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India SMART UTILITY Week 2024

Supporting Ministries



Session: Technical Papers for Presentation

Web3.0 and Metaverse for Utilities

Presented By

M. L. Sachdeva, Former Chief Engineer, Central Electricity Authority

In an Emerging Post Digital Society, **Blockchain** (decentralized & secure transactions), **Web 3.0** (a user-centric & intelligent Internet), and **Metaverse** (offering infinite virtual spaces for interaction and innovation) are becoming as integral to business & industrial communities[1]. However, before accepting any technology, the Three Rs viz. 'Requirement', 'Resources', and 'Relevance' are the key factors in determining the country's quest for advancement in emerging technologies.

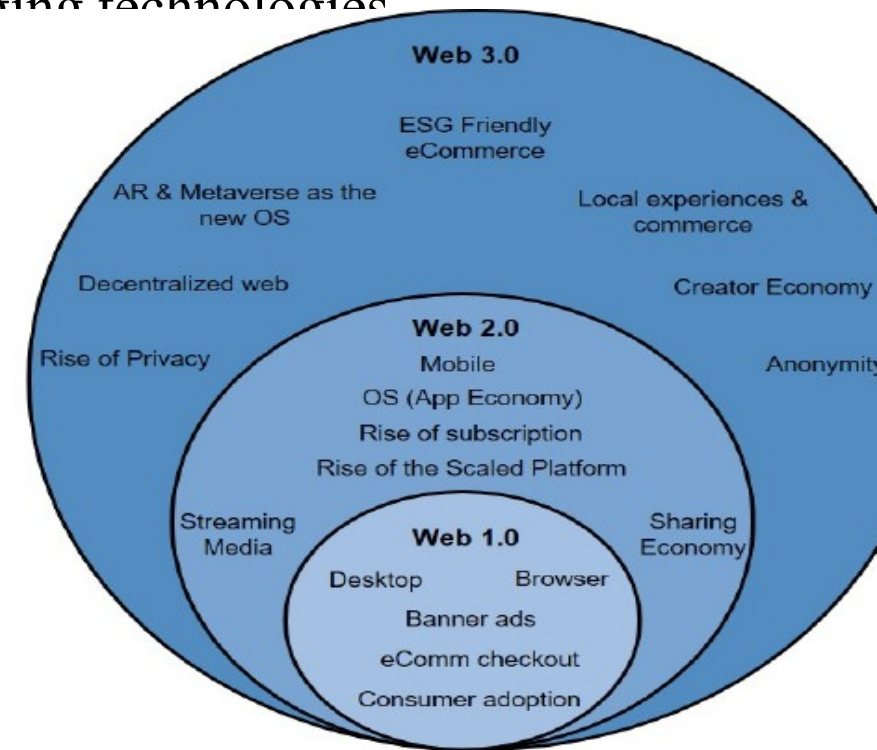
World Wide Web (Web) was initiated as

- **Web 1: (the early nineties)** People limited to **passively viewing content** (**Read only Era**) e.g AOL, Yahoo, Microsoft, and Google
- **Web 2: (Interactive Web)** (late nineties and resurfaced in 2002) Users interact and collaborate through social media dialogue as the creator of user-generated content in a virtual community, (**Meet, Read, & write Era**) e.g. **Facebook, Amazon, YouTube, Twitter, Google, etc.**

India witnessed Web 2.0 adoption during the mid-2000s (2005-2007) viz. 'Social Media Emergence', 'Blogging and User-Generated Content', 'E-Commerce and Online Services' and 'Mobile Internet', etc.

and now

Web3 is poised to revolutionize the internet by empowering users and promoting decentralization.



Web 3.0,(2013), is the latest version of the foundation for the World Wide Web incorporating the concept of blockchain-enabled decentralized applications supporting an economy of user-owned crypto assets and token-based economics . (read, write, own)

Web 3 /3.1 (2014 (Coined by Ethereum Co-founder) & 2021 (Cryptocurrency enthusiasts)

-Powered by AI, User-controlled data, and Token-based economics, it presents a significant shift towards a more personalized tailored to individual needs, providing a more interactive, dynamic, and customized Internet experience, intelligent, and user-centric web; **and**

