



AIORI-2 National Student Workshop

Report

Date of Workshop: September 2, 2025

Organized by:

India Internet Foundation (IIFON)

*IEEE India Council – Industry Academia Young Professionals Committee
(IAYPC)*

In Collaboration with Key Academic Institutions Across India

Venue:

Hybrid (Online Sessions & Distributed Campus Labs, India)

Empowering Future Internet Engineers

Building Resilience and Standards Leadership for India's Digital Future

Executive Summary

The **AIORI-2 National Student Workshop** marked a landmark in India's Internet engineering education, bringing together **26 institutions and ~1,500 students nationwide**. The event combined policy insights, deep technical sessions, and practical hands-on training, positioning students as **future contributors to global Internet standards**.

Key Highlights

- **Mr. Anupam Agrawal (IIFON Chair):** Positioned the Internet as societal infrastructure, stressed resilience over security, and highlighted students' role in future standardization.
- **Mr. Anand Raje (IIFON Co-founder, IEEE IAYPC Co-convenor):** Provided technical foundation on Internet protocols, BGP, DNS, submarine cables, and security challenges.
- **Dr. John Jose (IIT Guwahati):** Presented the "knowledge economy" model — dissemination, generation, and practice — linking Internet engineering to entrepreneurship.
- **Dr. Chengappa Munjandira (IEEE India Council):** Connected India's Digital Public Infrastructure (Aadhaar, UPI, DigiLocker) to resilient Internet systems and workforce development.
- **Shri Sushil Pal (Joint Secretary, MeitY):** Committed government and NIXI support for student-driven Internet measurement, labs, and participation in IETF/ISO/IEEE.
- **Mr. Dhruv Dhody (IAB Member):** Explained IETF's philosophy of open, consensus-driven standards and encouraged student entry via IRTF and hackathons.
- **Mr. Abhijan Bhattacharyya (TCS):** Linked Internet evolution to Industry 4.0, highlighting open standards, AI integration, and India's role in multiple SDOs (IETF, ITU-T, 3GPP).
- **Dr. Mansi Subhedar (IEEE IAYPC):** Coordinated multi-stakeholder collaboration, acknowledged milestones across faculty and student workshops, and outlined sustainability through hackathons and curriculum integration.



Quantitative Achievements

Dimension	Key Figures/Outcomes
Institutions Participated	26 across India
Student Reach	~1500 Students
Distinguished Speakers	7(Govt. Academia, Industry, IETF, IEEE IAYPC)
Measurement Tools Used	4(DNS, Ping, Traceroute, Mobile Testing)
Global Exposure	IETF & AIB pathways introduced
Engagement Continuity	Ongoing AIORI platform access & hackathon prep

Welcome Address - Mr. Anupam Agrawal (IIFON Chair)

Context Setting and Vision Statement:

Mr. Anupam Agrawal opened with a profound conceptual framework that positioned the workshop beyond traditional technical training. His opening remarks established several critical themes:

Internet as Societal Infrastructure: "Internet is no longer just a technology. It has become the nervous system of our society. Everything from communication to commerce to research is dependent on it." This framing immediately elevated the discussion from technical curiosity to national importance.

Measurement Imperative: The emphasis on continuous Internet measurement was positioned as essential for improvement: "it is extremely important that we understand it more deeply and we continuously measure it so that we can improve it and that is the fundamental reason why AIORI as a program exists."

Student Role Transformation: Students were positioned not as passive learners but as "future engineers who will represent our country in various standardization bodies." This aspirational framing created clear career pathways and national service opportunities.

Resilience Focus: A critical distinction was made between security and resilience: "We have been creating systems which are secure which are privacy aware but there is a need to create resilient digital systems." This technical nuance would become a recurring theme throughout the workshop.

Technical Foundation Session - Mr. Anand Raje

AIORI Program Evolution and Context

Historical Development: Mr. Anand Raje provided detailed background on the AIORI project's inception around 2019, emphasizing the identification of Internet problem statements and the decision to engage the academic community in technical solutions.

Community Engagement Strategy: The three-phase approach was outlined:

1. **Regional Faculty Workshops:** Successfully completed with AIORI Ambassadors trained
2. **Student Workshops:** Current phase with institutional coordination
3. **National Coordination:** Present workshop bringing together students from across India



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Platform Development Philosophy: The dedication of the AIORI platform to academia was emphasized, with specific mention of its integration into learning curriculum and its role in providing deeper Internet understanding perspectives.

Internet Infrastructure Deep Dive

Protocol Architecture Explanation:

Mr. Anand provided a comprehensive explanation of Internet protocols, positioning them as a "set of rules" necessary for heterogeneous devices and platforms to communicate effectively. The four-layer TCP/IP model was detailed with specific focus on DNS, network access, Internet layer, and BGP protocols.

