face multiple limitations like Slow Deployment, High Cost, Limited Coverage, Disaster Vulnerability etc. These issues create a communication gap that affects emergency response, public safety, and everyday connectivity in underdeveloped regions. A rapidly deployable and flexible solution is necessary to ensure uninterrupted communication in these scenarios.

02 ▶ Solution /Architechture

This project demonstrates a drone-based 5G network that can provide temporary, high-speed communication coverage using an adaptable, decentralized architecture. The core components of this solution include:

▷ **1×4 Phased Array Antenna:** The drone will carry a custom-designed 1×4 phased array antenna capable of dynamic beamforming, offering efficient signal transmission and reception in 5G mid-band frequencies.

▷ **Real-time Ad Hoc Network Deployment:** In addition to acting as a mobile base station, each drone will function as a node in a dynamic ad hoc network, autonomously establishing connections with nearby drones without relying on a centralized ground-based controller. This decentralized approach ensures self-organizing and self-healing communication links in case of drone failure, signal obstruction, or changing requirements.

▷ **Scalability and Mesh Networking:** Multiple drones can be quickly deployed to create a distributed mesh network where each drone communicates with its nearest neighbours. This enhances coverage, reduces bottlenecks, and improves resilience against single points of failure — critical for disaster zones and large-scale events.

▷ **Efficient Resource Utilization:** The system will leverage institutional facilities such as Vector Network Analyzers, Anechoic Chambers, and Spectrum Analyzers for antenna calibration and communication performance optimization before deployment.

▷ **Field Testing in Dynamic Environments:** Real-world testing will include multi-drone ad hoc networking scenarios to evaluate link stability, latency, handoff efficiency, and seamless coverage management.

This project stands apart from conventional temporary network solutions by introducing several novel aspects:

▷ **Drone-Based 5G Network with Ad Hoc Functionality:** Unlike traditional mobile base stations, this system integrates ad hoc networking capabilities into drone-mounted 5G nodes, enabling dynamic, self-organizing network formation without fixed infrastructure.

▷ **Dynamic Beamforming Antenna:** The phased array design allows precise control over signal direction, enabling high-quality point-to-point and point-to-multipoint communication between drones and ground users within the ad hoc framework.

▷ **Rapid Deployment and Scalability:** The ad hoc-enabled drones can be deployed individually or in groups, instantly establishing a peer-to-peer mesh network for coverage in complex terrains or crowded spaces.

▷ **Self-Healing Network:** If a drone leaves the network or fails, neighbouring drones autonomously reconfigure routing paths and adjust coverage beams, ensuring uninterrupted communication.

03 ▷ Conclusion

This project presents an innovative and practical solution to the challenge of temporary and emergency 5G network deployment. By integrating a 1×4 phased array antenna on a drone, the proposed system provides a highly mobile, cost-effective, and rapidly deployable communication solution. It directly addresses network coverage gaps in disaster-stricken areas, large-scale events, and remote rural regions. The successful implementation of this project will not only enhance emergency response capabilities and public safety but also create new business opportunities for telecom providers and disaster management agencies. With rigorous testing and optimization, this drone-based 5G network has the potential to revolutionize on-demand network deployment, making high-speed connectivity accessible where it is needed most.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-0547

1ST RUNNER-UP IN STUDENT/ACADEMIA CATEGORY

Touchwords Empowering Braille Education through 5G Connectivity

Team Members

Ms. Mokshda Malhotra , Dr. Surbhi Sharma

Institute

Thapar Institute of Engineering and Technology, Patiala, Punjab

01 ▶ Problem Statement

Despite notable advancements in assistive technology, existing refreshable Braille displays remain largely inaccessible due to high costs, limited scalability, and complex hardware requirements. Most current systems rely on piezoelectric actuators, which, while precise, are expensive, fragile, and limited to single-line outputs, making real-time reading of longer texts inefficient and impractical.

Furthermore, real-time implementation of Braille displays is often constrained by delays in text recognition, translation, and tactile feedback, especially when dependent on cloud-based services or limited connectivity.

This project proposes a cost-effective and reliable real-time refreshable Braille display that overcomes these limitations by adopting a master-slave device model powered by 5G communication. This architecture enables low-latency, synchronized data transfer from a central processing unit to multiple Braille output units. By utilizing electronic push-pull solenoids instead of piezoelectric cells, the hardware design is simplified while ensuring durability and responsiveness. The result is a scalable, robust system capable of delivering high-speed Braille output for printed and digital text, making real-time accessibility more practical and affordable for visually impaired users.

02 ▶ Solution /Architecture

This project suggests an improved access for people who are blind or deaf, through a real-time and low-cost assistive device. The device incorporates a modular system that transcribes printed text to Braille and audio, and, sign language gestures to audio.

The device allows subscribers to receive over-the-air software updates and is intended to integrate with a variety of other programs. This whole system can be developed using commercially available components and while relying on the Raspberry Pi and ESP32 as the building block. The project addresses the major design limitations of

current stage assistive technologies, namely, cost, portability, and limited use of audio outputs. It is designed to meet accessibility guidelines and could be certified and used in libraries, schools, smart homes, or NGOs. The mobility of this system promotes digital inclusion and the opportunity for users to control more of their lives and gain opportunities for learning and employment.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy-Technology, Ghaziabad.
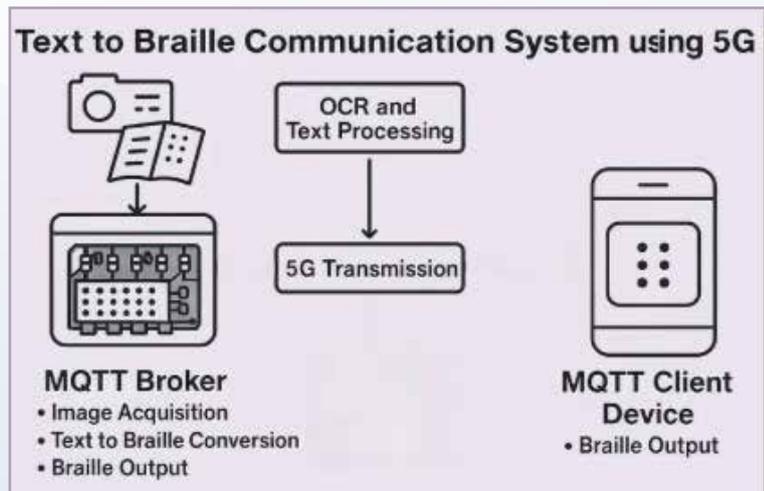
Conclusion

The integration of 5G technology in Braille learning enables real-time, low-latency transmission of educational content to tactile displays. It supports remote teaching, where a teacher's lesson or text is transmitted as an image and instantly converted into Braille for learners using the proposed solution. This seamless, synchronized experience enhances interactive and inclusive education for visually impaired students. By combining edge processing and 5G connectivity, the system bridges the digital divide and empowers independent learning through smart Braille technology.

Proposal No : HAC-2025-1095

JOINT 2ND RUNNER-UP IN STUDENT/ACADEMIA CATEGORY

5G- ENHANCED CRIME SCENE INVESTIGATION WITH XR & AI

Team Members
Mr. Suresh Kumar K, Mr. Krishnaveni A

Institute
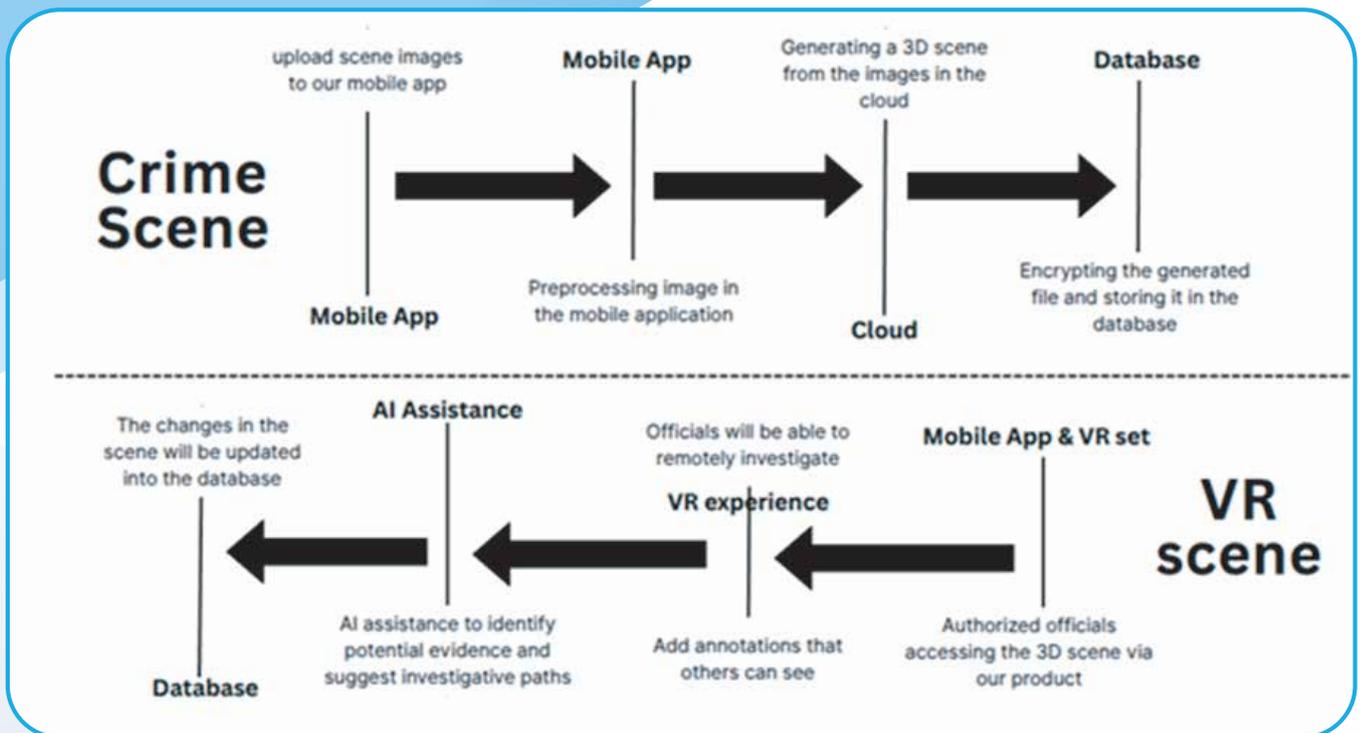NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

01 ▶ Problem Statement

To revolutionize crime scene investigation using 5G and Extended Reality (XR)

▷ **Dual Purpose :** Enhances the quality and efficiency of crime scene investigations and serves as a training tool for officers.

▷ **2Functionality :** Allows investigators to create detailed 3D models of crime scenes for remote examination, annotation, and sharing.

▷ **Collaboration :** Using high-speed 5G networks for seamless collaboration between field officers and remote specialists, ensuring expertise is available regardless of location.

02 ▶ Solution/ Architecture

▷ **Mobile App Workflow:** Investigators at the scene use a mobile app to capture multiple images from various angles. · The app performs initial image preprocessing (e.g., filtering, noise reduction) and uploads them securely to the cloud via 5G. Investigators receive live feedback on whether additional angles or better lighting is needed, guided by AI suggestions.

▷ **Cloud and AI Integration:** Uploaded images are processed on the cloud to reconstruct a photorealistic 3D model of the scene using Structure-from-Motion and neural rendering techniques.

▷ **Visualization and Collaboration:** Authorized officials can view and interact with the crime scene in AR/VR. Annotations made by one investigator are visible to all collaborators.Remote experts can log in, review evidence, and make live suggestions.

Crime Scene

upload scene images to our mobile app → **Mobile App** → Generating a 3D scene from the images in the cloud → **Database**

Mobile App — Preprocessing image in the mobile application — **Cloud** — Encrypting the generated file and storing it in the database

VR scene

The changes in the scene will be updated into the database ← **AI Assistance** ← Officials will be able to remotely investigate — **VR experience** ← **Mobile App & VR set**

Database — AI assistance to identify potential evidence and suggest investigative paths — Add annotations that others can see — Authorized officials accessing the 3D scene via our product

03 ▶ Conclusion

▷ **Enhanced Efficiency:** Reduces time to analyze and investigate scenes, Using IG URLLT Feature

▷ **Remote Accessibility:** Expertise can be brought in from anywhere using 5G.

▷ **Improved Training:** Empowers training institutes with real-world, interactive datasets. ·

▷ **Evidence Integrity:** Strong audit trail helps in court admissibility.

▷ **Scalable Solution:** Easily adapted by police departments nationwide.

Proposal No : HAC-2025-0491

Cultivating Pure Hearts Growing Green Future (GreenHeart)

Team Leader
Mr. Garvit Saluja

Institute
University Institute of
Engineering and Technology, Punjab University

01 ▶ Problem Statement

Farmers are struggling to optimize crop production due to a lack of real-time access to critical data on soil health, climate conditions, disease outbreaks, and fluctuating market trends. This information gap not only affects their yield and profitability but also contributes to inefficiencies in resource usage. On the flip side, consumers are increasingly distanced from the origins of their food, craving transparency and a direct connection with local farmers. This disconnect leads to a lack of trust and a missed opportunity for sustainable, locally-driven food systems.
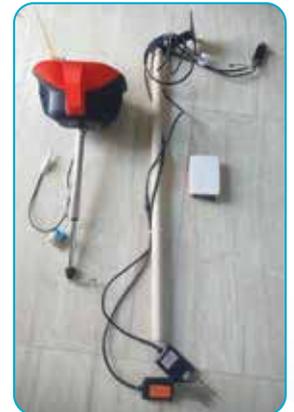
02 ▶ Solution /Architecture

Introducing GreenHeart, a cutting-edge dual platform app that revolutionizes the connection between farmers and consumers. For farmers, GreenHeart harnesses the power of IoT and AI to deliver real-time insights into soil health, climate conditions, and crop vitality, empowering them to make informed decisions and boost yields sustainably. Consumers, on the other hand, enjoy a direct link to fresh, locally sourced produce, enhancing transparency and supporting local farming communities. By seamlessly intertwining the worlds of agriculture and consumerism, GreenHeart cultivates a vibrant, transparent, and thriving food ecosystem

GreenHeart combines farming-as-a service, education, fintech, and market access in one seamless platform.
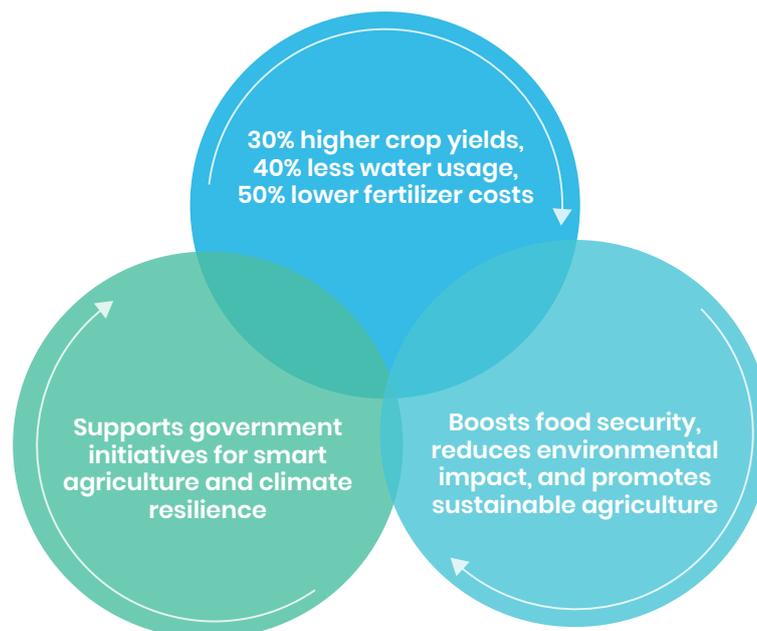
GreenHeart is an advanced AI, IoT, and 5G-powered precision farming solution designed to enhance both land-based and underwater farming. This system integrates real-time smart sensors, AI-driven analytics, and high-speed 5G connectivity to optimize agricultural productivity, resource efficiency, and sustainability.

- **Ultra-Low Latency (1ms):** Enables instant AI decision-making, improving farm automation & efficiency.

- **Massive IoT Connectivity:** Supports millions of AI-powered sensors, drones, and submarines for seamless operation.

- **Edge AI + Cloud Hybrid Computing:** Ensures low-cost processing, making the solution scalable & affordable.

- **Underwater & Remote Farming Expansion:** 5G NTN + Acoustic Networks enable AI-driven marine agriculture & deep-sea monitoring.