- Characterized by internet services and mobile Apps run on decentralized blockchain technology often includes **a broad spectrum of emerging technology** (Cryptocurrencies, Decentralized Autonomous Organizations (**DAOs**), Digital assets (Non-Fungible Tokens (**NFTs**) and some other cryptocurrencies (Solana NFT, CardanoKidz) - cryptocurrency **tokens that store extra information as digital contents of drawings, fine art, NBA virtual trading cards, music, digital images, video clips and even virtual real-estate in Decentraland (a virtual world for buying & selling).**

Telangana State (India) has accredited Web 2.0 and Web 3.0 blockchain Startups known as ‘India Blockchain Accelerator Program. The main aim is to foster early-stage Web 2.0 and Web 3.0 Startups to help them solve multiple real-life challenges.

1. **Metaverse** (General-purpose computers & smartphones, Digital Twin, Augmented Reality, Machine Reality & Virtual Reality)¹
 - **Metaverse Core technologies** are Extended reality (XR) including all aspects of augmented (AR), Mixed (MR), and Virtual reality (VR), Digital twin blockchain, and a stable, low latency and high throughput **wireless communication (6G)** as also Security and privacy (prime concerns in Metaverse development)
 - **WEF, in Jan 2023**, having set up **Metaverse ‘Global Collaborative village’** leveraging multiple utilities to make use of virtual facilities without traveling & physical presence **now set up ‘Polar Tipping Points Hub’ to harness virtual reality to transform complex global challenge (polar warming) into immersive, tangible experiences to bring global leaders together for meaningful dialogues** to better understand science and respond to risks of cascading climate tipping points. [2]
 - **Metaverse technology proposed application** includes improving **work productivity**, interactive learning environments, e-commerce, mass-audience interaction, healthcare, Finance, **Power/ Energy**, Real estate, etc.
 - Metaverse, in literature, is defined also by several pillars: Four / Six / Seven / **Eight Pillars (Ubiquitous computing, AI, Blockchain, Digital Twins, Virtual & reality interaction, Networking, Human-centered communication, and space convergence.)**
 - ETGovernment 8th Jan 24- GovTech Trends 2024: **‘From metaverse to IoT technology transforming governance’**, lists one of its trends as “Stepping into the Metaverse” and **cites South Korea’s ‘Metaverse Seoul’ recognize “The metaverse presents a unique opportunity to redefine citizen engagement, fostering deeper connections and promoting inclusivity in the governance process.”**[3]

2. Web3 and Metaverse Connection [4,5]

Web3 technology plays a crucial role in building a metaverse and promises consistency and interoperability across metaverse experiences.

- By uniting disparate metaverses into a **single coherent platform**, Web3 can enhance the metaverse’s functionality.

- **Web3 and Metaverse are poised to drive revolutionary advancement and technological breakthroughs** shaping new forms of communication,Slide 4

Categorization (Gaming, Social, Commercial, Education, Consumer, Enterprise, Industrial, Energy metaverse, and others (media, fitness, retail, health & travel)).

1. Enterprise Metaverse [7]

- **development of digital twin as an engine and often the immersive environment that replicates and connects every aspect of an organization to optimize experiences and decision making.** The true-to-life, data-fueled models of energy, building, and industrial operations are the cornerstone of the *Enterprise* metaverse.

2. Industrial Metaverse [8,9]

- **Elements** of the Industrial metaverse (**digital twins**) and Enterprise **VR** and **AR** experiences, **improved asset management, employee training**, and other business operations long before the metaverse gained its Web3 recognition in 2022.

- The industrial metaverse platform users improve the production process and carry out smart production scheduling by directly interacting with the equipment and production lines within the smart virtual factory.

- Pictured as an emerging user-centered space** that connects & enhances digital and physical worlds by integrating various technological trends (digital twins, ML, IoT, mixed reality, and reliable communication (5G)).

3. Energy Metaverse [10] –holds significant potential to drive progress towards a sustainable future

The digital ecosystem that interconnects ‘**digital twins of energy-related** societal & use data’ and ‘**information exchange** protocols to link all counterparts of the **physical energy ecosystem**’ including **planning, designing, testing, energy flow, and evaluation tasks** and studying the effects of changing the ecosystem's configuration and optimize new technologies, regulatory framework conditions, and business models before introducing into physical energy ecosystem.

