



**“Standards Driven Research”
Online Workshop at the NCC2021
29 July 2021, 0900-1230 IST**

Start Time (IST)	End Time (IST)	SESSION	TOPIC	SPEAKERS
0900	0905	Opening Session	Welcome Remarks	Prof Uday B Desai, Strategy Consultant- TSDSI
0905	0935	KEYNOTE	KEYNOTE: “The 5Gi Story – from Academic Research to a Global Standard”	Prof Abhay Karandikar, Director IIT Kanpur
0935	1015	CASE STUDIES	Academia: Ecosystem in India	Dr Sundaram Vanka, IIT Hyderabad
			Industry: Ecosystem in India	Mr Sharad Arora, Sensorise
1015	1030	Patent Perspective	How to Patent before publishing your paper/standardization	Mr Pankaj Bhagat, Chief Manager- IPM Cell, IIT Madras
1030	1130	Standardization Opportunities for 6G	Research Problems in relation to 6G: Core Network	Prof Mythili Vutukuru, IIT Bombay
			Research Problems in relation to 6G: Physical Layer	Dr Abhinav Kumar, IIT Hyderabad
				Dr Amit Kumar Dutta, IIT Kharagpur
1130	1215	“Need for active participation by Indian Research Community in formal Standardisation activities”		Remarks by Prof K V S Hari, IISc Bangalore
		Panel Discussion	Panel Discussion – “How to promote Standards driven research: what is the incentive?”	Moderator:
				Prof Ajit Chaturvedi, Director, IIT Roorkee
				Panelists:
				Mr Kishore Babu, DDG-SRI, DoT
				Prof Bhaskar Ramamurthi, Director, IIT Madras
				Prof Huzur Saran, IIT Delhi
				Prof Kiran Kuchi, IIT Hyderabad
Prof Neelesh Mehta, IISc Bangalore				
1215	1230	Closing Remarks and Way Forward	Closing Remarks and Way Forward	Ms. Pamela Kumar, DG-TSDSI



Prof Uday B Desai

Opening Session: Welcome Remarks

by

Prof Uday B Desai, Strategy Consultant- Telecommunications Standard Development Society, India (TSDSI)

Date & Time: 29th July 2021 (0900-0905 hours) Indian Standard Time

Bio:

Prof. Uday B Desai is the Founding Director of Indian Institute of Technology, Hyderabad. He is Professor Emeritus at IIT Hyderabad.

He is also the Chancellor of Anurag University. He is also Honorary Professor of Woosong University, South Korea. He was mentor director of IIT Bhilai from August 2016 to January 2017 and mentor director for IIIT Chittoor during the first five years of the founding of IIT Chittoor.

Prof Desai is currently associated with TSDSI as Strategy Consultant.



**Prof Abhay
Karandikar**

KEYNOTE: “The 5Gi Story – from Academic Research to a Global Standard”

by

Prof Abhay Karandikar, Director IIT Kanpur

Date & Time: 29th July 2021 (0905-0935 hours) Indian Standard Time

Abstract: The research and development of information and communications technologies especially wireless communications technology is being driven through global standardization efforts today. While these efforts are expected to transform the society, they also pose new challenges for nations and people who are unable to become a stakeholder in this process. The newer technologies are developed and standardized to take care of the needs of the stakeholders and those who are unable to participate in this process are likely to be left behind; their economic and national sovereignty threatened due to lack of IPR ownership. It is imperative therefore, that India as a nation embarks whole heartedly on this journey and become a key stakeholder in the global standardization efforts in ICT domain.

This talk tries to highlight some of the significant steps taken by us in this direction in the recent past and explains how "standards driven research" can play an important role in making India a powerhouse in the world of technology and innovation. It discusses the story of 5Gi, an enhancement to 5G communications technology to take care of the needs of India, especially rural India. It also takes us through the arduous but successful and gratifying journey the 5Gi had to make to move from the confines of our academic institutions to a global standard.