- **Data-Driven Smart Agriculture:** 5G enables AI-powered decision-making for sustainable, climate-resilient farming.
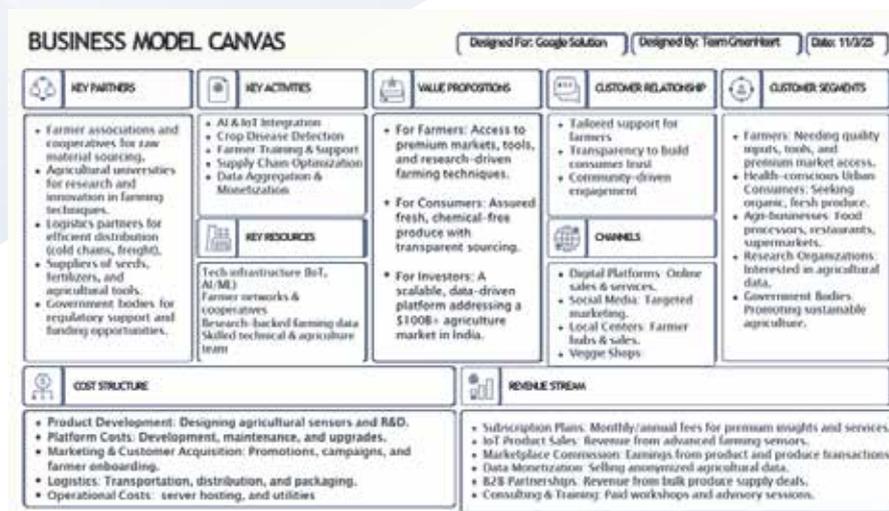
03 ▶ Conclusion

- 30% higher crop yields, 40% less water usage, 50% lower fertilizer costs
- Supports government initiatives for smart agriculture and climate resilience
- Boosts food security, reduces environmental impact, and promotes sustainable agriculture

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy Technology, Ghaziabad.

WINNER IN STARTUP/ MSME CATEGORY

Lifecircuit Hyperconnected Emergency Care Ecosystem

Team Leader
Dr. Bhaskar Rajakumar

Institute
Indian Institute of Science,Bangalore

01 Problem Statement

Cardiac-related deaths are the number one killer in India, accountingfor 27% of all causes. Cardiac arrests and heart attacks have seen a sharp rise, particularly among younger age groups. Many of these lifethreatening events occur in public spaces like gyms, bus stands, and sports grounds—yet lives are lost due to a lack of immediate Basic Life Support (BLS), Automated External Defibrillators (AEDs), and trained responders. Data suggests that timely CPR can double or triple survival chances. The golden hour—crucial for survival—is often wasted due to delayed intervention, lack of training, and poor coordination.

02 Solution/Architecture

LifeCircuit is an integrated, tech-driven ecosystem designed to drastically improve cardiac arrest outcomes through rapid response and real-time care. The system includes:

▷ **Mass BLS Training using AR/VR:** Scalable training of police, students, security personnel, delivery staff, and drivers.

▷ **Widespread AED Installation:** Smart AED stations deployed every 2 km in public spaces.

▷ **Remote Support via AR Glasses:** AED stations equipped with smart glasses for real-time ER guidance.

▷ **LifeCircuit Mobile App:**

- Triggers Code Blue alerts.

- Notifies trained responders nearby (like Uber for CPR).

- Maps route to incident + AED locations.

- Enables remote connection with emergency physicians.

- Integrates live vitals via IoT devices and connects ambulance + ER.

- Links patient data with ABHA ID, ensuring continuity of care by syncing with ABDM (Ayushman Bharat Digital Mission)-enabled health records.

- Enables automatic retrieval of past cardiac history and critical data from Personal Health Records stored under ABDM for faster clinical decision-making.
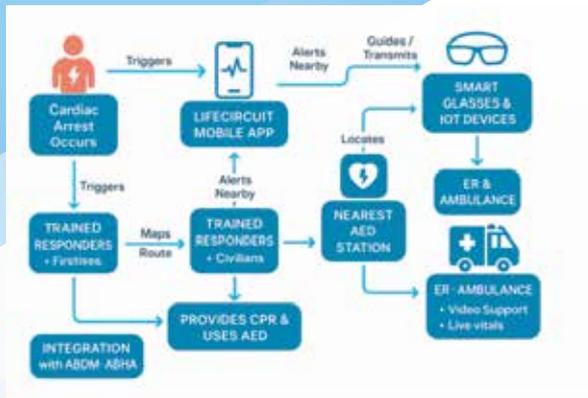

Figure 1: Flow Chart of
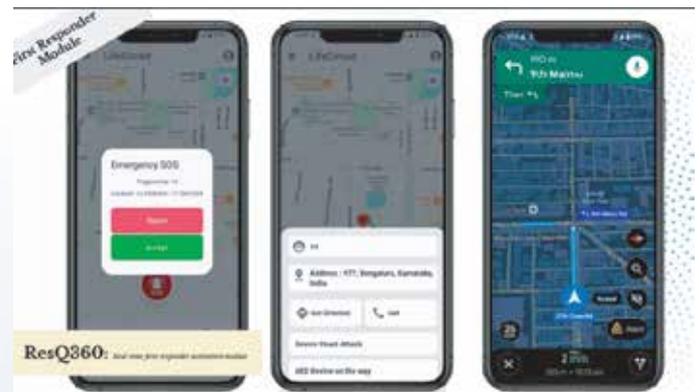tech integrated response during an event

Figure 2: Second Responder
Module

Key Technologies Used

▷ Augmented/Virtual Reality (AR/VR): Scalable training platform for BLS/ALS

▶ 5G Connectivity: Real-time, high-speed communication and data transfer

▷ Internet of Things (IoT): Pulse, BP, and AED monitoring

▷ Geolocation & Mapping: For nearest responder, AED, and ambulance routing

▷ Smart Wearables / AR Glasses: Real-time remote support during CPR

▶ AI Algorithms: For optimal response coordination and predictive alerts

▷ ABDM-ABHA Integration

Real-time syncing of health data with the Ayushman Bharat Health Account (ABHA).

03 Conclusion

Project LifeCircuit was demonstrated during 5G innovation Hackathon at National Communications Academy-Technology at Ghaziabad. Project presents a transformative and scalable cardiac emergency response ecosystem that bridges the critical gap between sudden cardiac arrest and timely life-saving intervention. By integrating AR/VR-based mass BLS training, widespread smart AED deployment, remote expert support, and a real-time 5G-enabled coordination platform, the solution ensures rapid action within the golden minutes.

Proposal No : HAC-2025-0102 Bangalore

1ST RUNNER-UP IN MSME/STARTUP CATEGORY

Padmakosham IoT SecureBox: The Future of Secure Document Handling with 5G

Team Leader

Mr. Anand Vardhan Tiwary

Institute
Visvesvaraya National Institute of Technology, Nagpur

01 ## Problem Statement

IoT SecureBox (named पद्मकोशम्) is an innovative secure container that leverages 5G connectivity and advanced security features to protect sensitive materials in transit.

02 ## Solution /Architecture

▷ **Tamper-Proof Design:** SecureBox has no physical keys, keypads, or biometric locks. It can only be unlocked remotely via a secure server, eliminating any local tampering possibilities.

▷ **5G Real-Time Tracking:** Built-in 5G connectivity continuously streams GPS location, temperature, vibration, and door angle data to the cloud. This provides live monitoring and instant alerts for anomalies or route deviations, ensuring end-to-end security.

▷ **Offline Data Resilience:** In no-connectivity zones, SecureBox stores all sensor and location data internally. Once 5G coverage is restored, it automatically syncs the buffered data to the cloud, ensuring no gaps in the security audit trail.

▷ **ML-Based Intrusion Detection:** Machine learning algorithms analyze movement and environmental data to detect unauthorized access attempts. Any suspicious activity triggers immediate alerts.

▷ **Industry Applications:** SecureBox's robust security and 5G connectivity make it ideal for safeguarding exam paper shipments, preserving an unbroken audit trail when transporting legal evidence, and securely moving classified documents.

Fig:1 Block Diagram of Modules & Components
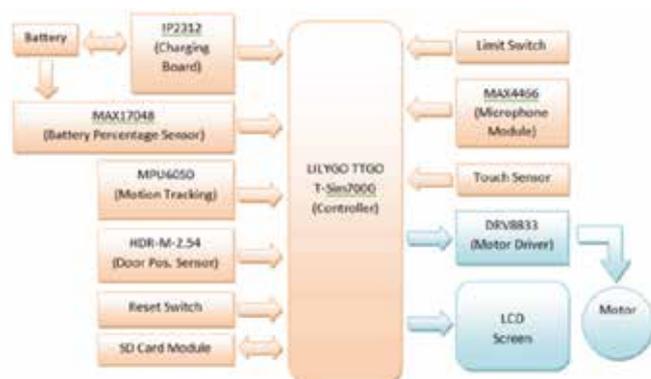
The IoT SecureBox is a transformative solution addressing security vulnerabilities in high-stakes logistics. By preventing tampering, unauthorized access, and data leaks, it enhances trust, compliance, and operational efficiency across multiple sectors.

▷ Education Sector : Ensuring Examination Integrity

▷ Judiciary & Law Enforcement : Secure Chain of Custody for Legal Evidence

▷ Banking & Finance : Secure Transport of Confidential Financial Data

▷ Logistics & Supply Chain : Enhanced Security for High-Value Asset Transportation

▷ Government Operations : Secure Handling of Classified Documents & Records

03 ▷ Conclusion

IoT SecureBox solution was demonstrated during the final evaluation round of 5G Innovation Hackathon held at IISc Bangalore. The solution presented is not just a novel gadget but it is also a timely answer to India's pressing security challenges in the physical realm of data and document handling. It can be scaled to the gigantic needs of Indian institutions, provide a precise market fit for critical sectors, align with every relevant law and guideline, remain affordable through smart procurement, and outshine any existing approach with its innovative edge.

Proposal No : HAC-2025-1426

Enhanced Automated Security System for Mobile Telecom Network against Cloning and unauthorised access

Team Leader
Mr. Vinay Bhardwaj

Institute
Malaviya National Institute of Technology, Jaipur

01 ▶ Problem Statement

As mobile networks evolve and expand, so do the associated cybersecurity threats. Existing security solutions such as Equipment Identity Register (EIR), which is used by mobile network operators to manage and secure mobile device on the network. EIR stores the device IMEI and categorised them into three lists i.e. White (Authorized), Grey (Unknown) and Blacklist (Blocked from network access). It is primarily used for blocking stolen devices, tracking suspicious devices using IMEI. However, it lacks the ability to address multiple and/or simultaneous threats such as IMEI spoofing, SIM cloning, unauthorized device usage, and device cloning. These issues compromise the security of telecom networks, leaving both users and network operators vulnerable. There are no standards in 3GPP for telecom network which can automatically detect IMEI spoofing and other cloning threats of handsets.

02 ▶ Solution/Architecture

This solution introduces a solution beyond the existing EIR capabilities and 3GPP telecom standard to address the challenges of Device cloning/IMEI spoofing/SIM cloning. This solution employs multi-factor device authentication approach by aggregating combination of multiple device-specific parameters to validate and authenticate devices in real-time with the mobile network. If the validation of the device parameters fails on the server, as a deterrence method the proposed solution will have an automated blacklisting of the vulnerable device by integrating into telecom networks, unauthorized access and cloning threats can be effectively mitigated. This comprehensive solution will move beyond sole reliance on IMEI, incorporating additional device attributes to ensure enhanced security and accuracy.

The solution demonstrated a security solution for telecom network that leverages a multi-parameter authentication model to combat unauthorized device access. This model combines unique device identifiers including IMSI, ICCID, Software binary version, MAC IDs,

Android ID, IMEI etc. The combined identifier will be authenticated at server by communicating in a secure way by encrypting the hash value of the combined identifier to ensure authenticity. A multi-layered verification system, consisting of mobile and server applications and a 3GPP-compliant Equipment Identity Register (EIR) database, supports real-time monitoring and validation of devices within the network.

ARCHITECTURE OVERVIEW (HIGH LEVEL)
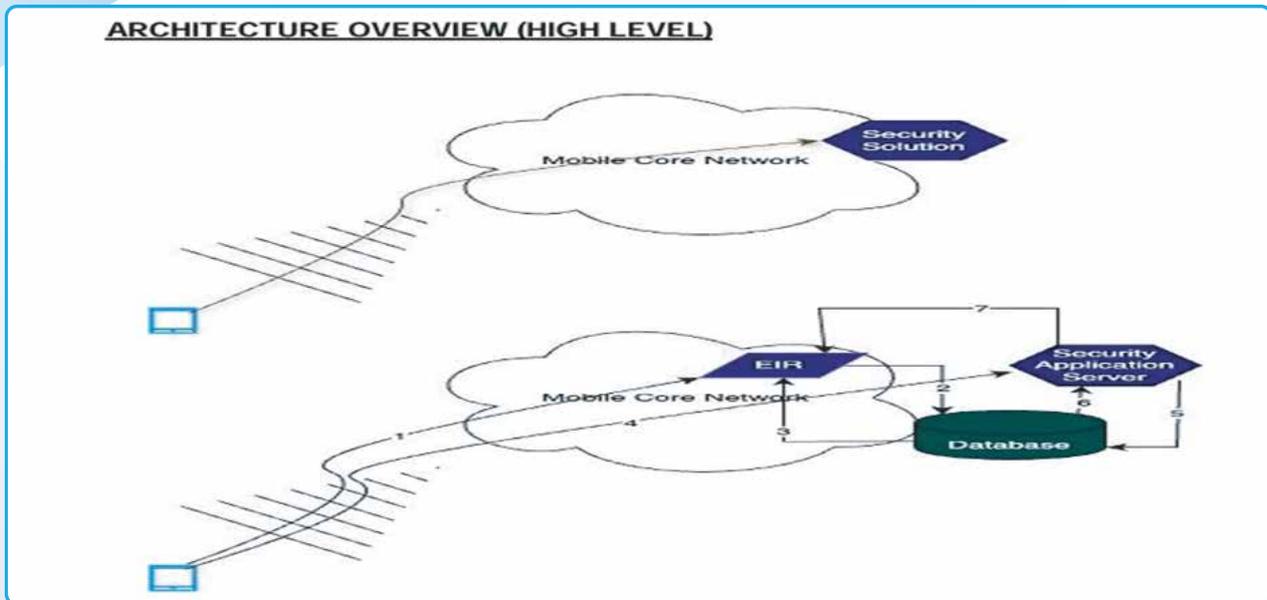
03 ▶ Conclusion

The solution provides an automated security solution to safeguard telecom networks from unauthorized device access, specifically addressing threats like IMEI spoofing, SIM cloning, and device cloning. Through a multi-parameter authentication approach, the solution combines IMSI, ICCID, Software binary version, MAC IDs, IMEI etc identifiers to validate device authenticity. The proposed security solution includes a mobile application, server application, and an EIR database, employing encrypted data transmission and periodic re-verification to ensure continuous security. This robust approach enhances telecom network resilience against identity cloning threats. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at National Communications Academy-Technology, Ghaziabad.

SPECIAL MENTION FOR THE BEST IDEAS

RAN Intelligent Drift Handling Enabler

Team Leader

Dr. Koteswara Rao Kondepu

Institute
National Institute of Technology Calicut

01 Problem Statement

The project focuses on developing an end-to-end drift detection and handling framework within the Radio Intelligent Controllers (RICs) for 6G networks, aiming to enhance Open RAN networks performance, reliability, and adaptability. The goal is to effectively manage Artificial Intelligence/Machine Learning (AI/ML) models deployed within the RICs to ensure consistent performance levels despite dynamic changes in user traffic patterns.
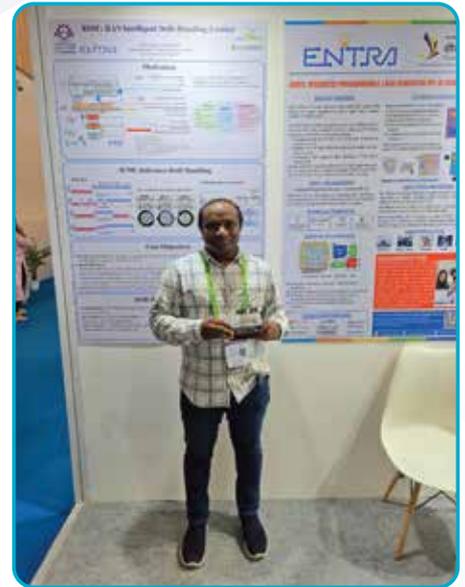
02 Solution /Architecture

The potential of Radio Access Network intelligence depends on effective AI/ML model management to ensure consistent performance. AI/ML model accuracy relies heavily on the quality and relevance of the training or observed datasets, and their inferences can be deployed as rApps/xApps/dApps via the RAN Intelligent Controllers (RICs) to optimize network behavior.

The arrival of new user traffic patterns, driven by dynamic service demands or network changes, may cause the performance of these models to degrade—a phenomenon known as drift. From a model perspective, performance degradation is the most immediate and critical consequence of drift; however, its impact becomes even more severe in highly adaptive and complex environments such as 6G networks. To remain effective, Open RAN must incorporate an adaptation strategy based on analyzing and mitigating drift caused by evolving user traffic. To our knowledge, no dedicated drift handling framework is tailored for the Open RAN ecosystem.

