



Telecommunications
Standards Development
Society, India

TSDSI – An Overview

Bringing the Indian Ecosystem Together to Drive 6G Standards



Our Objectives

- Developing, promoting and standardising India-specific Telecom/ICT requirements and solutions.
- Helping create standards-based manufacturing expertise in the country.
- Taking Indian requirements to global standards organisations.
- Providing guidance and leadership to developing countries.

Effective Standards Facilitate



Our Philosophy



Adhere to the principles of Openness, Transparency, Fairness, Consensus and Due Process in conducting its activities.



Maintain technology neutrality and provide a uniform playing field for its members.

Our Organizational Structure

General Body

Chairman: Satish Jamadagni (Reliance Jio)

Vice Chairman: Suresh Chitturi (Samsung)

Secretariat

Director General: AK Mittal

Governing Council:

21 Elected + 8 Govt. nominees

Standing Committees:

Budget & Finance

Rules & Regulations

Legal & IPR

Standardisation & Transposition

Roadmap

Outreach

Technical Groups:

Study Group - Networks

Chair: Abhijeet Abhimanyu Masal

Vice Chair: Sonali Garg

Study Group – Services & Solutions

Chair: Niranth Amogh

Vice Chair: Gomathy Padmanabha

Partnerships & Alliances



TSDSI is the Organizational Partner of 3GPP. This entitles TSDSI members to become Individual Members of 3GPP through TSDSI and contribute to 3GPP Specifications, taking their IPR into the global arena.

