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Interoperability of Services & Secure Data Management on Cloud Platform

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Key Issues of Data Centre(s), Cloud Services, Data Management

- **Key Issues of Data Centre(s)**
  - **Energy Consumption and Efficiency** : High Power Usage, High Power Costs, Cooling Challenges Carbon Footprint (Growing energy demand often exceeds renewable energy availability, especially in developing countries).
  - **Data Security and Privacy**: Multi-tenancy Risks, Data Breaches, Data Sovereignty.
  - **Downtime and Service Reliability**: Dependence on Network Connectivity, Single Provider Dependence, Hardware Failures and fallback on any other providers facilities.
  - **Cost Management and Hidden Expenses**: Complex Pricing Models, Data Egress Charges (Transferring data out of cloud environments), Resource Overprovisioning.
  - **Data Management platforms :** Limitation of services and data mobility across platforms as also some controls that hinder innovation. There is need for Secure Data Management on Cloud and related Platforms across.

Indian Consideration for Data Centre(s), Cloud Services, Data Management

- **India's cloud and data centre landscape is expanding rapidly.**
- **A growing demand for sovereign, secure, and interoperable cloud frameworks.**
- **Vision:**
  - Secure, portable, and standards-based cloud environments for India.
  - Need for Cloud Interoperability and Portability (CIP) Standards.
  - Nationally adopted standards may further contribute to global SDOs.
  - Need for secure Data Management and Data Transfer on multi cloud platforms.
  - National issues related to Data Sovereignty.

TSDSI Cloud Interoperability and Portability (CIP) Standards

- **Mandate for TSDSI:** Department of Telecommunications (DoT) mandated TSDSI to develop CIP Standards, Derived from TRAI's recommendations for national cloud independence.
- CIP standards address Indian ecosystem needs — government, telecom, verticals, and industry.
- Pre-standardization inputs: TRAI recommendations, TSDSI workshops, study reports.
- Standardization efforts with collaboration among domains, academia, CSPs, and industry for specs, standards, and APIs.
- Post-standardization: engagement with testbeds, implementors, and service providers.

Characteristics of Cloud Interoperability & Portability (CIP) Standards

- TSDSI CIP standards build a unified foundation for multi-cloud integration CIP standards to enable cloud Services interoperability & seamless multi-vendor integration.
- Support data and application portability, avoiding vendor specificity.
- APIs form backbone for smart city and other domain(s) integration & interoperability.
- API Gateway for 3rd-party interfaces, sequence flows, key gateway functions.
- Ensure unified interface, multi-protocol support, vendor neutrality, and QoS.
- Enable CSPs to share resources and services across providers.
- Support centralized control of multi-cloud environments.
- Define architecture, APIs, and frameworks for multi-cloud operation.

CIP Standards Key Functions

- Data sync, account/resource management, storage, orchestration, monitoring.
- Define reference architectures and APIs for interoperability.
- Cover data portability, hybrid cloud, and security use cases.
- Scope for applications portability.
- Enabling seamless integration, innovation, digital sovereignty in cloud ecosystem.
- Define architecture, APIs, and frameworks for multi-cloud operation.
- Enables cross-cloud data portability and secure integration.
- Supports India’s digital sovereignty and innovation goals.
- Playing important role in achieving digital autonomy and interoperability.
- Not to be hindered on data mobility and control limitations that hinder innovation.
- Secure Data Management on Cloud Platform.

TSDSI CIP Standards Architectures

- **Key Architectural Components**
  - Broker Architecture – Orchestrates service exchange across clouds.
  - API Gateway – Unified interface for cloud communication.
  - Data Mesh – Organizes and shares domain-wise data.
  - Microservices & Event-Driven Architecture – Enhances flexibility and scalability.
- **Broker Architecture**
  - Central orchestrator for inter-cloud synchronization.
  - Microservice-based modular design for agility.
  - Facilitates dynamic data translation and orchestration.
- **Security & Sovereignty Layer**
  - Implements Multi-Factor Authentication (MFA) and AES/RSA encryption.
  - Uses access token–based control for data and services.
  - Ensures compliance with national data residency and privacy mandates.

TSDSI CIP Standards Features

- **API Gateway for Multi-Cloud Integration**
  - Acts as the policy-controlled access layer for multiple clouds.
  - Supports both modern and legacy applications.
  - Handles API registration, capability updates, and secure communication.
- **Data Mesh and Smart Models**
  - Domain repositories: environment, water, transport, utilities and similar.
  - Encourages open, reusable, and interoperable standardized data models.
  - Supports federated analytics and cross-domain sharing.
- **Innovation & Use Case Impact**
  - Smart Cities – Real-time integration of urban systems.
  - e-Governance – Secure data flow across departments.
  - Defence, Healthcare, and IoT – Trusted federated cloud environments.
- **Enabling Digital Sovereignty**
  - Empowers India to own and govern its digital infrastructure.
  - Reduces dependency limitations in cloud operations.
  - Builds national trust, transparency, and resilience.

Data management on Cloud Platform

- Specification to be further matured, developed and extended for Nation-wide quality Data exchange/transfer.
- Data Tagging, Annotation, Labelling mechanisms are important along with meaningful analytics and data delivery as required. Data providers and Receivers in win-win
- Most existing efforts do not fully address national data-sharing goals. Hence, a standardized, open, and interoperable data tagging and management framework is to be worked upon process under extended CIP Standardization work.
  - To develop a Technical Specification for a nationwide data annotation, tagging and monetization platform, building upon TSDSI's existing CIP specifications.
  - Ensure compatibility and interoperability across diverse cloud providers and stakeholders.
  - Facilitate secure, scalable, and standardized citizen-level data and transfer to support government and enterprise applications including data full mobility across

Key take aways & invitation to work with TSDSI

- **Key Takeaways**
  - CIP delivers interoperability and security for India’s cloud future.
  - Enables data sovereignty and portability across ecosystems.
  - Establishes a foundation for scalable, collaborative innovation.
  - Consider CIP Standards as National Standards.
- **Collaboration and Ecosystem Development**
  - TSDSI invites collaboration with service providers, Government, academia, industry, and vertical domains.
  - Developing testbeds, pilots, certification programs, and open API repositories.
  - Strengthening India’s leadership in cloud standardization.
- **Future Directions**
  - Nationwide Data Annotation, Tagging, and Monetization Platform.
  - Built upon CIP to enable secure citizen-level data exchange.
  - Supports AI-driven governance and enterprise innovation.

Thank You

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TSDSI - Shaping the future of telecom and ICT standards