COMSNETS - Jan 2024

Democratizing Technology using Open Source and Open Standards

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Why Democratize Technology?

The World of Open Source

Role of Open Standards

Putting it all together

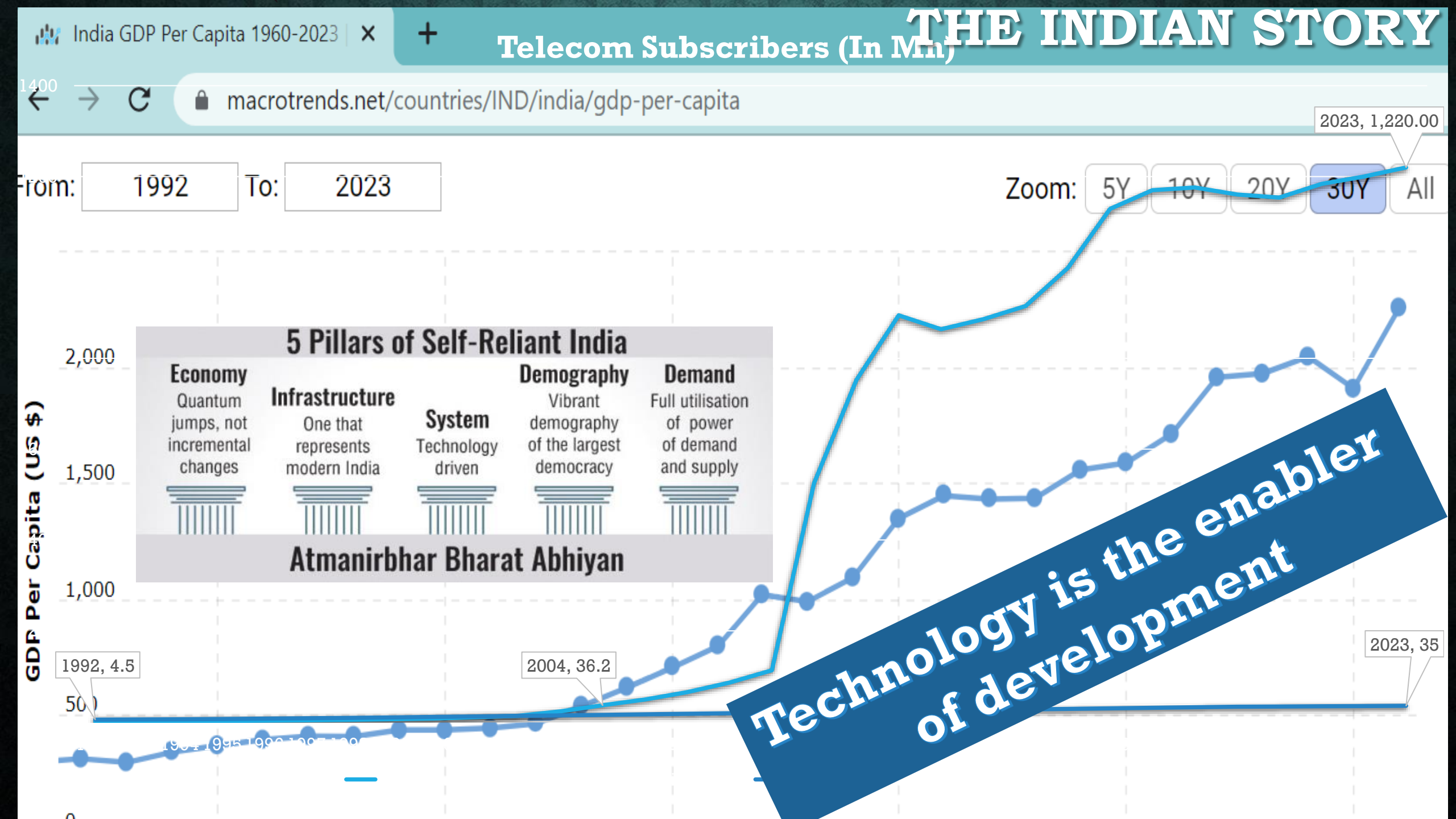
EVOLUTION OF HUMAN SOCIETY

The quest for just and equitable sharing of resources

WHAT DO WE WANT TO ACHIEVE ?

THE INDIAN STORY

Telecom Subscribers (In Mn)



“Democratising Technology is about broadening the set of people able to participate in Technologies that impact our lives.

- lowering the barrier to Innovation
- freedom to tinker,
- knowhow is essential to crafting good policy
- Systems Approach – using real implementations to explain design decisions”

Larry Peterson

EVOLUTION OF TECHNOLOGY FOR HUMANITY

The quest for just and equitable Quality of Life

THE OPEN SOURCE STORY

Believe It or Not!

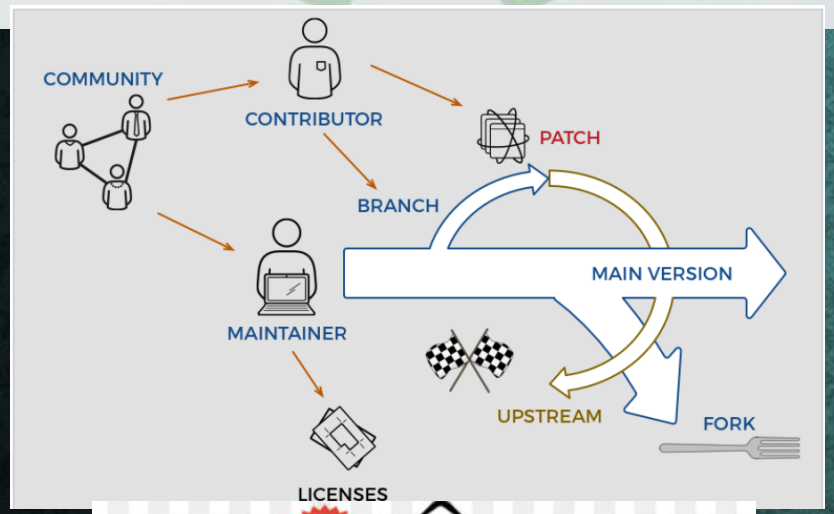
"F Prime has enabled a lot of goals we've had at JPL to design a truly reusable multi-mission flight architecture with the added bonus of the open-source collaboration and visibility afforded by the Mars Helicopter project," Canham said. "It's kind of an open-source victory, because we're flying an open-source operating system and an open-source flight software framework, and flying commercial parts that you can buy off the shelf, if you wanted to do this yourself someday." (The helicopter carries a combination of custom-made and off-the-shelf components – many from the world of cell phone technology – including its two cameras.)

https://www.nasa.gov/solar-system/meet-the-open-source-software-powering-nasas-ingenuity-mars-helicopter/

Did Chandrayaan & Mangalyaan benefit from this

Open source

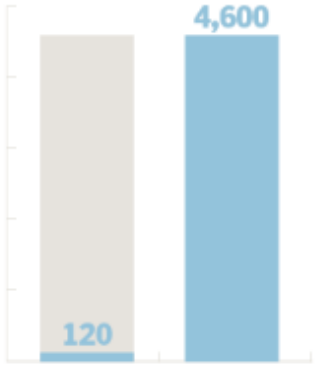
means the software is distributed for free with accessible source code that can be modified and improved by anyone



Open source by the numbers

Open source software usage among enterprises has exploded in the last decade, according to industry research. In the last three years, that usage has given way to open source contributions by enterprise developers, often under the auspices of corporate open source programs.

