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Blockchain for productivity
BLOCKCHAIN FOR PRODUCTIVITY FORUM

Transforming Public Utilities: Blockchain Use-Cases Over Digital Infrastructure Aligning G20 Agenda

September, 2023 Edition

www.blockchainforproductivity.in



About Us

Blockchain For Productivity Forum (BFPF) is an initiative to accelerate our progress in Blockchain Technology and to further carryout social projects by creating innovative solutions to bring about a positive change primarily in the life of rural people as their social welfare initiative by converting unemployment into entrepreneurship supported with scholarly, research and creative endeavours with commitment to society.BFPF aims at promoting Blockchain adoption across India and internationally. We are working with Government and Non-Government bodies to proliferate this amazing technology. We envision ourselves to be the thought-leaders behind the successful implementation in a variety of industries.

Vision

Blockchain for Productivity Forum, is incorporated with the sole vision of creating a forum of Experts for serving our community through Blockchain Technology that enrich their life and also disseminating knowledge among people, Corporations and Govt(s). it also aims to help to formulate appropriate policy or provide a suitable solution for a specific problem using ICT technologies. It will also expand its reach with experts both in India and abroad and have partnership among academic and business organizations to offer a creative and collective contributions to the country.

Mission

The establishment of Blockchain for Productivity Forum has a one stop mission- “Upliftment of the communities by facilitating services or business via various platforms leveraging ICT technology and keeping the records/transaction on secure, immutable distributed ledger technology (DLT) (also called Blockchain) in a sustainable and effective manner.” Our mission is to maintain a level of excellence and standards in all programs that will give the forum a national and international significance. Our effort will be to learn and discover the transformational potential of Blockchain Technology and its ability to change the life of common people.





Blockchain for productivity

**SatyaSpeak- "Blockchain Chalisa"
Blockchain Ek Sunehari Karri (Gold Chain)-
Internet of Wealth**

(A Simplified, Crowd-sourced (Idhar Udhar Se),
"Say-it-All" Forty liner)

**Mined by: Dr. Satya N. Gupta, NGNguru,
sg.ngnguru@gmail.com, +919910327489**



Blockchain, the Distributed Ledger Technology, Magically Grand. Solution for every Problem we have at Hand.

Call it KalapTaru, the Wish-Tree. A God-sent Gift to Mankind for near-Free.

Came shouting, "I have the Solution, Show me the Problem", Like "Bin Taale ki Chaabi" (Key in search of the Lock), in the movie Victoria Two Zero Three.

A Shared Ledger, Protocol of Trust, revolutionary way to Store, Validate and Monetize. The process, Transparent, Secure, Immutable and truly Wise.

Built on 5 Pillars of Cryptography, Hashing, Timestamping, Consensus Algorithm, Decentralized Database, Strong. Riding over New Internet in 5 layers- Basic Infra, Chain, Platform, Smart Contract, APIs applied all Along.

A Pucca system of Truth, Consensus based, Open, Accessible, Accountable and Efficient. A Data Ledger, Secure, Immune to Fraud, Hacking and Cyber-attacks, the future of Data-Evident.

Bring Transparency, Traceability, Trust to Transactions and make it Immute. They say Data, Data everywhere, "Lies, Damn Lies & Stats", Blockchain makes it Truth and nothing else but Truth.

"Blockchain" not spelled as "BITCOIN", can be "Be-All-End-All" Protocol. DLT creates DeFi, DeWi,DAO, NFT, DDLP, better, cheaper, faster and More.

There are Kitties, Ponzies, Cryptos, Coins but Blockchain goes much beyond. And all the things Good, True, Trusted and more to Stand.

Produce programmable Intelligent Assets, Tokens, Fungible and Non, Commodity, Open Platforms, anything "Yeh Dil Maange More". Creative Disruption to empower everyone, Leaving no one behind, Building better life at Earth, free-distributable Wealth to Explore.