Bio:

Prof Abhay Karandikar is currently the Director, Indian Institute of Technology (IIT) Kanpur, one of the premier technical institutes of India. Before joining IIT Kanpur as the Director in April 2018, he served as Institute Chair Professor in the Department of Electrical Engineering at Indian Institute of Technology (IIT) Bombay. He also served as Dean (Faculty Affairs) and Head of the Electrical Engineering Department at IIT Bombay. Prof Karandikar was the founding member and former Chairman of TSDSI. He was also Member (Part-Time) of Telecom Regulatory Authority of India (TRAI) from January 2017- January 2020. He serves on the board

of several companies and has founded and mentored start-ups in telecom and networking. He was member of High-Level Forum on 5G setup by the Government of India and Chaired the 5G Spectrum Policy Task Force.

Prof Karandikar has several patents issued and pending, contributions to IEEE, 3GPP standards, contributed chapters in books and large number of papers in international journals and conferences to his credit. Prof Karandikar was awarded with IEEE SA's Standards Medallion in December 2016 in New Jersey. His team also won Mozilla Open Innovation challenge prize in March 2017 for his work on rural broadband and digital empowerment in rural India. He is co-author of papers which won the Best paper awards in ACM MobiHoc 2009, Workshop on Indoor and Outdoor Small Cells WiOpt2014 and finalist for the best paper award in IEEE LCN 2012 and IEEE NCC 2014 conferences.



CASE STUDIES:

Academia: Ecosystem in India by Dr. Sundaram Vanka, IIT Hyderabad

Industry: Ecosystem in India by Mr Sharad Arora, Sensorise

Date & Time: 29th July 2021 (0935-1015 hours) Indian Standard Time

**Title: IEEE 802.11 as the Building Set for Wireless LAN Standards
Development by Dr. Sundaram Vanka, IIT Hyderabad**

Abstract: The IEEE 802.11 standards are a family of wireless LAN (colloquially, "Wi-Fi") standards created by contributing to, borrowing from - and innovating upon - a shared pool of techniques, many of which have been deployed at scale for the past twenty odd years. This building set model permits the independent development of multiple standards targeting widely different applications. For instance, a new wireless LAN IOT standard and V2X standard can be developed and ratified independently, all the while borrowing useful ideas from each other as necessary. This talk provides a flavor of the research activity in the context of the relevant terminology and the processes connected to IEEE 802.11 standards development, with the recently ratified 802.11-2021 as a case study. The talk ends with a discussion on the open problems and future directions in Wi-Fi.

Bio:

Dr. Sundaram Vanka is an Associate Professor in Department of Electrical Engineering at Indian Institute of Technology Hyderabad, India. Prior to joining IITH, Dr. Vanka was an R&D IC Design Engineer in the wireless system architecture group at Broadcom, Inc., in San Jose, California, USA that he joined after obtaining his PhD from the University of Notre Dame, Notre Dame, Indiana, USA in 2012. He was also among the early lead designers of Wi-Fi chipsets at Redpine Signals, Inc., (now part of Silicon Labs), from 2003-2007. Dr. Vanka obtained his B.Tech. and M.

Tech. degrees in Electrical Engineering from IIT Madras in 2003. His research interests span the mathematical modeling, simulation and prototyping of wireless systems and networks, especially low power applications.

Industry: Ecosystem in India by Mr Sharad Arora, Sensorise

Bio:

Mr. Sharad Arora is the Founder of Sensorise Digital Services. He is serving as Vice Chair, SGSS & GC Member, TSDSI. He is a Technology Evangelist who has expertise in Telecom Technologies & Operator IT and BSS, Certification Authority Technologies and Deployment, Network & Device Security, Machine to Machine Communications, Embedded Systems & IoT, Information Technology for Telecom VAS, SIM Cards, related infrastructure and Security.

He has continuously supported the standardisation and policy initiatives for Telecoms, IT, Transport and Urban Development. He has authored / edited in excess of six Technical Reports, three ITU contributions and Several IoT, Security, LPWAN Work Items of TSDSI other than being an active member of four TEC National Working Groups, MTCTE Committee on Certification, Telematics Working Group of Niti Aayog, TEPC, TRAI Consultation, Rapporteur, SmartCities Standards Advisory Committee, TSDSI Roadmap and Outreach Committee.