Network Fundamentals:

- **Switching vs. Routing:** Clear differentiation between broadcast domains (switches) where "everybody gets it" based on MAC addresses, versus routing (routers) working on IP layer for network-to-network connectivity
- **AS Numbers:** Detailed explanation of Autonomous Systems using familiar examples (Vodafone, Jio, BSNL) to illustrate how different networks maintain unique identities
- **BGP Importance:** Positioned as "one of the key pillar protocols of internet which if not there then you cannot envision internet"

Physical Infrastructure Reality:

Comprehensive coverage of the physical layer that students typically don't consider:

- **Submarine Cables:** "cables which are there in the oceans these are the cables which are transferring your packets to the destination from India to other countries"
- **Terrestrial Fiber:** Land-based fiber optic infrastructure within India
- **LEO Satellites:** Emerging technology with distinct performance characteristics and challenges
- **Infrastructure Investment:** Emphasis on the massive investment and multiple stakeholder involvement in global connectivity

Security Architecture Challenges

Protocol Security Gaps: Critical analysis of Internet security architecture:



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- **BGP Vulnerability:** Described as "not secured protocol" and a "three-napkin protocol which has been invented that all the AS can bunch the IP addresses together"
- **Patching Approach:** Explanation of BGPsec, RPKI, and other security extensions, with concern about increased centralization
- **PKI Centralization:** "because of this patching of protocols, the security aspect is becoming more centralized. The PKI infrastructure which is behind the security is kind of more centralized"
- **Research Opportunities:** Questions raised about optimal security approaches and underlying centralization challenges

DDoS Mitigation Beyond Appliances: Technical insight that "it's not that firewalls that can mitigate DOS attack" but protocol-level solutions like RTBH (Remotely Triggered Black Hole) can provide more effective mitigation when properly implemented by transit providers.

DNS Resolution Process Detailed Explanation

Step-by-Step DNS Query Process:

1. **Local Resolution Attempts:** Browser checks host file (legacy from Sir John Postel's original Internet management)
2. **Recursive Resolver Query:** Browser contacts configured DNS resolvers acting as query service
3. **Hierarchical Resolution:** Root servers → CCTLD/TLD servers → Authoritative servers
4. **Resource Record Retrieval:** Final IP address obtained from authoritative servers
5. **Web Content Fetching:** Browser uses resolved IP to fetch actual web content

Performance Analysis Framework: "whenever you start a query on the internet there are bunch of servers there are bunch of technologies that take very few milliseconds to respond to you. Think of what kind of technologies are behind it."

Multi-Entity Security Model: Emphasis that "security of the internet is not a one entity's job. It is a kind of multiple entity job. The resiliency is also not a one entity job."

Academic Vision Session - Dr. John Jose (IIT Guwahati)

Knowledge Economy Framework

Three-Phase Knowledge Model:

Dr. John Jose articulated a sophisticated framework for capacity building in knowledge economies:

1. **Knowledge Dissemination:** "Very few people know about something and they use platforms for knowledge dissemination. What happens in classrooms, in labs, in your structured course, everything is about knowledge dissemination where the learned people are creating a platform for unlearned to get a chance to learn."
2. **Knowledge Generation:** "We are moving into the next phase of knowledge generation. Something that is unknown... We will be defining problem statements which will be kicking off with the help of a hackathon. We will be defining you and you will all come to know there are some interesting problems where we don't know the answer."
3. **Knowledge Practice:** "You find that knowing the internet is yet another means of getting an input, getting a livelihood and you make a business out of it. You are going to become the entrepreneurs who will offer services and products which will strengthen our internet."

Historical Parallel: Comparison to India's software industry development: "just like how India is a knowledge superpower in terms of exporting software, something that was envisioned four decades before by a bunch of enthusiastic scientists or computer programmers. Today we are second to none in terms of building the resilient software that is running in machines across the planet."

Industry Perspective - Dr. Chengappa Munjandira (IEEE India Council)

Digital Public Infrastructure Context

India's Global Leadership:

Dr. Chengappa positioned India's achievements in digital public infrastructure as global benchmarks:

- **Aadhaar:** Identity infrastructure serving over a billion people



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- **UPI (Unified Payments Interface):** Revolutionary payment system
- **DigiLocker:** Digital document storage and verification
- **Emerging Platforms:** UMANG, DIKSHA, Bhashini as next-generation services

Infrastructure Dependency Analysis: "Behind every digital public infrastructure service lies an invisible yet critical backbone, the internet infrastructure. Without robust internet infrastructure, even the most innovative digital platforms cannot function effectively."

National Priority Framework

Workforce Development Imperative: "This makes skilling a new generation of engineers, researchers, practitioners in the internet infrastructure a national priority at this point in time."

Systematic Dependencies:

- **Aadhaar for Identity:** Requires reliable DNS systems and backbone networks
- **UPI for Payments:** Depends on secure, resilient internet exchanges
- **DigiLocker for Documents:** Needs robust routing and edge infrastructure
- **Scale Requirements:** "A skilled workforce, the skilled engineers ensure the system runs smoothly, securely at scale, preventing disruptions that could impact millions"

Technology Transition Challenges

5G/6G Evolution: "The future of 6G depends not only on spectrum and devices but also on core internet routing exchanges edge infrastructure. Students who can upskill on these domains enable the nation not just to consume these technologies but also lead in setting global standards."

Digital Divide Bridging: "Urban India has largely embraced digital services but rural and remote regions still face connectivity gaps by developing expertise in internet measurements, internet exchange points, community-driven networks."

Cybersecurity and Sovereignty: "From phishing to large scale cyber attacks, vulnerabilities in internet infrastructure can paralyze entire sectors. Building skills in network security, protocol design, resilient architecture ensures that we as a nation retain digital sovereignty."

Student Transformation Message



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Beyond Consumption to Creation: "You would start contributing to the standards in global forums to transform the consumers of digital platforms into the creators of the infrastructure that sustains them."

Foundational Relationship: "Digital India will be as strong as the internet it runs on and the internet will only be as strong as the people who would build, manage and secure."

Workshop as Catalyst: "Don't consider this as just another event but a catalyst of transformation. Take this workshop as your launchpad to inspire you to explore, innovate, think beyond conventional boundaries."