Reduce Fraud, Tempering, Manipulation, Risk, Cost. Enhance Productivity, Security, Value, and Trust. Public, Private or Hybrid, best of both the Chains-Transparency and Security of "Public" and Scalability and Privacy of Private.

"Smart Contract", the Cornerstone, Automate multi-party multi-dimension Deals. Good-bye to Time-overrun, Cost-overrun, Arbitration and Appeals.

Making Central Bank Digital Currency (CBDC) Intelligent, Compliance-oriented, Pseudonymous. Centralized Train Control Decentralized, "Fail-Safe" becomes "Failure-

Not-An-Option”, efficient Supply Chain, Asset Management, Employees Supercharged and Passengers delightful.

Digital-Divide to Digital-Dividend, Demography-Dividend becomes Wealth-Creation, Anonymous becomes Pseudonymous, programmable privacy-on Demand. WhatsApps messages Traceable, Origin and Provenance proving with Timestamp.

Powered by IPV6 (New Internet)– Secured P2P communication, No Man-in-Middle. Personal IP Address to all things Living and Non-living, Address space being multi-Trillions of Trillion.

PW-WANI, Decentralized, near-Free and Open-Roamed, like UPI of Payment. Aadhar fueling Self- Sovereign Identity (SSI) as All-in-One verifiable Document.

Decentralized, Geographically-spread Domain Name Servers(DNS), Delay-less, Sovereign, Efficient. Make Digital Infra Open, Reliable, Secured, Accountable and Zero-Trust.

Steward and Accelerator of Digitalization journey, Harbinger of Techade of Bharatland. Death knell for NAT (Network Address Translation), Spam, Unsolicited Calls, Fake-News, Darknet and Double-Spend.

Tokenize any Asset, Digital or Physical, make it Secure, Non-Fungible, Valuable and Unlocked. Making you Wealthy, Wise and Knowledgeable, all Three. Metaverse Decentralized, Democratized toward Internet of Ownership, Web3.

Double farmers Income, enable Remote-Voting, Ram Rajya making ‘Citizen the King’. Globalize Indian Stack and e-Rupee, making it Universal and simplified Thing.

Innovate Peer2Peer Sharing Economy to own your Data & share Wealth from Tech-cos and Aggregators. Accelerate Govt. transformation to “More Governance- Less Government”, Maximize overall Societal Welfare.

Move Digital Economy towards Token Economy to Social Economy, near-Zero cost for Micro-services and Transactions. Informal sector inclusion, make Philanthropy accountable, track End-use of funds, monitor Impact through Beneficiary Direct.

“Internet of Value” becomes “World Wide Ledger of Trust”. Better we call it Web3, “World Wide Owned Wealth”.

Add Speed, Scale & Scope to “Gati Shakti”, “Embrace Blockchain or get Blocked”, “Platformize or Perish”. Pioneer Blockchain-as-a-Service (BAAS), leveraging Talent.

“One World – One Family – One Future”, to have “One Blockchain” as well. A single Universal Chain to build the Future of Mankind, the Whole.

BharatChain, Open Digital Public Good, to position India as Blockchain Capital of World.

BlockChain, a Sunehari Karri- not just 5T Economy or Developed Nation or “Sone Ki Chirriya” can make Bharat “Sone ka Hathi” (Gold Elephant) in Amaritkal.



Board of Directors

Dr. Satya N. Gupta, NGNguru

PhD (CVU), CEng. DIISc. DRP, IRSSE(VR)
Chairman, Blockchain for Productivity Forum

Chairman, Bharat IPv6 Forum
Evangelist, DigiGaon Job Factory Foundation
Secretary General, ITU-APT Foundation of India
Chairman, BLUETOWN, India & BIMSTEC, S. Asia



An International expert in NGN technologies, Regulation, Interconnection and Broadband with 42 years' experience in all aspects of Telecom, including 25 years with Govt. and Regulator, Dr. Gupta is publicly recognized as an Analyst, Author, Advocate and Advisor on ICT related Policies, Projects and Business. After post-graduation from IISc. Bangalore joined ministry of Communication in 1981 and Ministry of railways in 1983 and rose to the level of Additional Secretary in TRAI. He is recipient of coveted Minister of Railways award for outstanding performance for Digitalisation project.