This project addresses that gap by developing a real-time drift detection and mitigation framework that dynamically adapts to user traffic changes, ensuring sustained AI/ML model performance and maintaining optimal RAN operation.
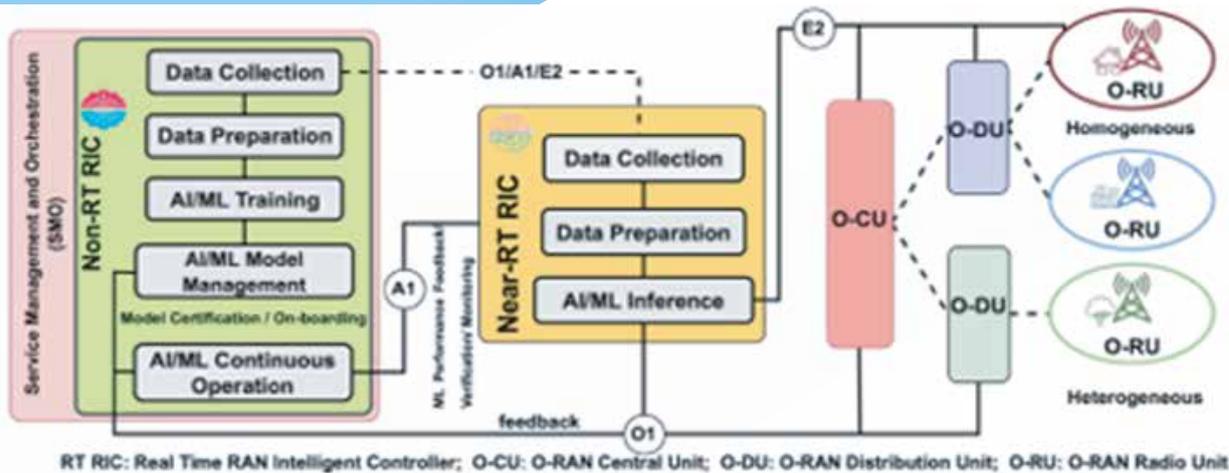
Figure 1: System Architecture [2]

03 ▶ Conclusion

Implementing real-time drift handling in Open RAN environments marks a transformative step for the socio-economic and telecommunication sectors, due to controlling the over/under-provisioning of the resource. From an Industry viewpoint, the functionality of detecting and adapting to drift in real time boosts progress towards self-optimizing RAN systems that are fully autonomous, alleviating the need for manual model retraining. This improvement lowers the Operational Expenditure (OpEx) of Mobile Network Operators (MNOs) and makes service delivery more responsive. The framework gives the vendors a distinct advantage by enabling the preservation of AI model integrity to retain their value based on shifts in network traffic for intelligence functions. The proposed solution provides better management of resources and leads to lower-footprint.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC–2025–0740

5G- Enabled Smart Onion Spoilage Detection and Alert System

Team Members

Mr. Abhijit Pingale ,Mr. Shaunak Thigale,
Mrs. Monika Kamtamkar, Dr. Pranoti Bansode-Gaikwad

Institute
Dr. Babasaheb Ambedkar
Technological University and
Savitribai Phule Pune University

01 ▶ Problem Statement

Onions are a staple vegetable in most regions of the world, including in Indian cuisine. In India, onions rank as the second-largest commercial vegetable crop globally, following China.

While storage plays a key role in post-harvest losses in India experiences about 42% of its total onion losses during storage and marketing stages. Several factors contribute to these losses, including poorly designed storage structures, improper storage temperatures, fluctuating relative humidity, inadequate handling practices, and prolonged storage durations. Common challenges include sprouting, quality deterioration, and physiological weight loss. To address these issues, the adoption of improved post-harvest technologies and scientifically designed storage systems is crucial.
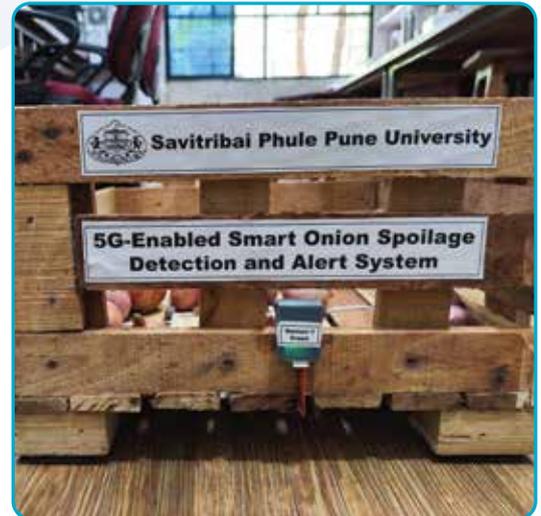
02 ▶ Solution /Architecture

The 5G-enabled Smart Onion Spoilage Detection System uses IoT sensors such as gas, temperature, and humidity sensors placed inside storage racks to monitor onion freshness in real time. Sensor data is transmitted over a 5G network and displayed on a user-friendly MQTT dashboard and mobile app with a clear graphical interface for farmers. Spoiled onions release higher concentrations of sulphur-based volatile organic compounds (VOCs) like ammonia and ethylene, which can rapidly damage nearby onions. By detecting these gases early, the system provides alerts for timely intervention, preventing chain-reaction spoilage, reducing post-harvest losses, and supporting better storage management and overall farm profitability.
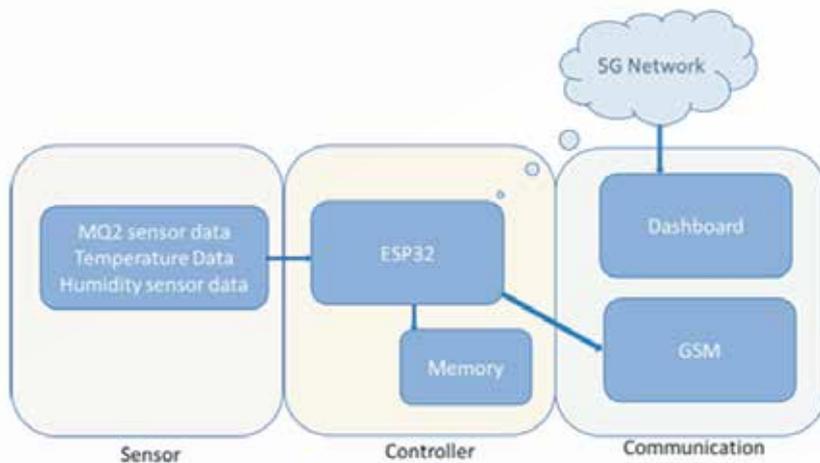
Fig1 : Architure of the system

This project uses an MQ2 gas sensor to detect spoilage in stored onions by monitoring gases released during decay. The ESP32 microcontroller reads sensor values, activates alerts, and communicates with a GSM module. A tri-color LED system indicates spoilage levels—green for fresh, orange for moderate spoilage, and red for severe spoilage—along with a buzzer for high-risk alerts. Collected data is transmitted wirelessly to a dashboard over a 5G network and to the farmer's mobile phone for remote monitoring. This solution enables early detection, reduces wastage, and supports timely action to protect onion storage quality and farmer profits.
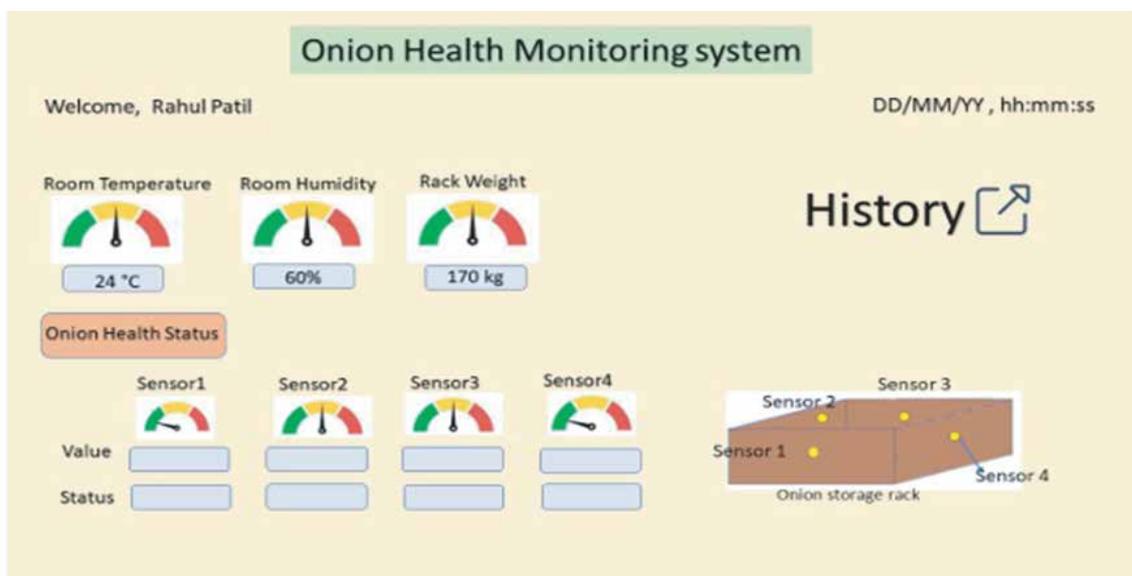
03 ▶ Conclusion

The implementation of a spoilage detection system in the agricultural sector significantly reduces losses during storage and transportation by enabling early identification of decaying produce. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, bangalore.

SPECIAL MENTION FOR THE BEST IDEAS

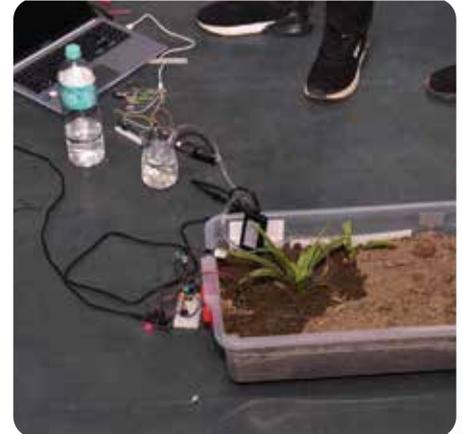## Smart Sprinkle Using 5G

Team Leader
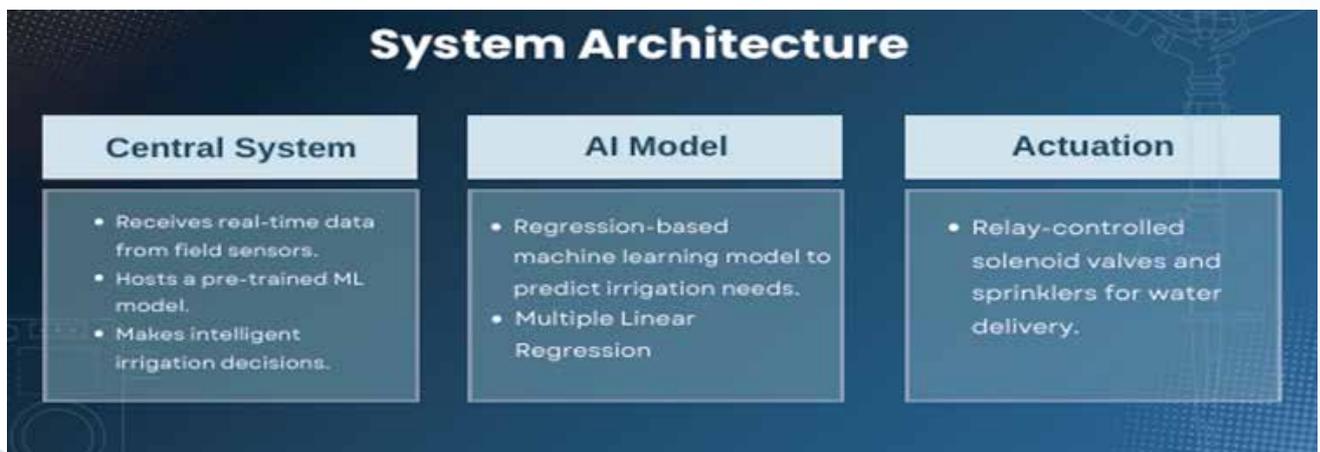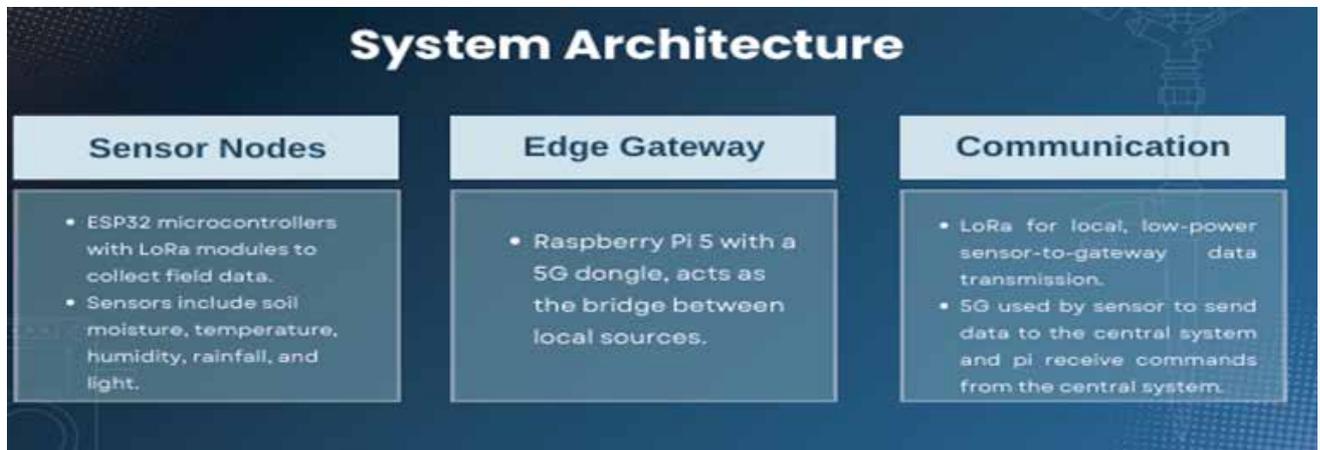
Mr. Shashank Kukreti

Institute
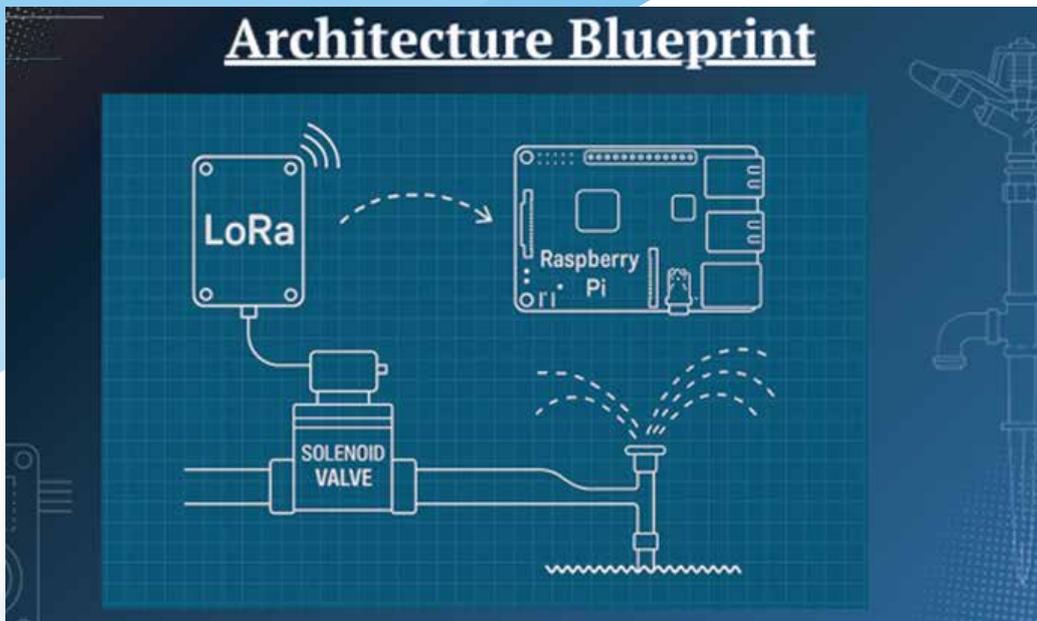NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI

01 Problem Statement

Traditional irrigation systems in tea gardens and paddy fields are inefficient, often relying on manual methods leading to overwatering, water wastage, and crop damage. Current automated sprinkler systems lack intelligent decision-making and rely on local, often inaccurate data.

02 Solution /Architecture

System Architecture

Sensor Nodes	Edge Gateway	Communication
• ESP32 microcontrollers with LoRa modules to collect field data. • Sensors include soil moisture, temperature, humidity, rainfall, and light.	• Raspberry Pi 5 with a 5G dongle, acts as the bridge between local sources.	• LoRa for local, low-power sensor-to-gateway data transmission. • 5G used by sensor to send data to the central system and pi receive commands from the central system.