Government Commitment - Shri Sushil Pal (Joint Secretary, MeitY)

Pre-Recorded Message

Medical Analogy for Internet Measurement: "The internet today is not just a network of the network. It's the lifeline of our economy, of our education, our healthcare and our governance. To ensure that it remains secure, resilient and inclusive, we need to measure it continuously. Just like a doctor monitors the vital signs of the body."

Diagnostic Framework: "Without the data, there can be no diagnosis and without diagnosis, there can be no solution. This is where all of you students of engineering and computer science play a pivotal role."

Direct Government Support Commitments

Practical Research Support: "The anchors which are being provided as a part of the AIORI project provides you a playground for you to measure the internet. By learning to measure the internet by deploying these anchors, you are enabled to run the experiments and by analyzing the results you become the engineers of the internet."

Standards Participation: "Historically much of this work has been dominated by developed countries. Today India must claim its rightful seat at the global standardization table. And the way to do this is by empowering our students and the researchers to engage with organizations like IETF, ISO and IEEE."

Specific Support Offers:

1. **Project Support:** "NIXI and the Ministry of Electronics and IT is ready to support the student for any product or any standardization project where they choose to participate in any of these forums"



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2. **Direct Access:** "I urge you all to reach out to us for any support you need for development of any standard or protocol for the internet operations"
3. **Infrastructure Development:** "NIXI is in the process of setting up an internet lab and we look forward to the very keen students who are ready to actually work on the internet operation with NIXI for doing more advanced research"

National Moment Recognition: "India stands at a crucial moment in history. Our digital economy is expanding rapidly. Our innovation system is vibrant and our youth is full of energy. With programs like AIORI 2, we are ensuring that this energy is channelized towards strengthening the internet itself, the foundation on which all digital transformation rests."

Advanced Technical Session - Mr. Dhruv Dhody (IAB Member)

IETF Mission and Philosophy Deep Dive

Document-Centric Approach: Mr. Dhruv emphasized IETF's specific focus: "IETF focuses at a very specific part which is high-quality relevant technical documents. We want to focus only on the standards aspects, the technical documents that influence the way people design, use and manage the internet."

Influence vs. Control Model: Critical distinction explained: "You will notice two things. We are not talking about actually running things. So, this is not the IETF is not the organization that is actually running the internet. Second thing that you will see is there is nothing that we have which says that we can force people to do anything. All we do is influence."

Quality-Based Success: "Only if we do that that's how IETF is successful and that's the balance that we have between various other organizations... There are other standards organizations. There is of course ICANN which is more responsible for the policy angles especially related to DNS. There is an internet governance forum."

IETF Ethos and Participation Model

Universal Access Principle: "Everyone can participate. What that means is all you need is an email address and just by that email address you join a mailing list and you are part of the IETF. IETF doesn't have membership. It doesn't have any dues. You don't have to have any particular qualifications, none of that."

Open Knowledge Sharing: "All our work is made available for free. Not just our actual standards that we develop but everything in between. All the copies which we call internet drafts



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which get evolved towards the standards. All our meeting minutes slides everything is available for free."

Technical Merit Focus: "We judge our contribution only on technical merit. So it should not matter who is the one who is proposing the idea. It is the technical validity of that idea that should matter."

Voluntary Deployment Philosophy: "Finally we have success by voluntary deployment. We cannot force anyone just because there is an RFC that somebody has to implement... first the vendors need to see and people who are implementing should see that yes it's worth implementing. Then when it comes to service providers they should think that yes it's worth deploying. Then as a customer one has to see that yes I want to actually use this feature."

Standards Development Rationale

Interoperability Foundation: "The idea of the internet as Anand was describing was all about connecting various different networks and all those networks don't look alike. They are all heterogeneous... But what needs to happen is we all need to agree on some basic protocols."

Practical Examples: "Take an example of HTTP any browser on any kind of device whether it's mobile phone or whether it is your laptop Mac OS can talk to any server because the HTTP was standardized and anyone who comes up with a new idea or a new way of doing this they don't have to worry they just have to implement that standard."

Permissionless Innovation: "By making it open we allow innovation to happen... you could see exactly what is happening you can add new features based on the changes in the network and that allows us to have the actually what we call as permissionless innovation that you don't have to come to the IETF and ask IETF's permission to innovate over the products that the IETF has already made."

Organizational Structure and Process

Lego Block Philosophy: "When they are new to the IETF they'll understand how the whole internet works. There is a whole blueprint behind it... actually IETF never did that. What IETF did was something like a Lego block. We focus on one tiny block, maybe as a chartered item in our working group developing that one protocol or one specific thing but we do not focus on or do not specify how that thing needs to work with other things around it."

Innovation Benefits: "That's led to innovation so now people in the industry can see that yes even though HTTP is standardized if I want to use this in IoT or in a totally different environment. They never had to come to the IETF and ask for a blueprint change. They can just do that and that allows you to do this permissionless innovation."