A triple master in Electronics Design Technology, IT Management and Telecom Policy and Regulation, globally known as “NGNguru” he is trainer and coach for telecommunication technologies, policy and regulation and a Regulatory advocate. Author of "Everything over IP-All you want to know about NGN". He also authored a concept called “Job Factory- Converting Unemployment into Intrapreneurship”. His recent research-based work, “Long Tail - Walking the Extra Mile on Rural Broadband Business”, brings out the innovative business models for rural broadband connectivity. He has also established and mentoring a consulting startup named SAAM CorpAdvisors managing “Govt. Affairs as a Service”. He was also awarded Global Visionary Award by Vision World Academy in 2019 for his Mission for Rural Women Empowerment through DigiGaon Job Factory Foundation, a Social Enterprise. Based on his impact making business model “Hotspots- as- Managed Service”, has been awarded PhD (HC) by Commonwealth Vocational University, Kingdom of Tonga, Asia Pac.

As founding Chair of Blockchain for Productivity Forum he is engaged with various Govt. depts. and Regulatory bodies with a mission to create an Universal and Ubiquitous Blockchain Infrastructure in country as Digital Public Good and recognized among the top 50 Influencers of Blockchain in India by the community. Recently, he has been appointed as India Ambassador for Data Spaces by IDSA, EU.

He is Secretary General of ITU-APT Foundation of India, Vice-President of DCIF and Chairs BIF committee on Rural Digital Infrastructure. He has been inducted in the Govt High Level Coordination Committee to accelerate the IPv6 migration in the country. As a part of his pastime, Speaking-Tourism, he conducts training programs in the areas of NGN Technologies, Broadband Policy and Regulation, Interconnection Costing in NGN Era, Spectrum Management, IPV6, Digital Transformation, Blockchain and Blue-Ocean Strategy, all over the world. He is first Indian recipient of IPv6 Hall of Fame Award-2019 and Lifetime Achievement Award-2022 by Global IPv6 Forum and appointed Chairman of Bharat IPv6 Forum-Towards Atm anirbhar Connected Bharat.

Presently, he is leading as Executive Chairman, BLUETOWN, India & BIMSTEC, S. Asia to forge newer partnerships and “Making It Happen” the Vision of “Connecting the Unconnected people living in Rural areas of World”.

Dr. K.V. Damodharan

CEO



Dr. Damodharan is Highly qualified and experienced professional and has over 30 years of experience in Economic regulation, Financial analysis, Cost and Management Accounting, tariff fixing, and monitoring. He has strong background in regulatory economics, with a specialization in telecommunication and airport economic regulation and possesses postgraduate degrees in Commerce, Economics, MBA Finance, FCMA, and a Ph.D. in Applied Economics and Business Management.

Qualified COST ACCOUNTANT (FCMA) with extensive experience in the finance, economics, and regulatory areas of the Telecom Regulatory Authority of India (TRAI), Competition Commission of India (CCI), Department of Telecommunications/BSNL/TCIL, and the Airport and Railway sector he was involved in a wide range of regulatory issues including assessment of market competition, tariff fixing, tariff monitoring, regulatory compliance, licensing issues, pricing of various products/components, assessment of sector viability and operations, economic utilization and pricing of scarce public resources, quality of service issues, capital planning, forecasting, determination of tariffs and methodologies, determination of cost of equity/debt and fair rate of return, and drafting of orders and regulations etc. He was trained at several prestigious international institutes, including the IIM Calcutta, Administrative Staff College of India, TEMIC Canada, Interconnect Communications Bath, UK, Nan Yang Technical University, and LIRNE Asia Singapore etc. Published many articles and served as a visiting faculty at various esteemed organizations and universities, including IIT Delhi, UPES Dehradun, IMU Chennai, and ICWAI.