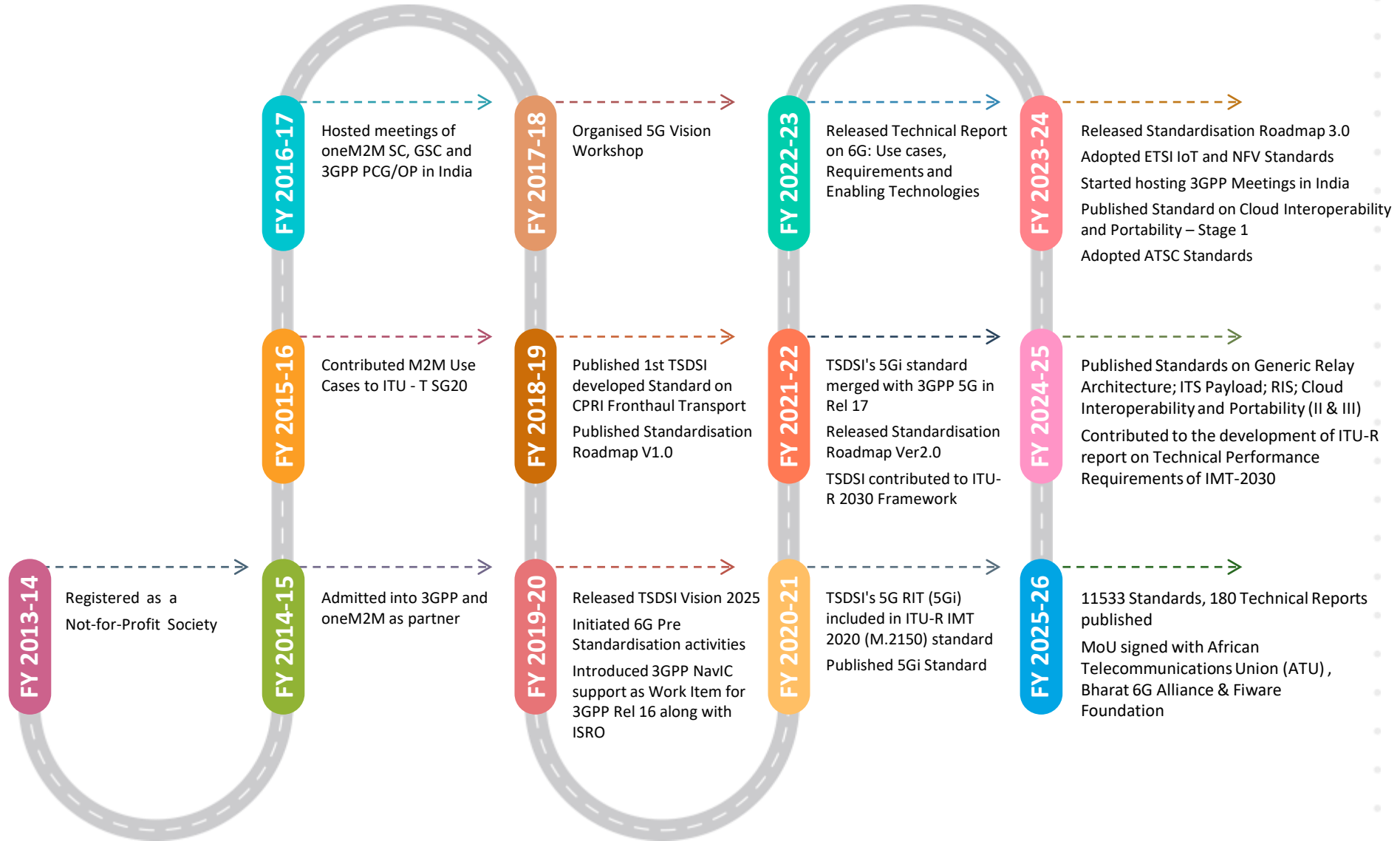


TSDSI is Partner Type I of oneM2M project a leading forum driving M2M service layer standards. It entitles TSDSI member organizations to become Individual Members of oneM2M and contribute to standards development in M2M space.

Multilateral MoU

TSDSI is a member of the Multilateral MoU for conducting Global 5G Events (other members being 6G-IA, XGMF, 6G Forum, IMT-2020 (5G) PG, 6G Brasil)

Journey So Far



OUR ACTIVITIES

Technical Groups

Study Group - Networks

- 6G
- 5G Enhancements
- Broadcast offload
- Spectrum Studies
- Open Systems
- Wireless Backhaul
- Visible Light Communications
- Quantum communications

Study Group- Services & Solutions

- **Security** – Security aspects in the end-to-end Telecom/IoT networks & related standards, Multilayer user plane security, Post Quantum Cryptography, QKD interoperability, AI/ML model and delivery of services, enablers for 6G, SEAL extension for UAV/UAM & AI/ML workloads, QLESS for MmTC in 6G among others
- **Application layer** – Localization, Metaverse, UAV Drones, Telerobotics, Sustainable 6G networks, V2X applications in 6G Networks, integrated sensing at application level, public safety use cases for 6G, AI-powered seamless tracking of supply chains
- **Services Architecture and Framework** – Edge solutions, Critical Communications, Tactile Applications, RAN Slice Services, Cloud Interoperability, Rural Broadband services and marketplace, cost modelling data services, Data management (CIP), Smart Agriculture, , ITS & autonomous driving, Network exposure & digital twin, Split AI in 6G context, UAV/UAM, Role based Service delivery mode, Agentic AI & AI explainability frameworks for 5G/6G

Strategic Initiatives

- Technology Roadmap Item Proposal Forums
 - Global Standards Coordination, Engagement with Startups & Industry, Standards Driven Research, Test & Certification
-
- ITU Sector Member
 - Contributions to 3GPP, oneM2M and ITU
 - Regularly hosting 3GPP and oneM2M Meetings in India
 - Adoption Agreements with ATSC, ETSI and IEEE-SA
-
- TSDSI Tech Deep Dive Conference
 - Workshops to promote Standards Engagement