Patent Perspective: How to Patent before publishing your paper/standardization

by

Mr. Pankaj Bhagat, Chief Manager- IPM Cell, IIT Madras

Date & Time: 29th July 2021 (1015-1030 hours) Indian Standard Time

Abstract: The talk will cover:

Impact of Publication on patent protection

When to publish the paper

What's the remedies available after publication

What's the process for filing patents

Bio:

Mr. Pankaj Kumar Bhagat has 18+ years of diverse experience in IP Leadership, IP management, licensing and commercialization of IP. Currently, at IITM he is leading 12-members team in the areas of IP management, Patent analytics, Patent prosecution for Indian and Foreign Patents.

At IITM, Pankaj has created compelling IP strategy, IP commercialization models and end-to-end IP solutions to cater the requirement of the Institute on par with top Foreign Universities both in value and cost. His leadership helped a small unskilled-office employee into a professional IP team including patent agents that now owns and drives Indian and International strategic IP operations helping to build IP portfolio and achieve NIRF and ARIIA ranking to the institute.

Pankaj was an accomplished Examiner of Patents & Designs at Indian Patent Office, Govt. Of India with a distinction of examining more than 650 Patent applications from diverse technology domain making them in order for grant by the Controller of Patents.

Pankaj has also excelled in designing commercial IP strategies and sizeable patent portfolio to Tata Motors Ltd. Pune, Thermax Ltd. Pune and Infosys Ltd, Bangalore previously working as an IP specialist before he joined Indian Institute of Technology Madras (IITM) in May 2018 as Head and Chief Manager-IPM at IC&SR.



Standardization Opportunities for 6G: Research Problems in relation to 6G

Core Network by Prof Mythili Vutukuru, IIT Bombay

Physical layer by Dr Abhinav Kumar, IIT Hyderabad and Dr Amit Kumar Dutta, IIT Kharagpur

Date & Time: 29th July 2021 (1030-1130 hours) Indian Standard Time

**Title: Research challenges in the 5G core
by Prof Mythili Vutukuru, IIT Bombay**

Abstract: This talk will present some of the research challenges in the design and implementation of the 5G core. The 5G core connects the radio access network to external networks. The control plane of the 5G core is responsible for implementing signaling procedures like registration, authentication, session management, and mobility, while the data plane forwards user traffic. We first compare the performance of the various implementation options of the 5G core control plane and discuss how the choice of the underlying network stack impacts the performance of the 5G core components. Next, we look at the costs and benefits of the various implementation options of the 5G core data plane, including evaluating the performance gains due to hardware acceleration of the data plane. The talk will end with a summary of research directions that can drive standardization efforts in the future.

Bio:

Prof Mythili Vutukuru is an Associate Professor at the Department of Computer Science and Engineering at IIT Bombay. Before joining IITB in 2013, she obtained her Ph.D. and M.S. degrees in Computer Science from the Massachusetts Institute of Technology in 2010 and 2006 respectively. After her Ph.D., she worked at Movik Networks, a start-up in the telecom space, for 3 years before joining IITB. Earlier,

she obtained a Bachelors in Computer Science and Engineering from the Indian Institute of Technology, Madras in 2004.

**Title: Research opportunities in RAN for 5G and Beyond 5G networks
by Dr Abhinav Kumar, IIT Hyderabad**

Abstract: In this talk, we will briefly study the key use cases in 5G. Some PHY and MAC technologies in 5G radio access network (RAN) that enable these use cases will be discussed. Potential advantages and shortcomings of these technologies will be analyzed. The requirements for Beyond 5G networks will be discussed. Based on these requirements, potential research opportunities in RAN for 5G and Beyond 5G networks will be highlighted.