Currently serves as CEO of the Blockchain for Productivity Forum (a registered trust), Chairman of Elteridium Technology Pvt. Ltd., and an Advisory Board member of the Power Grid Corporation of India (PSU).

Dr Shiv Kumar

Director General



Digital Transformation specialist and Thought Leader I Domain expertise in Mobile Communication, Telecom & IT Policy Advocacy & Regulatory. Shiv possess 3.5 Decades experience rendered services to QUALCOMM, NOKIA, NSN, ERICSSON, DoT, BSNL/MTNL & Software Technology Parks of India (STPI)-MeitY, Govt. of India. At present he is a Principal Advisor at Broadband India Forum (BIF), an independent think-tank of India, on Policy Advocacy and Regulatory in IT and Telecom Arena. He is also a DG- Blockchain for Productivity & Bharat IPv6 Forum.

Shiv is also a techno-entrepreneur in the area of Skilling, Capacity Building and offering Business Solutions in IPv6, Blockchain, Cyber Security and IoT. Trusted by small to big, fortune 500 companies like NEC Technologies, Panasonic India, Larsen and Toubro (L&T), NIXI, MDA, TSSC, CBS Technologies and many more. Providing solutions, competence enhancement services, re-skilling and up-skilling. He had mentored and transformed the life of over One Lakh youth. Collaboration and Excellence is core to his strategy. Being part of Skill Development Initiatives of Govt. of India, he had successfully accomplished various projects with TISS, NIELIT, CoE) on Smart City Communication Technologies in collaboration with TSSC (under Aegis of NSDC) and NIESBUD.

He had been playing an active role and contributing to professional societies and social organisations as a Fellow of IETE and a Member of AIMA, NASSCOM and Data Security Council of India (DSCI). He is a Master Trainer on 5G technologies, Industry 4.0 (IASC), Certified on Advanced Cyber Security from SETS under Principal Scientific Advisor (PSA), to Govt. of India

Board of Members



Venu Vohra
Board Member

Venu Vohra, A technology evangelist by choice, entrepreneur, with a mission of delivering impactful solutions using cutting edge technologies Blockchain, AI, IoT.

Has more than 15 years of diverse professional experience in Fintech, Supply chain and Education industries. Currently working in the space of Data Privacy, Self sovereign identity and Decentralised Finance. He is also actively working in both public & private blockchains He is a board member at blockchain for productivity forum and a technology advisor at UPES, Dehradun.



Prof. Akhil Damodaran
Board Member

Prof. Akhil Damodaran is a highly experienced professional with a strong background in the telecom, IT, aviation, and education industries. He has been recognized as a winner of the Celerity 40 under 40 Supply Chain Achievers award in 2021. Currently, he is serving as the Cluster Head Emergent Vertical in the School of Business at UPES, where he is creating innovative metaverse classroom experiences for students. In addition to his role at UPES, he is the CEO of Elteridium, a blockchain smart contract firm for public private partnership. He has also been involved in several other organizations, including serving as an advisory member for IVIVI Tech Solutions, a leading artificial intelligence company, and as a regional mentor for the Atal Tinkering Lab at NITI Aayog. Akhil Damodaran has a diverse educational background, with a bachelor's degree in engineering in electronics and instrumentation from RGPV, a postgraduate degree in technology management from IIT Delhi, and a degree in competition law from National Law University Delhi. He has published numerous research papers in reputable journals, including Scopus and ABDC.