- By providing a virtual living lab, Energy Metaverse allows for the exploration of future scenarios** that would be too costly or impractical to investigate in the physical world. [10]

- Energy companies rely on a vast range of industrial assets, and digital twins can support the predictive maintenance of these assets and monitor their performance***

Power Utilities' leading Role – Opening Gateway for other utilities sharing transformative facilities available on Metaverse:

- **Schneider Electric [11]** developed its **EcoStructure Platform, digital twin technology**, and explored the use of digital twins in the **enterprise metaverse** inter-alia **Enel, Italy power plant optimizing its performance** thereby reducing maintenance costs, and **RTP, Transport Company, Paris monitoring real-time performance & optimizing maintenance schedules** of its metro system.
- **Siemens [12]** (June 2022) announced enabling **Industrial metaverse** through solutions forming part of the **Siemens Xcelerator open digital business platform**. Siemens's 'Software as a Service' (SaaS) subscription model, makes it more affordable for small and medium-sized companies to adopt.

Siemens together with NVIDIA, AWS & Microsoft within the Siemens Xcelerator ecosystem, leveraged **showcase Industrial Metaverse thru producing an immersive working model of a Battery gigafactory for a Norwegian battery company, Freyr**.

- **ENEL Italy [13,14]: Enel Grids, one of the First to launch metaverse named GridVerse** (the evolution of digital twin) describing its similarity as a virtual place with a model of Enel assets where collaborations may be made to create business cases.

Early use cases that are being enabled in the Metaverse of the energy sector include 3D representation for remote assistance to field workers, virtual assistance for worker safety, and virtual worker training.

Alongside **Enel** (having experience in digital twins) partly spun out in its **JV subsidiary Gridspertise and Dubai Electricity & Water Authority (DEWA)** with its DEWaverse announced a **metaverse initiative**.

Use cases implemented include **workplace meeting room and workshop, universal customer service agent, and the MetaDrone solar panel monitoring and management**.

USE CASE / CASE STUDY Energy Metaverse



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- **SAP [15] announced its initiative on Metaverse**, aimed at accelerating cloud adoption **among Indian enterprises thru using SAP platform** entailing measures to **support digital B2B services** ('Rise with SAP', SAP's Digital Core, Procurement, Customer and People Experience solutions').
- **Honeywell(USA)[16]** invents and manufactures technologies such as improving energy efficiency, enabling cleaner energy generation, and supporting homeland security and **uses metaverse technologies in their R&D and development facilities to allow employees to collaborate on new product designs from anywhere in the world**
- **Northrop Grumman (Hq. in Falls Church, Virginia, USA) [17]**

Northrop Grumman has been using Metaverse to create a 3D virtual environment that allows for the creation of realistic models of their products for aerospace, electronics, information systems, and shipbuilding for over 10 years. This allows Northrop Grumman to plan and design their manufacturing process more efficiently, as well as reduce the need for physical prototypes.

- **ABB Industrial Metaverse (shaping energy & power landscape) [18]**

ABB shipped the first batch of 2 out of 9 E-Houses dimension 4000 sqm (98 m) E-House **for providing Power supply to a facility** located 200 km **northwest of Abu Dhabi** comprising **Five gas turbine generators connected to ABB's modularized E-Houses**. The modular E-House units are equipped with LV and MV switchgear, as well as ancillary (motor control centers, variable-frequency drives, and Electrical Control Monitoring System (ECMS)).

- **South Korea's Metaverse Seoul"[19]- Social Metaverse:** started 1st Service Phase in Feb. 2022 for admin. services (economy, education, and tax affairs) and the balance 2 phases (Expansion in 2023-24 & Application 2025-26) covering economy, tax education, administration, and communication) for citizens.