Number of open source projects on the rise



SYNOPSYS COVERITY SCAN REPORT 2017

180,000

Number of open source projects tallied in 2019 by IntroBooks

THE RISE OF OPEN SOURCE SOFTWARE E-BOOK

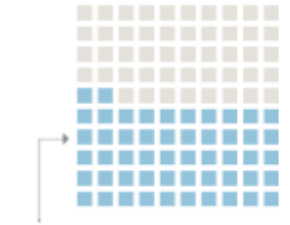
Open source everywhere

of codebases audited by security firm Synopsys in 2019 contained open source components

Percentage of open source within audited codebases

2020 OPEN SOURCE SECURITY AND RISK ANALYSIS REPORT

Benefits of open source contribution



52% of 2,700 participants in a Linux Foundation survey have open source programs or plan to create one

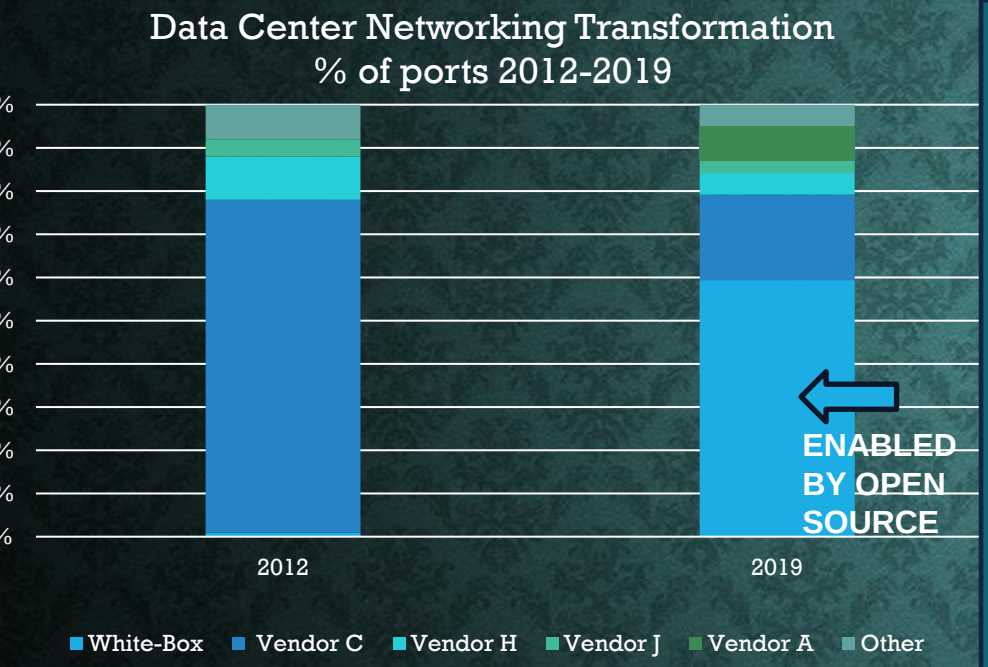
41% say open source programs are responsible for ensuring high code quality and frequent releases to open source communities

LINUX FOUNDATION TODO GROUP OPEN SOURCE PROGRAM MANAGEMENT SURVEY 2019

36% of Linux Foundation survey participants mention developer recruitment and retention as a primary benefit of open source programs in 2019

LINUX FOUNDATION TODO GROUP OPEN SOURCE PROGRAM MANAGEMENT SURVEY 2019

INSIGHTS FROM THE WORLD OF OPEN SOURCE



Data Center Networking: transformed in the last decade from a proprietary box business into an ***open*** software business, creating massive new opportunities in the cloud

Linux Statistics

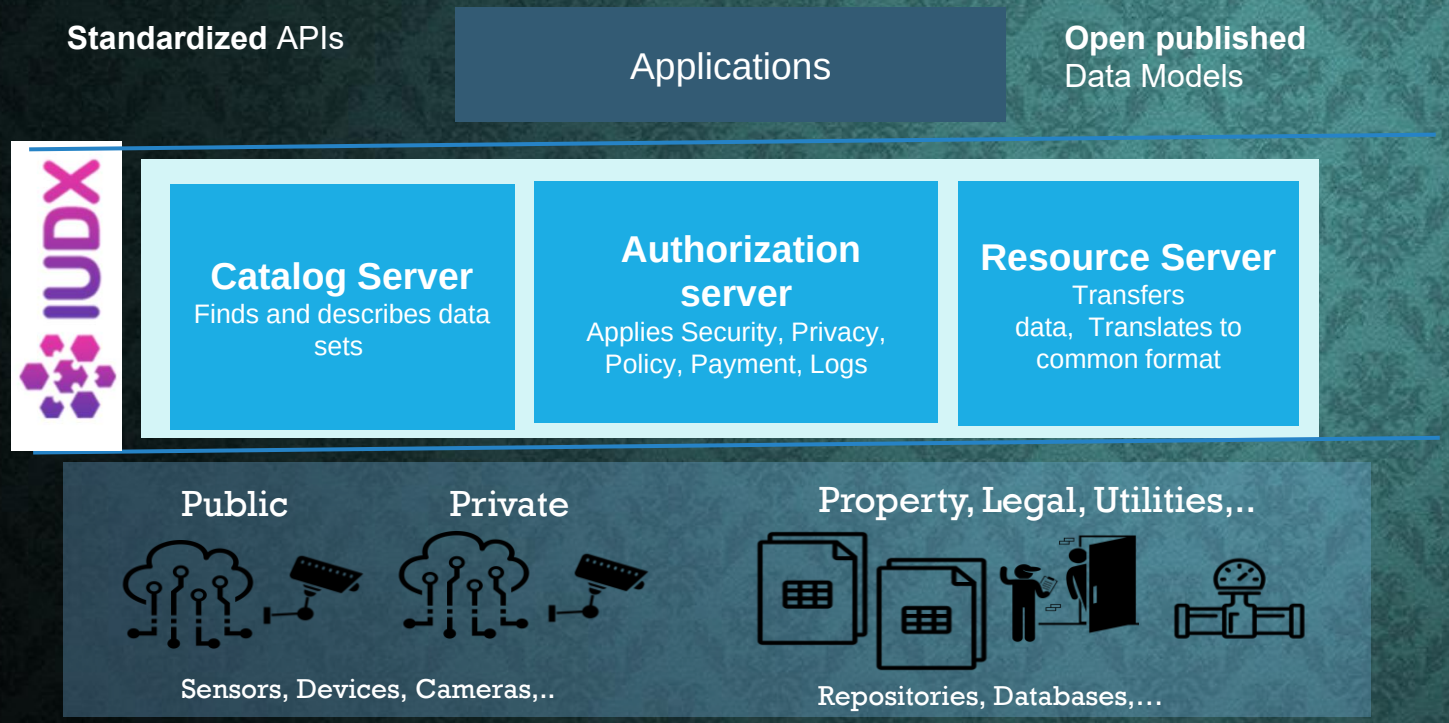
- Linux powers 85% of smartphones.
- 47% professional developers use Linux-based OSs
- 96.3% of the top one million web servers are running Linux.
- Linux powers 39.2% of websites whose OS is known.
- The world's top 500 fastest supercomputers all run on Linux.
- Linux is third most popular desktop OS- 2.09% market share
- Linux market size worldwide - $15.64 billion by 2027.
- Today, there are over 600 active Linux distros.

Microsoft acquired GitHub, for $7.5 billion.

CEO Satya Nadella said, "we strengthen our commitment to developer freedom, openness and innovation."

