Quarterly Newsletter of the Telecommunications Standards Development Society, India

tsdsi NEWSLETTER

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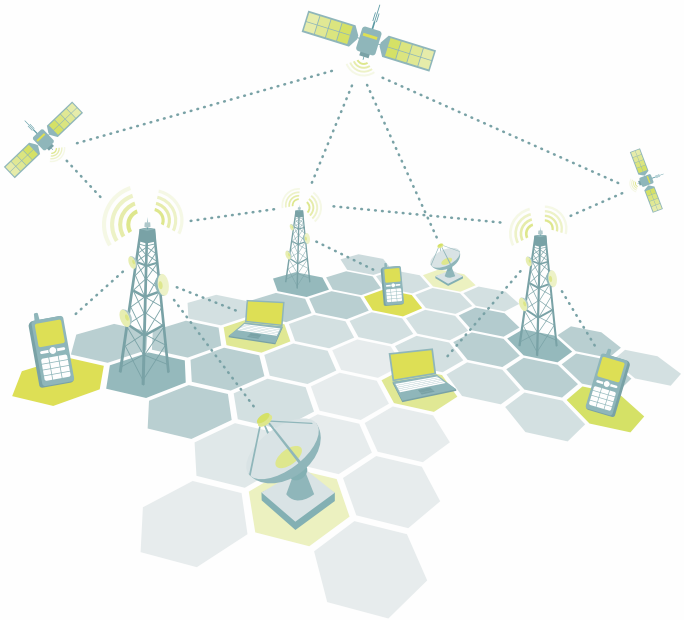
HIGHLIGHTS (April - June 2025)

TSDSI releases Technical Reports on

- The Role of Edge Intelligence in a 6G Communication Network TSDSI TR 6038 V1.0.0
- Research Directions and Collaboration on Intelligent Transport Systems Communication Standards: MAC and ISAC Perspective TSDSI TR 6039 V1.0.0
- Enhancing RBSA for 5G: Pioneering Next-Generation Connectivity Solutions TSDSI TR 6040 V1.0.0



Call for Sponsorships:

Support 3GPP RAN WG Meetings being hosted by TSDSI by becoming a sponsor. Click the link below for details:

3GPP RAN WG Sponsorship

INVITED ARTICLE

TSDSI released a technical report on "*Semi-Autonomous Collaborative Telerobotics*" (TSDSI TR 6035 V 1.0.0) that explores telerobotics use cases spanning healthcare, manufacturing, education, etc., emphasizing the use of edge-cloud continuum for embodied intelligence. It contains reference architectures, communication-computation KPIs, and introduces innovative concepts like multi-user federated control and AR/voice-guided robot navigation. Read more about the report in an article by its champions - Abhijan Bhattacharyya, Ashis Sau, Suraj Mahato (Network Solutions and Services, Tata Consultancy Services)

Standardization Activities

TSDSI has released the following new Technical Reports:

Networks Study Group:

- **The Role of Edge Intelligence in a 6G Communication Network** TSDSI TR 6038 V1.0.0

  This report explores the potential roles played by edge intelligence in a future 6G communication network. It highlights how real-time AI processing at the network edge enhances efficiency, reduces latency, ensures privacy and enables advanced applications like autonomous driving, XR, and smart health etc. The report outlines architecture, energy-efficient models and business strategies for deploying intelligent edge capabilities in next-generation networks.

Services and Solutions Study Group:

- **Research Directions and Collaboration on Intelligent Transport Systems Communication Standards: MAC and ISAC Perspective** (TSDSI TR 6039 V1.0.0)

  This report highlights the need for a new multiple access scheme, medium access control protocols for Rate Splitting Multiple Access (RSMA) and Integrated Sensing and Communication (ISAC) for the development of standards in intelligent transportation systems. It proposes the development of novel MAC protocols for RSMA based vehicular systems and way forward for development of standards. The report also examines the use of frequency-modulated continuous wave (FMCW) radar for unmanned aircraft system (UAS) localization in a network.