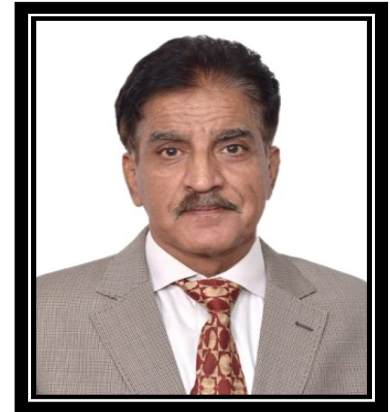
Advisors



Dr. Labh Singh
Advisor, Blockchain For
Productivity Forum



Mr. Sunil
Additional Director General
Prasar Bharti



Dr. B. M. Baveja
Ex. Senior Director
Ministry of Electronics & IT



Mr. Anurag Agrawal
Co-Founder & Director,
DataBloc Technologies



Lt. Gen. AKS Chandele
Rt. Director General, Corps of
EME, Indian Army



Prof. Tarun Dhingra
Dean-Academics, Jaipuria
Institute of Management

Members



OUR SPONSORS

Software Technology Parks of India (STPI) is a premier S&T organization under Ministry of Electronics and Information Technology (MeitY) engaged in promoting IT/ITES Industry, innovation, R&D, startups, product/IP creation in the field of emerging technologies like IoT, Blockchain, Artificial Intelligence (AI), Machine Learning (ML), Computer Vision, Robotics, Robotics Process Automation (RPA), Augmented & Virtual Reality, Animation & Visual effect, Data Science & Analytics for various domains like Gaming, FinTech, Agritech, MedTech, Autonomous Connected Electric & Shared(ACES) Mobility, ESDM, Cyber Security, Industry 4.0, Drone, Efficiency Augmentation, etc.

STPI is establishing CoEs/Technology incubators for building India's leadership in the above mentioned technology areas across the country in a collaborative manner. Till date, STPI has launched 22 Centres of Entrepreneurship (CoEs).

STPI is aspiring to become the largest technology startup ecosystem in the country and has been endeavouring to transform the country into a software product nation as envisaged in National Policy on Software Products (NPSP) 2019. In order to achieve this, STPI has evolved a collaborative model wherein government, industry, academia, and other stakeholders are playing a vital role for providing end-to-end support to startups. Aligned with this vision for promoting R&D, innovation, product & IPR creation, STPI is providing state-of-the-art infrastructure, skilling, mentoring, market connect and other necessary support pan-India to startups.

STPI has also embarked on launching **Next Generation Incubation Scheme (NGIS)**, a futuristic incubation scheme to offer comprehensive support & services and extend seed funding to startups from 12 STPI incubation facilities pan-India at Agartala, Bhillai, Bhopal, Bhubaneswar, Dehradun, Guwahati, Jaipur, Lucknow, Prayagraj, Mohali, Patna & Vijayawada under a common umbrella. To further strengthen the startup ecosystem in the country, STPI has set up RF Lab, EV Lab, AV Lab, IoT Lab, MoCap Lab, AI/DA Lab, Innov IoT Lab, CV/AI Lab, ESDM Lab, Health Informatics Lab, MediElectronics Lab, VR/AR Lab, Fintech SandBox, FabLab, SMARTLab, and Atal Incubation Centre (AIC) to enable startups leverage these facilities for building innovative technology products and solutions in an indigenous manner.

Since its inception in 1991, STPI has been working towards equitable and inclusive IT-led growth pan-India which in turn has helped promoting Software exports, Science, Technology & Innovation (STI) and Software product development. With 11 jurisdictional directorates and 63 centres, STPI has expanded its presence pan-India to support IT/ITeS Industry. Working closely with all stakeholders, STPI has played a key role in transforming the country as the preferred IT destination, a fact that aptly proven by the stupendous growth in exports by STPI-registered units from Rs. 52 crores in 1992-93 to Rs. 4,96,313 crores in 2020-21, which is approx. 50% of the national software exports and 2.3% of India's GDP. The first historic event that triggered the high-octane growth of IT Industry in India was the establishment of three Software Technology Parks (STPs) at Bengaluru, Bhubaneswar and Pune in 1989. Consequently, in 1991 these three STPs were merged to create a single entity Software Technology Parks of India

“Apiary - A Centre of Entrepreneurship (CoE) in Blockchain Technology” at STPI Incubation Centre, Gurugram, has been set up at STPI, Gurugram in association with Ministry of Electronics and Information Technology (MeitY), Govt. of India, Dept. of IT, Electronics & Communications (DITECH), Government of Haryana to connect startup, provide support with collaboration, attract investors and ultimately strengthen the startups community for making India a world leader in technology space and creating a pipeline of future jobs-creating businesses.