- i) **ISO/IEC 23005-2011/ 2020(4th edition)**: applicable for a variety of metaverse-related business services, where the association of audiovisual information, rendered sensory effects, and characteristics of virtual objects (e.g., avatars and virtual items) can benefit the interactions between virtual and real worlds
- ii) **IEEE 2888 -2019**: Standardized interfaces for synchronization of cyber and physical worlds. IEEE 2888.1 & .2 standards offer foundations for building metaverse systems, where both virtual and real worlds can affect each other. IEEE 2888.3 standard is for digital things (i.e., virtual objects)
- iii) 1st IEEE P2048 Metaverse standard was officially established Nov.10th, 2022, embodying ‘Terminology, Definitions, and Taxonomy’ under the IEEE Metaverse Standards Committee (CTS/MS). The Working Group is preparing 12 standards for virtual reality (VR) and augmented reality (AR). **The initial eight IEEE P2048 standards projects for virtual reality and augmented reality in development focus on different areas of critical work, and include::**
 - i) **IEEE P2048.1TM—Device Taxonomy and Definitions** ii) IEEE P2048.2TM—Immersive Video Taxonomy and Quality Metrics
 - iii) IEEE P2048.3TM—Immersive Video File and Stream Formats iv) IEEE P2048.4TM—Person Identity
 - v) IEEE P2048.5TM—Environment Safety vi) IEEE P2048.6TM—Immersive User Interface
 - vii) IEEE P2048.7TM Map for Virtual Objects in Real World viii) IEEE P2048.8TM Interoperability Between Virtual Objects & the Real World
- iv) **Industrial countries at a) & b) and Emerging Countries at c) & d) have taken the lead in exploring the formulation of standards for the metaverse.**
 - a) **South Korea’s** Ministry of Science, Technology, Information, and Communication organized Samsung, Korea Telecom, SK Telecom, and Hyundai Motor to establish the Metaverse Alliance.
 - b) **Japan’s** Ministry of Economy, Trade, and Industry issued reports on the future possibilities of virtual space to guide the metaverse industry development
 - c) **Brazil** has experiences linked to the research in the context of the Digital Education Research Group UNISINOS/CNPq, developed in Brazil using different technologies in metaverses.
 - d) **China’s** internet companies, represented by Tencent and Alibaba, have also invested in the metaverse. Tencent has proposed the authentic internet, invested in Epic Games and Roblox, and increased its investment in cloud games and short video content. Byte Dance continues development in AI and algorithms and has purchased a stake in a UGC social platform.
- v) **The Bureau of Indian Standards / Industry / Institutions shall get together and take the initiative including at the IEC / CIGRE level.**



ISFU [20] is the forerunner for disrupting P2P transaction technology of surplus power from Roof Top Solar prosumers to Consumers and Discoms / utilities. The Use Cases (2) are discussed as under and in the next Slide(10) which also shows financial benefit/loss:

1. UPPCL/ MVVNL, Lucknow (UP) Pilot P2p Project

- (i) ISFG implemented & operated P2P Pilot Project (3months) simulated trading hosted by **UPPCL/ MVVNL, Lucknow** from Dec 20 to May/June 21 thru **Power Ledger (Australia)** on its own Decentralized public blockchain and its energy trading software (xGrid),
- ii) The UP P2P Pilot Project performed energy transactions among 12 consumers (9 Roof-top Solar prosumers capacity 20KW (8 Residential & 1 C&I) and 3 consumers (2 Residential & 1 C&I) deploying Powerledger P2P (xGrid).
- iii) Uttar Pradesh Electricity Regulatory Commission (UPERC) issued a [tariff order](#), directing all the utilities in the state of UP to implement P2P energy trading

2. Tata Power DDL, North Delhi Pilot P2P Project including Shakti TATA LEM Microgrid

- (i) Tata Power DDL, North Delhi, implemented the Pilot project Comprising P2P (xGrid) and Shakti TATA LEN, Microgrid (uGrid) directly under a contract agreement with Power Ledger, Australia in association with ISFG from Jan 21 to Oct 21.
- ii) The TATA Pilot Project performed using P2P (xGrid) energy transactions among 117 consumers (71 Roof-top Solar prosumers (55 Residential & 16 C&I) and 62 consumers (29 incl 3 EVs Stns. Residential & 32 C&I) (Total of 2MW over 150 sites that included TPDDL's locations as well as their actual prosumers be using the platform to sell their excess energy to other residential and commercial sites in a dynamic pricing environment, with benefit from P2P energy trades) deploying smart meters with Radiofrequency technology (NB-IoT services of Reliance-Jio Network is a low-power, wide-area network radio technology standard developed by 3GPP, to enable a wide range of cellular devices and services.); and
- iii) Shakti TATA LEM comprising Prosumers {3 Solar Site total 200KW + Community Battery 1no. 274KWh/ 200KW} and Consumers {20 (Domestic) + 30 (C&I)} and Meters 24-34 in Microgrid using Powerledger public blockchain (uGrid).