TSDSI Standardization Roadmap 3.0

6G/5G ENHANCEMENTS	APPLICATIONS/ VERTICALS	QUANTUM COMMUNICATIONS	VISIBLE LIGHT COMMUNICATION	SPECTRUM STUDIES			
<p>Use cases and services, KPIs, Key Technologies and network architecture and evolution for 6G, Rural Coverage and Capacity Enhancement, Waveform Design for THz Communication, Network Energy Saving in 5G and its Evolution towards 6G Sustainability Requirements, Channel Models for Integrated Sensing and Communication in Beyond 5G Systems, Non GNSS/NTN Positioning, Ambient IoT – A New Paradigm for Resource-Efficient IoT Deployments, Unified Global Communication Infrastructure Reference Architecture, Network Capabilities Exposure, Sustainable Development with Minimal Energy Consumption in 6G</p>	<p>5G use cases for Verticals, Study on System Requirements for NR based Future Railways Mobile Communication System (FRMCS), Collation of Satellite Imagery for agriculture using 5G network, Requirement for a Reference Architecture for Solar-powered Unmanned Aerial Vehicle</p>	<p>Next generation secure, adaptable and cost effective solutions for Quantum security, Quantum communication, security and modelling, Trusted node testing, Underwater QKD, PQC in embedded systems and Device Biometrics</p>	<p>Standards for Visible Light Communication, Standardization of FSO systems for broadband communication</p>	<p>Spectrum Coexistence studies towards 6G, Flexible Dynamic Spectrum Access architecture</p>			
NON-TERRESTRIAL NETWORKS	INTELLIGENT TRANSPORT SYSTEMS	CLOUD	WIRELESS BACKHAUL	SECURITY	AI/ML	OPEN SYSTEMS	RURAL BROADBAND
<p>Positioning in 6G Communication networks using Multi GNSS including NavIC, Multi-dimensional multihop non terrestrial networks with BS functionality onboard</p>	<p>Standard and regulations for Autonomous driving System, Reference Architecture for Automated Electric Road Transportation, Connected Multi-Modal Transportation</p>	<p>Cloud Resource Management in Future Networks</p>	<p>UAV based backhaul, 4G/5G Fronthaul & Backhaul, Wireless-to-Building (WTTB)</p>	<p>Security standards for IoT and Machine-to-Machine, Quantum Security</p>	<p>AI/ML in & for Future Networks, AI/ML based Mobility Enhancements</p>	<p>Open Disaggregated Networks</p>	<p>Architectures for Rural Broadband</p>

TSDSI Accomplishments

Group	Technical Reports Published	Technical Standards Transposed
Study Group- Networks	21	11243
Study Group- Services & Solutions	159	290

Technical Standards Developed and Published

- Multi-User Semi-Autonomous Telerobotics – QoS Aspects
- Cloud Interoperability & Portability Standard (Stage I, II and III)
- 5Gi (merged with 3GPP Rel 17 in 2022)
- CPRI Fronthaul Transport
- A Generic Relay Architecture for 5G and Beyond (adopted by TEC as National Std)
- Methods and Interface Design for RIS-assisted Communication Systems
- Standardization of common data payload for adaptive traffic control system and other Intelligent Transportation system

Standards Adopted

- Adoption of ETSI IoT and NFV Standards as TSDSI Standards
- 19 Specifications of ATSC 3.0 Standards
- Transposed 3GPP and oneM2M Specifications into TSDSI Standards

TSDSI transposed standards mandated as National Standards by TEC

- 3GPP Specifications for 3G, 4G and 5G
- 3GPP Specifications for Indian Telecom Security Assurance Requirements
- oneM2M Rel 2 & Rel 3 Standards

Technical Reports Published (1/2)

6G / 5G Enhancements

- Study of RIS empowered end-to-end application scenario with a focus on UE controlled and private deployments: Technical, cost-model and ownership aspects
- Study on Framework for AI/ML Operation Splitting in 6G Context
- AI Driven Massive Digital Twinning Framework for Networks
- Railway Communications using 5G: Use Cases & Reference Architecture
- Dynamic Joint Deployment of SDN Controllers and Hypervisors for Softwarized 5G and Beyond
- The Role of Edge Intelligence in a 6G Communication Network
- Study of Multiple Access for 6G Communication
- Suggested Recommendations for Sustainable 6G Networks
- Radiative Near Field Communication with Extreme MIMO
- Systems Requirement for NR based Future Railways Mobile Communication System
- Enhancing RBSA for 5G: Pioneering Next-Generation Connectivity Solutions
- 5G Extensions for Broadcast Offload
- Slice Identification in 5G RAN for End-to-End Secure Services
- 6G: Use Cases, Requirements and Enabling Technologies
- Visible Light Communication/Li-Fi
- Enhancements of flexible UL/DL Resource Utilization
- Functional Split and Fronthaul Interface in FBS Driven C-RAN for 5G and Beyond

Spectrum Studies

- Characterization of E-band for 4G/5G Backhaul & Rural Broadband
- 6 GHz spectrum for IMT services in India

Broadcast Convergence

- Broadcast Offload
- 5G Broadcast based Service Delivery for TV, Radio, IPTV and File-casting
- 5G Extensions for Broadcast Offload