- **Enhancing RBSA for 5G: Pioneering Next-Generation Connectivity Solutions** TSDSI TR 6040 V1.0.0

  This report is an advancement on an earlier TSDSI Technical Report on Rural Broadband Services and Architecture (TSDSI TR 6023 V1.0.0), specifically addressing network connectivity from Gram Panchayats to related villages using Wi-Fi mesh technologies. It further enhances the earlier recommended architecture by leveraging technical advancements of 5G, including mobility, enhanced coverage, and pragmatic infrastructure and deployment strategies. New use cases are outlined in the areas of health, education, sanitation, and economic growth using the services of 5G technology. It focuses on 5G and beyond as an optimized global ecosystem that operates under a unified standard, avoiding fragmentation or multiple disjointed solutions.

Technical Activities

TSDSI members are currently conducting technical studies and developing standards in the areas of 6G, 5G enhancements, broadcast offload, spectrum studies, wireless backhaul, VLC, quantum communications, Security, application layer interfaces and related protocols, services architecture and frameworks. New proposals on topics in these areas and additionally from the TSDSI Standardization Roadmap 3.0 are being deliberated in the Networks, and Services & Solutions Study Groups.

Following new technical activities have been initiated in April-June 2025 period:

Networks Study Group:

Technical Studies:

- New Candidate Waveforms for Link level performance Enhancements for NR NTN & NR-IoT NTN in LEO Satellite Systems (SI158)

Services and Solutions Study Group:

Development of Standards:

- Architecture and information flow to enable application-layer driven dynamic QoS provisioning for multi-user intelligent telerobotics and similar applications requiring exchange of multi-modal data traffic WI1-NIP390

Technical Studies:

- AI-Enhanced Massive Digital Twinning Framework for Networks Supporting Sustainable Development Goals SI154
- AI-Powered Air Interface for ITS SI155
- SDN-Based Optical Network for QKD: Secure and Adaptive Architecture SI156
- Study of Slice-specific Handovers for 5G and Beyond Networks SI157

Please visit https://tsdsi.in/standardization-documents/ for a full list of ongoing Technical activities.

Please reach out to sweta@tsdsi.in and Chandrakanta@tsdsi.in for details of our technical activities in the Networks and Services & Solutions Study groups respectively.

Liaisons:

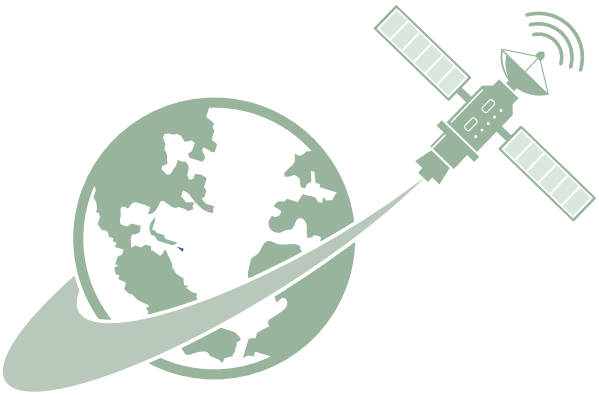
TSDSI received following liaison statement (LS) in the reporting period:

- From ITU-T for contributions to the new Focus Group on Artificial Intelligence Native for Telecommunication Networks (FG-AINN)

TSDSI sent the following Outgoing Liaison Statement:

- Response to JCA-IMT2020 LS16 date 6 March 2025 regarding update to the information in the IMT2020 and beyond Roadmap

List of Liaisons received and sent by TSDSI can be viewed at https://tsdsi.in/liaison-statements/.



ACTIVITIES

Strategic Initiatives:

TSDSI Vision

Fast changing technologies, speed of digital transformation, along with recent policy directives including Telecom Act 2023 and New Telecommunications Policy 2025 are expected to advance India's digital eco-system.

Standards are important cogs in the wheel to enable economies of scale, provide secure and trusted networks and services, promote connected world of applications and services, align national interests across the global telecom value chain and facilitate market leadership. TSDSI, as the national Telecom Standard Development Organization plays an important role in contributing to the global standards development activities in the telecom space.

TSDSI has initiated an exercise to create a new vision for itself that aligns with technology and policy developments in the country while keeping the global context in view. Prof V Sridhar, Professor, Centre for IT and Public Policy, IIIT Bangalore (TSDSI Member) will lead this initiative under the aegis of the Standardization Committee of its Governing Council.

