



5G & BEYOND CONFERENCE (07 MARCH 2024)

The session commenced with providing an overview of the conference's objectives & potential research areas for the researchers in the audience. The academic Research topics in '5G & Beyond' were discussed and the achievements in MeitY's '5G & Beyond' initiative were presented by the respective faculty. The PI & Co-PIs presented their research work & their contributions to R&D. The invited MeitY & CDOT officers gave very interesting perspective to '5G & Beyond' research potential areas to the research community present in the Conference. The numbers shared by MeitY, Ms Meenakshi Agarwal on the advances in India's Telecom research achievements due to Ministry's initiatives were very encouraging.

Prof. Brijesh Lall: The PI of the '5G & Beyond' project delivered the introductory speech at the inauguration of the conference, where he not only extended a warm welcome but also shared his valuable perspectives on state -of-the-art research topics like Semantic Communications, Haptics, Multimodal Communications in the future of Mobile Connectivity. In his remarks, Prof Lall delved into the potential implications of these emerging technologies, providing attendees with a deeper understanding of their significance in the current landscape and beyond. The introductory session highlighted Prof Lall's deep insights into new areas of research, his achievements & expert knowledge on Govt, Industry & Academic Research Initiatives.



Prof. Subrat Kar: Presented an exciting lecture titled “**Why 6G ticks some boxes for me**”, where he explored the possibilities and merits of next-generation communication technologies beyond 5G. Prof Kar introduced the audience to his research area in TN-NTN convergence : Building Ground-HAP: HAP Free-Space Optical Links (H2G+G2H and H2H) for some India-specific use cases in disaster management maritime and rural communications. The lecture was much appreciated by the research community.



Prof. Arzad Alam Kherani: He presented an engaging and insightful discussion on haptics during the conference, participating remotely. Throughout his presentation, he provided a thorough examination of Haptics, delving into intricate details and fostering a deep understanding of the subject matter, the challenges like grip & slip predictions and solutions. His talk offered valuable insights into the realm of Haptics, exploring its URLLC applications, challenges in real time setups and potential implications. By sharing his expertise and knowledge, he enriched the conference proceedings and contributed to the collective understanding of this fascinating field. Prof Arzad's

team has made multiple contributions in 3GPP & also filed a number of patents in this research area combining multimodal Haptics with Multi Access Edge Computing.

Prof Arzad was joined by his ex- researcher **Prof. Ashish Singh Patel who** delivered a captivating and enlightening presentation on multi-access edge computing (MEC) during the conference, joining virtually. He conducted a comprehensive analysis of MEC, offering detailed insights into its concepts, 3GPP & ETSI Standards based deployment strategies for functionalities, interface APIs, and potential applications. His presentation delved into the intricate workings of MEC, exploring its role in optimizing network performance, enhancing latency-sensitive applications, and facilitating edge computing capabilities.



Dr. Ashish Singh Patel (Presenting)

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- Markov chain:
 - CPU utilization depends on the arrival/completion of processes.
 - The CPU utilization is divided across 10 quantized states.
 - Maximum two-state transition (left/right/same).
 - Let X_n , $n = 0, 1, \dots$ be a ten-state Markov chain model
 - where $X_n = i$, CPU utilization in range $i \cdot 10$ to $(i+1) \cdot 10$.
 - P_{ij} : Transition probability value from state i to j .

State diagram

Transition probability

$$P_{i,i-2} = P_{i,i-1} = P_{i,i} = P_{i,i+1} = P_{i,i+2} = \frac{1}{5}$$

State	CPU utilization	Edge	Cloud
0	0-9	M1, M3	M2
1	10-19	M1, M3	M2
2	20-29	M1, M3	M2
3	30-39	M1, M2	M3
4	40-49	M1, M2	M3
5	50-59	M1, M2	M3
6	60-69	M1, M2	M3
7	70-79	M1	M2, M3
8	80-89	M1	M2, M3
9	90-100	M2, M3	M1

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Decision table logic

Turn on microphone (Ctrl + D)