Applications / Verticals

- Study on Solution for Artificial Intelligence supporting Use cases in Agriculture Domain – Plant Leaf disease Identification
- Recommendations for use of Dynamic AI/ML Models for Self-Sustainable V2X Applications in 6G
- Enablement of Common Data Payload for Agricultural Automation Solutions
- Study on the Usage of oneM2M for Smart Agriculture end-to-end Monitoring Use Case in Indian Context
- System requirements in Metaverse use cases in mobile network
- Communication Requirements & Recommendations for Energy Sector
- Enablement of Common Ontology for Adaptive traffic control system and other Intelligent transportation system products
- Slice Identification in 5G RAN and Core for End-to-End Secure and Resilient Slice Services
- Study of UAV/Drone 3GPP Standard Applicability to India Use Cases
- Drone Communication Services
- Public Protection Disaster Recovery (PPDR)
- Indian Languages in Mobile Transactions
- Information Centric Networking
- Data Pruning in Smart IoT Applications
- M2M Use Cases in Various Verticals - India Context
- NB IoT capabilities for Energy Metering
- Semi-autonomous collaborative telerobotics
- Research Directions and Collaboration on Intelligent Transport Systems Communication Standards

Technical Reports Published (2/2)

Open Systems

- Open Disaggregated RAN

Wireless Backhaul

- Solar Panel Based Optical Wireless Communication
- Channel Characteristics of 60GHz for 4G/5G Backhaul
- Evaluation of the existing IAB architecture in 5G Networks

Security

- SDN-Based Optical Network for QKD: Secure and Adaptive Architecture
- AI/ML-based Security Implementation in 6G Wireless Communication Systems
- Study of 5G and 6G Beyond Network Security Architecture to support Multilevel End-to-End User Plane Security
- PQC in Embedded System to Secure the Connected Devices
- Study on Security enabler for 6G
- Interoperability of Multi-vendor QKD Hardware using SDN
- Network Security Encryption Mechanism
- Enhancement of Privacy in Future Networks
- Usage of oneM2M for Smart Agriculture End-to-End Monitoring Use Case in the Indian Context
- Study of Post-Quantum Cryptography for Future 5G Networks and Application
- Enhancement of the Privacy of User Subscription Identity in Future Networks
- Reducing Threats to the National Critical Infrastructure using DNS
- Study on the security aspects of Artificial Intelligence (AI) / Machine Learning (ML) models for 5G and 6G applications
- A location privacy-preserving scheme to mitigate the authentication relay attack under False Base Station (FBS) in 5G and 6G

Services Architecture

- Carrier Grade Linux Specification
- Enablement of Common Edge Connectivity for Public Utility Purposes
- Implications of Network Slicing on Unified Communication as a Service (UCaaS)
- Slice Identification in 5G RAN and Core for Scalable and Resilient Slice Services
- Edge Intelligence for haptics IoT use cases
- Network Security
- Performance Measurements for Dual SIM Devices
- Cloud Interoperability and Portability Standards
- Rural Broadband Services and Architecture
- Service Delivery using 5G Broadcast for TV, Radio, IPTV and File-casting



<https://tsdsi.in/tr/>

PUBLISHED WHITE PAPERS



[Healthcare
Whitepaper](#)



[Automated Electric
Road Transportation](#)



[Insights into Smart
City Solutions](#)



[Standardization Opportunities for
Quantum Communication
Technologies](#)



[6G Use Cases and
Enabling Technologies](#)



[Status of Telecom
Startup Ecosystem in
India](#)



[Privacy & Personal Data
Protection on Mobile
Devices](#)



[Feasibility of Open
Source for 5G](#)