Interaction with TEC

An interaction between TEC officers and TSDSI leaders Mr A K Mittal, Director General and Mr Vijay Madan, Mentor and Advisor- Services and Solutions, was held on 22 May 2025 to discuss ongoing technical work related to development of 6G standards and collaboration between TEC and TSDSI. Shri Shubhendu Tiwari, Advisor (T), DoT and Smt Tripti Saxena, Sr DDG TEC presided over the meeting.

Pre-standardization Activities

TSDSI Technology Roadmap Item Forums:

TSDSI has constituted Technology Roadmap Item Proposal (TRIP) Forums to carry out discussions with stakeholders in select areas of its Standardization Roadmap with the objective of recommending topics that can potentially be taken up for developing standards within TSDSI. The forums are open to participation by non-members.

Currently, TRIP forum on Automated Electric Transportation, IoT/M2M is active.

Discussion on 6G Use Cases:

An interaction session with Ms. Feifei Lou, SA1 expert from 3GPP, on 6G use cases and requirements was organised on 16 June 2025 for TSDSI members.

TSDSI's Study Group - Services & Solutions further conducted a detailed online discussion on 24 June 2025 to analyze 3GPP TR 22.870, focusing on Stage 1 use cases and requirements for 6G. The discussion aimed to identify gaps, map overlaps, and opportunities for contributions; assign moderators for specific use case categories; and create SIGs (Special Interest Groups) for focused engagement. It discussed topics related to Integrated Sensing & Communication (ISAC), Immersive Communications, Artificial Intelligence (AI) as enablers, Use cases of Industry and Verticals, Mission Critical Communication, Ubiquitous Connectivity.

Post-standardization Activities

TSDSI transposed 3GPP specifications related to Releases 13 to 18 (440 nos. new and updated specifications) based on the outcomes of 3GPP TSG #106 meetings have been submitted to Telecom Engineering Centre (TEC) for adoption as national standards.

GLOBAL STANDARDS ROUNDUP

ITU-R:

ITU–R WP5D#49: ITU-R WP5D meeting #49 was held in Kobe, Japan from 24 June to 3 July 2025 in hybrid mode. 10 TSDSI member representatives attended the meeting. Two contributions approved by the Networks Study Group on "TSDSI view towards the working document towards a preliminary draft new report ITU-R M.[IMT-2030.TECH PERF REQ]" and "TSDSI views on the working document towards a preliminary draft new report ITU-R M.[IMT-2030.Evaluation] were submitted in this meeting.

ITU-T:

TSDSI members participated in meetings of ITU-T SG5 (Environment, EMF, climate action & circular economy) and SG17 (Security) in the reporting period.

AI for Good 2025: 11 use cases were submitted by 7 Member organisations to the ITU Innovate for Impact - AI for Good 2025 Summit. A few experts also applied for Technical Advisory Committee (TAC) and scholar positions. Use cases from 5 member organizations (TCS, Tata Elxsi, HFCL, GE Healthcase and IIT Gandhinagar) have been selected for inclusion in the final report of the summit. Prof Anthony Franklin (IIT Hyderabad), Dr Sameer Kulkarni (IIT Gandhinagar) and Dr Sonali Garg (HFCL) were selected as TAC experts.

GLOBAL STANDARDS ROUNDUP

ITU-T (cont'd):

TSDSI members have been participating and contributing in the meetings of ITU-T Focus Group on AI for Native Networks (AINN). Following use cases from TSDSI (through its members - TATA Elxsi and TCS) were submitted to the meeting of this group hosted by Telecom Engineering Centre (TEC) in New Delhi from 11 to 13 June 2025:

- FG-AINN-I-102: Use Case - Native API support for dynamic distribution of inference tasks in an Edge-Cloud continuum [TCS]
- FG-AINN-I-103-R1: AI-Native Digital Twins for Cognitive Network Optimization and Management [TATA Elxsi]

3GPP:

A cumulative 456 representatives from TSDSI members participated in 42 meetings of 3GPP technical groups and made 658 contributions in the reporting period.

TSDSI will host the 3GPP RAN Working Group meetings – RAN1, RAN2, RAN3, RAN4, and RAN5 – in Whitefield, Bengaluru, from 25 to 29 August 2025. This presents an excellent opportunity for TSDSI's 3GPP members in India to participate in these meetings within their country, reducing costs and efforts associated with international travel.