12:01 | 5G & beyond conference 7 March 2024

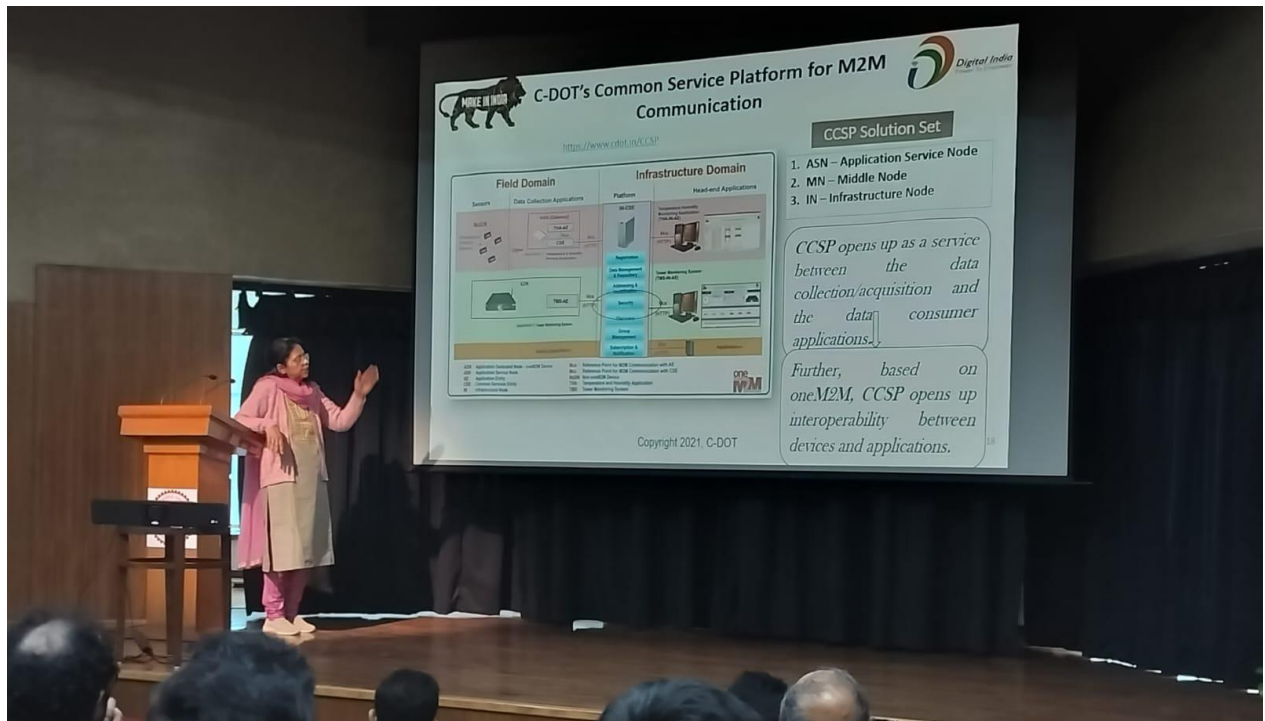
Dr. Ashish Singh Patel

Khan Aysha

Prof. Subidh Ali: Dr Ali conducted a thorough and detailed analysis of various aspects of security, covering topics ranging from cybersecurity threats to data protection measures. He provided valuable insights into the evolving landscape of security challenges and solutions, offering practical strategies for mitigating risks and safeguarding sensitive information. By delving into the complexities of security issues, he sparked meaningful discussions and empowered attendees with knowledge to address the ever-changing security landscape effectively.



Prof. Dhiman Saha: He delivered a captivating and enlightening presentation on security gaps in Mobile communications including addressing SUPI vulnerabilities & False Base Station challenges. Prof Saha's team headed by Dr Sowjanya has filed patents in this area and also made valuable contributions in 3GPP. His talk captivated the audience with his deep insights and expertise in the security domain. His presentation not only shed light on the complexities of security challenges but also delved into the intricacies of patent law and its implications for technological innovation. By sharing his knowledge and expertise, he engaged the audience and fostered a deeper understanding of both security and patent-related issues, leaving a lasting impact on conference attendees.