System Architecture

Central System	AI Model	Actuation
• Receives real-time data from field sensors. • Hosts a pre-trained ML model. • Makes intelligent irrigation decisions.	• Regression-based machine learning model to predict irrigation needs. • Multiple Linear Regression	• Relay-controlled solenoid valves and sprinklers for water delivery.

Architecture Blueprint

- System only waters when needed
- Reduces dependency on labor and guesswork.
- Right amount of water = healthier roots = more output
- System design is applicable across multiple crop types and geographies.
- Contributes to smart farming initiatives

03 ▶ Conclusion

AI-powered smart irrigation system using 5G-enabled IoT sensors to intelligently manage water usage in tea gardens and paddy fields. The system aims to enhance water supply efficiency, reduce crop damage, and enable remote and autonomous irrigation based on real-time environmental data.

The project prototype was demonstrated during the final round of 5G Innovation Hackathon at National Communications Academy-Technology.

Proposal No : HAC-2025-864

SPECIAL MENTION FOR THE BEST IDEAS

Mentor Mitra AI Redefining Learning Experiences with 5G and Edge AI

Team Leader

Mr. Maitreya Agarwal

Institute
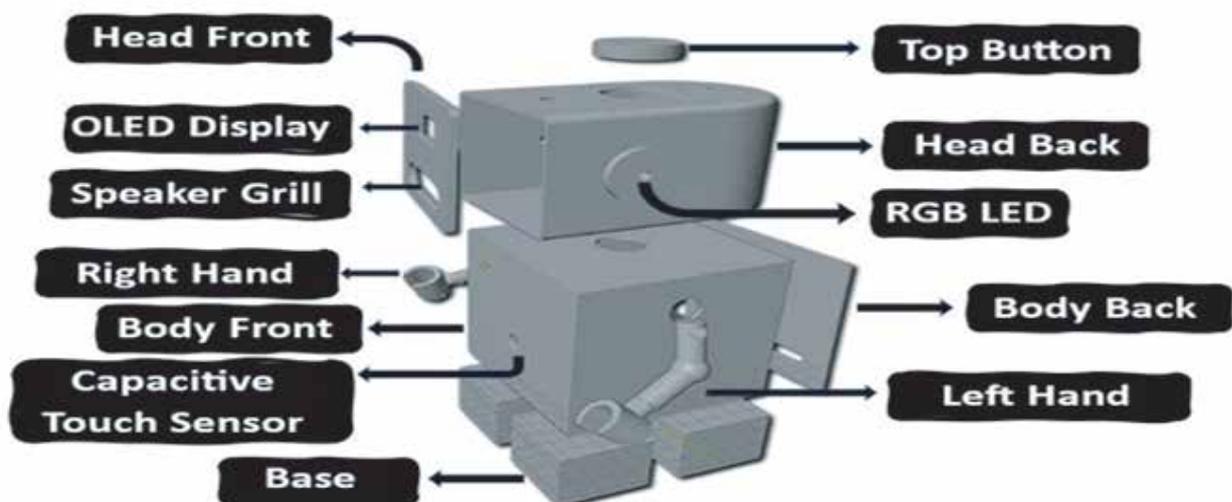
Jaypee Institute of Information Technology, Noida

01 ▶ Problem Statement

Many children lack engaging, interactive educational tools that adapt to their unique learning styles, leaving them disengaged from traditional learning methods. The objective is to design an innovative educational toy to empower children by combining the excitement of robotics with the supportive capabilities of generative AI.

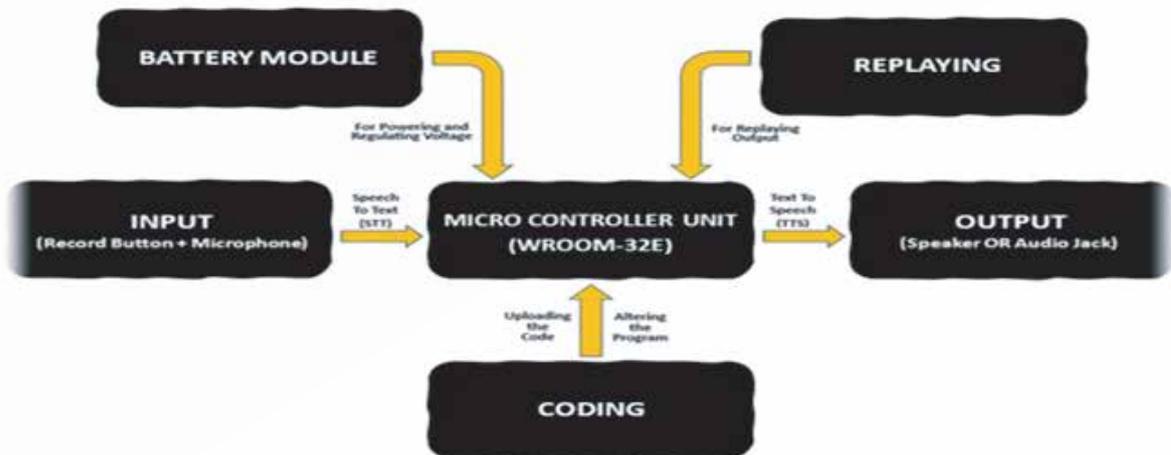## 02 ▶ Architecture/Solution

- Head Front
- OLED Display
- Speaker Grill
- Right Hand
- Body Front
- Capacitive Touch Sensor
- Base
- Top Button
- Head Back
- RGB LED
- Body Back
- Left Hand

▶ Interactive OLED Display

▶ Multi-Sensory Touch Interaction

▷ Sound Activation & Response : When sound is detected, the robot moves its arms (servo motors) and activates RGB LED lights.

▷ Gemini AI Access Button

Complete Workflow of our Robot

BATTERY MODULE

For Powering and Regulating Voltage

REPLAYING

For Replaying Output

INPUT
(Record Button + Microphone)

Speech To Text (STT)

MICRO CONTROLLER UNIT (WROOM-32E)

Text To Speech (TTS)

OUTPUT
(Speaker OR Audio Jack)

Uploading the Code   Altering the Program

CODING

03 ▷ Conclusion

This AI-powered robot serves as an interactive companion for children, promoting learning through emotional engagement, sensory feedback, and playful interactions. The robot helps children develop cognitive, social, and motor skills by responding to touch, sound, and temperature changes. With real time guidance, sensory interaction, and cloud connected content, Mentor Mitra empowers kids to learn, play, and grow—anytime, anywhere— at 5G speed.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon at National Communications Academy-Technology, Ghaziabad

OTHER FINALISTS OF 5G INNOVATION HACKATHON 2025

EVALUATED AT NATIONAL COMMUNICATIONS ACADEMY - TECHNOLOGY, GHAZIABAD

S. No.	Proposal/ Project Description	Institute	Pages
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02	AI-Driven Hybrid 5G-Satellite Solutions for Disaster Resilience, Education & Healthcare (Project ID: HAC-2025-0851)	Jaypee Institute of Information Technology, Noida	33
03	Real-Time Suspicious Activity Detection in High-Security Zones Using 5G-Enabled Drone Feed with MEC and Docker-Based YOLO Deployment (Project Id: HAC-2025-0933)	Banasthali Vidyapith	34
04	Aerial ISAC Enabled Geospatial Data Extraction for Intelligent Surveillance (Project ID: HAC-2025-1010)	Indian Institute of Technology, BHU	35
05	5G-Enabled AI-IoT Smart Traffic Management and Enforcement System (Project ID: HAC-2025-1015)	Indian Institute of Information Technology, Manipur	36
06	Real-Time Detection of Anomalies and QoS Deviations in Multi-Service Traffic over 5G Private Networks using AI techniques (Project ID: HAC-2025-1027)	Banasthali Vidyapith	37
07	MEC-Enabled Microclimate Fault Analytics for Smart Mining Infrastructure over 5G Private Networks (Project Id: HAC-2025-1029)	Banasthali Vidyapith	38
08	Adaptive Traffic Signal Control Using Real-Time Video Analytics and 5G-Enabled Edge Computing (Project Id HAC-2025-1157)	Birla Institute of Technology and Science, Pilani	39
09	Visual-SLAM for Collaborative UAV Applications in Army Surveillance Using 5G (Project ID: HAC-2025-1167)	Birla Institute of Technology and Science, Pilani	40
10	Real-Time Open Source Face Recognition on CPU Edge Server (Project ID: HAC-2025-1262)	Indian Institute of Science, Bangalore	41
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12	Crash Prevention through Vehicle-to-Everything (V2X) Communication using 5G Technology (Project ID: HAC-2025-1536)	Thapar Institute of Engineering and Technology, Patiala	43
13	AgriFlysense: A 5G-Enabled Cost effective SWIPT Drone-Assisted Sensor Node for Smart Agriculture Monitoring (Project ID: HAC-2025-1582)	Indian Institute of Technology Ropar	44
14	A 5G-Enabled Smart Farming Assistant (Project ID: HAC-2025-1765)	IIIT, Kalyani	45
15	A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management (Project ID: HAC-2025-1817)	National Institute of Technology Hamirpur (H.P.)	46
16	Empowering 5G and Beyond: Intelligent RIS-Assisted Multi-User Communication with Passive Sensing and Machine Learning (Project ID: HAC-2025-1856)	Delhi Technological University	47

Proposal No : HAC–2025–0609

Bridging Communication Barriers with AR Smart Glasses for Deaf and Mute Individuals

Team Leader

Mr Vishisht Mishra

Institute
Department of Computer Science and Engineering, Central University of Haryana

01 Problem Statement

A substantial portion of the deaf community, relies on visual communication methods, primarily sign language. However, access to qualified sign language interpreters is limited, and communication barriers are exacerbated in diverse, multilingual settings and noisy environments common across India. The scale of this challenge, particularly considering that nearly 69% of people with disabilities reside in rural areas with often limited access to services, highlights a critical unmet need for effective, affordable, and versatile assistive communication technologies tailored to the Indian context.

02 Solution/ Architecture

This project focuses on developing an innovative solution: Augmented Reality (AR) smart glasses designed to bridge communication gaps for deaf and mute individuals in India. This system envisions integrating multiple communication modalities – including Automatic Speech Recognition (ASR), Brain Computer Interface (BCI), Text-to-Speech (TTS), and real-time translation – into a wearable AR platform. The glasses aim to provide real-time communication support by displaying subtitles of spoken conversations, translating languages, vocalizing text input generated via BCI or other methods, and potentially incorporating visual aids like sign language avatars or lip-reading assistance. The system leverages advancements in Artificial Intelligence (AI) for processing these modalities and relies on 5G connectivity, particularly its Ultra-Reliable Low Latency Communication (URLLC) capabilities, to enable the real-time performance crucial for natural conversation flow.

System Architecture Diagram:
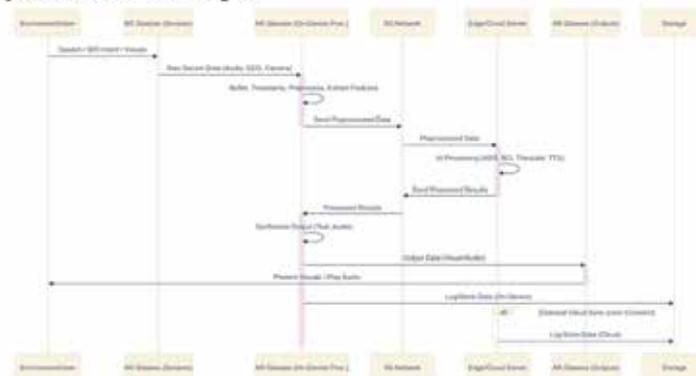
03 Conclusion

The project was demonstrated at 5G innovation Hackathon at National Communications Academy, Ghaziabad, showed low cost prototype for Augmented Reality (AR) smart glasses designed to bridge communication gaps for deaf and mute individuals.

Proposal No : HAC-2025-0851

AI-Driven Hybrid 5G-Satellite Solutions for Disaster Resilience, Education & Healthcare

Team Leader

Mr. Apoorv Adarsh

Institute
Jaypee Institute of Information Technology, Noida

01 ▶ Problem Statement

Disaster Impact: Floods and cyclones frequently damage terrestrial networks, delaying emergency alerts and rescue coordination. Traditional 5G requires expensive fiber backhaul and is unsuitable for rugged terrains, while satellite-only solutions like Starlink are costly and lack localized edge processing. This results in digital exclusion of rural populations, deepening inequality and vulnerability during disasters.

02 ▶ Solution/ Architecture

The project proposes an AI-driven hybrid 5G–Satellite Network to deliver resilient, affordable, and intelligent connectivity for rural and disaster-prone regions. The system integrates:

▷ Low-cost ground stations (Raspberry Pi + LimeSDR) for edge processing,

▷ ISRO's LEO satellites for reliable non-terrestrial backhaul, and Edge AI models for real-time telemedicine, disaster prediction, and AR/VR-based education.

Hybrid NTN Components: Terrestrial 5G: Ground-based gNodeBs (base stations). Non-Terrestrial: LEO satellites (e.g., ISRO's CMS series) or HAPS (high-altitude platforms). Edge Computing: Local data processing to reduce latency. Gateway Stations: Connect satellites to the 5G core network.

Figure
System Overview
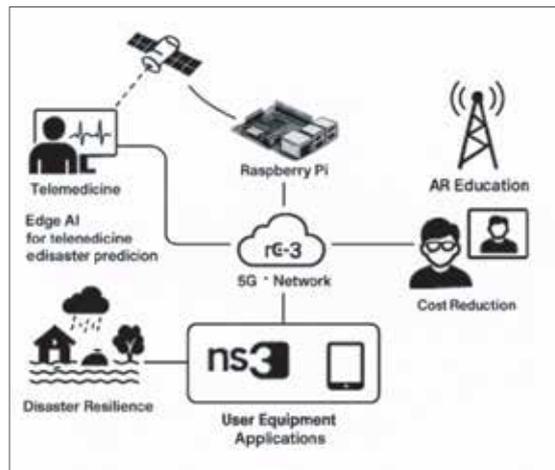
03 ▶ Conclusion

The proposed AI-driven hybrid 5G–Satellite solution addresses the critical need for reliable, affordable, and scalable connectivity in underserved regions. By integrating terrestrial and non-terrestrial networks with edge intelligence, the project ensures continuous service during disasters, enhances rural healthcare and education, and contributes to India's Digital Bharat mission.
The project was demonstrated during the final round with a conceptual framework design by the team.

Proposal No : HAC-2025-0933

Real-Time Suspicious Activity Detection in High-Security Zones Using 5G-Enabled Drone Feed with MEC and Docker-Based YOLO Deployment

Team Leader

Ms. Anisha Riya

Institute
Banasthali Vidyapith

01 Problem Statement

India's strategic defence zones and border regions are frequently exposed to security threats including illegal infiltration, smuggling, and unauthorized surveillance. Existing security systems rely heavily on manual patrol and outdated surveillance technologies that lack real-time analytics, are bandwidth limited, and are not scalable in rugged or remote areas. Delayed threat identification and response can have severe consequences on national security and public safety

02 Solution/ Architecture

This project introduces a real-time surveillance system utilizing a 5G-enabled drone, integrated with Multi-access Edge Computing (MEC) and Docker-based object detection. The drone captures video using a camera attached to a Raspberry Pi, which streams the feed via RTSP/RTMP to a 5G core network. The feed is processed on an Ubuntu VM hosted on a MEC server, where YOLO is deployed inside a Docker container. This setup allows immediate detection of threats like unauthorized personnel, vehicles, or weapons and sends annotated output to a monitoring station using Flask and socket programming. This containerized and scalable approach enables the deployment of intelligent monitoring systems even in inaccessible terrains.

03 Conclusion

This project was demonstrated with a conceptual framework during the final rounds. Through the integration of 5G, MEC, and Dockerized deployment, it ensures rapid detection of unauthorized activities, significantly reducing response time and enhancing the efficiency of defence operations. The use of cost-effective, modular and scalable design allows for easy deployment across diverse terrains. In the long run, such intelligent monitoring systems may contribute to a safer living environment for communities near sensitive zones and support the country's broader goals of security, innovation, and economic resilience.

Proposal No : HAC-2025-1010

Aerial ISAC Enabled Geospatial Data Extraction for Intelligent Surveillance

Team Members

Mr. Aditya D. Arkalgud, Mr. Ayush Anand Kerhalkar, Mr. Ayush Yadav.

Institute
Indian Institute of Technology, BHU

01 Problem Statement

To cater to the issues int in disaster response, industrial inspection, smart surveillance, and urban air mobility, enabling resilient communication and real-time situational awareness even in low-visibility or GPS-denied environments the 5G system is required to be deployed here.