Call for Sponsoring these meetings is currently open. Please contact Mr. Kuljit Singh(kuljit@tsdsi.in) or Ms. Bindoo Srivastava (bindoo@tsdsi.in) or click the link below to know more.

"https://tsdsi.in/invitation-to-sponsor-3gpp-ran-wg-meetings-hosted-by-tsdsi-in-bengaluru-august-25/"

oneM2M:

TSDSI has initiated the process of transposing Release 4 of oneM2M specifications.

32 representatives from TSDSI member organisations participated in the oneM2M Technical plenary meetings held in the reporting period.

GENERAL UPDATES

Operational Matters

TSDSI has issued its Prevention of Sexual Harassment (POSH) Policy in April 2025. This policy is in compliance with the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 ("POSH Act"). An awareness program on the POSH act and the TSDSI policy was conducted on 28 April 2025. The policy can be viewed at <link here>.

Outreach

Session on "Research, Innovation & Standardization Roadmap: Bharat 6G 2025 - 3rd International Conference & Exhibition, 14 May'25

TSDSI partnered with Bharat Exhibitions as a Standard Partner to conduct a Session on "Research, Innovation & Standardization Roadmap at Bharat 6G 2025 - 3rd International Conference & Exhibition on 14 May 2025.

It discussed learnings from 5G, role of verticals and AI, the open RAN context, and how Industry – Academia and Research entities can collaborate strategically to achieve the Bharat 6G Vision.

The session was moderated by Prof. Brejesh Lall (IIT Delhi) and featured a distinguished panel comprising Pimmy Gandotra (Bharti Airtel), Sonali Garg (HFCL), R. K. Pathak (Bharat 6G Alliance), Dinesh Chand Sharma (SESEI), and Suresh Warrior (Elena Geo).

The panel recommended "development of technologies that solve problems and can be monetised; focussing on creating intellectual property (IP) for 6G aligned with ongoing standardization efforts; synergising efforts of industry, startups, research forums and academia for conducting research, trials and pilots to develop products and solutions that can be commercialised and spawn startups."

New Members Induction

An Induction Session on TSDSI was conducted on 10 June 2025 for new members of TSDSI. 76 participants attended the session that covered overview of TSDSI, TSDSI standardization process, technical activities and global standards landscape (3GPP, ITU, oneM2M) etc.

Speaking Opportunities:

Mr Satish Jamadagni, Chair TSDSI delivered a talk in the **5th Epoch Series - The *5G Journey...and the 6G Destination Hyperconverged TMT Networks: Space+Terrestrial 25V.1*** online on 17 April 2025.

TSDSI Member Expert Dr. Abhinav Kumar (IIT Hyderabad) delivered a talk on TSDSI in a **Panel Discussion on Standards in Communication** at the "2025 IEEE International Conference on Acoustics, Speech, and Signal Processing" (ICASSP 2025) on 11 April 2025.

Col P K Jaswal, TSDSI Secretariat delivered a lecture on TSDSI and its activities to **Group A Officers of Telecom & Finance as part of the Common Induction Training Module at National Communications Academy** on 30 April 2025.

Ms Bindoo Srivastava & Ms Chandrakanta Rathore from TSDSI Secretariat delivered talks on "Standards leadership in the context of AI and its role in enhancing the efficiency of the telecom and ICT sectors" and "case study of India's technical contribution to the ITU-T SG13, focused on semi-autonomous collaborative telerobotics" respectively in a Workshop on "AI Standards for increasing the efficiency of telecommunications/ICTs: Shaping the Future Responsibly" organised by ITU Regional Office for Asia and the Pacific and National Communications Academy - Finance in the National Communications Academy campus in New Delhi from 5 to 8 May 2025.

INVITED ARTICLE

Study on Semi-Autonomous Collaborative Telerobotics

Abhijan Bhattacharyya, Ashis Sau, Suraj Mahato
Network Solutions and Services, Tata Consultancy Services

The success of IMT-2020 and beyond technologies depend heavily on futuristic vertical applications. Robotics is one such vertical. There can be many deployment and usage scenarios for robotics. One of the challenging variations, from communication and computation aspects, is semi-autonomous telerobotics with embodied intelligence and capability to collaborate with human as well as other 'fellow' robots. Given the resource constraints of the robot hardware and the need for cost-minimization, the embodied intelligence needs to be offloaded to a network ecosystem supporting edge-cloud continuum, something that is expected to be natively supported in AI-native networks in IMT-2030. Such systems find application for remote collaborations and physical process automation across industry segments like manufacturing, healthcare, education, hospitality, etc.