Working Areas Structure:



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1. **Internet Area:** IP, IPv4, IPv6, NTP, DNS, core infrastructure protocols
2. **Routing:** BGP, OSPF, ISIS, Path Computation Element (PCE), SR-v6, Segment Routing
3. **Web and Internet Transport:** TCP, UDP, QUIC, HTTP, congestion protocols
4. **Applications and Real-time Media:** WebRTC, SIP, Voice over IP, calendaring protocols
5. **Security:** Cross-cutting security considerations for all protocols
6. **Operations and Management:** YANG, NETCONF, RADIUS, protocol management

Global Community Statistics

Recent Meeting Data (Madrid, July 2025):

- **Total Participants:** ~1,700 people
- **In-Person:** 1,000 attendees
- **Remote:** 640 participants
- **First-Time Participation:** ~20% always new participants
- **Hackathon Engagement:** ~50% of participants join Saturday/Sunday hackathons

Geographic Distribution Analysis:

- **US Leadership:** Largest participant group
- **Major Contributors:** China, Germany, UK, India
- **Indian Growth:** Participation increased especially through remote engagement
- **Remote Accessibility:** "Remote participation has always been pretty good at IETF"

Community Scale Indicators:

- **Mailing List Participation:** 7,831 unique email addresses posting across IETF lists
- **Document Production:** Significant annual RFC publication numbers



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- **Working Groups:** ~126 active groups (11 new, 13 closed in recent period)
- **Diversity Metrics:** ~20% academia participation, growing civil society and government involvement

Internet Architecture Board (IAB) Role

Long-term Technical Direction: "We are there to provide more long-range technical direction for internet development in long terms... whereas IAB looks at things in a much more long-term perspective."

External Relations: "We are the body that is more like a foreign arm or foreign office... talking to other organizations things like ICANN internet society, all the ITU organizations and all the liaison coordination."

Workshop Function: Examples of upcoming workshops:

- **Age Verification Workshop:** Addressing policy debates on content restriction for children
- **Geolocation Workshop:** IP address-based location services analysis
- **Purpose:** "Not to do the actual work but these are a way for us to bring the right set of people in the room and see if we can generate ideas on what's next to happen"

Student Engagement Pathways

IRTF as Entry Point: "Joining IRTF is a much easier entry point into the IETF process because all the research groups and working groups always meet together... You would see a lot of these things happening."

Research vs. Standards Timeline: "IETF is focusing on delivering things that are needed right now like within the time frame of like one year or 6 months whereas a research group is looking at trying to understand the problem first trying to understand all the parameters and something that might be needed in 3 years down the line."

Community Finding: "As a student and from academia you will find your peers there. You'll find your community much more easily in a research group than at some of the working groups, especially long-running working groups with lots of history behind them."

Relevant Research Groups for Students:



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- **Quantum Internet Research Group:** Future networking technologies
- **Measurement and Analysis Protocol (MAP) RG:** Directly relevant to AIORI work
- **Path-Aware Decentralization:** Next-generation routing concepts
- **Sustainability (SUSTAIN):** Environmental impact of Internet protocols
- **Space Research Group:** Satellite-based Internet infrastructure
- **HRPC (Human Rights and Protocol Considerations):** Policy-technology intersection
- **Global Access to Internet for All:** Digital divide bridging

Hackathon Philosophy and Implementation

Running Code Emphasis: "IETF has always believed that we should not look for the perfect solution. We are looking for a solution that has rough consensus and especially one which has running code behind it."

Historical Context: "There was this whole debate about whether to use TCP IP stack and the OSI stack where OSI was more of a perfect layering... and TCP IP was something that was already working and things that were already in the running code and they had momentum behind it."

Hackathon Structure:

- **Timing:** Weekend before IETF meetings
- **Open Participation:** Registration-based, remote participation available
- **Format:** Community-driven space for implementers to collaborate
- **Activities:** Interoperability testing, measurements, demos, standards feedback
- **Purpose:** "Take it back to the working groups where the standards were being developed. So inputs coming in from implementation going back into the standard making."

India Internet Engineering Society (IIES)



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Community Building: "IIES also is sort of like a community of folks who are interested in IETF who attend IETF meetings or IETF adjacent sometimes they are not implementing they are just implementing IETF protocol they are interested in the conversations that are happening at the IETF."

Resources Available:

- **Website:** iies.in with membership opportunities
- **WhatsApp Group:** Direct community interaction
- **Events:** Annual "connections" events and regular webinars
- **Upcoming:** Post-quantum cryptography (PQC) webinar end of September 2025
- **Activities:** "RFC We Love" sessions for community engagement

Industry Applications Session - Mr. Abhijan Bhattacharyya (TCS)

Knowledge Pyramid Framework for Industry 4.0

Systematic Knowledge Evolution: Abhijan introduced a sophisticated framework connecting Internet engineering to modern AI and Industry 4.0 applications:

Data → Information → Knowledge → Wisdom Pipeline: "We have this concept of the knowledge pyramid where we have this data we sense data then we gather information then knowledge and then we exchange knowledge and we then gather wisdom. So currently this is exactly what is unfolding in the era of industry 4.0."

AI Integration: "Information gives you knowledge and then when all the knowledge base comes together you get the wisdom which is AI. And AI is getting embedded more and more within the network."

Historical Internet Evolution Context

ARPANET Origins: "It started with the concept of ARPANET. So something like we have called DRDO in India. So similarly there is DARPA in the United States... At that time packet switching was just and people started to find the utility of packet switching and they started to connect the computers."

Machine-Human Relationship Evolution: "That was the time when machines started to become the representation of human minds more and more and that is... and now machines are more and more becoming representation of our entire environment. We talk about the smart world and all these things."

Geographic Expansion Timeline:

- **1969-1970:** Few university machines in corner locations
- **1977:** Cross-country connectivity (two coasts of United States)
- **1980s:** International expansion to Europe
- **Later 1980s:** Reached Asia and global connectivity

Internet Core Principles Analysis

End-to-End Principle: "There should not be any bias in the link in between. So it is end to end although there are many technologies that are coming up today with the advent of 5G which is kind of going a little bit against the principle if we can strictly observe but that is also in the interest of quality of service."