WIKIPEDIA : Wikipedia has accumulated a total of 5.72 billion visits, 41.4 million registered users in the English Wikipedia, 46,000 editors have been active in the last 12 months - 66% editing articles; 42% research articles and 28% write new articles

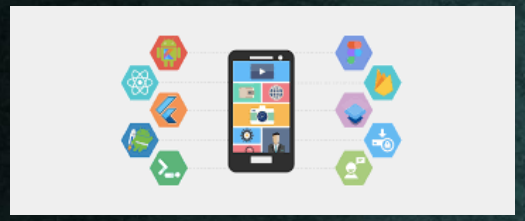
India Urban Data Exchange: An open data exchange platform



- **Smart City Mission** and **Indian Institute of Science** came together to conceptualize & build IUDX
- **Open Source,** Cloud deployable, product level software components
- **Collaborative** Govt, Industry, Academia, citizens and communities
- Applicability to **Other sectors**
  - Agriculture – ADeX
  - Geo-spatial – UGiX
  - Data Privacy – P3DX
  - eGovernance – IPeG
  - Smart Africa Trust Alliance

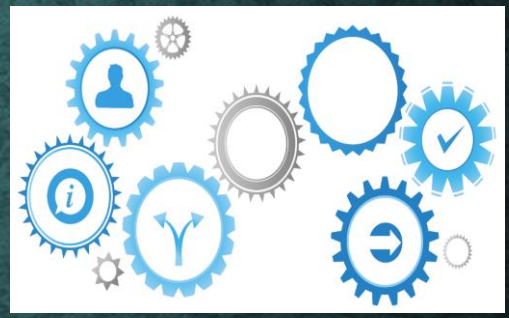
IUDX Deployed as cloud service in over 38 cities

A DATA *SPACE* BUILT AROUND IUDX



An App ecosystem

Urban Governance Data Space



Data Policy and Economics

Training, Best Practices,
Use case templates

Public Data

Privately Owned Data

NATIONAL GEOSPATIAL POLICY 2022

- To develop a coherent national framework in the country and leverage it to move towards digital economy and improve services to citizens.
  - To enable easy availability of Geospatial data collected utilizing public funds, to businesses and general public.
  - To have a thriving Geospatial industry in the country involving private enterprise.
- Establish and strengthen an integrative interface for all digital data having location dimension collected or developed utilizing public funds, for easy access, sharing, use and reuse.
- Develop a Geospatial Knowledge Infrastructure (GKI) underpinned by Integrated Data & Information Framework.

The focus of the policy is to make geospatial technology and data, agents of transformation for achieving the Sustainable Development Goals (SDGs), bringing efficiency in all sectors of economy and instilling accountability and transparency at all levels of governance.

Actionable Insights from well layered geospatial data is crucial in tackling the 'where' and 'how' of sustainable development goals

SOME GEOSPATIAL USE CASES

Environment

Lake Surface Conditions

Land Threats to Environment

Droughts and Floods

Urban

Land Use Land Cover

Urban Deforestation

Infrastructure Planning

Agriculture

Soil Monitoring

Farm Delineation

Yield Estimation

Disaster Management

Epidemic Prediction

Forest Fire Prediction

Storm Response

OVERVIEW

Consumers

Application Developer, Government Agencies, Research Community

UGI-X

Catalogue Server

Finds and describes datasets

Consent Server

Security, Privacy, Policy, Payments

Resource Server

Translates data to common format

Analytics Engine

Analytics Ready Data, Foundation models, Function Repository

DATA

Public Data

SOI, NSRC, Forest Dept, State govts etc.

Private Data

Companies that generate data, e.g., Image data from drones and satellites, hydrology data etc.

DATA EXAMPLES

Spatiotemporal

Topography

LIDAR

Administrative maps

Satellite

WHY DO WE NEED STANDARDS ?

"Standards should facilitate interoperability, support fair trade and fair competition, increase user, consumer and Government confidence and stimulate innovation"

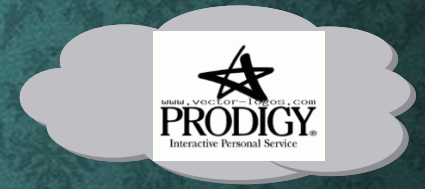
- Karen Bartleson – IEEE President, former President IEEE-SA in her book" Ten Commandments for Effective Standards"

Case Study : Internet

BEFORE INTERNET PROTOCOLS, ONLINE NETWORKS WERE ISLANDS

Proprietary Email Client

Proprietary Email Client



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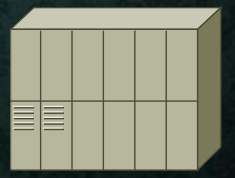


Case Study : Internet

WITH INTERNET PROTOCOLS, ONLINE NETWORKS CONNECTED

Proprietary Email Client

Proprietary Email Client

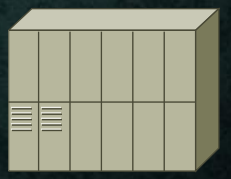
Interoperable Server Side Protocols and Formats

TCP/IP
AS/BGP/OSPF
DNS
SMTP
MIME

"Inter net"

Proprietary Email Client

Proprietary Email Client



Case Study : Internet

THE PROPRIETARY SERVICES MADE WAY FOR RAPID AND OPEN INNOVATION

Open and Standard Interfaces, beyond email!

Low Cost ISP

Interoperable Server Side Protocols and Formats

TCP/IP
AS/BGP/OSPF
DNS
SMTP
MIME

"Internet"

Open and Standard Interfaces, beyond email!

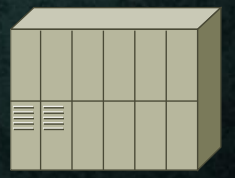
Low Cost ISP

Low Cost ISP

Open and Standard Interfaces, beyond email!

Low Cost ISP

Open and Standard



The need to participate in Standards Development –

INDIA specific challenges & building Global Competitiveness

	AREA (million Sq Km)	Population (in Billion)	GDP nominal (Trillion $)	Average Watts/ person
NORTH AMERICA	24.71	0.579	38.1	1378 -USA
EUROPE	10.18	0.743	19.07	651 -EU
NA + Europe	34.89	1.323	57.0	
CHINA	9.597	1.379	11.2	492
INDIA	3.287	1.324	2.64	87

Unique Challenges:

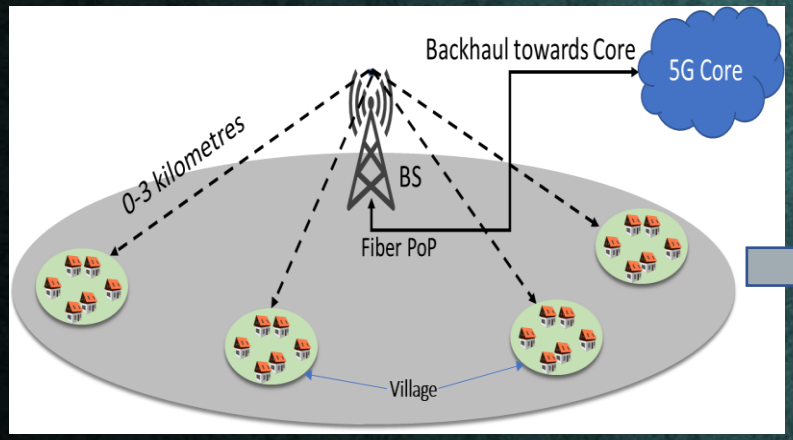
1. Rural Broadband for all – Fiber to Panchayat
2. Diversity ++ - language, culture, last mile, geographical
3. Greenfield deployment – ability to Leapfrog Technology Solutions

Leapfrog in SOCIO-ECONOMIC DEVELOPMENT enabled by TECHNOLOGY

Globally Competitive in: deployment of new Technology & development of new Technology

CASE STUDY: 5Gi Journey: From Requirements to Standard

Courtesy : "A Case for Large Cells for Affordable Rural Cellular Coverage", Saidhiraj Amuru, Radha Krishna Ganti et al.