TSDSI has published a technical report Study on Semi-Autonomous Collaborative Telerobotics" (TSDSI TR 6035 V1.0.0) [1]. It provides different usage scenarios for intelligent collaborative telerobotics systems and provides a "reference architecture" and KPIs in terms of the QoS required for each traffic type. Since the usages involve lot of embodied intelligence on the robot-side, the report takes the computation load and latency into account as part of the KPIs which are presented in terms of communication and computation KPIs.

An intriguing factor for telerobotics systems is the multi-modal exchange of data traffic as it involves multisensory communication (Figure 1) where each sensor needs different Quality of Service (QoS) requirements, but the final end-user experience depends on the collective quality of reception of all the different types, as well as the responsiveness of the in-network computation for the embodied AI.

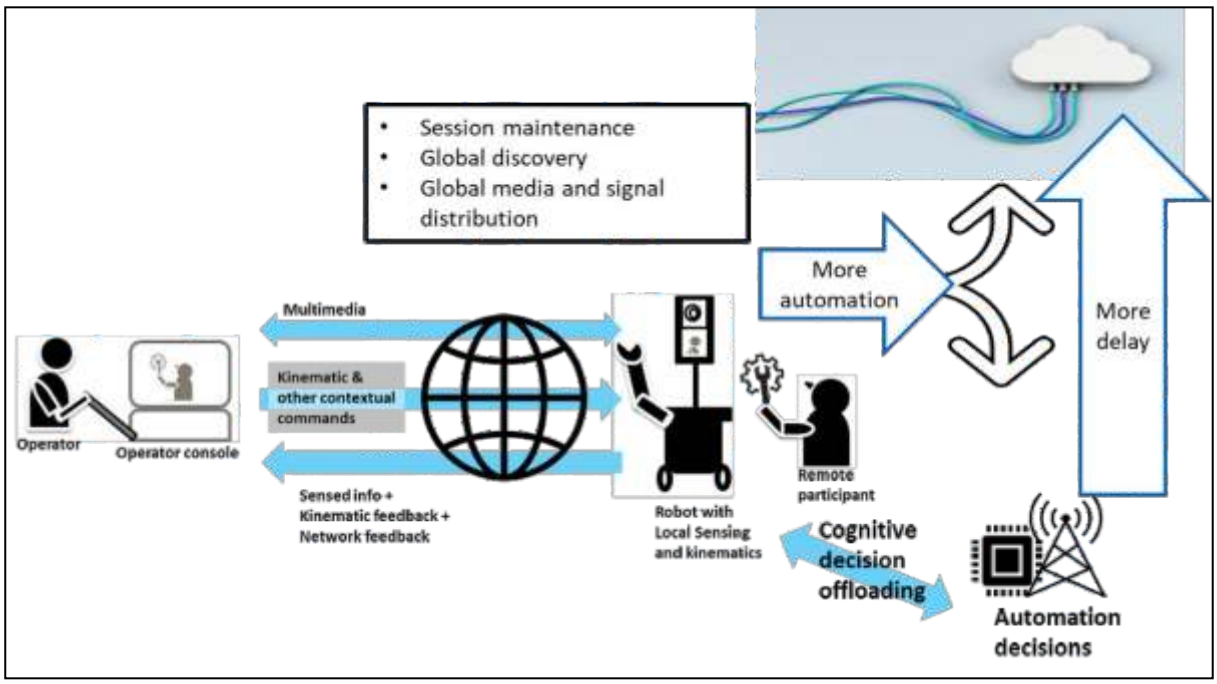


Figure 1 A multi-sensory telerobotics system with Edge and Cloud computing

The report presents a concept of multi-user telerobotics where multiple users from distant geographies can log in into the same telerobotic session with a single robot. The users may control the robot in a *federated yet exclusive* fashion such that only one user can operate the robot at a given time with exclusive *operator* access. The other users may watch the session by getting live feed from the robot. Once the present operator relinquishes the operator privilege, another user may gain operator access based on the need. This scenario is depicted in Figure 2 with users remotely inspecting a distant warehouse through a telerobotics session. One user is an operator, and the other user is an observer at a given point of time.