Bio:

Dr. Abhinav Kumar received the BTech+MTech (Dual Degree) and PhD degree in Electrical Engineering from the Indian Institute of Technology Delhi, in 2009 and 2013, respectively. From September to November 2013, he was a research associate in the Indian Institute of Technology Delhi. From December 2013 to November 2014, he was a postdoctoral fellow at the University of Waterloo, Canada. Since November 2014, he has been with Indian Institute of Technology Hyderabad, India, where he is currently an Associate Professor. His research interests are in the different aspects of Wireless Communications and Networking. He is a Senior member of IEEE.

**Title: Waveform Design for Wideband THz Communication
by Dr Amit Kumar Dutta, IIT Kharagpur**

Abstract: THz communication will become an integral part of the 6G communication, specially in the short-range wide band data transfer. However, due to very large RF frequency and very large bandwidth, it comes with severe bottleneck including frequency channel. In this talk, we discuss a possible transmitter side waveform design based on the parallel OFDM and Filter banks, which may be suitable to counter this frequency dependency. We will also describe a very narrow beam forming technique in the context of MIMO-OFDM THz filter bank system.

Bio:

Dr. Amit Kumar Dutta is currently working as an Assistant Professor at IIT Kharagpur, India. Prior to this, he has worked in Texas Instrument, Broadcom Technology, NXP for almost 14 years in total in the field of DSP/Communication algorithm and System-on-Chip development. He has several IEEE Transactions and granted US patents to his credit. He holds PhD in Wireless communication from Indian Institute of Science, Bangalore. His current research interests include THz communication, General Physical Layer, 6G and beyond, Quantum Signal Processing and VLSI architecture for DSP/Communication.



Prof K V S Hari

Prof Ajit K. Chaturvedi	Mr. Kishore Babu	Prof Bhaskar Ramamurthi
Prof Huzur Saran	Prof Kiran Kuchi	Prof Neelesh Mehta

“Need for active participation by Indian Research Community in formal Standardisation activities”

Remarks by Prof K V S Hari, IISc Bangalore

PANEL DISCUSSION: “How to promote Standards Driven Research: What is the incentive?”

Moderator: Prof Ajit Chaturvedi, Director, IIT Roorkee

Panelists: Mr. Kishore Babu, DDG-SRI, DoT; Prof Bhaskar Ramamurthi, Director, IIT Madras; Prof Huzur Saran, IIT Delhi; Prof Kiran Kuchi, IIT Hyderabad; and Prof Neelesh Mehta, IISc Bangalore

Date & Time: 29th July 2021 (1130-1215 hours) Indian Standard Time

Bio:

Prof K V S Hari is a Professor in the Department of ECE, Indian Institute of Science, Bangalore. He holds a BE (ECE) degree from Osmania University, Hyderabad, MTech (Radar and Communication Systems) from IIT Delhi and PhD (Systems science) from U C San Diego and has been a visiting faculty at Stanford University and KTH- Royal Institute of Technology, Stockholm. His research interests are in Signal Processing with applications to 5G wireless communications, radar systems, autonomous vehicles, and affordable MRI systems. He is a co-author of an IEEE 802.16 standard on wireless channel models. He was an Editor of EURASIP's Signal Processing from 2006 to 2016 and is currently the Chief Editor (Electrical Sciences) of Sadhana, the journal of the Indian Academy of Sciences published by Springer. He is a Fellow of the Indian National Academy of Engineering and a Fellow of IEEE and also on the Board of Governors, IEEE Signal Processing Society.