The AEGIS 5G project is a UAV-based reconnaissance and disaster management system leveraging 5G New Radio (NR) technology and Integrated Sensing and Communication (ISAC). This innovative approach allows the UAV to perform both high-speed communication and environmental sensing using the same 5G radio signals, eliminating the need for separate LiDAR and optical sensors. The UAV uses adaptive antenna arrays with beamforming to simultaneously transmit and receive data while sensing its surroundings through backscattered 5G signals. The onboard system fuses these radio-based measurements with NavIC/GPS data for precise localization and mapping.

02 Solution/ Architecture

- ▷ Unmanned Aerial Vehicle (UAV) platform with sufficient payload capacity
- ▷ Multi-directional antenna array with beamforming capability
- ▷ Software Defined Radio (SDR) modules for 5G NR waveform generation
- ▷ Field Programmable Gate Array (FPGA) or System-on-Chip (SoC) for onboard signal processing
- ▷ 5G Base Station (gNodeB) for communication and sensing integration
- ▷ Onboard processors for control, data fusion, and AI-based decision-making
- ▷ Navigation with Indian Constellation (NavIC) and GPS modules
- ▷ 5G Core Network (Non-Standalone, including UPF, SMF, and AMF components)
- ▷ Edge computing and cloud infrastructure for data aggregation and analysis
- ▷ Power management unit and batteries optimized for UAV flight
- ▷ Sensors for telemetry (altitude, velocity, orientation)
- ▷ Ground control station with visualization and data analytics interface
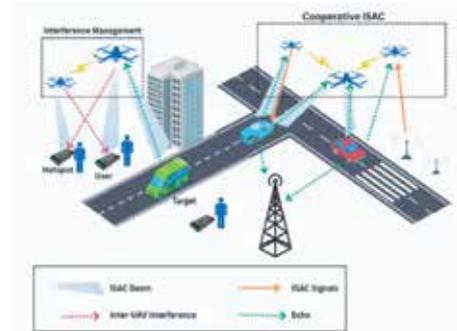
03 Conclusion

The AEGIS 5G platform showcased the convergence of 5G communication and radar-like sensing through ISAC technology, significantly enhancing UAV capabilities for real-time surveillance, disaster management, and autonomous navigation. By replacing conventional LiDAR and camera systems with RF-based environmental sensing, the project demonstrates reduced cost, lower power consumption, and improved environmental resilience.

Proposal No : HAC-2025-1015

5G-Enabled AI-IoT Smart Traffic Management and Enforcement System

Team Leader

Mr. Gannamraju Sai Koushik

Institute
Indian Institute of Information Technology, Manipur

01 ▶ Problem Statement

This project aimed to develop a 5G-enabled AI-IoT-based Smart Traffic Management and Enforcement System to enhance road safety, streamline traffic flow, prioritize emergency vehicles, and detect violations like signal jumping, helmet enforcement, and drunk driving in real time. Additionally, it aimed to optimize street light automation, fault detection, and provide real-time traffic updates and road work information, thereby improving both city infrastructure and public safety

02 ▶ Solution/ Architecture

The system integrates AI, IoT sensors, and V2X communication to monitor traffic, detect violations, and manage signal timing dynamically. A centralized 5G-enabled control room processes real-time data from vehicles, cameras, and infrastructure for immediate action. An AI engine handles fatigue, helmet, and drunk-driving detection, while a mobile app enables public interaction & updates Edge and cloud architecture ensure fast local decisions and scalable analytics for smarter, safer urban mobility.

FLOW DIAGRAM
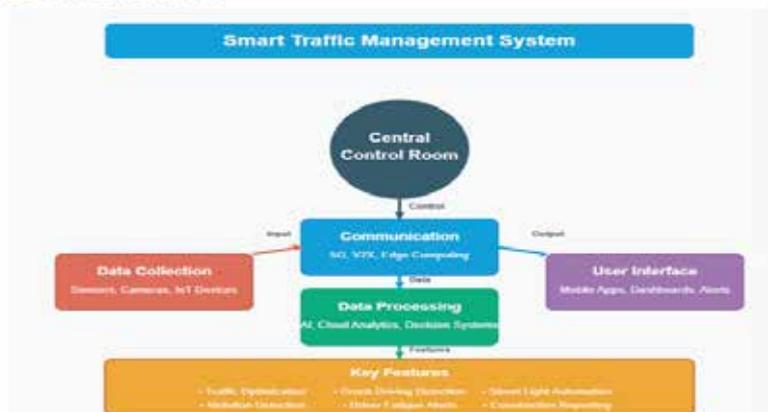
03 ▶ Conclusion

▶ Enhanced Road Safety: AI-driven detection of violations such as drunk driving, speeding, and driver fatigue plays a vital role in preventing accidents, lowering fatality rates, and ensuring safer roads for all.

▶ Improved Traffic Flow: Real-time traffic optimization and intelligent signal control help reduce congestion, leading to smoother commutes and time savings for citizens.

▶ Public Awareness & Accountability: A dedicated mobile app provides real-time notifications of traffic violations, road closures, and infrastructure updates—fostering transparency and encouraging responsible driving

The project was demonstrated during the final round of the 5G Innovation Hackathon with a prototype.

Proposal No : HAC-2025-1027

Real-Time Detection of Anomalies and QoS Deviations in Multi-Service Traffic over 5G Private Networks using AI techniques

Team Members

Ms Riya Raj, Ms. Muskan

Institute
Banasthali Vidyapith

01 Problem Statement

With the rapid adoption of 5G private networks in industries, healthcare, and smart infrastructure, ensuring consistent Quality of Service (QoS) across multiple applications has become critical. However, the real-time performance of such networks can degrade due to unexpected traffic surges, network misconfigurations, hardware failures, or interference, which can lead to service disruptions.

02 Solution/ Architecture

A real-time QoS deviation analysis and anomaly detection system using AI-based techniques in a 5G private network lab setup has been envisaged focussed on the following:
Step1: Multi-Service Traffic Monitoring. Step2: QoS Parameter Extraction such as Latency (L), Jitter (J), Packet Loss Rate (PLR), and Throughput (T), from the packet data that will be captured. For real-time QoS assessment, Wireshark's comprehensive insights into traffic behaviours allow for accurate measurement of delays, variation, data loss, and transfer rates. Step3: Real time Anomaly Detection Services—such as UE registration, NG setup, real-time camera streaming, voice/video over NR, and general web usage—each generate distinct traffic patterns and introduce specific operational complexities.
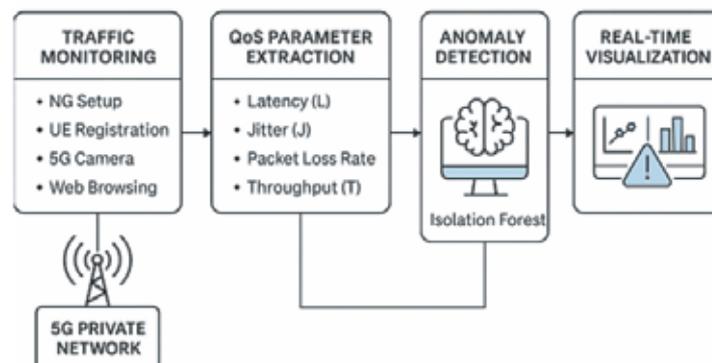
03 Conclusion

▷ Improved Reliability in Critical Infrastructure

▷ Faster Response to Network Issues By identifying network anomalies before they become more serious, the AI model (Isolation Forest) enables proactive intervention rather than reactive troubleshooting.

▷ QoS Assurance Across Diverse Applications Multiple services (such as browsing, AR/VR, high-definition video, and IoT sensor data) operate simultaneously in real-world private networks. The system ensures consistent performance across all of them, helping maintain Service-Level Agreements (SLAs) and user satisfaction.

The project was demonstrated during the final round of Hackathon with a working model.

Proposal No : HAC-2025-1029

MEC-Enabled Microclimate Fault Analytics for Smart Mining Infrastructure over 5G Private Networks

Team Leader

Ms. Mukta Dhar

Institute
Banasthali Vidyapith

01 ▶ Problem Statement

This project proposed a real-time microclimate fault detection system for underground mining environments using Multi-access Edge Computing (MEC) and 5G private networks.

Underground mines faces extreme environmental conditions—temperature, humidity, and gas concentration fluctuations—that can quickly escalate into safety hazards. Traditional systems depend on centralized processing, causing delays in response.

02 ▶ Solution/ Architecture

The proposed solution uses:

▷ IoT sensors to monitor temperature, humidity, gas, and vibration.

▷ 5G-enabled gateways to ensure ultra-reliable, low-latency data transmission.

▷ Edge-based AI/ML models (LSTM/CNN-LSTM) deployed on MEC servers to analyze data locally and detect anomalies in real-time.

▷ Flask-based dashboards for visualization and alerting (via SMS, email, and notifications).

▷ Cloud storage for long-term data analysis and predictive maintenance.

This approach ensures quick detection of hazards, reduced downtime, enhanced worker safety, and compliance with mining safety regulations.
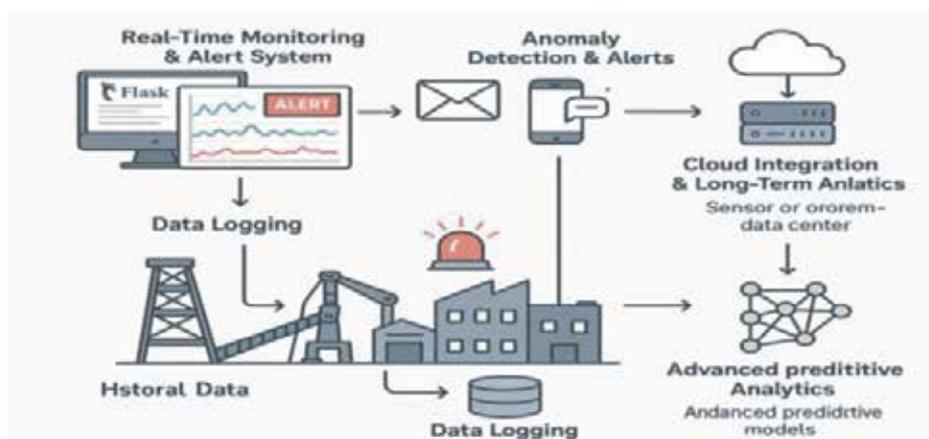
03 ▶ Conclusion

The MEC-enabled microclimate fault analytics system revolutionizes underground mining safety and monitoring by integrating AI-driven anomaly detection, 5G connectivity, and edge computing. By processing sensor data locally at the edge, the system achieves real-time fault detection and ultra-low latency response, significantly improving worker safety, operational reliability, and maintenance efficiency.

The project was demonstrated successfully with a working prototype during the final rounds of Innovation Hackathon.

Adaptive Traffic Signal Control Using Real-Time Video Analytics and 5G-Enabled Edge Computing

Team Leader

Mr. Projeet Roy, Mr. Kanwardeep Singh Gahlot, Ms. Neha Choudhary

Institute

Birla Institute of Technology and Science, Pilani

01 Problem Statement

Traffic congestion is a significant challenge in urban areas, leading to increased travel time, fuel consumption, and air pollution. One of the primary causes of this congestion is the use of traditional traffic light systems that operate on pre-set, fixed timers, regardless of the actual traffic conditions at any given time.

02 Solution/ Architecture

The project aimed to develop an intelligent traffic light control system that dynamically adjusts signal timings based on live traffic data using real-time video analytics and edge computing. The core functionality involves dynamic signal timing, where green light durations are calculated in real-time based on the number of vehicles detected in each direction using video analytics. Leveraging 5G connectivity, the system enables ultra-low latency communication between intersections, traffic cameras, and cloud-based edge servers, allowing for immediate processing and decision-making.
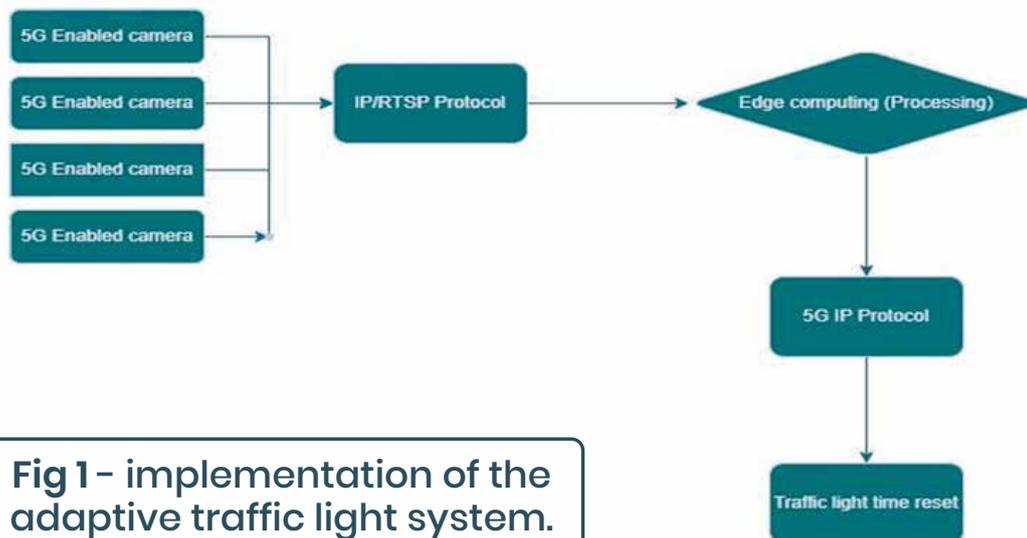
Fig 1 - implementation of the adaptive traffic light system.

03 Conclusion

This project was demonstrated during the final rounds of Innovation Hackathon with 5G-enabled traffic management use case, integrating edge computing and real-time video analytics to create an adaptive and intelligent signal control system. By dynamically adjusting traffic light durations based on live vehicle density, the system aimed to improve urban traffic efficiency while reducing congestion and emissions.

Proposal No : HAC-2025-1167

Visual-SLAM for Collaborative UAV Applications in Army Surveillance Using 5G

Team Members
Mr. Pranav M, Mr. Kanwardeep Singh Gahlot, Ms. Neha Choudhary

Institute
Birla Institute of Technology and Science, Pilani

01 Problem Statement

Traditional SLAM (Simultaneous Localization and Mapping) relies mainly on LiDAR and Inertial Measurement Unit (IMU) for mapping and localization, but visual-SLAM (VSLAM) offers a lighter, more cost-effective option using cameras. When fused with LiDAR and IMU data, VSLAM can provide strong performance in dynamic environments, making it ideal for UAVs where weight and power are limited. With 5G integration, UAVs gain high-bandwidth, low-latency communication to share mapping data in real time.

02 Solution/ Architecture

The primary objective of this project is to design and implement a 5G-assisted VSLAM framework tailored for collaborative UAV missions in critical applications such as army surveillance and autonomous delivery systems. The proposed system aims to significantly enhance the capabilities of UAVs operating in outdoor environments by utilizing high-speed 5G connectivity for improved situational awareness, data sharing, and low-latency communication. A 5G-enabled MEC framework further supports collaborative SLAM among multiple UAVs, while combining SLAM with integrated sensing and communication (ISAC) allows navigation and perception to be enhanced through edge computing and reduced onboard processing.
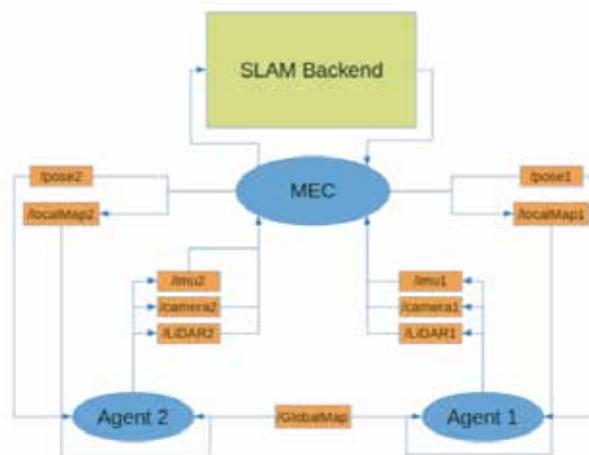
03 Conclusion

The project involved the integration of Visual-SLAM with 5G for UAV-based surveillance applications. By utilizing the high-speed, low-latency communication capabilities of 5G networks, this project aimed to develop a reliable VSLAM system that ensures accurate and real-time navigation for UAVs in complex surveillance environments. The system will significantly enhance the effectiveness of UAVs in critical tasks such as border security, surveillance of strategic areas, and monitoring in disaster zones.

Proposal No : HAC-2025-1262

Real-Time Open Source Face Recognition on CPU Edge Server

Team Leader

Mr. A Sivaramakrishnan

Institute
Indian Institute of Science, Bangalore

01 ▶ Problem Statement

5G Architecture provides a very power EDGE compute component which the devices can leverage to facilitate a low latency and highly available application infrastructure framework. This project envisaged the extensive usage of the EDGE compute framework to build AI recognition models based on CPU with the use case of facial recognition that can be used in enterprise and industrial framework providing the required value enhancement to the private 5G setup for devices like camera and mobile applications.