Universal Access: "If you have internet anywhere in the world you should be able to get access to data."

Freedom of Expression: "No censorship... again these are the fundamental concepts. But these are I can't say that in today's world these are absolutely obeyed by all countries, all geographies, every people."

Open Standards as Binding Force: "Binding all of them was an open standard so IETF is... Right now I'm representing India in ITU-T... I'm representing my organization in 3GPP... in OneM2M and I have represented my organization extensively in IETF."

Multi-SDO Experience and Comparison

Standards Organization Participation: Abhijyan provided unique perspective from active participation in multiple standards bodies:

- **ITU-T:** Representing India in telecommunications standardization
- **3GPP:** Mobile communications standards (5G development)
- **OneM2M:** Machine-to-machine communication standards



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- **IETF:** Internet protocol development

IETF Distinctiveness: "I can see the difference between IETF and other organizations. So open means it is... IETF has the philosophy of freeing the mind. So it is more than your organization. It is more the individual. It is a celebration of individual intellect."

Internet Evolution Milestones

Critical Periods in Internet Development:

- **1969:** ARPANET inception
- **1980:** "Epic battle between OSI and TCP/IP. TCP/IP won just because of vendor support"
- **1990s:** "Com boom www and http and we had static contents"
- **2000:** "People got excited thanks to the advancements in multimedia technology people started to think how whether we can also send multimedia so streaming multimedia started chat server were started"
- **Late 2000s:** "Social web and video on demand"
- **2010:** "Peer situation where internet really went into our pockets... with the advent of smartphone and internet became really wireless"

1986 Landmark: "1986 is a landmark when we thought about when the world started to talk about technology standards for the internet because it's a common language with which the entire world should talk."

Internet Society Formation (1992): "We had internet society... it emerged as a kind of legal umbrella and with a lot of social responsibilities of taking the internet to the masses."

IETF Philosophy Deep Dive

Democratic Principles: "The slogan that IETF gives is we reject kings, presidents and voting. We believe in rough consensus and running code."

Rough Consensus Definition: "Rough consensus is that we may always agree to disagree but at least there is some level of agreement on which we can say okay we can tentatively accept this or we can say we were not vehemently opposing this. So there is some kind of agreement based on which we, even our society, also runs not everything that we like but we accept."

Individual Merit Focus: "Unlike many standardization organizations you do not need any special membership... anybody can join a mailing list and put their opinion there to contribute technically. It does not matter which company or where you are, you can be a freelancer."

Workshop Coordination and Organizational Leadership - Dr. Mansi Subhedar (IEEE IAYPC)

Organizational Framework and Multi-Stakeholder Collaboration

Partnership Coordination: Dr. Mansi Subhedar, serving as Co-convener of IEEE IAYPC 2025, played a crucial coordinating role throughout the workshop, ensuring seamless collaboration between multiple organizational stakeholders.

Joint Initiative Recognition: She emphasized the collaborative foundation: "This initiative is a joint initiative of IEEE India Council Industry Academia Young Professional Committee 2025 and IIFON team. So I would like to thank each and every person who is involved at both the ends of IAYPC as well as the faculty members who attended the regional workshops."

Milestone Achievement Acknowledgment

Three-Phase Success: Dr. Subhedar highlighted the workshop as the "third milestone that the team has achieved after conducting the regional workshops in 11 different cities across India and then the faculty members who attended this workshop conducted the student awareness sessions in their own institutes."

Systematic Stakeholder Recognition: She provided comprehensive acknowledgment of the multi-stakeholder ecosystem

Academic Leadership:

- Dr. Chengappa Munjandira (Vice Chair Industry Relations, IEEE India Council)
- Dr. John Jose (Adviser IAYPC 2025)
- Dr. Ruchika Gupta (Convenor IAYPC)
- Dr. Mansi Subhedar (IEEE IAYPC)
- Mr. Anand Raje (Co-convener IAYPC and co-founder)
- Mr. Anupam Agrawal (Chair, IIFON)

Government Partnership:

- Ministry of Electronics and Information Technology, Government of India
- Internet Society
- NIXI (National Internet Exchange of India)
- Office of Principal Scientific Advisor, Government of India
- IIFON team

Program Sustainability and Future Vision

Student Engagement Platform: "I'm sure this national workshop will give us the platform to collaborate in a global way and to contribute from our side in internet standard development."

Continued Participation Encouragement: She specifically requested students to "attend all the remaining sessions as well so that it will help all of us to reach to the next milestone which is scheduled in terms of hackathon."

Domain Positioning: Dr. Subhedar positioned Internet engineering as a specialized field: "This domain which is slightly not covered mostly as compared to the domain of AI, ML, cyber security, blockchain etc."

Practical Session Preparation and Implementation

Distributed Laboratory Coordination

Hub-and-Spoke Practical Implementation: The afternoon practical sessions represented the workshop's most innovative component, with centralized coordination enabling distributed hands-on learning across 26 institutions simultaneously.

Campus-Based SPOC Leadership: Each participating institution's Single Point of Contact took responsibility for local laboratory management, ensuring standardized learning experiences while accommodating local infrastructure variations.

Platform Integration: Students were enrolled by their respective faculty SPOCs into the v2.aiori.in platform, providing access to structured assignments and measurement tools.