Bio:

Prof. Ajit Kumar Chaturvedi received the B.Tech., M.Tech., and Ph.D. degrees in Electrical Engineering from Indian Institute of Technology Kanpur in 1986, 1988, and 1995, respectively. He served the Department of Electronics Engineering at Indian Institute of Technology, Banaras Hindu University, Varanasi from 1994 to 1996. Subsequently, he joined the faculty of the Department of Electronics and Computer Engineering at Indian Institute of Technology Roorkee. In 1999, he moved to Indian Institute of Technology Kanpur where he also held the positions of Head of the Department of Electrical Engineering, Dean of Research & Development and Deputy Director. He is now the Director of IIT Roorkee. Prof. Chaturvedi was the Coordinator of the BSNL-IITK Telecom Centre of Excellence which has done large number of projects for the Indian telecom sector. He is a recipient of the INSA Teachers award, the Distinguished Teacher award of IIT Kanpur and Tan Chin Tuan Fellowship of Nanyang Technical University, Singapore. He is a founding member of the Telecom Standards Development Society of India (TSDSI). Prof. Chaturvedi was a member of the DoT committee which recommended criteria for spectrum allocation to telecom operators, in 2008. His research interests are in communication theory and wireless communications.

Bio:

Mr. Kishore Babu is currently DDG-SRI, DoT.

He has 28 years of experience in diverse leadership positions in Information & Communication Technologies (ICTs), Telecommunications.

He is responsible for Multilateral Cooperation from the Department of Telecommunications with International and Regional Organizations.

Kishore Babu has made important contributions on ITU, APT and other Platforms for ITU WTDC, ITSO Assembly Parties meeting, ITU WCIT, WSIS, APT meetings.

Bio:

Prof. Bhaskar Ramamurthi got his B.Tech in Electronics from IIT Madras in 1980, and his M.S. and Ph.D in Electrical Engineering from the University of California at Santa Barbara, in 1982 and 1985 respectively. After working at AT&T Bell Laboratories for a couple of years, he joined the faculty of IIT Madras, his alma mater, in 1986. He took over as Director, IIT Madras in September 2011. He played a key role in the formation of Telecommunications Standards Development Society, India (TSDSI) and was its Chair from October 2018 through October 2020.

His areas of specialisation are Communications and Signal Processing. His research work is in Wireless Networks, Modulation, Wireless Data, and Audio and Video Compression. He is currently also honorary Director of the Centre of Excellence in Wireless Technology, a public-private initiative at the IIT-M Research Park to make India a wireless technology leader.

He is a Fellow of the Indian National Academy of Engineering, and of the Institute of Electrical and Electronics Engineers (IEEE). He was awarded the Vasvik Award for Electronic Sciences and Technology (2000), the Tamil Nadu Scientist Award for Engineering and Technology (2003), India Semiconductor Association TechnoVisionary Award (2011), Doyens of Madras Award for (2014), ACCS-CDAC Foundation Award (2015) and RWTH Honorary Fellow Award (2020).

Bio:

Prof Huzur Saran is the Head of the Department of Computer Science at IIT Delhi. Prior to joining IIT Delhi in 1990, he did his Ph. D in Computer Science from the University of California, Berkeley in 1989 and, a B.Tech in Electrical Engineering from the Department of Electrical Engineering at the IIT Delhi in 1983. His research is focused on Computer Networks and Algorithms. Prior to this he was the Head of the Amar Nath & Shashi Khosla School of IT, at IIT Delhi.

Prof Saran has been actively working in 4G wireless technologies. During 2000-2002 he was a Visiting Professor at the Information Systems Lab, Stanford where he worked on the media access control layer of an exploratory 4G wireless systems. He has been investigating wireless access and mesh technologies to enable ICT for rural masses.

More recently his group has been working on a rural content distribution framework for building disruption tolerant applications and in the area of peer-to-peer audio/video collaboration frameworks for online education (supported in part under the National Mission on Education through ICT). Dr Saran has also collaborated in the past with AT&T Research and Lucent Bell Labs in the area of Network Performance Analysis as a consultant (during 1993-2000).

Dr Saran has also been a consultant during 2004-2010 to Solidcore Inc, a Software Startup. During this time he helped define and build a novel software protection technology for critical servers and embedded products. Solidcore was purchased by McAfee in 2009 for its pathbreaking Dynamic Whitelisting technology.