02 ▶ Solution/ Architecture

To provide affordable, private face recognition for India's last-mile 5G edge infrastructure. It is designed for enterprise and industrial applications, enabling devices like cameras and mobile applications to use facial recognition for scenarios such as attendance, security, and safety. It utilizes Niral's EDGE compute solution deployed in 100 5G Labs in India to establish an enterprise and industrial application framework for facial recognition with CPU-based recognition model to ensure affordability and efficiency. It Offers an open-source, CPU-efficient, privacy-centric, and extensible solution with REST APIs and UI dashboards. It is 100% open-source pipeline with reproducible builds.
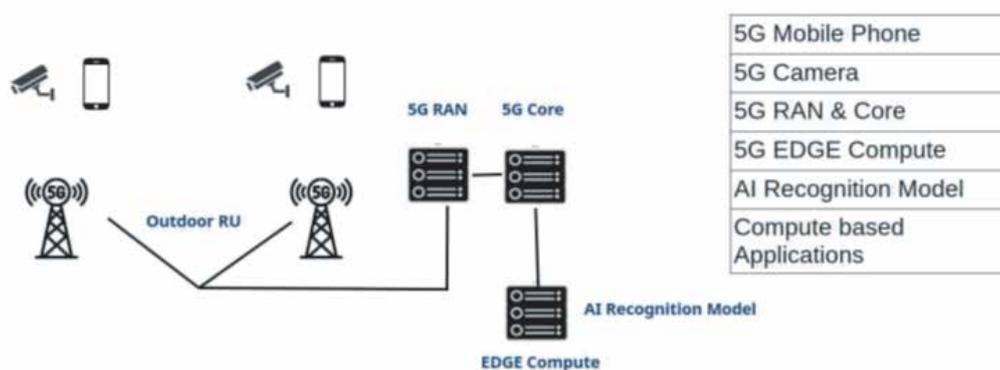
Fig: Architecture of the project

03 ▶ Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. It a scalable, privacy-centric, and cost-effective facial recognition solution tailored for India's 5G edge infrastructure. It is fully open-source and optimized for CPU-based deployment. The solution ensures strong data privacy by performing all biometric processing locally on the edge server, without requiring cloud storage. It also has significant educational value, providing hands-on learning opportunities for students working with AI and 5G technologies.

Autonomous Drone For Virtual Intelligent Care Assistance

Team Members

Mr. Nikhil, Mr. Buxi, Mr. Vishal, Mr. Mohit
Mr. Maroof

Institute
Delhi Technological University

01 Problem Statement

ADVICA (Autonomous Drone for Virtual Intelligent Care Assistance) is an innovative drone-based system designed to transform emergency response in India. It integrates autonomous drones, AI voice assistance, and virtual ICU capabilities to provide real-time medical support, monitor patient vitals, and aid rescue operations—especially in remote or high-risk areas. Featuring GPS-based navigation, advanced obstacle avoidance, and live video streaming,

02 Solution/ Architecture

- It ensure rapid and autonomous drone deployment to emergency locations using GPS-based navigation.
- Provide an onboard Virtual ICU kit for vital monitoring (heart rate, SpO_2, temperature, respiratory rate).
- Enable live surveillance and real-time video feed to support remote medical decision-making.
- Offer multilingual AI voice assistance for patient guidance and psychological support.
- Improve safety with intelligent obstacle avoidance in complex environments.
- Enhance emergency operations in disaster zones, smart cities, and remote regions with internet/5G support.

03 Conclusion

Project ADVICA was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Ghaziabad highlighted the integration of autonomous drones, AI, and medical monitoring to support emergency care in remote and high-risk areas. It enhances response speed, reduces human involvement in dangerous situations, and improves access to life-saving support.

Crash Prevention through Vehicle-to-Everything (V2X) Communication using 5G Technology

Team Members
Mr.Yash Bhargava, Mr. Manan Jain, Ms. Aditi Sharma, Ms. Simrat Kaur

Institute
Thapar Institute of Engineering and Technology, Patiala

01 Problem Statement

Road safety remains a major concern as autonomous and connected vehicles evolve. Traditional systems using LiDAR, cameras, and radar operate independently, leaving vehicles unaware of hidden hazards beyond sensor range, such as accidents behind blind curves or roadblocks ahead. Current GPS-based platforms like Google Maps send alerts using satellite data and crowdsourced updates, but this information often arrives with delays of several seconds to minutes.

02 Solution/ Architecture

⮞ To design and implement a 5G-enabled accident prevention system using real-time obstacle detection, braking, and remote monitoring.

⮞ To implement a basic 5G-powered Vehicle-to-Everything (V2X) communication framework, enabling the vehicle to exchange safety-related information with nearby vehicles (V2V), infrastructure elements like traffic signals (V2I), and network/cloud services (V2N).

⮞ To demonstrate the capabilities of 5G in enabling ultra-low-latency, reliable communication between the vehicle and an external dashboard, supporting real-time monitoring, control commands, and emergency interventions

5G Network → AWS IoT Core → Traffic Management

Connected Vehicles

Satellite/GPS

5G-V2X System Architecture

03 Conclusion

The 5G-enabled V2X accident prevention system demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad showed that how real-time communication and autonomous sensing can significantly improve road safety. By integrating ultrasonic detection, automatic braking, and remote monitoring, the prototype effectively prevents collisions and enhances situational awareness beyond sensor range.

AgriFlysense: A 5G-Enabled Cost effective SWIPT Drone-Assisted Sensor Node for Smart Agriculture Monitoring

Team Members

Mr. Vikas Kumar, Mr. Malav
Dr. Ashwani Sharma

Institute
Indian Institute of Technology Ropar

01 Problem Statement

This project, titled "A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management," proposes an advanced drone system that integrates Digital Twin technology and AI-based decision-making. The framework aims to transform disaster response and infrastructure monitoring through a coordinated fleet of autonomous drones equipped with multi-modal sensors such as thermal imaging, LiDAR, and ground-penetrating radar (GPR). These drones perform real-time detection of affected individuals and structural conditions while operating over reliable, ultra-low-latency 5G/6G communication networks. The Digital Twin continuously simulates and optimizes missions, overcoming the limitations of manual and disconnected drone-based operations.

02 Solution/ Architecture

- To design a miniaturized, dual-band drone-mounted antenna enabling Simultaneous Wireless Information and Power Transfer (SWIPT) for sustainable, long-duration drone-assisted operations.

- To develop compact, polarization-insensitive, microwave-powered, battery-free sensor nodes capable of harvesting energy via Wireless Power Transfer (WPT) and transmitting environment data (e.g., temperature, humidity) using 5G-based wireless communication.

- To implement and demonstrate the complete AgriFlySense system in a realistic agricultural environment, validating its reliability for continuous monitoring and field-scale deployment.

03 Conclusion

The project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad, offers a comprehensive and scalable solution to the challenges of post-disaster response and infrastructure management. By integrating AI, multi-modal sensing, 5G communication, and Digital Twin technology, the proposed framework provides a robust alternative to current manual and disconnected systems. It addresses critical gaps by enabling real-time mission optimization, secure remote operation, and coordinated drone behavior.

◄◄

A 5G-Enabled Smart Farming Assistant

Team Members

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Mr. Subhradeep Mandal, Dr.(Mrs.) Dalia Nandi1

Institute
IIIT, Kalyani

01 ▶ Problem Statement

Krishibandhu, meaning "Friend of the Farmer," is an AI and IoT-powered smart agriculture assistant that uses 5G connectivity and cloud computing to modernize farming. It collects real-time soil and environmental data through IoT sensors and uses drone or mobile images to assess crop health. The information is processed in the cloud using LSTM (Long Short-Term Memory) machine learning models to predict soil moisture, plant health, and weather conditions.

02 ▶ Solution/ Architecture

▷ To provide farmers with real-time and accurate weather forecasts using IoT data and LSTM-based prediction models for better irrigation and crop management decisions.

▷ To enable early detection of crop diseases using AI-based analysis of images captured via mobile phones or drones, and notify farmers instantly with recommended actions.

▷ To monitor soil moisture continuously through IoT sensors and support smart irrigation—either by advising farmers or automatically controlling water flow.

▷ To ensure accessibility and user-friendliness by delivering alerts and guidance in multiple local languages, making the system inclusive for rural communities.

▷ To deploy a low-cost, scalable solution using affordable hardware and cloud-enabled 5G connectivity, suitable for small and marginal farmers across diverse regions.
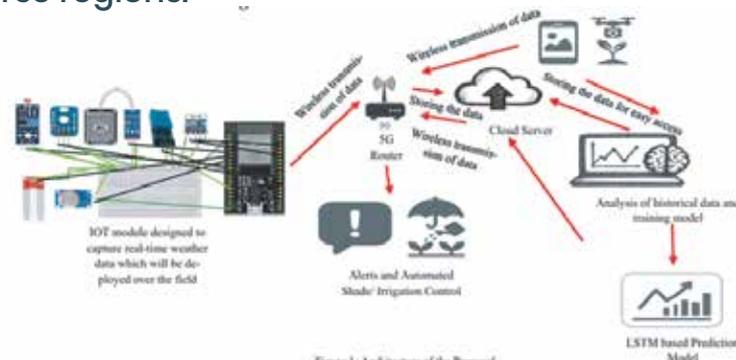
Figure 1: Architecture of the Proposal.

03 ▶ Conclusion

The project Krishibandhu was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. The project demonstrated a step toward transforming Indian agriculture by combining cutting-edge technologies like 5G, AI, IoT, and cloud computing to support real time, data-driven farming. Developed and tested using the 5G lab infrastructure at IIIT Kalyani, this smart farming tried to addresses the core challenges faced by farmers—unpredictable weather, delayed disease detection, water mismanagement, and lack of accessible expert guidance.

Proposal No : HAC-2025-1817

A Framework for an Autonomous Drone-Based Network Using Digital Twin and AI-Driven Optimization for Disaster Recovery and Infrastructure Management

Team Members

Mr. Arun Kushwaha, Mr. Utkarsh Maurya,
Mr. Ananay Kaushal, Mr. Nitin Saini, Mr. Rahul Prasad

Institute
National Institute of Technology
Hamirpur (H.P.)

01 Problem Statement

Natural and man-made disasters—like landslides, earthquakes, floods, and building collapses—often result in tragic loss of life, primarily because of delayed victim detection and inefficient emergency response coordination. Existing response systems rely heavily on manual fieldwork and disconnected operations, which lead to delays in rescue efforts.

02 Solution/ Architecture

This system integrates AI-driven multi-sensor fusion, combining thermal imaging, LiDAR, and GPR for real-time disaster response using autonomous UAVs. It utilizes a decentralized coordination protocol with 5G/6G networks for ultra-reliable, low-latency communication, enabling dynamic mission reconfiguration. Edge-based machine learning pipelines, powered by devices like the Jetson Nano, process data locally, reducing cloud dependency and bandwidth usage. A real-time, physics-aware Digital Twin model simulates the disaster environment for predictive optimization. Secure operations are ensured through Zero Trust principles, IDS, and encrypted communication, providing remote, reliable control and ensuring the integrity of mission-critical data and operations.

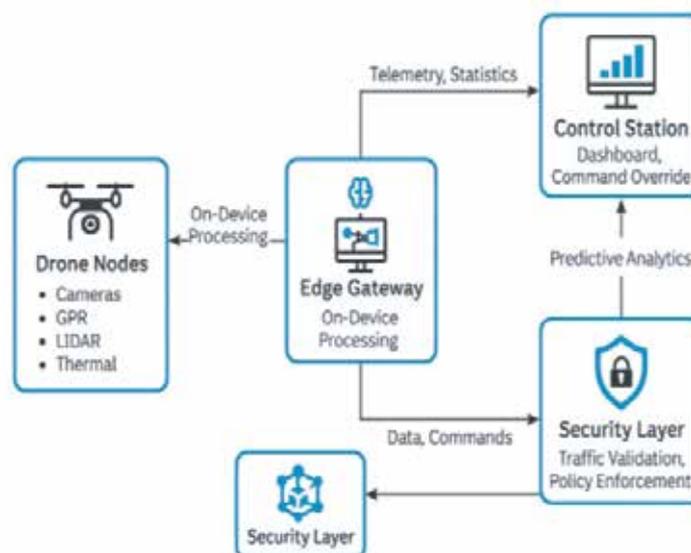

Fig1: System Architecture

03 Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Ghaziabad. This project tried to establishes a cutting-edge framework that integrates 5G connectivity, Digital Twin technology, and AI-driven autonomous drones to transform disaster response and infrastructure management.

Proposal No : HAC-2025-1856

Empowering 5G and Beyond: Intelligent RIS-Assisted Multi-User Communication with Passive Sensing and Machine Learning

Team Leader

Mr. Ankit Kumar Pal

Institute
Indraprastha Institute of Information, Delhi

01 ▶ Problem Statement

This project demonstrated a next-generation communication solution for Non-Terrestrial Network (NTN) applications. It features a fixed transmitter (TX) and a RIS positioned at the center of a semicircle, with stationary users arranged along the arc. Passive sensing by Near-Field Radio Frequency (NRF) modules at the RIS estimates users' azimuth locations through ML, followed by dynamic beam steering at the RIS using Field-Programmable Gate Array (FPGA)-programmed 1-bit Space-Time Coding (STC).

02 ▶ Solution/ Architecture

The proposed system architecture is designed around a highly controlled and replicable environment to facilitate precise testing and validation:

▷ A fixed TX is deployed at a predefined, known location to ensure a stable source of RF signals throughout experiments.

▷ A RIS, integrated with PIN diode control, is strategically positioned at the origin of a semicircle. This setup ensures that the RIS can dynamically manipulate the wireless environment by reflecting signals toward desired directions.

▷ Stationary RXs are distributed along the arc of the semicircle. These receivers are located at unknown azimuth angles (denoted as θ_1, θ_2, etc.), simulating realistic scenarios where the exact positions of users are not known beforehand.

This architecture provides a controlled yet challenging setup, where the RIS must intelligently adapt and steer signals toward multiple users based on real-time sensing and machine learning inference.

03 ▶ Conclusion

This project was demonstrated during final evaluation of 5G innovation Hackathon at National Communications Academy-Technology, Gahziabad. It is a future-ready, energy-efficient wireless communication framework designed for Non-Terrestrial Networks (NTN), drones, and airborne systems by integrating Reconfigurable Intelligent Surfaces (RIS), passive RF sensing, and machine learning. It enables real-time DoA estimation without active feedback, dynamic beam steering through FPGA-controlled 1-bit STC, and simultaneous multi-user communication using harmonic multiplexing, all while maintaining scalability through low-cost hardware.

OTHER FINALISTS OF 5G INNOVATION HACKATHON 2025

EVALUATED AT INDIAN INSTITUTE OF SCIENCE, BANGALORE

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02	Multi-Sensor PRS/SRS Fusion for Precise Positioning of UE Using AI 5G Drones as Virtual gNB in NTN (HAC-2025-0600)	SASTRA Deemed University	50
03	HoloScout: An IoT-Powered, ML-Driven Stealth Recon Drone for Urban Intelligence Gathering Team Members : Yash Parkhi (HAC-2025-0644)	Symbiosis Institute of Technology, Pune	51
04	RIS-Assisted 5G ISAC System for Passive Intrusion Detection in Industrial Perimeter Security (HAC-2025-1065)	Visvesvaraya National Institute of Technology, Nagpur	52
05	CoPercept-AMR: Quantum Metamaterial-Based Reconfigurable Surface for Quantum Communication (HAC-2025-1617)	M S Ramaiah Institute of Technology	53
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13	CoPercept-AMR: 5G-Enabled Drone-Based Damage Assessment and Remote Monitoring of Radio Towers (HAC-2025-1100)	Indian Institute of Technology Gandhinagar	61
14	Enhancing Public Transportation for the Visually Impaired Integrated with 5G (HAC-2025-1127)	BMS College of Engineering, Bengaluru	62
15	CoPercept-AMR: A Next-Generation Localization Framework for Autonomous Mobile Robots in 5G-Enabled Smart Environments (HAC-2025-1169)	Indian Institute of Information Technology Dharwad	63
16	5G-Enabled River Water Level Forecasting for Bridge Safety and Flood Mitigation (HAC-2025-1648)	Sri Sivasubramaniya Nadar College of Engineering	64
17	KASHYAP: AI-Driven 5G-Enabled Autonomous Seed Sowing Machine for Smart Farming (HAC-2025-1671)	Maulana Azad National Institute of Technology, Bhopal	65
18	5G-Enabled Mobile Gait Analysis: Advancing Real-Time Biomechanical Monitoring (HAC-2025-1695)	School of Computer and Information Sciences, University of Hyderabad, Telangana	66
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CoPercept-AMR : Farm Guard: 5G-AI-Blockchain Enabled Post-Harvest Crop Resilience System

Team Members

Rebba Chandra Sekhar,
P venkateswaramma, G.S Arind Reddy

Institute
GITAM Institute of Technology and Management
Deemed to be University

01 ▶ Problem Statement

Predict hyperlocal weather threats (<1km) using edge AI and trigger real-time crop protection. Empower farmers with AI-based price forecasting and blockchain-backed MSP compliance. Digitize and optimize cold storage using 5G-IoT for real-time availability and spoilage alerts.