Engagement with Global Forums

TSDSI@ITU

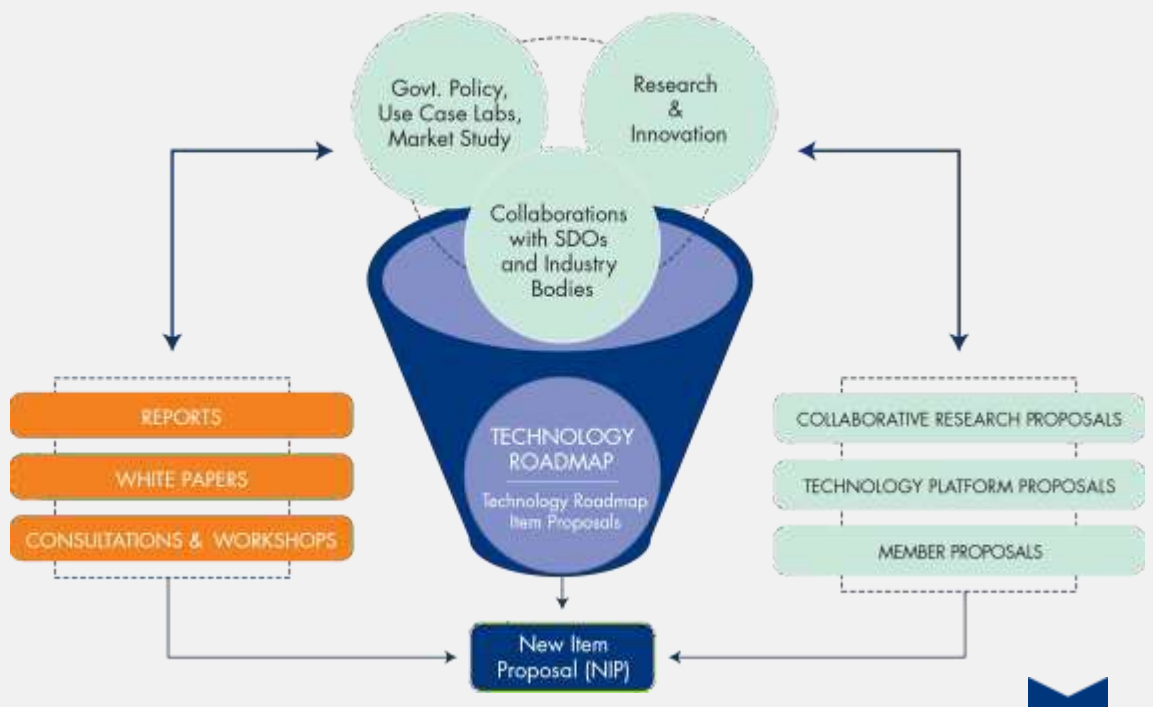
- Sector Member of ITU-R and ITU-T
- 5Gi standard - recognized as one of the ITU-R Recommendation M.2150, now merged into 3GPP 5G Rel 17
- Contributing regularly to ITU-R WP5D IMT2030 (aka 6G)
- Contributing to ITU-T SG13, FG AINN
- A.5 Certified by ITU-T