India Requirement LMLC

Config A
- 700 MHz
- ISD 1.732km
- 120/500 km/h

Config B
- 4 GHz
- ISD 1.1732km
- 120/500 km/h

Existing rural models 3G, 4G, 5G

Config C (LMLC)
- 700 MHz
- ISD 6 km
- 3/30 km/h

New model 5G

TSDSI's LMLC Req. incorporated @ ITU in Q3 2017

3GPP 5G Standard + Indian Enhancements

To address Indian needs

Technical studies and finalization done in TSDSI

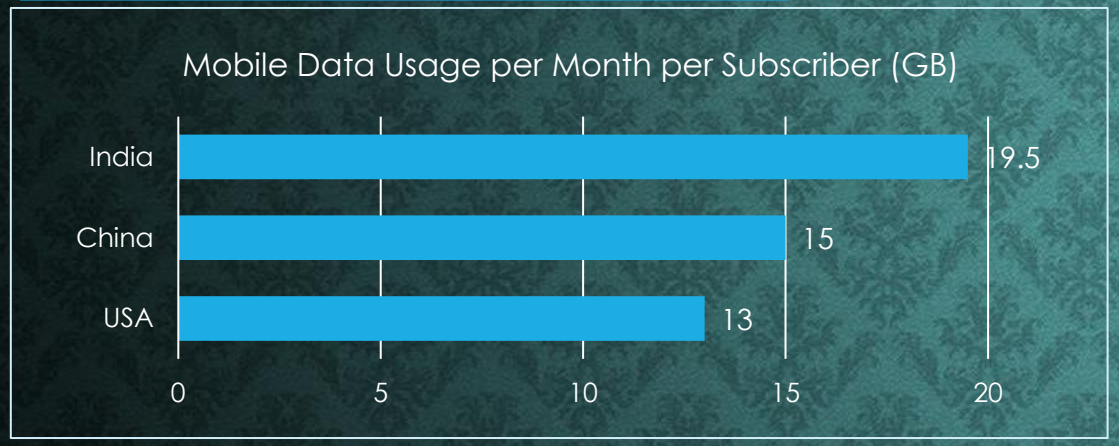
TSDSI creates 5Gi Standard

TSDSI 5Gi Standard merged into 3GPP Release 17

CASE STUDY : BROADCAST- BROADBAND CONVERGENCE

D2M INDIA VISION & MISSION STATEMENT

India Mobile Data Consumption



- **Total mobile data consumed in India is expected to more than double by 2024[1]**
- 70% of traffic is Video traffic. Video traffic is consumed more in the rural parts than in the urban parts of the country
- Consumption is primarily restricted by mobile data price, which have been steadily increasing since late 2019

Source : [1] Nokia: India Mobile Broadband Index 2023

Mission and Vision

D2M as a Digital Public Good Service can enable direct broadcasting of video/data to mobile devices and other smart devices at a low cost thus widening accessibility

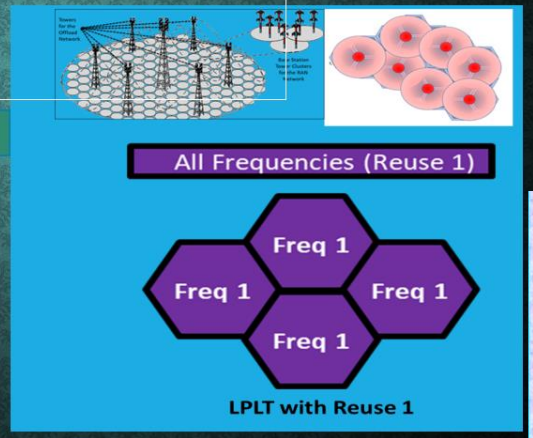
210 Million

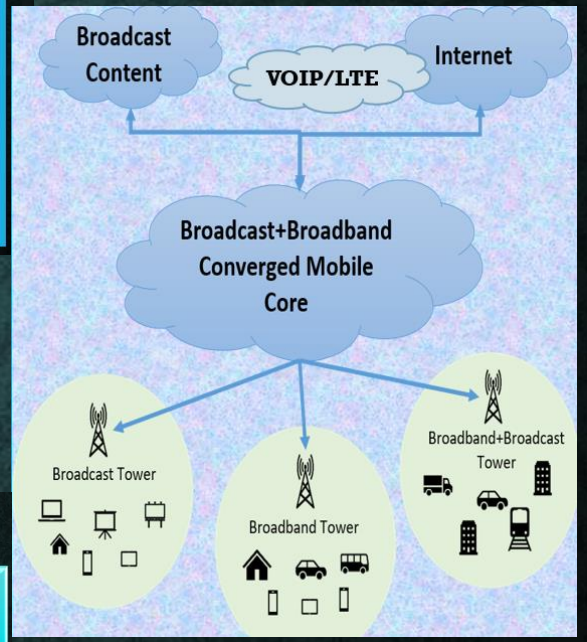
1150 Million

Low Power, Low Tower :

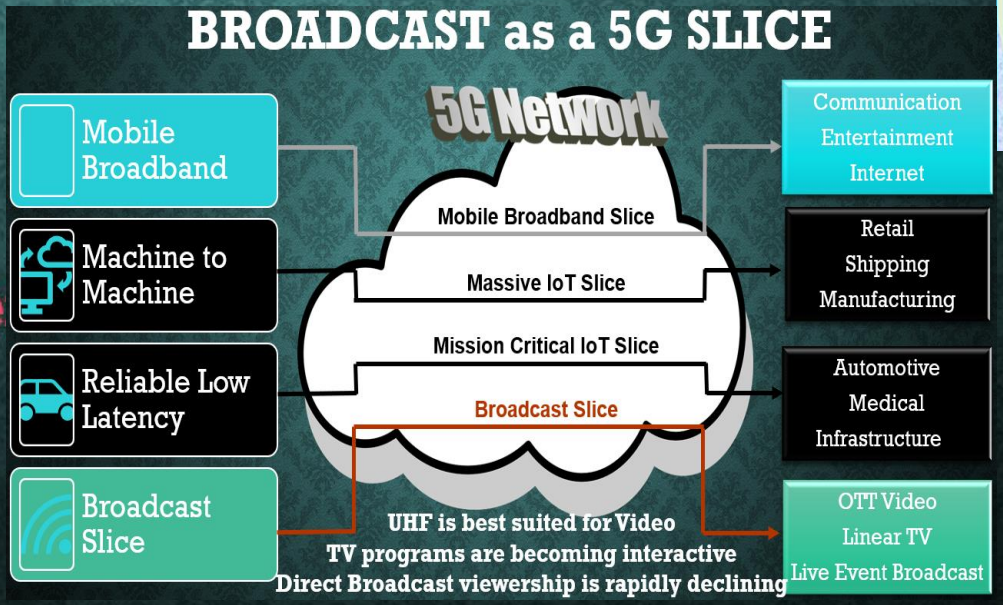
Shared Infrastructure, Efficient Spectrum Usage , Cellularised "SFN"