Delhi Govt. in the '**Delhi Solar Policy 2024**', thru Energy World 30th Jan 24, announced '**The peer-to-peer trading model, to enable owners of solar energy systems to sell their excess generated electricity in real-time to other consumers in Delhi through P2P Energy Trading Platform**

3. CESC, Calcutta

CESC along with ISGF and Powerledger facilitated the largest peer-to-peer (P2P) trading project with over 1,000 participants (213 prosumers and 788 consumers), transacted P2P a total of 742.53 GWh renewable energy over four months.



Utility Particular	UPPCL/MVVNL, Lucknow [8] [10]	i)Tata Power DDL and Government of National Capital Territory of Delhi [9] [10] ii)Shakti TATA LEN in Delhi	
Project Name	P2P Trading of Rooftop Solar Power on Blockchain in Lucknow, Uttar Pradesh - regulatory sandbox approach & Mockup trade	i) TATA Power DDL rolls out Live Peer to Peer (P2P) Solar Energy Trading Project ii) A Model for Local Energy Markets in Microgrids	
Duration	Dec 20 to May/June 21 / Project to go live: Dec2020	Jan 21 to Oct21 ii) March 2023 to Dec 2024 (still in progress)-	
Consultant	ISGF New Delhi	ISGF	
Service Provider	Power Ledger, Australia	Power Ledger, Australia	
Nos of Participants	12	Tata Power	Delhi, Tata (Shakti Microgrid)
		117	Prosumers (3 Solar Site total 200KW + 20 (Domestic) + 30 (C&I) Meters 24-34
Break of Participants	Prosumers 9 (8nos Residential + 1no. C&I) Consumers 3 (2nos Residentials + 1no. C&I)	Prosumers 55 {39nos Residential +16 (C&I)} Consumers 62{29incl 3EV Stns.}+ 32 nos C&I	3 Solar C&I sites Total 200KW Community Battery 1no. 274KWh/ 200KW)
Rates Pros(Resi)	Rs. 7.0/Unit, Fit=Rs 2.0/Unit, P2P av / unit=Rs 5.2/unit	Rs. 6.5/Unit, Fit=Rs 5.8/Unit, P2P av / unit=Rs 7.30/unit	N.A
Pros (C&I)	Rs 8.7/Unit, Fit=Rs 0.0/unit, P2P av/unit= Rs5.5/unit	Rs 7.75/Unit, Fit=Rs 5.8/unit, P2P av/unit= Rs7.6/unit	
Consumers	3 (2nos Residential + 1no. C&I)	61 {29(including 3EV Charging Stns) + 32(C&I)}	20(Domestic) + 30 (C&I)

Rates C(Domestic) C (C&I)	Rs. 7.0/Unit, P2P av / unit=Rs 5.2/unit Rs 8.7/Unit, P2P av/unit= Rs5.5/unit	Rs. 6.5/Unit, P2P av / unit=Rs 7.0/unit (trial rate benefit pros) Rs 7.75/Unit, P2P av/unit= Rs7.4/unit	N.A
Power (KW) i) Solar ii) Community Battery	9(8Prosumers +1 C&I) Total 25KW	>2MW Nil	i) 3 Solar C&I sites Total 200KW ii)1no. 274KWh/ 200KW
Trading Plat form	Power Ledger Blockchain-Smart meter (Crystal Power make) Power Ledger Blockchain- UPPCL Oracle CC&B billing system	Power Ledger-	Power ledger-Local Energy Market (LEM) Energy Trading Platform
Pricing Model	Fixed P2P Pricing, Dynamic Pricing, Dynamic with Preferential Pricing	Fixed Price, Dynamic Pricing, preferential pricing, Trading aggregator	Dynamic vs Preferential
Recommendations	The Pilot Project recommends that to take the technology beyond the pilot stage in India, a set of regulations and technical specifications must be agreed upon and followed by all stakeholders in the P2P network. The Regulatory change is underway with a rule change announced in April 23. For key recommendations and more details refer [12]	To test out various trading algorithms, including dynamic trading, to create an energy auction pool between prosumers and consumers and Grid-connected DEL resources (EVs& EV charging Stations, BESS, etc. For more details [12] A proposed draft of the reform was issued on May 26th, 2023, aiming to facilitate the scheme's extended growth within the State.	LEM promotes P2P trading between multiple buyers & sellers by offering buy & sell rates that are more attractive than current buy tariffs and FIT. LEM supports both Flat tariff & ToU tariff structures. For more details refer [12].
Financial Benefits	UPPCL/MVVNL, Lucknow [8] [10]	TATA Power DDL	TATA Power DDL
i) prosumers	i) Total: 39,658 INR (Per meter and month: ~551 INR	i) Domestic Prosumers Total: 130,600 INR. Per Meter and month: ~371 INR	i) Consumer Total: 29,061 INR Per meter and month: ~ 81 INR
ii) consumers	ii)Total: 5,690 INR (Per meter and month: 237 INR)	ii)C&I Prosumers Total: 182,831 INR. Per meter and month: ~1039 INR	ii) C&I Consumers Total: 33,142 INR. Per meter and month: ~112 INR