Bio:

Dr. Kiran Kuchi, a professor at IIT Hyderabad, is a globally recognized innovator in the realm of 5G standards development. He has introduced the culture of developing wireless Standards Related Patents in India through his leadership role at Telecom Standards Development Society, India (TSDSI) and has contributed towards the creation of several important technologies in the 5G standards. Dr. Kuchi has invented & co-invented over 100 patents in the 4G/5G technology, of which more than 50 patents have resulted from his work carried out in India.

Bio:

Prof Neelesh B. Mehta is a Professor in the Department of Electrical Communication Engineering at the Indian Institute of Science (IISc), Bangalore. His research focuses on wireless communications. He has worked on 3G/4G/5G cellular communication standards, energy harvesting and green wireless sensor networks, cognitive radio, cooperative communications, multi-antenna technologies, and multiple access protocols.

He is a Fellow of the IEEE, Indian National Science Academy (INSA), Indian National Academy of Engineering (INAE), and National Academy of Sciences India (NASI). He is a recipient of the prestigious Shanti Swarup Bhatnagar Award, DST-Swarnajayanti Fellowship, NASI-Scopus Young Scientist Award, Hari Om Ashram Prerit Vikram Sarabhai Research Award, and the INAE Young Engineer Award. He currently serves on the Steering Committee of the IEEE Transactions on Wireless Communications and on the IEEE ComSoc Awards committee. In the past, he has served as an editor for the IEEE Wireless Communication Letters and Journal on Communications and Networks. He served as an editor of the IEEE Transactions on Communications during 2013-19. He served on the Executive Editorial Committee of the IEEE Transactions on Wireless Communications during 2014-17 and was its Chair during 2017-18. He served on the Board of Governors of the IEEE Communications Society from 2012-15.



Ms. Pamela Kumar

Closing Remarks and Way Forward

by

Ms. Pamela Kumar, Director General, Telecommunications Standards Development Society, India (TSDSI)

Date & Time: 29th July 2021 (1215-1230 hours) Indian Standard Time

Bio:

Ms. Pamela Kumar is Director General, Telecommunications Standards Development Society (TSDSI), Founding Chair & Current President of CCICI and the Bharti Chair Visiting Professor at UIET Panjab University.

Since her joining TSDSI as Director General in early 2017, TSDSI has made a mark in the global standards arena – with its contribution of the Low Mobility Large Cell (LMLC) requirement for 5G Rural broadband in ITU and later approval of its Radio Interface Technology (RIT) - 5Gi as an IMT2020 technology standard by the ITU. She drove adoption of TSDSI Transposed oneM2M as the national standard for IoT/M2M in India. She worked with Department of Telecom to conceptualise 5G High Level Forum, leading several of its task forces and is now actively driving execution of its recommendations. TSDSI has forged deep partnerships with global SDOs and forums under her watch.

She spent the first 10 years of her career at AT&T, Bell Labs in USA and at C-DOT in Bangalore. Later, she held leadership positions in Texas Instruments, IBM, Hewlett Packard Enterprise, R&D labs in India. She also did a short stint with 2 startups, setting up the R&D centers of Network Programs and Alliance Semiconductors. She holds 3 Patents granted by USPTO and has 5 patent applications pending in the Networking Accelerators domain. She has been a Keynote/ invited speaker in 90+ Local and Global forums.

Pamela has held various honorary positions - Vice Chair of 3GPP PCG, member of the IEEE-SA Nominations & Appointments Committee, Member at large- IEEE

Standards Association Board of Governors, Chair of the IEEE Charles Steinmetz Awards Committee, General Chair of IEEE ANTS Conference & COMSNETS Conference, Coordinator Industry Relations for IEEE Region 10, Chair for IEEE Computer Society Chapter & Vice Chair of IEEE Bangalore section, etc.

Pamela earned her B.E in Electronics and Electrical Communication from Punjab Engineering College Chandigarh, Master's degree in Electrical Engineering from Rutgers University, USA and Executive MBA from IIM Bangalore.

She is passionate about the role of technology in driving quality of life and socio-economic development. She firmly believes that national and international collaborations between Industry, Academia and Government are key enablers for sustainable development.