For every Fn Frequency used in a DMA, Fn+1, Fn-1 can not be used





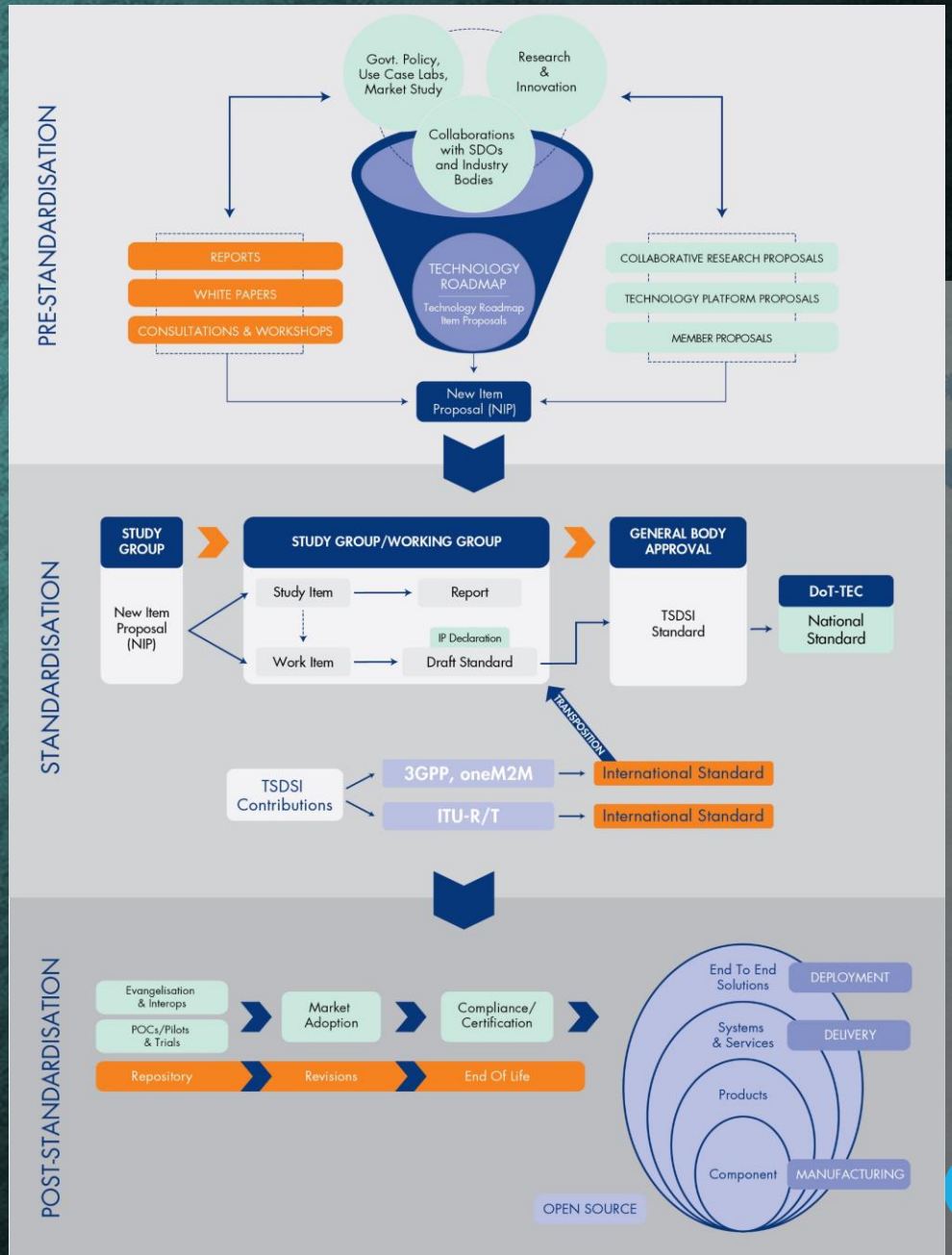
BROADCAST as a 5G SLICE



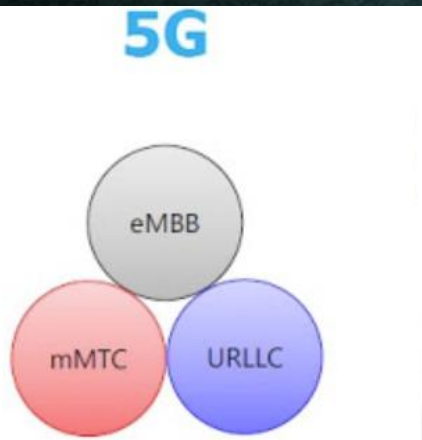
UHF is best suited for Video
TV programs are becoming interactive
Direct Broadcast viewership is rapidly declining

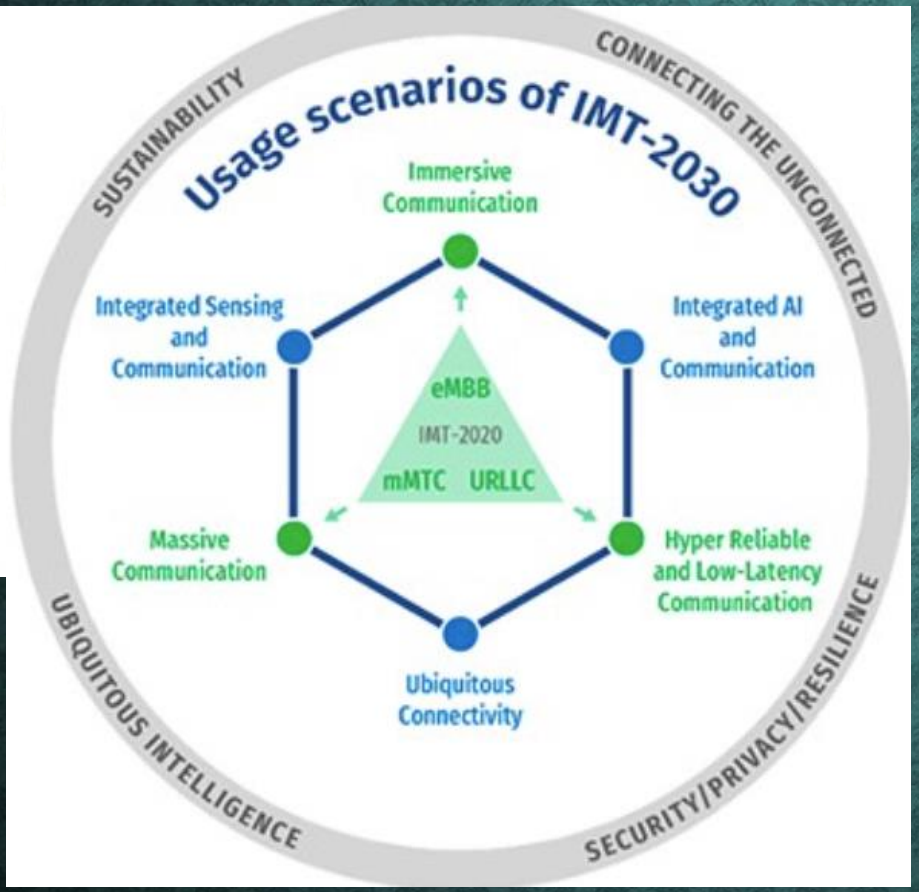
Democratisation across STANDARDS DEVELOPMENT LIFECYCLE

- Pre-Standardisation -
  - Standards Driven Research Projects
  - Use Case Labs
  - Patents, PoCs & Pilots
  - Roadmaps & Market Surveys
  - 6G Alliances & Workshops
- Standardisation –
  - Contributions!! Contributions!! Contributions
  - Testbeds,
  - InterOps & Plugfests
- Post-Standardisation –
  - Evangelisation
  - Trials
  - Compliance & Certification