Four-Component Measurement Framework



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DNS Measurements:

- **Technical Focus:** Domain Name System query analysis with response time measurement
- **Practical Application:** Students tested DNS resolution across different recursive resolvers
- **Learning Outcomes:** Understanding of hierarchical DNS structure and performance variations
- **Real-World Relevance:** Connection between DNS performance and overall Internet experience

Ping Operations:

- **Measurement Scope:** Round-trip time analysis across various network destinations
- **Performance Analysis:** Latency comparison between different services and geographic locations
- **Problem Identification:** Recognition that bandwidth availability doesn't guarantee service performance
- **Diagnostic Skills:** Development of network troubleshooting capabilities using basic tools

Traceroute Analysis:

- **Path Discovery:** Network route visualization from campus anchors to target destinations
- **Routing Efficiency:** Identification of routing detours and suboptimal path selection
- **Geographic Understanding:** Recognition of international vs. national routing patterns
- **Infrastructure Awareness:** Practical understanding of Internet's physical topology

Mobile Application Testing:

- **Multi-Platform Analysis:** Smartphone-based measurements complementing fixed-line testing



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- **Access Technology Comparison:** Performance differences between mobile and fixed broadband
- **Real-World Scenarios:** Testing reflecting actual student Internet usage patterns
- **Quality Assessment:** Understanding service quality variations across different access methods

Assessment and Documentation Framework

Individual Submission Requirements: Each student completed separate assessment forms for each measurement type, ensuring comprehensive engagement with all technical components.

Progress Tracking: Real-time monitoring through the AIORI platform enabled immediate feedback and support for struggling students or institutions.

Academic Integration: The structured assessment system provided measurable learning outcomes suitable for institutional grading and academic credit.

Data Collection: Student measurements contributed to the larger AIORI Internet Measurement Network, providing educational value while supporting national Internet research objectives.

Workshop Conclusion and Future Pathway Establishment

Hackathon Preparation Framework

Problem Statement Development: The workshop established the foundation for upcoming hackathon challenges, with students now equipped to engage with advanced Internet engineering problems over 2-3 month periods using the AIORI platform.

Team Formation Opportunities: Inter-institutional connections established during the workshop created potential for collaborative hackathon teams spanning multiple colleges and geographic regions.

Timeline Coordination: Clear pathway established from current workshop (September 2) through hackathon finale (November, Chandigarh University) to potential IETF participation (March 2026).

Sustained Engagement Model



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Platform Access Continuity: Students retained access to AIORI measurement tools for ongoing research and learning beyond the workshop timeframe.

Faculty Network Activation: Campus SPOCs equipped to continue Internet engineering education at local level, extending workshop impact through semester-long activities.

Research Integration: Framework established for incorporating Internet measurement work into student projects, thesis research, and academic curriculum development.

Comprehensive Impact Assessment

Quantitative Achievements

Participation Scale:

- **26 Confirmed Institutions:** Active participation during live session with local SPOC coordination
- **Geographic Distribution:** Pan-India coverage including institutions from Chennai (South), multiple other regions
- **Student Engagement:** Multiple students per institution with classroom-based group participation in several locations

Technical Content Delivery:

- **6 Distinguished Speakers:** Government, academia, industry, and international standards experts
- **4 Measurement Tools:** Comprehensive hands-on experience with professional-grade Internet analysis capabilities
- **Real-Time Platform Usage:** Simultaneous access and coordination across distributed campus locations

Technical Excellence and Innovation Demonstration

Hybrid Event Execution Mastery



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Sophisticated Logistics Management: The successful coordination of 26 institutions through hub-and-spoke model while maintaining centralized content quality demonstrates advanced event management capabilities in technical education.

Multi-Platform Integration: Seamless combination of Zoom conferencing, YouTube live streaming, distributed campus laboratories, and online measurement platform usage represents significant technical achievement in educational delivery.

Quality Control Maintenance: Consistent technical content delivery across diverse institutional infrastructures while accommodating local variations in connectivity and laboratory capabilities.

Content Integration and Pedagogical Innovation

Theory-Practice Connection: Masterful integration of high-level policy discussions (government strategy), technical deep-dives (protocol architecture), and hands-on implementation (measurement tools) created a comprehensive learning experience.

Multi-Stakeholder Perspective: Students exposed to government policy makers, academic researchers, industry practitioners, and international standards experts in a single coordinated program.

Career Pathway Clarity: Clear progression established from current student status through hackathon participation to potential international standards involvement and professional opportunities.

Long-Term Sustainability and Ecosystem Impact

Movement Infrastructure Establishment

AIORI Ambassador Network: Workshop leveraged existing faculty training to create sustainable local delivery capability across participating institutions.

Platform Continuity: Students retain ongoing access to professional-grade Internet measurement tools beyond workshop completion, enabling extended learning and research engagement.

Government Partnership: Direct support commitments from MeitY and NIXI establish institutional foundation for continued program development and student support.

Industry Integration: Clear pathways established connecting academic learning with professional opportunities in telecommunications, Internet infrastructure, and technology services sectors.



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Global Positioning and Standards Engagement

IETF Participation Pipeline: Workshop established a clear pathway for student progression from local Internet measurement work to international standards development participation.

Research Contribution Framework: Student measurement activities contribute to national Internet infrastructure understanding while providing educational value.

International Representation: Framework created for India's enhanced participation in global Internet governance and standards development processes through student and faculty engagement.

Critical Success Factors and Replication Framework

Enabling Conditions for Success

Multi-Stakeholder Alignment: Successful coordination between government (MeitY/NIXI), academia (IEEE IAYPC), industry (TCS, Huawei), and international organizations (IETF/Internet Society) created a credible and comprehensive program.