[12]: Powerledger, ISGF and IEX: 'Opportunities from Energy Market Regulatory Reforms in India', July 2023]

KEY TAKEAWAYS / RECOMMENDATIONS



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1. India adopted Web 2.0 in 2005-07 and Telangana State has accredited Web 2.0 and Web 3.0 blockchain Startups known as 'India Blockchain Accelerator Program'. The main aim is to foster early-stage Web 2.0 and Web 3.0 Startups to help them solve multiple real-life challenges.
2. Web 3.0/ 3.1, powered by AI, User-controlled data, and token-based economics **presents** a significant shift towards personalized tailored web to individual needs, providing more interactive, dynamic, customized Internet experience, user-centric web and **Characterized by internet services and mobile Apps on decentralized blockchain** often includes **a broad spectrum of emerging technology** (Cryptocurrencies, DAOs, NFTs and cryptocurrency **tokens storing extra information as digital contents even virtual real estate buying/ selling in Decentraland**.
3. WEF set up Metaverse 'Global Collaborative village (Jan 2023)' leveraging multiple utilities to make use of virtual facilities have now set up 'Polar Tipping Points Hub' to harness virtual reality to transform complex global challenges (polar warming) into immersive, tangible experiences to bring global leaders together for meaningful dialogues to better understand science and respond to risks of cascading climate tipping points.
4. ETGovernment 8th Jan 24- 'GovTech Trends 2024: From metaverse to IoT technology transforming governance', mentions a trend "Stepping into the Metaverse" and cites South Korea's 'Metaverse Seoul' offering to their citizens' virtual access to public services, event attendance, and even historical tours thru virtual Town Hall meetings' and opined "The metaverse presents a unique opportunity to redefine citizen engagement, fostering deeper connections and promoting inclusivity in the governance process."
5. Energy Metaverse Use Cases performed by **Siemens** with NVIDIA, AWS & Microsoft; **Schneider**; **ABB**; **Honeywell**, **Northrop Grumman** provide services thru block chain and Digital twins and **SAP** is playing a leading role in opening gateway for Indian utilities to share the transformative facilities available on Metaverse. South Korea started 1st Phase of its Social Metaverse' Metaverse Seoul' in Feb 2022 and planned expansion and Applications in 2023-24 and 2025-26 respectively for its citizens.
6. **IFSU** forerunner for disrupting P2P Technology in India facilitated successfully performing Pilot P2P projects in Kolkata, Lucknow, and Delhi for tariff fixation along with respective power utilities and PowerLedger, Australia (Contractor) leading to:
 - i) Uttar Pradesh Electricity Regulatory Commission (UPERC) issued a **tariff order**, directing all the utilities in the state of UP to implement P2P energy trading
 - ii) **Delhi Govt.** in the Delhi Solar Policy 2024, as per Energy World 30th Jan 24, inter-alia announced 'The peer-to-peer trading model will enable owners of solar energy systems to sell their excess generated electricity in real-time to other consumers in Delhi through P2P energy Trading Platform'
7. India disrupts Web 3.1 and Metaverse (Energy, Industry, Enterprise, Social, etc.) as also formulate national Standards to be globally competitive

THANK YOU
For discussions/suggestions/queries email: isuw@isuw.in
[visit: www.isuw.in](http://www.isuw.in)

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