02 ▶ Solution/ Architecture

Stage	Tech Stack	5G Use Case
Weather Protection	IoT sensors + TinyML	5G D2M multicast alerts
Price Optimization	LSTM AI + Ethereum blockchain	5G URLLC for price APIs
Smart Storage	LoRaWAN sensors + GIS mapping	5G mMTC for IoT density

Societal & Industrial Impact

Quantified Benefits

Metric	Impact	Source
Loss Reduction	30–40% (₹45,600 cr/year)	NABARD 2023
Farmer Income	22% higher profits	NITI Aayog 2024
Cold Storage Efficiency	35% lower spoilage	NCCD 2023

Stakeholder Benefits

▷ **Farmers :** MSP transparency, reduced spoilage.
▷ **Government :** Supports Digital Agriculture Mission 2025.
▷ **Startups :** Open APIs for weather and pricing data.

03 ▶ Conclusion

Farm Guard delivers a scalable, secure, and intelligent post-harvest solution using 5G, AI, and blockchain. By addressing weather risk, price exploitation, and storage inefficiencies, it empowers farmers, supports national agri-tech goals, and creates a resilient agricultural supply chain. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Multi-Sensor PRS/SRS Fusion for Precise Positioning of UE Using AI 5G Drones as Virtual gNB in NTN

Team Members
Janani G, Gobika L, Subarenjani N, A Rajesh

Institute
SASTRA Deemed University

01 Problem Statement

This project proposes an AI-powered system for precise localization and trajectory prediction of UAVs in GPS-denied environments using 5G Positioning Reference Signals (PRS), Sounding Reference Signals (SRS), and sensor fusion. By deploying drones as virtual gNBs within Non-Terrestrial Networks (NTN), the system enhances mission-critical operations such as search and rescue, disaster response, and military coordination. A Multilayer Perceptron (MLP) model is trained on features like Time of Arrival (ToA), Angle of Arrival (AoA), RSSI, and interference levels to predict UAV position and movement in real time.

02 Solution /Architecture

Fuse PRS/SRS, path loss, and CSI data to extract key localization features. Train an MLP model using ToA, AoA, RSSI, and interference metrics .Deploy the trained model on SDR hardware for real-time UAV localization. Predict UAV trajectory using AI models for dynamic mission planning. Enable virtual gNB functionality in drones for enhanced communication in disaster zones.

Societal & Industrial Impact

▷ **Disaster Relief**: Enables rapid localization and communication in earthquake and landslide zones (e.g., Myanmar, Wayanad).

▷ **Military Operations**: Tracks troop positions and supports secure communication via drone-based gNBs.

▷ **Public Safety**: Captures aerial imagery and facilitates contact between victims and rescuers.

▷ **Infrastructure Resilience**: Replaces damaged gNBs with AI drones for uninterrupted service.

03 Conclusion

This project demonstrates a robust AI-driven framework for UAV localization and trajectory prediction using 5G PRS/SRS and SDR-based sensor fusion. By transforming drones into virtual gNBs, it ensures resilient communication and precise positioning in critical environments. The system's scalability, real-time performance, and societal relevance position it as a key enabler for future NTN deployments in 5G and beyond.

Proposal No : HAC-2025-0644

HoloScout: An IoT-Powered, ML-Driven Stealth Recon Drone for Urban Intelligence Gathering

Team Leader
Yash Parkhi

Institute
Symbiosis Institute of Technology, Pune

01 Problem Statement

Reconnaissance in high-risk urban and underground environments presents challenges such as limited visibility, complex layouts, and safety hazards for human personnel. HoloScout is a ground-based drone system designed to address these issues using advanced technologies like Simultaneous Localization and Mapping (SLAM), visual odometry, and AI-driven detection. It enables safe, efficient, and intelligent surveillance in confined spaces, supporting defense, disaster response, and industrial inspection missions.

02 Solution/ Architecture

Hardware Components

- ▶ Four Mecanum wheels for omnidirectional movement.
- ▶ Camera module connected to Raspberry Pi for visual data capture.
- ▶ ESP32 microcontroller for movement control and sensor processing.
- ▶ MPU6050 IMU for motion tracking and stability.
- ▶ Optional ToF sensors for obstacle detection.
- ▶ Power system using Samsung INR21700 cells with boost and buck converters.

Software Architecture

- ▶ OpenCV for image processing and feature extraction.
- ▶ SLAM algorithms (GMapping/Cartographer) under ROS for mapping and localization.
- ▶ AI models (TensorFlow/PyTorch) for face and object detection.
- ▶ Remote interface for live video, map visualization, and drone control.
- ▶ Database for storing images, maps, and positional data.

Communication Protocols

The system leverages 5G for high-speed, low-latency data transmission. Key protocols include:

- ▶ MQTT: Efficient telemetry data exchange.
- ▶ WebSocket: Real-time control communication.
- ▶ WebRTC: Secure peer-to-peer video streaming.

03 Conclusion

HoloScout sets a new standard for urban reconnaissance by merging SLAM, AI, and IoT into a compact, intelligent drone system. Its ability to navigate complex indoor environments and deliver actionable intelligence makes it a valuable tool for defense, disaster response, and industrial applications. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1065

RIS-Assisted 5G ISAC System for Passive Intrusion Detection in Industrial Perimeter Security

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Institute
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01 Problem Statement

Design and validate a RIS-assisted 5G ISAC system for passive intrusion detection. Use RIS to steer and enhance 5G signal reflections in NLOS zones. Extract Channel State Information (CSI) and Doppler features for motion detection. Train AI models to classify motion types using signal variations. Integrate with VNIT's MEC server for real-time alerting and visualization

02 Solution/ Architecture

Component	Functionality
RIS Panels	Programmable phase control for beam steering and zone scanning
Passive Receiver	Captures CSI and CIR from reflected 5G signals
MEC Server	Hosts AI models for motion classification and alert generation
Operator Dashboard	Displays intrusion zones and triggers alerts via SMS/email
VNIT 5G Lab	Provides standalone 5G network, gNB, and testing tools

Methodology

▶ **RIS Integration:** VNIT's RIS panels steer beams across test zones for enhanced signal return

▶ **Signal Processing:** Passive receivers extract CSI and CIR; detect anomalies via Doppler shifts and time-of-flight changes

▶ **AI Classification:** Models trained to distinguish human, vehicle, and ambient motion patterns

▶ **Visualization:** Real-time dashboard displays intrusion zones; alerts sent via multiple channels

▶ **Validation:** Simulated industrial perimeter (~100 sqm) with mobile targets; test runs measure accuracy, latency, and false alarms

03 Conclusion

The RIS-assisted 5G ISAC proposal by VNIT Nagpur represents a breakthrough in industrial perimeter security. By repurposing 5G infrastructure for passive sensing and integrating RIS technology, the system delivers non-invasive, real-time intrusion detection in environments where traditional surveillance fails. It aligns with national goals in smart infrastructure and strategic security, and lays the foundation for future 6G networks that unify communication, sensing, and control. With strong validation and scalable design, this solution positions VNIT as a leader in RIS-ISAC innovation for industrial safety. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1617

CoPercept-AMR: Quantum Metamaterial-Based Reconfigurable Surface for Quantum Communication

Team Leader
Swetha Amit

Institute
M S Ramaiah Institute of Technology

01 Problem Statement

This project proposes a Quantum Metamaterial (QMM)-based Reconfigurable Intelligent Surface (RIS) for secure quantum communication in the Terahertz (THz) spectrum. The RIS integrates Vanadium Dioxide (VO_2) as a phase-change material, a Sapphire substrate, and a Niobium (Nb) superconducting ground plane. By leveraging temperature-induced phase transitions and quantum coherence effects, the surface dynamically switches between absorption and reflection modes at 5.5 THz. This enables adaptive wavefront control, quantum key distribution (QKD), and interference suppression—critical for 6G and quantum-secure networks.

02 Solution/ Architecture

▶ **VO_2 Layer**: Acts as a tunable absorber or reflector based on temperature or THz excitation. Exhibits quantum superposition near phase boundaries.

▶ **Nb Ground Plane:** Superconducting below 9.2 K, enabling perfect reflection and minimal energy loss. Transitions to absorptive state under magnetic fields or THz-induced pair breaking.

▶ **Sapphire Substrate:** Provides ultra-low loss, thermal stability, and compatibility with quantum emitters and superconducting circuits.

▶ **Quantum Behaviour:**
VO_2 and Nb exhibit superposition of electromagnetic states, allowing simultaneous absorption and reflection.
THz pulses trigger ultrafast transitions, enabling real-time reconfigurability without mechanical components.

03 Conclusion

This project pioneers the fusion of quantum metamaterials with reconfigurable intelligent surfaces for secure THz communication. By combining VO_2's tunable phase-change behaviour with Nb's superconducting properties, it delivers a dynamic, low-loss, and quantum-coherent platform for next-generation networks. The proposed QMM-RIS sets a new benchmark for quantum-secure 6G infrastructure and cryptographic innovation. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1626

EdgeAI-Enabled Real-Time Fruit Harvester for Automated Smart Farms

Team Members
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Institute
GITAM Institute of Technology and Management Deemed to be University

01 Problem Statement

This project proposes a low-cost, high-accuracy fruit harvesting system powered by EdgeAI and 5G connectivity. Unlike traditional cloud-based solutions, the system performs real-time inference locally, minimizing latency and ensuring uninterrupted operation in remote farms. The harvester integrates vision sensors, AI-based fruit readiness detection, and a robotic arm for actuation. A novel model partitioning technique enables deployment of complex AI models across resource-constrained edge devices and edge servers, maintaining accuracy without relying on expensive hardware. The system is scalable, patentable, and designed to benefit small, medium, and large farms alike.

02 Solution/Architecture

Automate fruit harvesting using EdgeAI for real-time inference. Maintain high detection accuracy without cloud dependency. Reduce hardware cost via model partitioning across edge and edge server. Use 5G for low-latency communication between devices. Enable modular, scalable deployment across diverse farm types

Component	Functionality
Vision Sensor	Captures fruit images for analysis
Edge Device (e.g., Raspberry Pi)	Hosts partial AI model layers for initial inference
Edge Server (ES)	Completes model inference and sends harvesting instructions
5G Connectivity	Enables fast data transfer between edge and ES
Robotic Arm	Executes harvesting based on AI inference
Mobile Interface	Displays live feed and system status to farmer

03 Conclusion

This EdgeAI-powered fruit harvester offers a transformative solution for precision agriculture. By combining model partitioning, low-cost hardware, and 5G connectivity, it delivers real-time, accurate, and scalable automation for farms of all sizes. The system addresses key challenges in labor, cost, and latency while enabling future-ready smart farming. With strong potential for patenting, research publication, and commercial deployment, it positions itself as a pioneering innovation in agricultural robotics—bridging the gap between affordability and advanced automation. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore

Proposal No : HAC-2025-0052

Software-Defined Networking for Non-Terrestrial Networks: Optimizing Sub-6 GHz Connectivity

Team Members

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01 Problem Statement

This project proposes a dynamic, AI-enhanced Software-Defined Networking (SDN) framework for Non-Terrestrial Networks (NTN) operating in the Sub-6 GHz spectrum. As NTN infrastructure—comprising LEO satellites, UAVs, and HAPS—becomes integral to global connectivity, efficient spectrum utilization and interference mitigation are critical. The proposed system leverages SDN's centralized control, AI/ML-based predictive resource management, and real-time traffic rerouting to enhance spectral efficiency, network resilience, and seamless integration with terrestrial 5G/6G networks.

02 Solution/ Architecture

The architecture includes:

- ▷ **USRP (SDR Front-End) :** Acts as the RF interface for Sub-6 GHz transmission/reception across satellites, UAVs, and ground stations.
- ▷ **SDR Software (GNU Radio/MATLAB) :** Handles modulation, demodulation, channel estimation, and error correction.
- ▷ **Middleware Layer :** Bridges SDR and SDN, enabling real-time feedback for routing and spectrum optimization.
- ▷ **SDN Controller (ONOS/Ryu/OpenDaylight) :** Uses OpenFlow to dynamically manage traffic, allocate spectrum, and reroute data to avoid interference.
- ▷ **AI/ML Models :** Analyze historical and real-time data to predict demand, optimize bandwidth, and adapt to disruptions.
- ▷ **Edge Computing Nodes :** Perform local processing to reduce latency and support time-sensitive applications like IoT and V2X.
- ▷ **User Devices :** Connect via NTN for broadband, messaging, and sensor data in remote or underserved areas.
- ▷ **Feedback Loop :** Continuously adjusts network parameters based on signal quality and user demand.
- ▷ **NTN-Terrestrial Integration**: SDN enables seamless communication between NTN and 5G core networks.
- ▷ **Network Slicing:** Supports diverse applications (IoT, emergency response) with virtualized services.
- ▷ **Dynamic Spectrum Sharing:** Efficient use of Sub-6 GHz bands via AI-driven allocation. URLLC: Ensures low-latency, high-reliability links for mission-critical tasks.
- ▷ **mMTC:** Scales IoT connectivity in remote areas with energy-efficient NTN operations.

03 Conclusion

This project presents a scalable, intelligent framework for optimizing Sub-6 GHz NTN connectivity using SDN and AI. By addressing spectrum scarcity, interference, and resource allocation challenges, it lays the foundation for resilient, adaptive, and globally integrated NTN systems—crucial for the future of 6G, IoT, and ubiquitous broadband access. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-0727

NeuroLink Rover: A 5G-Enabled Brain-Computer Interface for Remote Rover Control in Critical Operations

Team Members
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01 Problem Statement

Traditional robotic control systems rely on handheld devices and stable connectivity, which are often compromised in dynamic or obstructed environments. In contrast, BCI systems offer intuitive, distraction-free control by interpreting brainwave patterns. However, their deployment in field robotics has been limited due to latency, signal precision, and safety concerns.

NeuroLink Rover addresses these challenges by leveraging 5G's ultra-reliable low-latency communication (URLLC), high bandwidth, and edge computing capabilities. This enables robust, real-time transmission of EEG signals and sensor feedback, making thought-controlled robotics viable for critical operations.

02 Solution/ Architecture

The NeuroLink Rover system comprises several interconnected layers:

▷ EEG Acquisition Layer

Portable headsets like OpenBCI or Muse 2 capture multi-channel EEG signals, detecting patterns such as alpha, beta, theta, and gamma waves.

▷ Signal Processing and Classification

EEG data undergoes filtering, artifact removal, and feature extraction using tools like FFT and band-pass filters. Machine learning models—SVM, LDA, or CNNs—classify mental commands (e.g., blink for forward, concentration for turn).

▷ 5G Communication Layer

Commands are transmitted over 5G networks with <1 ms latency. Edge servers process data locally, reducing reliance on cloud infrastructure and ensuring responsiveness.

▷ Rover Control Layer

A Raspberry Pi-based control unit interprets commands and activates motors, sensors, and cameras. Feedback from onboard systems is sent back to the operator via 5G.

▷ Operator Feedback Display

Real-time visualization through AR headsets or dashboards allows the operator to monitor rover status and surroundings, creating a closed-loop control system.

03 Conclusion

NeuroLink Rover represents a transformative leap in human-machine interaction. By combining neuroscience, robotics, and 5G, it enables cognitive control of machines in real time—redefining remote operations in critical environments. This project lays the foundation for neuroadaptive systems that extend human capabilities while enhancing safety, precision, and accessibility. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

NeuroCareNet: A 5G-Powered Federated AI Network for Early Detection of Brain Disorders

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01 Problem Statement

NeuroCareNet is a privacy-preserving, 5G-enabled federated AI platform designed to detect neurological disorders such as brain tumors, Alzheimer's, and Parkinson's at early stages. It integrates multimodal data—MRI/CT scans and voice recordings—processed locally at hospital edge nodes. Through secure federated learning, encrypted model updates are shared across institutions to collaboratively train diagnostic models without exposing patient data. The system supports real-time alerts, clinical dashboards, and national health data compliance, enabling scalable, equitable, and secure neuro diagnostics.