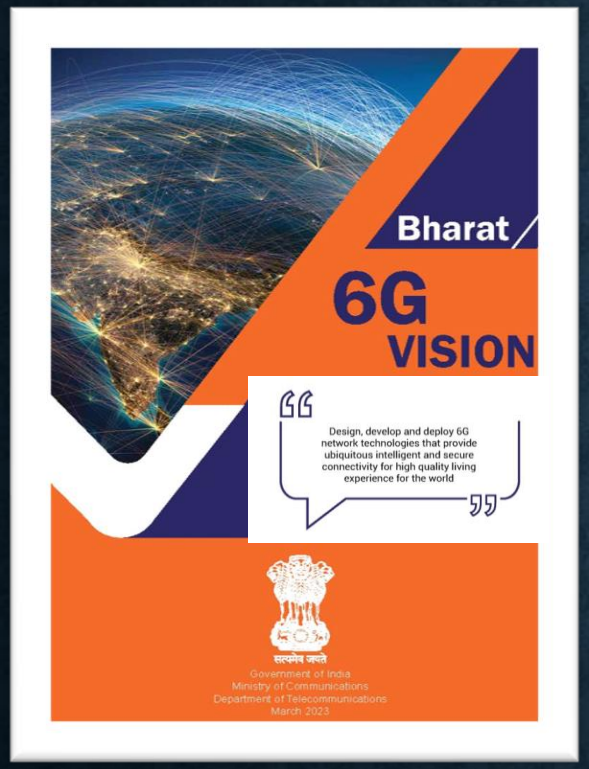
BEYOND 5G TOWARDS 6G

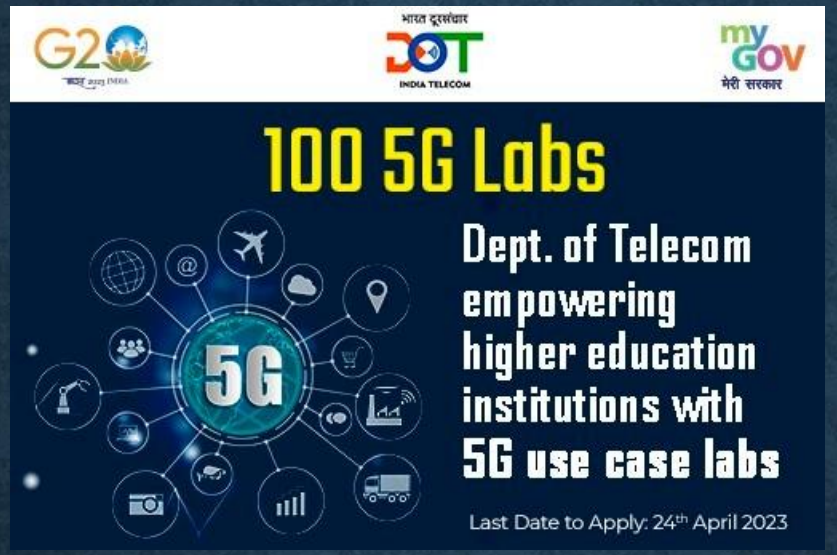




The complexity and explosion in Use cases may best be handled by a " Democratised Technology Ecosystem"