Prof. Soumava Mukherjee: He delivered a captivating and enlightening session focusing on his research area in mmWave PHY/RF design and development, where he delved into the intricacies of this frequency range of spectrum. Prof Soumava discussed his research work on Design and Implementation of Multibeam MultiPanel Antenna Array for Cellular mm-Wave 5G Vehicle-To-Everything (V2X) , Design of a dual-polarized SIW cavity-backed self-quadruplexing antenna for mmWave 5G applications, antenna elements separation for fully steerable array and his other research works. Prof Soumava discussed his post Doc Dr Amar Datta Choudhary challenges in fabrication & performance testing. Prof Soumava's unique design & research perspective has enabled multiple contributions in 3GPP & patents filed



Prof. Vireshwar Kumar: He presented an engaging and enlightening session that centered on Security, diving deep into the complexities of this vital component of communication systems. Throughout his presentation, he explored various facets of security, including its implications and challenges within the context of application capture system diagrams. Prof Vireshwar discussed RDoS attack modeling in details and the combination of various simulators which have been deployed for the modeling. This effort was appreciated by the research community present as being particularly challenging.



Meenakshi Agarwal, Scientist E at MeitY: Madam delivered a compelling and informative session focused on the research and development (R&D) initiatives undertaken by the Ministry of Electronics and Information Technology (MeitY) concerning 5G & Beyond Telecom & broadband cellular standards. Throughout her presentation, she provided insights into the various R&D efforts led by MeitY. This included discussions on the latest technological advancements, ongoing projects, and future directions in this domain. By shedding light on MeitY's initiatives, she not only highlighted the organization's commitment to technological innovation but also offered attendees valuable insights into the evolving landscape of mobile communications & the very successful initiatives based on solid data. Her engaging session sparked discussions and provided a deeper understanding of the efforts by MeitY for driving advancements in this crucial area of telecommunications.





Panel discussion

Moderator **Pranav Jha**, Industry expert and presently leading 5G research out of IIT Bombay, wrapped up the day with panel discussion on Standards Driven Research (SDR), featuring esteemed experts. The panelists included **Aurindam Bhattacharya** from CDOT, **Dr. Debashish Mitra**, industry representatives, and Professors **Soumava Mukherjee** and **Vireshwar Kumar**.

During the discussion, Mr. Jha facilitated a dynamic exchange of ideas and insights among the panelists, covering various aspects of Standards Driven Research. Each expert brought their unique perspective to the table, sharing their experiences and expertise in the field. Aurindam Bhattacharya, representing CDOT, likely provided insights into the practical applications and

advancements of SDR within telecommunications infrastructure. Debashish Mitra ex-TCS and now Professor of Practice at IITD, drawing from his experience, discussed industry trends and challenges related to implementing SDR specifically in Industry. Professors Soumava Mukherjee and Vireshwar Kumar contributed academic perspectives, exploring the theoretical underpinnings and potential future directions of SDR in India. Overall, the panel discussion served as a valuable platform for exchanging knowledge, fostering collaboration, and stimulating further exploration into the realm of SDR ecosystem, its challenges & implementation at the grassroots level in Higher Education.





5G & Beyond conference

**Venue: Auditorium, Ground floor, Research & Innovation Park, IIT Delhi,
Hauz Khas Campus, New Delhi-110016
7th March 2024
Agenda**

DAY 1 Thursday, 7th March 2024

Time Start (IST)	Time End (IST)	Description	
09:00	09:30	Registration	
09:30	11:00	Opening Session	
		Name	Welcome
		Prof. Brejesh Lall	Welcome
		Prof. Subrat Kar	Why 6G ticks some boxes for me
		Ms. Shikha Srivastava – CDOT	CDOT Initiatives
11:00	11:30	Tea Break	
11:30	13:00	Technical session	
		Name	Topic
		Prof. Arzad Alam Kherani, Prof. Ashish Singh Patel	Haptics + Multi Access Edge Computing
		Prof. Subidh Ali	Security
		Prof. Dhiman Saha	Security
13:00	14:00	Lunch	
14:00	16:30	Technical session	
		Name	Topic
		Prof. Soumava Mukherjee	PHY/ RF
		Prof. Vireshwar Kumar	Security
		Ms. Meenakshi Agarwal, MeITY	MeiTY Initiatives
IITD – Soumava Mukherjee, CDOT – Aurindam Bhattacharya, Industry representative – D Mitra, IITD- Vireshwar	Panel discussion: Moderator: Mr Paranv Jha Contribution to SDR ecosystem		
16:30	17:00	TEA	

THANK YOU