Technical Infrastructure Readiness: AIORI platform maturity and campus network capabilities enabled sophisticated practical learning experiences at scale.

Faculty Preparation: Prior AIORI Ambassador training provided essential local leadership and technical expertise for effective workshop delivery.

Government Support: High-level policy commitment and resource allocation demonstrated national priority status and ensured participant confidence in program sustainability.

Replication and Scaling Considerations

Geographic Expansion Potential: Workshop model suitable for replication across additional institutions with proper advance coordination and technical preparation.

Content Modularity: Individual session components (policy, technical, standards, practical) could be adapted for different audiences or extended into longer-format programs.

Partnership Framework: Multi-stakeholder coordination model provides a template for similar technical capacity building initiatives in other domains.

Assessment Integration: Structured evaluation approach enables incorporation into formal academic programs and professional certification pathways.



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Strategic Program Development

Curriculum Integration Initiative: Development of semester-long course materials incorporating workshop content and ongoing platform access for academic program enhancement.

Industry Partnership Expansion: Direct collaboration agreements with telecommunications companies and Internet infrastructure providers for internship and career placement opportunities.

International Exchange Program: Formal partnerships with international institutions and standards organizations for student exchange and collaborative research opportunities.

Research Network Formalization: Inter-institutional research collaboration framework leveraging AIORI platform capabilities for multi-campus Internet engineering projects.

Conclusion and Strategic Significance

The AIORI-2 National Student Workshop conducted on September 2, 2025, represents a landmark achievement in India's Internet engineering education landscape and establishes a new paradigm for technical capacity building at national scale. Through its innovative hybrid delivery model, comprehensive content integration, and sophisticated multi-stakeholder coordination, the workshop successfully engaged 26 institutions while delivering substantive technical education and clear career pathway development.

The workshop's significance extends far beyond immediate learning outcomes to establish sustainable infrastructure for India's enhanced participation in global Internet governance and standards development. The combination of government commitment, academic excellence, industry relevance, and international standards engagement creates a replicable model for technical education that addresses critical national priorities while serving individual student development needs.

Most importantly, the workshop demonstrates that complex technical education can be delivered effectively at national scale when proper coordination frameworks, technical infrastructure, and multi-stakeholder partnerships are established. The success of this initiative positions India to become a significant contributor to global Internet infrastructure development rather than merely a consumer of technologies developed elsewhere.

As participants progress through the hackathon phase and potentially to international IETF engagement, this workshop will be recognized as the foundational moment when India's student community gained access to the tools, knowledge, and pathways necessary for leadership in global Internet engineering and standards development. The workshop's comprehensive approach to combining policy awareness, technical depth, practical skills, and career

development creates a sustainable foundation for continued growth in this critical technology domain.