TSDSI@3GPP

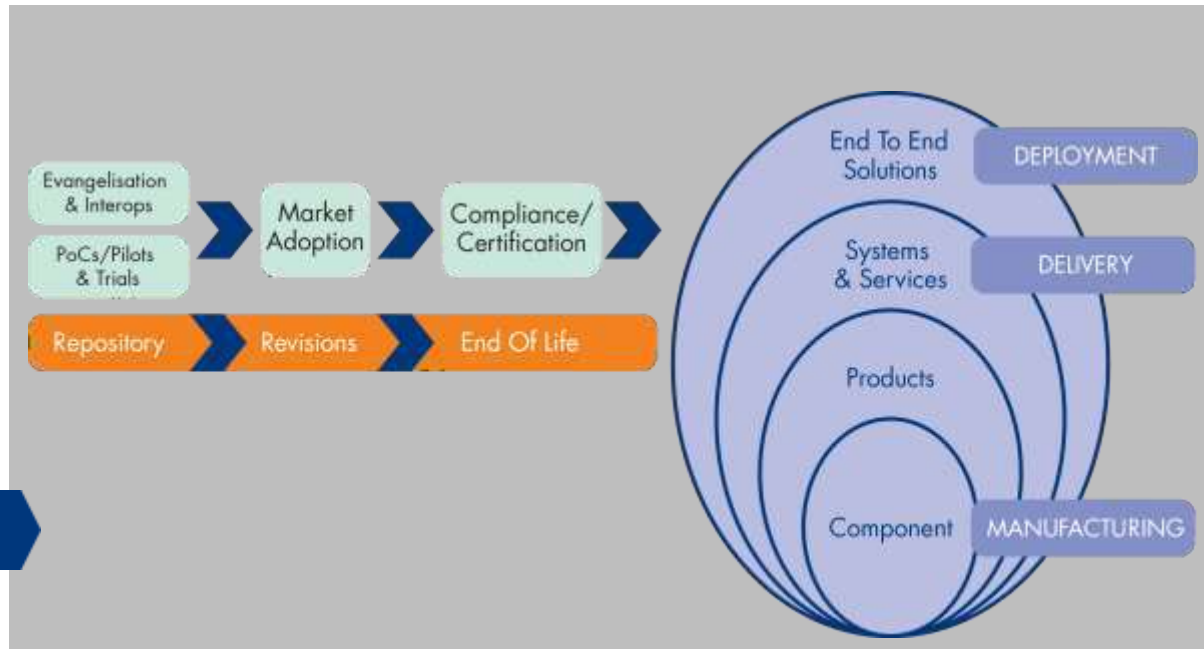
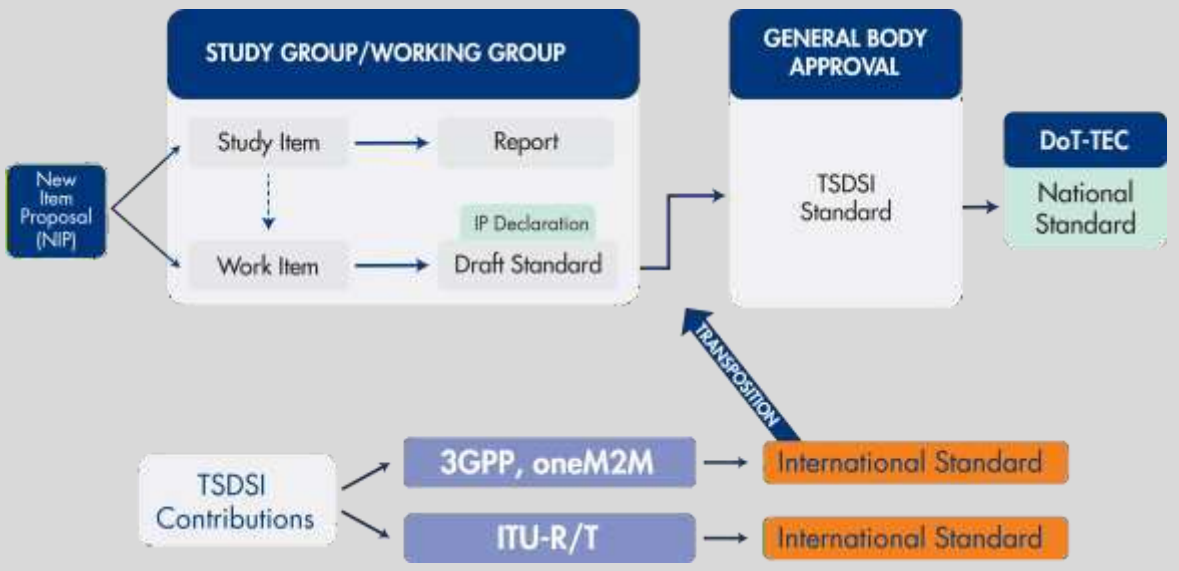
- One of 7 Organizational Partners of 3GPP | 50 TSDSI members are 3GPP IMs
- Regularly hosting 3GPP WG meetings in India
- TSDSI transposed 3GPP Specs are submitted to TEC for adoption