INVITED ARTICLE

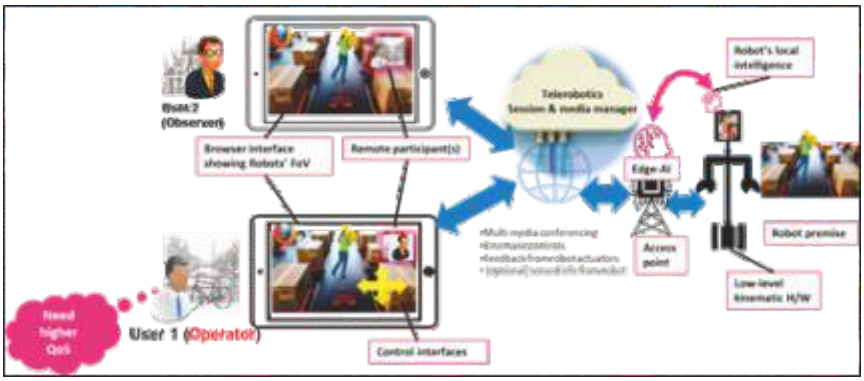


Figure 2 Multi-user federated intelligent telerobotics session with edge-cloud hybrid

Telerobotics requires simultaneous eMBB (video) and URLLC (commands) slices supported in a single application, and the QoS requirements also dynamically varies depending on the present role of a particular user, or the present context of the application. For instance, the operator user obviously requires higher QoS guarantee than the observer users, in order to perform control operations.

The report provides a reference architecture with hybrid topology that establishes a P2P session between the operator and the robot within the main telerobotics session, to ensure lower latency than the main session connections over a central cloud system.

Use Case Scenarios:

The Report describes a few typical use case scenarios such as:

Area	Use Cases
Manual Manoeuvering (Single-Human-Single-Robot)	Remote medical consultations, factory inspections, rural teaching
Voice-Based Manoeuvering	Remote museum visits, telemedicine, remote education
Multi-Human-Single-Robot	Multi-doctor consultations, multi-inspector factory checks
Pointing to Object for Navigation	Reduced operator effort by allowing the operator to select an object on the view streamed from the robot
Map-Based Navigation	Applicable in any semi-autonomous remote navigation situation in hospitals, offices, homes, etc. where a preloaded map (to scale) is available to the telerobotics system cloud and can be loaded on demand. Unlike previous cases, in this scenario the operator can indicate any location on the map beyond the field of view (FoV)
Person Following	Random remote interpersonal interaction while attending a conference through a telerobotics session
Multi-Robot Housekeeping	Retail store object rearrangement using multiple robots. This involves both cloud and edge computing for smooth execution

The report suggests exploring application-driven QoS provisioning to enhance quality of experience (QoE). It is estimated that this kind of activity may potentially lead to an application-level standardization for such vertical applications.

Conclusion:

The report provides comprehensive KPIs for different telerobotics applications scenarios, which may be supported by future AI-native network (AINN) deployments in 5G and 6G. From a design guidance perspective, it is recommended to limit the use of Edge computing to the robot-end for democratized deployment. It also suggests future TSDSI work on standardized frameworks for multisensory applications with dynamic QoS needs.

This Report may be useful for communication service providers (CSPs) as well as system integrators (SIs) in network infrastructure planning with native computation support for artificial intelligence (AI). It may also be useful for end-to-end application designers, building similar applications, as it provides a few reference architectures and guidance on the necessary infrastructure requirement to ensure smooth execution.

About the Authors:

Abhijan Bhattacharyya:
Abhijan Bhattacharyya is a Sr. Scientist in the Network Solutions and Services unit of TCS. He has industry experience of more than 21 years and specializes in communication standards, protocols and architectures.

Ashis Sau:
Ashis Sau is a Researcher in the Network Solutions and Services unit of TCS. He has been with TCS for more than seven years and specializes on WebRTC and other Internet protocols for real-time communication.

Suraj Kumar Mahato:
Suraj Kumar Mahato is a Researcher in the Network Solutions and Services unit of TCS. He has an industry experience of about 3 years and specializes in robotic platforms.