OUR SPONSORS

NIXI is a not for profit Organization under Section 8 of the Companies Act 2013, and was registered on June 19th, 2003. NIXI was set up for peering of ISPs among themselves for the purpose of routing the domestic traffic within the country instead of taking it all the way to the US/abroad, thereby resulting in better quality of service (reduced latency) and reduced bandwidth charges for ISPs by saving on international bandwidth. NIXI is managed and operated on a neutral basis, in line with the best practices for such initiatives globally. NIXI has three business verticals under them:

IXP: Internet Exchange Points (IXPs) are the most critical part of the Internet's Infrastructure. An Internet Exchange Point is a facility that allows Internet Service Providers to "meet" and exchange traffic, also called peering. This saves money on international bandwidth for the ISPs and improves connectivity for their customers by reducing latency.

IRINN: A division functioning under NIXI and provides allocation and registration services of Internet Protocol addresses (IPv4 & IPv6) and Autonomous System Numbers to its Affiliates.

.IN Registry: Government of India has authorized NIXI as .IN Registry. It is India's top-level domain on the Internet. Like .COM, .IN can be used for email, websites and other applications. But unlike other domains, .IN is a unique symbol of India and its role in the world. The .IN Registry by itself will not carry out registrations. It will do so through a number of Registrars to be appointed by it through an open process of selection on the basis of transparent eligibility criteria. Now .IN domain names are available to anyone on a first-come-first-served basis.

Website Link: <https://www.nixi.in>



OUR SPONSORS

TCIL, a prime engineering and consultancy company, is a wholly owned Government of India Public Sector Enterprise under the administrative control of the Department of Telecommunications(DOT), Ministry of Communications, Government of India. TCIL was set up in 1978 for providing Indian telecom expertise in all fields of telecom, Civil and IT to developing countries around the world. The company's core competence is in the fields of Switching, Transmission Systems, Cellular services, Rural Telecommunication, Optical fibre based backbone trans systems, IT & Networking Solutions, Application Software, e-Governance, 3G Networks, WIMAX Technology and also Civil construction projects.

Vision

"To excel and maintain leadership in providing Optimal solutions on a Turnkey basis in Telecommunications and Information Technology Service Sector globally and to diversify by providing excellent infrastructure facilities, particularly in the high-tech areas ."

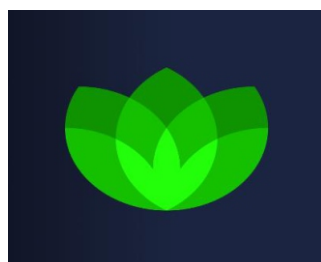
Mission

"To excel in providing solutions in information and Communication Technology, Power and Infrastructure Sectors globally by anticipating opportunities in technology".



Serenity Shield is a revolutionary, decentralized and privacy-centric data storage Blockchain solution that allows users to store, transmit, and retrieve their confidential files and documents with ease with a built in Inheritance option . Our flagship product is called “ Strongbox” . At Serenity Shield, we believe that you and you alone should own and control your data. Our beliefs are rooted in the principles of decentralization and our collective right to confidentiality. With a commitment to putting users back in charge of their information, Serenity Shield's vision is to empower individuals and businesses to securely and confidently interact in the digital world.

Our philosophy revolves around redefining the relationship between data, technology, and humanity, ensuring that innovation serves the greater good. That's why our platform offers a unique and innovative way to plan for your inheritance, ensuring that your legacy and digital assets live on for generations to come. We aspire to transform the digital landscape by championing individual sovereignty and inspiring a new era of digital succession planning. Our StrongBox® DApp enables individuals to reclaim control over their data, identity, and digital assets while protecting their loved ones, families, and businesses.