02 Solution/ Architecture

Enable early detection of brain disorders using multimodal AI (imaging + voice).Preserve patient privacy via federated learning and secure aggregation. Deploy edge AI inference at hospitals for real-time diagnostics. Use 5G for fast model synchronization and alert delivery Integrate with EHR and telemedicine platforms for clinical usability. Support scalable deployment across rural and urban hospitals

Component	Functionality
Edge Node	Local preprocessing, AI inference, FL client (Docker/Kubernetes)
Aggregation Server	FL orchestration (Flower/FLARE), secure aggregation (HE/SMPC)
Clinical Dashboard	Risk scores, imaging overlays, voice biomarker tracking, EHR integration
5G Connectivity	eMBB for model sync, URLLC for alerts, slicing for QoS isolation

03 Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore

Proposal No : HAC-2025-819

IntelliResQ: 5G-Based Smart Traffic and Emergency Response System for Disasters

Team Members
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01 ▶ Problem Statement

Deploy edge AI-enabled smart traffic nodes for adaptive signal control and incident detection Detect emergency vehicle sirens and trigger green wave pre-emption. Disseminate disaster alerts via BLE/LoRa mesh to reach last-mile users. Enable vehicle-to-network (V2N) communication for rerouting and incident reporting. Use 5G slices for low-latency control, high-bandwidth video, and massive IoT connectivity. Support authorities with centralized dashboards and predictive analytics

02 ▶ Solution/ Architecture

Component	Functionality
Smart Traffic Nodes	Edge AI for vehicle detection, adaptive signal control, 5G URLLC for command execution
Audio Detection Units	Siren recognition via CNNs, direction estimation, alert transmission via 5G/LoRa
Disaster Mesh Nodes	BLE/LoRa/Wi-Fi mesh for local alert propagation, solar-powered, gossip protocol
Vehicle OBUs / App	BLE alert reception, rerouting guidance, incident reporting via phone sensors
Central Control System	Cloud/MEC backend for data aggregation, traffic simulation, alert orchestration

03 ▶ Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore

Proposal No : HAC-2025-1069

5G-Enabled Multi-Sensor Rod System for Real-Time Slope Stability Monitoring in Open-Cast Coal Mines

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Institute
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01 Problem Statement

India's open-cast coal mines face frequent slope failures, leading to fatalities and operational losses. This proposal from VNIT Nagpur introduces "Omni-Rods"—rugged, sensor-embedded rods deployed into dump slopes and benches to monitor geotechnical conditions in real time. Using VNIT's private 5G infrastructure, these rods transmit high-frequency data to edge servers, where AI models detect early signs of instability and trigger alerts. The system merges geotechnical instrumentation, 5G connectivity, and AI analytics to create a scalable, predictive safety solution for smart mining.

02 Solution/ Architecture

Develop a multi-sensor rod prototype for slope stability monitoring. Integrate 5G IoT modules for ultra-low latency data transmission. Build AI models to predict slope failures using fused sensor data. Create a real-time dashboard for alerts and risk visualization. Validate the system up to TRL 6 using VNIT's 5G lab infrastructure

Component	Functionality
Omni-Rod	Embedded sensors: accelerometers, gyroscopes, piezometers, pressure sensors, thermocouples, LVDTs
Microcontroller	Collects sensor data and transmits via 5G
5G Gateway	Connects rods to VNIT's 5G Core and MEC servers
Edge Server	Performs anomaly detection and prioritizes alerts
Cloud Dashboard	Visualizes risk levels and sends SMS/email notifications

03 Conclusion

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

HydroTerRa: Automated 5G Drone and Digital Twin Platform for Scalable Soil Moisture Monitoring

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01 Problem Statement

HydroTerRa is a fully automated 5G-enabled drone system designed to revolutionize soil moisture monitoring across agricultural landscapes. By integrating FMCW radar, edge computing, and digital twin visualization, the platform delivers real-time, actionable irrigation insights with minimal farmer intervention. The system addresses water scarcity, labor inefficiencies, and crop yield variability—offering a scalable solution for precision agriculture.

02 Solution/Architecture

Deploy autonomous drones with FMCW radar for soil moisture scanning. Enable real-time data transmission via 5G and edge processing. Visualize moisture data through a digital twin interface. Reduce water usage by 25% and increase crop yields by 15–20%. Operate without manual scheduling or sensor deployment.. Create rural employment and bridge the digital divide.

Feature	Role	Impact
eMBB	High-speed radar data transfer	Seamless real-time transmission
URLLC	Low-latency alerts	Immediate irrigation adjustments
Edge Computing	Local processing	Reduced cloud dependency
Network Slicing	Prioritized data flow	Reliable performance in rural zones
mMTC	IoT scalability	Multi-drone, multi-sensor support

03 Conclusion

HydroTerRa offers a transformative leap in precision agriculture by automating soil moisture monitoring and irrigation planning. With its 5G backbone, radar-based sensing, and digital twin interface, the system empowers farmers to make data-driven decisions while conserving water and boosting yields. It's a scalable, inclusive, and future-ready solution for sustainable farming. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Copercept – AMR 5G-Enabled Drone-Based Damage Assessment and Remote Monitoring of Radio Towers

Team Leader

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01 Problem Statement

This project, developed by a team from IIT Gandhinagar, introduces a cutting-edge prototype that integrates drone technology, 5G connectivity, and advanced computer vision (CV) to automate the assessment of structural damage to radio towers—especially during disasters like floods and earthquakes. The system enables real-time remote monitoring and expert diagnosis, significantly reducing inspection time, labor costs, and communication downtime in critical scenarios.

02 Solution/ Architecture

The architecture is modular and layered, comprising:

▷ **Drone Subsystem**
Equipped with optical, multispectral, and optional thermal or LiDAR sensors, drones capture real-time imagery and transmit it via 5G.

▷ **5G Connectivity Hub**
Ensures seamless, high-speed communication between drones, edge processors, and cloud servers.

▷ **Edge Processing**
Performs initial data decoding, compression, and lightweight CV inference for quick anomaly detection.

▷ **Cloud Processing**
Conducts deep analysis using advanced CV models (e.g., U-Net, Mask R-CNN) and aggregates historical data for trend analysis.

▷ **Data Storage & Dashboard**
A robust database stores imagery, metadata, and analytical results, which are visualized through an interactive dashboard for expert review.

▷ **Expert Remote Monitoring**
Real-time alerts and diagnostic tools allow experts to assess tower conditions and guide remediation efforts remotely.

03 Conclusion

This prototype demonstrates a transformative approach to infrastructure monitoring, combining drones, 5G, and AI to deliver rapid, accurate, and scalable damage assessment. It addresses critical gaps in current inspection methods and sets a strong foundation for future research, commercialization, and deployment in disaster-prone regions. The system exemplifies how technology can enhance resilience, reduce costs, and protect vital communication infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1127

Enhancing Public Transportation for the Visually Impaired Integrated with 5G

Team Members

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01 Problem Statement

This project from BMS College of Engineering addresses the challenges faced by visually impaired individuals in navigating public transportation. The team has developed a low-cost, intelligent IoT system using ESP32 microcontrollers and GPS modules to provide real-time audio prompts for bus identification. Communication between sender (on the bus) and receiver (at the bus stop) modules is achieved via ESP-NOW protocol. To overcome range limitations and improve scalability, the system is being enhanced with Over-the-Air (OTA) firmware updates and 5G connectivity using the SIM8200 module—enabling real-time GPS data transmission and centralized management across urban and rural deployments.

02 Solution/Architecture

▶ **Sender Module:** ESP8266 + NEO6M GPS transmits bus location.
▶ **Receiver Module:** ESP8266 + VS1053 MP3 shield on Arduino UNO plays audio alerts.
▶ **Protocol:** ESP-NOW enables low-latency communication within 15–20 meters.
▶ **Challenges:** Limited range, battery dependency, and lack of remote monitoring.

Societal & Industrial Impact

Societal Benefits

▶ Reliable transit access for visually impaired individuals
▶ Real-time GPS tracking in rural and disaster-prone areas
▶ Sustainable, low-power architecture reduces e-waste
▶ Promotes inclusive smart infrastructure

Industrial Applications

▶ Logistics and fleet tracking
▶ Smart agriculture and remote monitoring
▶ Manufacturing and oil & gas automation
▶ Unmanned systems in hazardous environments.

03 Conclusion

This project delivers a resilient, scalable, and inclusive IoT solution for public transportation accessibility. By integrating OTA updates, 5G connectivity, and power-aware logic, it creates a dynamic network of ESP32 nodes coordinated by a central gateway. The system is ready for real-world deployment and aligns with national goals for smart, inclusive infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Copercept - AMR Next-Generation Localization Framework for Autonomous Mobile Robots in 5G-Enabled Smart Environments

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01 Problem Statement

AMRs operating in dynamic environments like factories, warehouses, and smart cities face significant challenges in localization due to GPS unavailability, sensor occlusions, and scalability issues in multi-agent settings. Traditional methods often fail to deliver consistent performance under these conditions. CoPercept-AMR proposes a solution by leveraging cooperative perception—sharing sensor data among robots and infrastructure—to create a redundant and resilient localization system. This requires ultra-reliable low-latency communication (URLLC), high bandwidth, and distributed fusion techniques, all enabled by 5G.

02 Solution/ Architecture

The CoPercept-AMR architecture is modular and layered, comprising

▷ **Perception & Sensing Layer :** AMRs and infrastructure units (e.g., RSUs, drones) are equipped with sensors like LiDAR, cameras, IMUs, and GPS. These capture spatial features and motion vectors, forming the raw input for localization.

▷ **Communication Layer (5G V2X) :** Real-time data exchange occurs via V2V (robot-to-robot), V2I (robot-to-infrastructure), and V2N (robot-to-network) links. 5G NR sidelink and gNB-assisted interfaces ensure deterministic, low-latency communication.

▷ **Cooperative Perception & Fusion Layer :** Shared data is fused using Bayesian filters, Graph SLAM, and deep learning models. Temporal and spatial alignment techniques resolve occlusions, allowing AMRs to perceive beyond their line of sight.

▷ **Localization & Mapping Layer :** The system estimates robot positions, corrects GPS drift, and maintains global map consistency through cooperative SLAM.

▷ **Edge Intelligence Layer :** Lightweight AI models run on edge nodes to perform sensor fusion, anomaly detection, and task prioritization. Federated learning enhances privacy by avoiding raw data transmission.

▷ **Visualization & Monitoring Layer :** A central dashboard provides live tracking, signal overlays, and alerts. AR/XR tools and drones support visualization for testing and demonstrations.

03 Conclusion

CoPercept-AMR represents a leap forward in autonomous robot localization, combining cutting-edge technologies to overcome longstanding challenges. Its fusion of cooperative perception, 5G connectivity, and edge intelligence sets the stage for safer, smarter, and more scalable robotic systems in the era of Industry 4.0 and smart cities. . The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1648

5G-Enabled River Water Level Forecasting for Bridge Safety and Flood Mitigation

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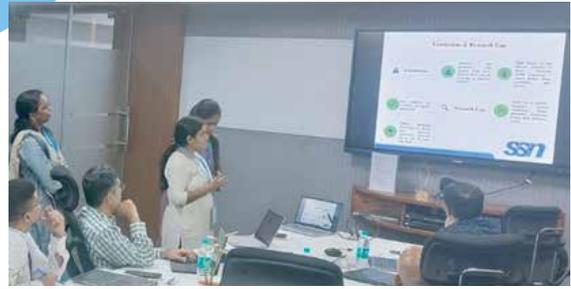
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of Engineering

01 Problem Statement

This project from Sri Sivasubramaniya Nadar College of Engineering proposes a 5G-enabled real-time river monitoring system to enhance bridge safety and flood preparedness. By integrating smart sensors, edge AI, and cloud analytics, the system delivers predictive water level insights and early alerts to authorities. It addresses infrastructure vulnerability, climate-induced flood risks, and delayed emergency response—offering a scalable solution for disaster mitigation.

02 Solution/ Architecture

Sensor Layer
- Ultrasonic/radar sensors monitor water levels.
- Rainfall and atmospheric sensors capture environmental data.
- Metadata (GPS, timestamp) enriches each reading.

Communication Layer
- 5G routers transmit data instantly.
- Dual-path routing: edge for immediate analysis, cloud for long-term storage.
- Network slicing ensures priority for emergency data.

Edge Computing Layer
- AI/ML models detect anomalies and predict flood onset.
- Alerts triggered locally for rapid response.
- Reduces cloud dependency during severe weather.

Cloud Platform
- Stores historical data and supports regional flood modeling.
- Correlates sensor data with weather forecasts and dam releases.
- Provides dashboards for planners and emergency teams.

Alert System
- Sends notifications via SMS, mobile apps, and public sirens.
- Enables proactive bridge closures and evacuations.

03 Conclusion

This 5G-enabled river monitoring system offers a transformative approach to flood mitigation and bridge safety. By combining smart sensing, edge AI, and cloud analytics, it delivers timely, predictive insights that empower authorities to act before disaster strikes. Scalable, resilient, and SDG-aligned, it's a future-ready solution for climate-resilient infrastructure. The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1671

Kashyap AI-Driven 5G-Enabled Autonomous Seed Sowing Machine for Smart Farming

Team Members
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01 Problem Statement

KASHYAP is an autonomous seed sowing robot designed to modernize Indian agriculture through precision farming and real-time connectivity. Developed by students at Maulana Azad National Institute of Technology, Bhopal, the rover integrates AI-based decision-making, environmental sensing, and 5G communication to automate seed placement, monitor field conditions, and transmit live data to farmers. It reduces labor dependency, improves sowing accuracy, and enables remote farm management—especially in rural areas with limited infrastructure.

02 Solution/ Architecture

Component	Functionality
Raspberry Pi 4	Central controller for sensors, motors, and AI logic
Sensors	Soil moisture (FC-28), temperature/humidity (DHT22), IMU (MPU6050), GPS (NEO-6M), ultrasonic for seed count and obstacle detection
Seed Mechanism	Triple-layer shutter system for singulation, blade for trenching, soil cover plate
Mobility	Conveyor belt-based tracked system for all-terrain navigation
5G Module	Quectel RM500Q for real-time data transfer and remote control
Farmer App	Live video feed, remote commands, field monitoring dashboard

03 Conclusion

▶ System initialization calibrates sensors and sets sowing parameters
▶ 5G enables bi-directional communication and scalability across multiple rovers
▶ Sensor data guides AI model to calculate sowing depth and spacing
▶ Triple-shutter system dispenses one seed per cycle, verified by ultrasonic sensor
▶ Soil covering plate ensures optimal germination conditions
▶ GPS-based field mapping and grid generation automate sowing routes

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1695

5G - Enabled Mobile GAIT Analysis Advancing Real-Time Biomechanical Monitoring

Team Leader
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01 Problem Statement

Gait analysis is a vital tool in healthcare and sports science for assessing human locomotion and detecting mobility disorders. Traditional systems rely on expensive, marker-based setups in controlled environments, limiting accessibility and scalability. This proposal introduces a mobile application that leverages 5G infrastructure and edge computing to deliver real-time, clinical-grade gait analysis using only a smartphone camera—eliminating the need for specialized hardware and democratizing access to biomechanical monitoring.

02 Solution/Architecture

Hardware & Network
▶ Smartphone camera captures video frames.
▶ 5G-enabled transmission to Multi-access Edge Computing (MEC) servers.
▶ Real-time feedback via dashboards over ultra-low latency 5G links.

Software Pipeline
▶ MediaPipe BlazePose for 2D joint keypoint detection.
▶ Edge-based anonymization (face removal) and pose data generation.
▶ AI models for gait parameter estimation and anomaly detection.
▶ Local storage of results for post-analysis.

03 Conclusion

▶ **Healthcare :** Remote monitoring for 1,000+ patients annually.
▶ **Sports :** Injury risk reduction through real-time feedback.
▶ **Commercialization :** Freemium app for consumers; subscription model for clinics and teams.

The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.

Proposal No : HAC-2025-1881

Log Insight AI-Powered Real-Time Log Search Analytics and Backhaul Monitoring System for Telecom Infrastructure

Team Members
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01 Problem Statement

Log Insight is a centralized, scalable log analytics platform designed to deliver real-time visibility, anomaly detection, and predictive diagnostics across telecom infrastructure. Built on the Elastic Stack (ELK), ScyllaDB, and integrated machine learning, the system ingests high-volume logs from routers, firewalls, switches, and cloud-native workloads. It enables full-text search, intelligent correlation, and live dashboards for operational monitoring. By automating root cause analysis and backhaul latency tracking, Log Insight enhances network resilience, security, and compliance—supporting both 5G and legacy systems.

02 System Architecture

Component	Functionality
Data Sources	Routers, switches, firewalls, 5G core, OSS, VPNs, Kubernetes clusters
Ingestion Layer	Rsyslog, Filebeat, Metricbeat in HA mode
Processing Layer	Logstash with Grok parsers for normalization
Storage Layer	Elasticsearch (text search), ScyllaDB (structured event data)
Analytics Engine	ML models for anomaly scoring and pattern detection
UI Layer	Kibana dashboards with filters and visualizations
Alerting Engine	Rule-based and AI-based triggers for real-time alerts

03 Conclusion

Log Insight delivers a robust, AI-powered log analytics platform tailored for telecom infrastructure. By combining centralized ingestion, real-time search, and intelligent anomaly detection, it empowers operators to maintain resilient, secure, and compliant networks. With scalable architecture and 5G integration, the system is ready for deployment across government, enterprise, and telecom environments—setting a new standard for operational intelligence in the digital era. . The project was successfully demonstrated during the final round of 5G Innovation Hackathon Evaluation at Indian Institute of Science, Bangalore.