PROGRAMS

TTDD 2025:

TSDSI organises its Annual Flagship program - TSDSI Tech Deep Dive (TTDD) Conference to bring together technocrats, researchers and standards experts from around the world for discussions on topics related to global standardisation activities, and emerging and futuristic technology trends.

The 8th edition of TTDD will be held from 15 to 18 July 2025. Its theme is "**Standardising 6G: Architecting Intelligent, Secure and Sustainable Networks & Services**".

The conference will have six fully online technical sessions from 15 to 17 July 2025 on the following topics:

- New network architecture possibilities for 6G
- Will AI find a central role in 6G?
- Future path and Challenges for integration of Non-Terrestrial (Satellite, HAPS and UAVs) & Terrestrial Networks for 6G communication
- Security in a hyper connected world, especially for 6G
- Management of service Delivery Architectures
- The OFDM dilemma and Potential new Waveforms for 6G

On the last day, 18th July, the conference will be conducted in hybrid mode starting with a workshop on "New Networks and Services aspects of 6G Ecosystems". This will be followed by a Summary presentation of findings from the online Technical sessions and the TSDSI Outstanding Technical Contributions (OTC) Awards (FY 24-25) ceremony. The OTC Awards recognize an individual's efforts in contributing to and/or championing a technical activity within TSDSI during the financial year (April through March).

EVENTS

Upcoming Events

Meetings/Workshops/Conferences/Webinars	Date	Venue
ITU-T FG AINN Meeting #4	11 Jul 2025	Geneva, Switzerland
TSDSI Tech Deep Dive 2025	15 - 18 Jul 2025	New Delhi, India
3GPP RAN1#122, RAN2#131, RAN3#129, RAN4#116, RAN5#108 meetings	25 - 29 Aug 2025	Bengaluru, India
oneM2M TP 71	08 - 12 Sep 2025	Sophia Antipolis, France
3GPP CT, RAN, SA#109	15 - 18 Sep 2025	Beijing, China
ITU-T SG20	15 - 25 Sept 2025	Switzerland, Geneva
ITU-R WP5D	07 - 16 Oct 2025	TBD
India Mobile Congress 2025	08 - 11 Oct 2025	New Delhi, India
Bharat 6G Symposium	9-10 Oct 2025	New Delhi, India
IEEE Future Networks World Forum	10-12 Nov 2025	Bangalore, India
oneM2M TP 72	10-14 Nov 2025	TBD
3GPP PCG#55/OP 54	13-14 Nov 2025	Online
World Telecommunication Development Conference 2025 (WTDC-25)	17 - 28 Nov 2025	Baku, Azerbaijan
ITU-R SG 5 Meeting	1-2 Dec 2025	Geneva, Switzerland
IEEE International Conference on Advanced Networks and Telecommunications Systems	15-18 Dec 2025	New Delhi, India

Visit here for the Upcoming Calendar of Events.

MEMBERSHIP UPDATES

TSDSI welcomes following organisations that joined us as members in April-June 2025:

New Corporate Members:

Narnix Edge Private Limited, Wireless 4 Scale Laboratory Private Limited, AGILINK Systems Private Limited, Free Stream Technologies Private Limited, Susan Future Technologies Private Limited (converted from Guest to Corporate member)

New Guest Members:

Space Pulse Technosolutions Private Limited

The full member list can be viewed here https://tsdsi.in/present_members/.
To apply for TSDSI membership, please visit https://tsdsi.in/membership/.

About **TSDSI**

Telecommunications Standards Development Society, India (TSDSI), aims at developing and promoting India-specific requirements, standardizing solutions for meeting these requirements and contributing these to international standards, contributing to global standardization in the field of telecommunications, maintaining the technical standards and other deliverables of the organization, safe-guarding the related IPR, helping create manufacturing expertise in the country, providing leadership to the developing countries (such as in South Asia, South East Asia, Africa, Middle East, etc.) in terms of their telecommunications-related standardization needs.

TSDSI is recognised by the Department of Telecommunications as India's Telecom Standards Development Organisation (SDO).

TSDSI is registered as a Society under the Societies Registration Act (Act XXI of 1860).

This issue covers activities from 1 April 2025 to 30 June 2025

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