TSDSI@oneM2M

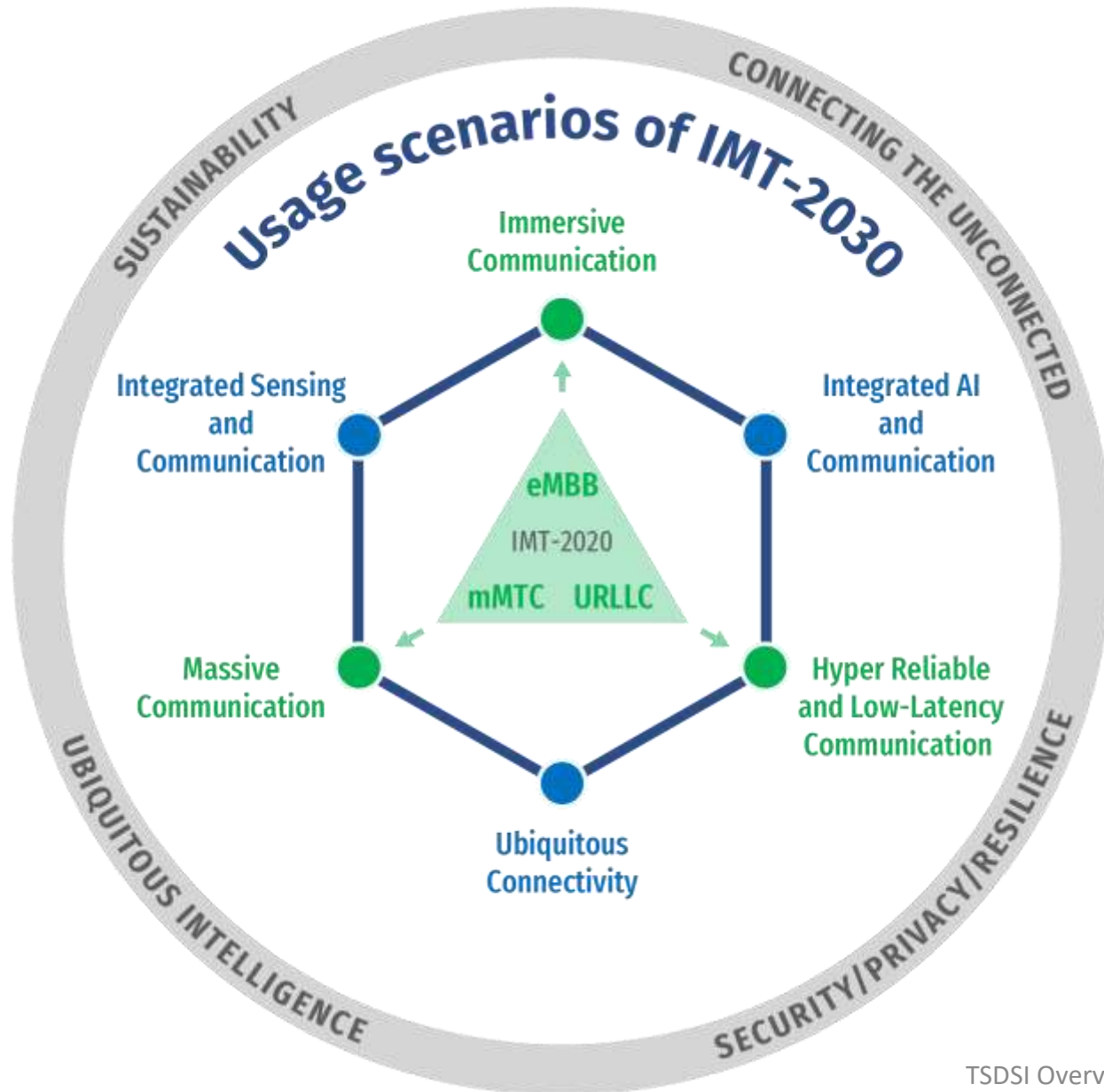
- TSDSI is Partner Type I of oneM2M | 47 TSDSI members are oneM2M IMs
- Regularly hosting oneM2M TP meetings and awareness workshops in India
- TSDSI transposed oneM2M Specs are submitted to TEC for adoption



Standardization Lifecycle



ITU-R FRAMEWORK FOR IMT-2030 AND TSDSI ROLE



TSDSI contributed to ITU-R Framework document and Future Technology Trends document in 2021-22 and 2022-23

Current Standards Development Activities

6G

Coreless RAN

New Architecture for
6G Communication
Systems

AI Architecture for RAN
(SON/RRM)

Update to TS on Methods
and interface design for
RIS- assisted
communication System

Positioning standard for
6G using Multi-GNSS
including NavIC in India

Functional Split and
Fronthaul Interface in FBS
driven C-RAN for 5G and
Beyond

Wireless/Backhaul

Characterization of E-
band for 4G/5G Backhaul
& Rural Broadband

Applications

Local language repository as
an enabler for financial
workflows

Integrated Communication
and Sensing

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

Recommendations for Network
architecture and requirements for
enabling AI-powered seamless
operation and tracking for mine
supply chains leveraging non-
public and public networks

Services Architecture & Framework

Architecture to support
tactile applications with edge
intelligence over 5G system