Workshop in Action

Chennai



Loyola-ICAM College of Engineering and Technology



September 2, 2025

St. Joseph's College of Engineering



Kings College of Engineering, Punalkulam, Pudukkottai, Tamil Nadu

September 2, 2025

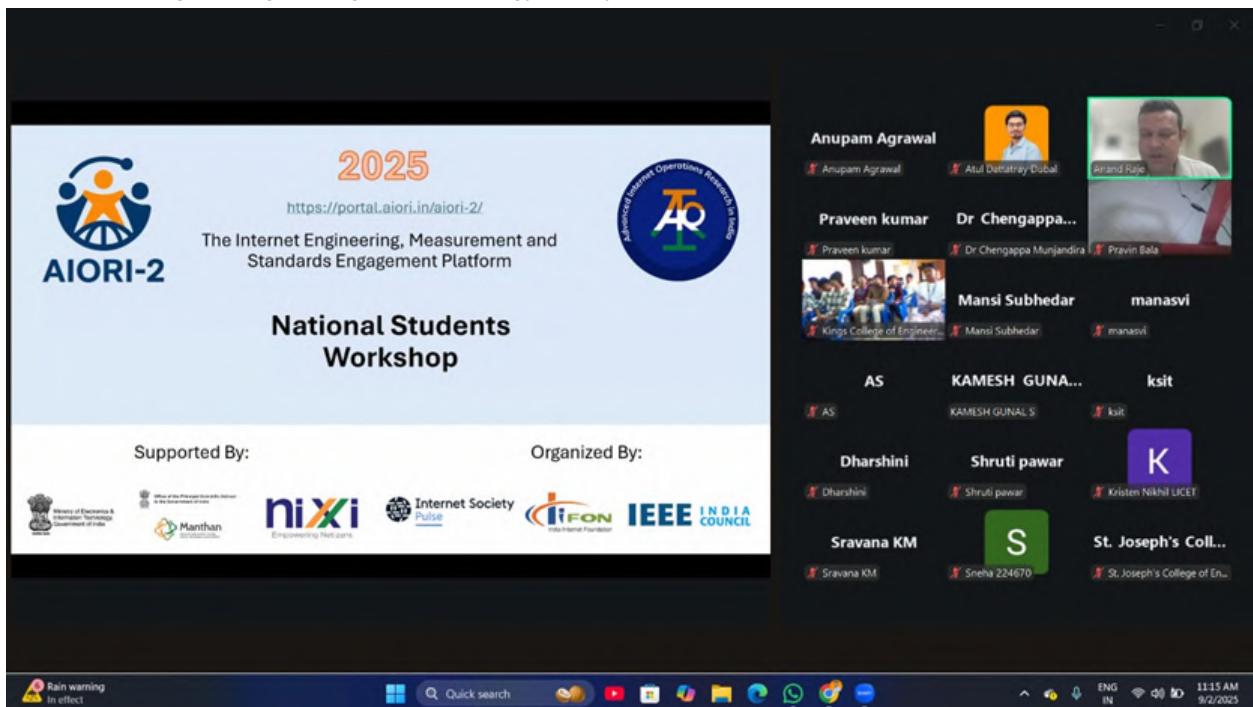


St. Joseph's Institute of Technology, Chennai

Mumbai



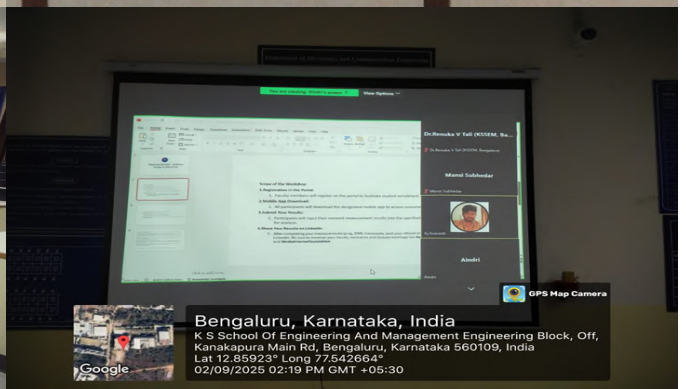
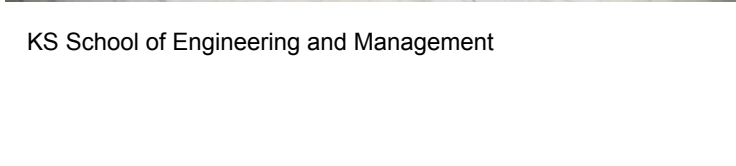
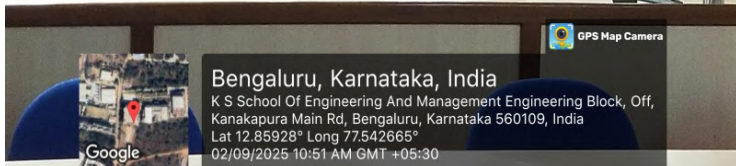
Pillai HOC College of Engineering and Technology, Rasayan



Online Students - Pillai HOC College of Engineering and Technology, Rasayan

September 2, 2025

Bengaluru



KS School of Engineering and Management

September 2, 2025



Christ University, Kengeri Campus



Vemana Institute of Technology, Koramangala



Anuvartik Mirji Bharatesh Institute of Technology Belagavi

September 2, 2025

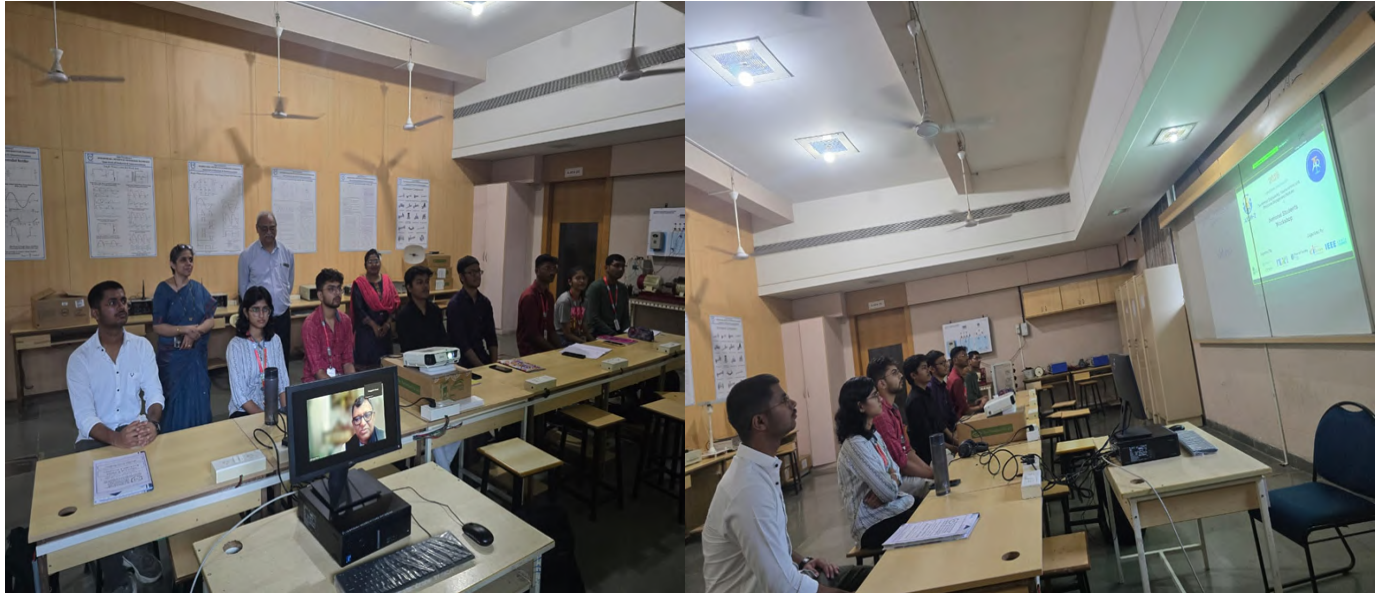


KSIT



KLEIT, Hubballi

Pune



International Institute of information technology Pune

Participating Institutes



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