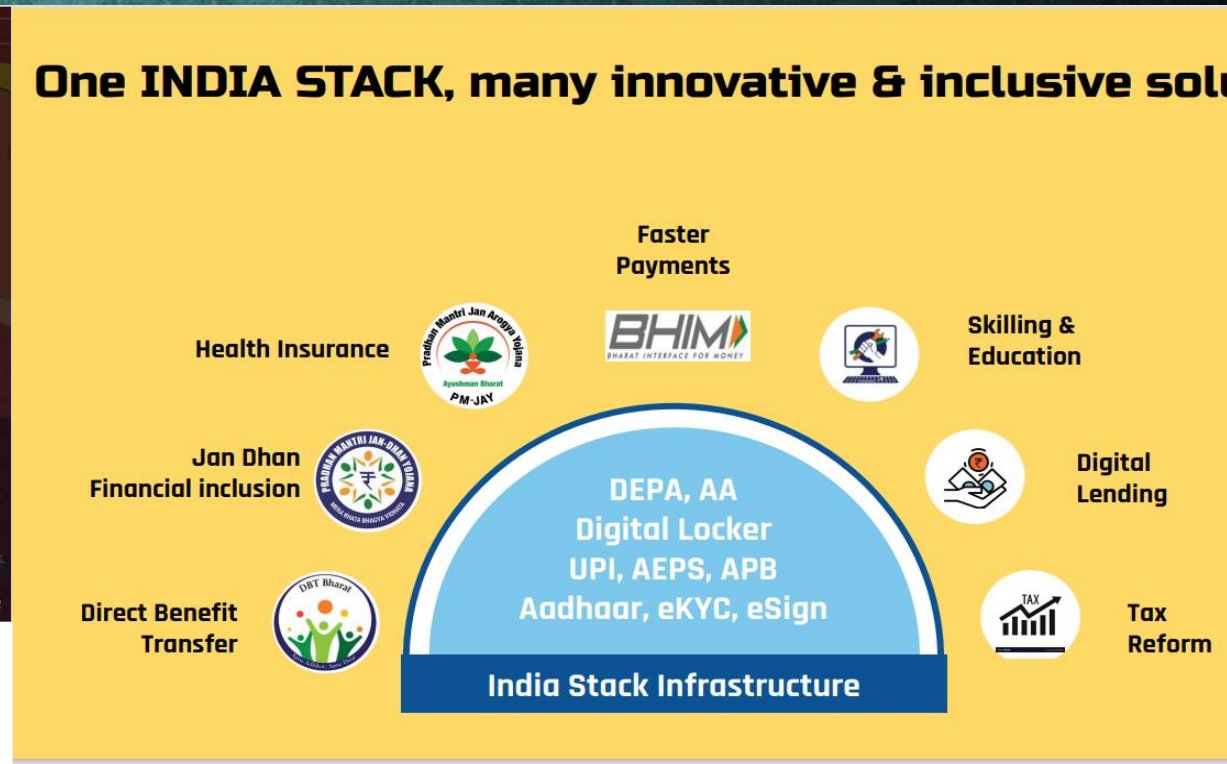
SOME DEMOCRATISATION INITIATIVES

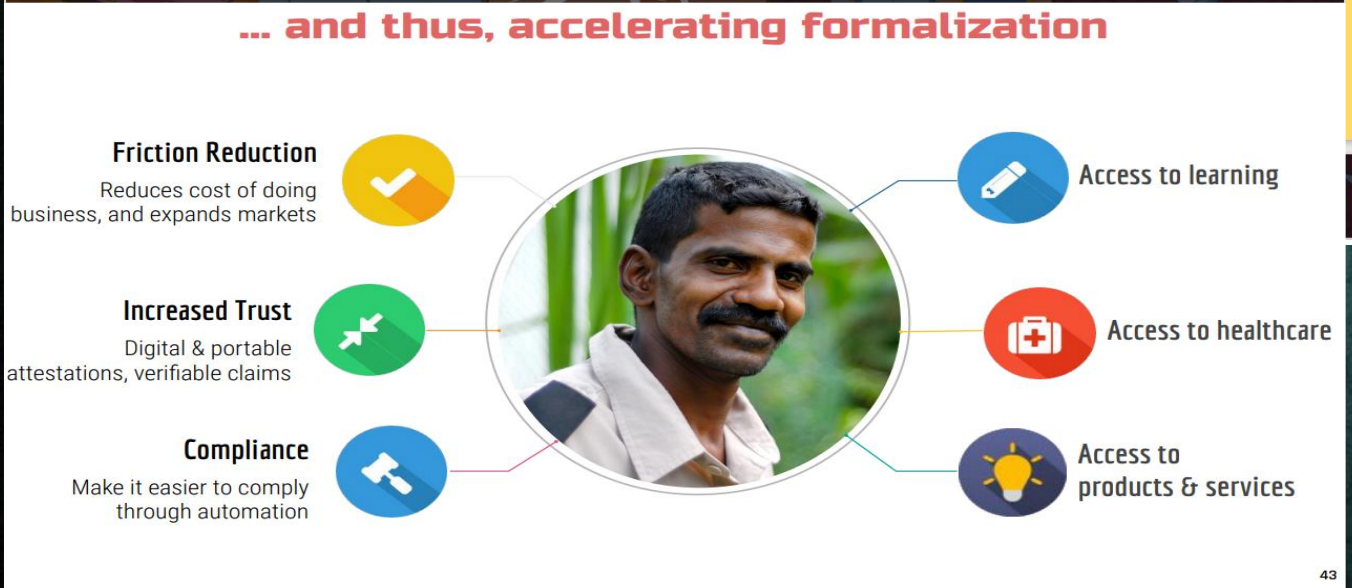


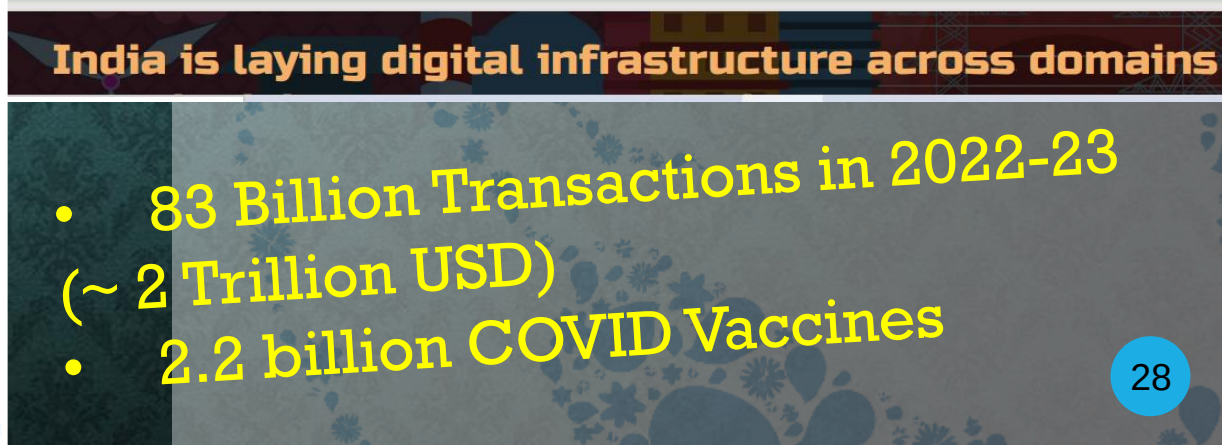


PARTICIPATION IN DEVELOPMENT OF TECHNOLOGY

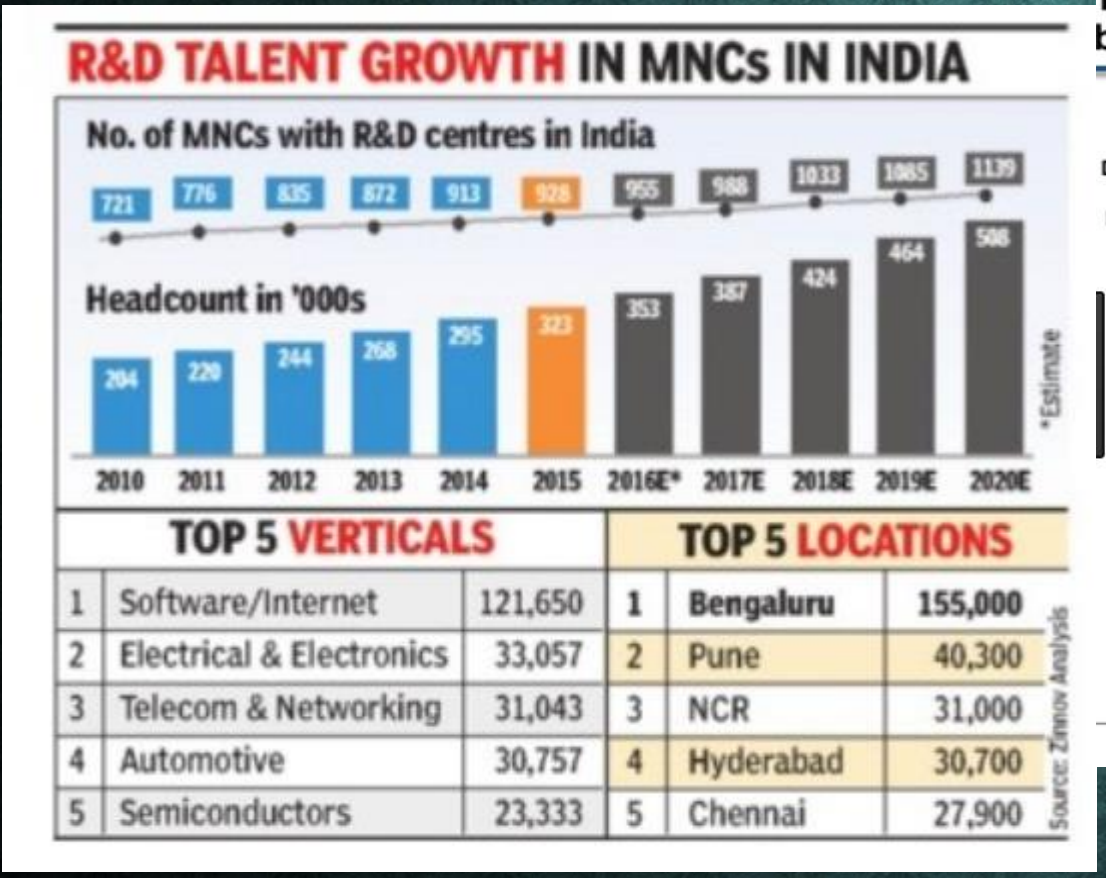
Key to Socio-economic development

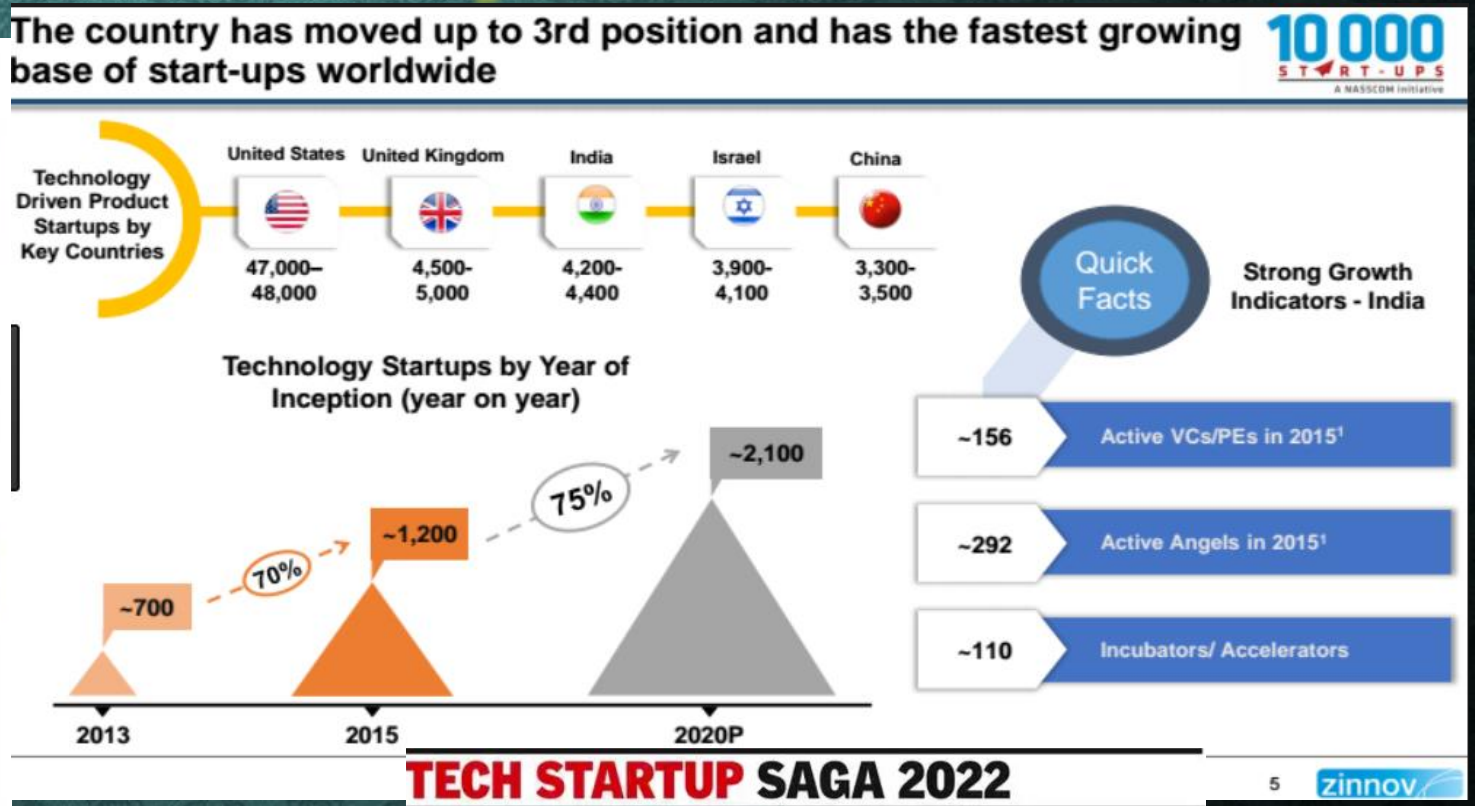




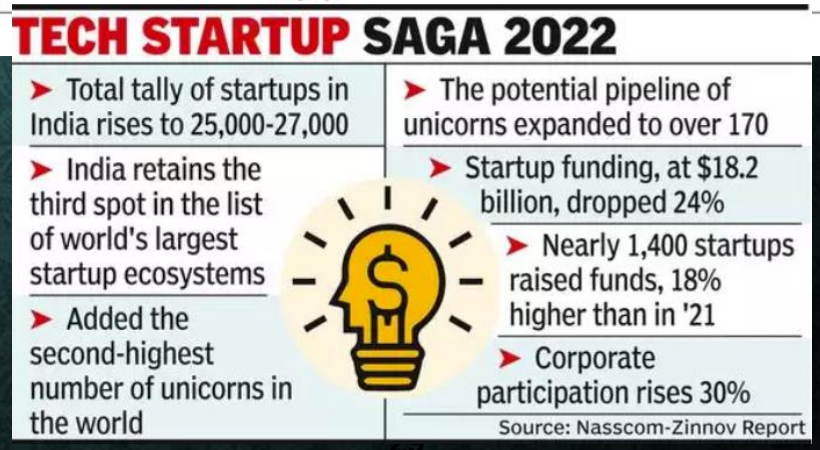


Technical Community ready & aspiring to participate in the Global ecosystem