Rural Broadband Services
Architecture (RBSA) –
Operational Framework and
Marketplace Design

Technical Standard &
Regulation for Autonomous
Driving Systems

AI-Native Digital Twin
Architecture for Massive
Digital Twinning in 5G/6G

Security

QLESS: Quantum-Safe
Lightweight Secure
Session for mMTC in 6G

Ongoing Technical Study Areas

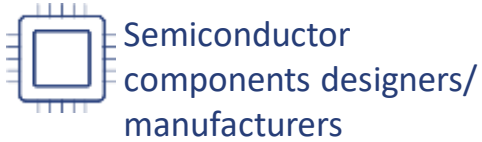
- 6G
- 5G Enhancements
- VLC
- Quantum
- Security
- Application Layer (focusing on vertical domains)
- Services Architecture & Frameworks
- AI/ML
- UAV

Other Focus Areas

Spectrum, Drones, HAPS, FWA, Small Cells, Open Hardware & Platforms, Carrier Grade Linux Systems, NR NTN & NR IoT NTN, Broadcast Offload

Our Membership

TSDSI attracts members from all sections of Telecom/ICT Ecosystem



An organization can join TSDSI as a Corporate/Associate/Guest member. Corporate Members can join 3GPP and oneM2M.

Membership Type	Description	Privileges
Corporate	Entities registered in India and engaged in Telecom related activities	<ul style="list-style-type: none"> Participate in and Contribute to Technical Activities Participate in Decision making and voting Eligible to hold office bearer positions
Associate	Industry Associations, Foreign Entities, Foreign Industry Associations	Participate in & Contribute to Technical Activities
Guest	Organizations who wish to explore the need for becoming a member before taking up Corporate or Associate Membership, can be granted, on request Guest Membership for a period of 6 months.	Participate in Technical Activities and contribute on invitation



Join Us



Member List

References

Current Technical Studies: SGN

6G / 5G Enhancements

- New Candidate Waveforms for Link level performance Enhancements for NR NTN & NR-IoT NTN in LEO Satellite Systems
- Simulation Environment and benchmarking for RIS performance Evaluation
- Study of Autonomous Reconfiguration of RIS for Reduced Control Overhead
- Open interfaces for RIS-assisted communication
- TSDSI Contribution to ITU-R IMT-2030 TPR
- Handling of Diverse Services in Future Mobile Networks
- Minimum Performance Spec for Mobile Devices
- Network Energy Saving functionality of the 5G-Advanced system and its Evolution
- Joint communication & sensing in 5G networks & beyond
- Defining qualitative metrics for 6G KPI definitions
- Study of waveforms for B5G communication systems
- Functional Split and Fronthaul Interface in FBS driven C-RAN for 5G and Beyond

Wireless Backhaul

- Characterization of E-band for 4G/5G Backhaul & Rural Broadband

Spectrum Studies

- Sub-THz Channel Modeling
- Study of the channel model for integrated sensing and communication network in FR3 and THz band

Quantum Communication

- Trusted node mapping for diverse Quantum channels
- Underwater QKD

VLC

- Enhancement to media access control (MAC) protocols for visible light communication (VLC) in indoor scenarios

Others

- Evolution Aware Solutions for LoRa Deployment
- Study on scalable and energy-efficient synchronization in digital broadcasting systems

Current Technical Studies: SGSS

Security

- PQC Migration Strategies for 5G and 6G Mobile Networks
- Extension of SEAL for Authentication, Authorization, and Key Exchange of UAV/UAM-Hosted Applications and AI/ML Workloads in 5G/6G Networks

Applications / Verticals

- Public Safety Use Cases for 6G Networks
- AI-Powered Air Interface for ITS
- Study of Slice-specific Handovers for 5G and Beyond Networks

Services Architecture

- Agentic AI framework for Autonomous Telco operations
- AI Explainability framework for 5GS/6GS
- Study on UAV communication and security standards for secure airspace control
- Network Capabilities Exposure
- Enablement of common edge connectivity for public utility purposes
- Framework for AI/ML operation splitting in 6G context
- AI-Enhanced Massive Digital Twinning Framework for Networks Supporting Sustainable Development Goals
- Technology recommendations for Telecom Service Providers to increase efficiency towards Capex/Opex

Thank You