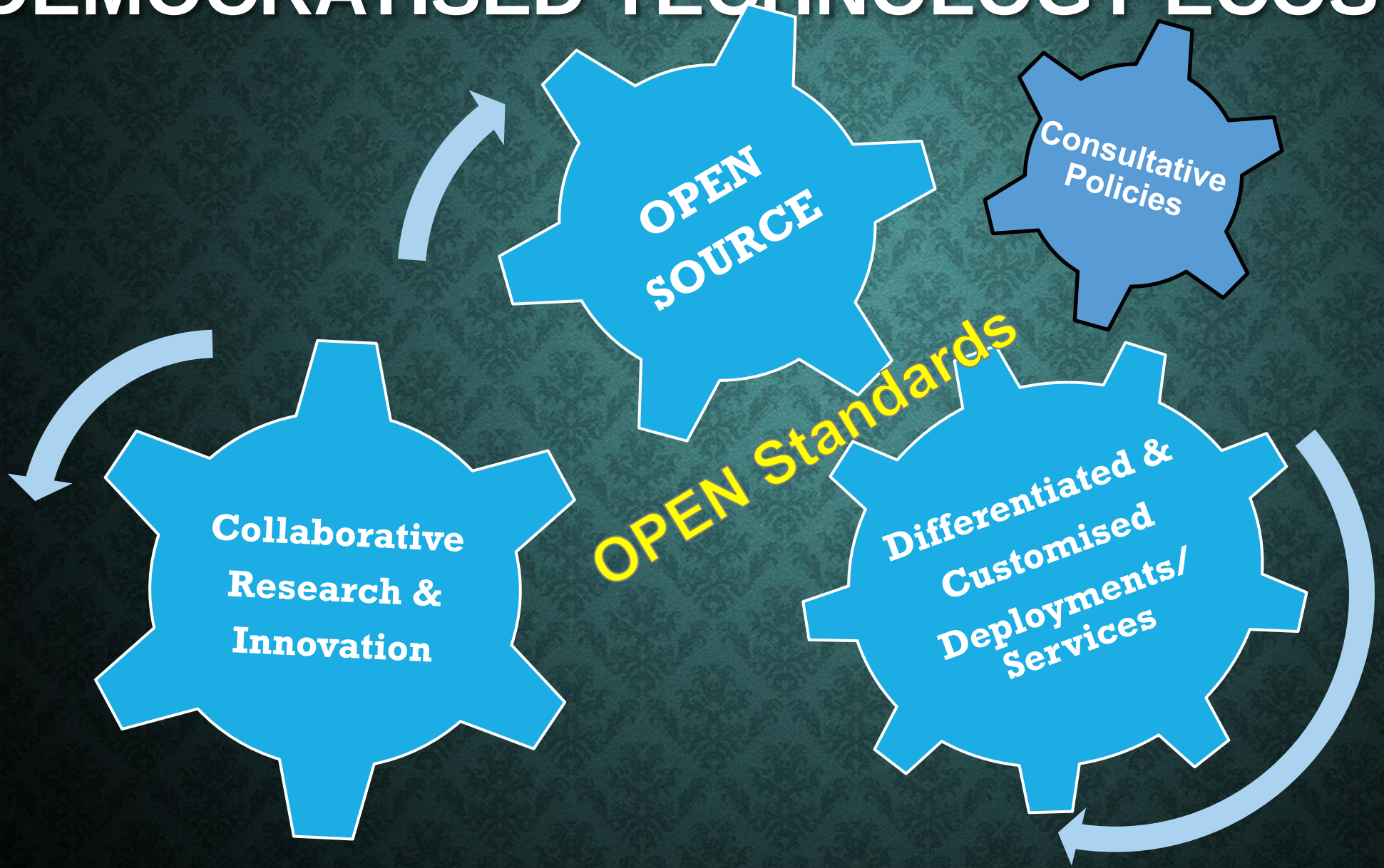




Growing Developer Community



DEMOCRATISED TECHNOLOGY ECOSYSTEM



Collaborating and contributing
in an open, fearless forum
is a lot of fun and learning.

IEEE is one of the oldest OPEN Forums,
Let us join hands and
take your engagement with IEEE to the NEXT level thru Open Source, Open Standards & Collaborative Research

THANK YOU

Acknowledgements
1. IUDX Community
2. IISc (IOS-MCN) Community
3. TSDSI Community