“Serenity Shield, the Key to your Digital Future “

ARTICLES

Gyan Vahini–National Knowledge Transport Grid (NKTG)

Creation of an Open Access Digital Public Good through Blockchain Cooperative, Functional Separation and Infrastructure Investment Trust using Smart Contracts and Data Spaces

**Dr. Satya Narain Gupta, NGNguru
Chairman- Blockchain for Productivity Forum, India**

(With valuable contributions from Dr. KV Damodaran, CEO and Team)

1. Executive Summary:

The most critical element of a robust digital ecosystem is the underlying connectivity/ transport infrastructure, which has become critical to nation's economic growth and overall societal well-being. Need for data transport capacity in today's developing economy is rapidly becoming more demanding with advances in information and communications technology (ICT) and its all-encompassing emerging applications. This critical public infrastructure - some of it being hybrid infrastructure that constitute passive, active and digital components, is critical to delivering the next wave of communications, innovation and economic growth for everybody and things.

Lack of high quality, resilient, secured and trusted infrastructure in the form of National Backbone Network (NBN) has been India's limitation especially in bridging the Digital Divide between Urban and Rural masses and in achieving higher and all-inclusive economic growth, leaving-no-one-behind.

India's mobile penetration witnessed an impressive growth during the past few decades, but same lagged behind for data access, resulting into a digital divide in the form of "Digital Access Deficit". Therefore, there is an urgent need to develop a ubiquitous & resilient Digital Infrastructure Grid in the country, given India's highly diverse geographies with many remote and inaccessible regions. Creation of such critical infrastructure calls for a holistic approach, political will, a long-term vision, innovative technological solutions & out of box business model, while making use of existing infrastructures already created in silos by Public and Private sector Actors.

One of the compelling emerging technology worth considerations to solve the above challenge is Blockchain, which is Decentralised, Trusted, Distributed Ledger Technology for immutable and secured records of assets of any type and efficient way of transactions as well as self-executing multi-party contracts. Forming a Blockchain Cooperative using the salient concepts of Functional Separation, Indefeasible Right of Use, Smart Contracts and Democratised pro-rata ownership unit allocation is the way forward to meet the nationwide Digital Connectivity challenge, by establishing namely Gyan-Vahini Infrastructure Investment Trust (GVInvIT).

This White Paper elucidates how Blockchain can be game-changing technology for creation of a Trusted Open-Access Public Digital Infrastructure, while also leveraging the concepts of Functional-Separation, Infeasible-Right-of-Use, Data Spaces, which can facilitate efficient management and sharing of the resources to make it democratised-owned, cost-efficient, resilient and secured.

The main benefits for various Actors in the game are summarised below:

- i. Gyan Vahini Infrastructure Investment Trust (GVInvIT) will help Public (Govt.) service providers/Telcos/Operators like: BSNL ,BBNL, RailTel, PowerTel and GAILTEL as well as Private Telcos and IP1s in monetising their existing Optical Fibre and other assets, as well as turning the spare capacity of their backhaul network into additional revenue stream, thus creating Value for Stakeholders, Wealth for Nation and lot of Jobs.
- ii. It will create a much needed seamless, secured, resilient, accountable nation-wide Digital Backbone Network by making maximum use of the existing infrastructure.
- iii. It will help in unlocking the potential of the optical fibre assets of the public sector player BSNL, leveraging its nation-wide presence and expertise eventually turning-around BSNL which has been struggling to come out of losses due to underutilisation and ill-maintenance of its core infrastructure.
- iv. It will help, in operation and maintenance of the pooled transmission network to meet the SLAs & uptime, to meet the critical and enterprise customers requirement.
- v. BSNL/MTNL/BBNL/Voda-Idea, will be able to get working capital and project debt against these assets without need for any Sovereign guarantee and burden on scarce Govt. resources.
- vi. The creation of an Open Access Digital Public Infrastructure Grid will help in reducing the dependency on fragmented and single owner assets and enable seamless exchange of traffic between infrastructures available, in plug-and-play manner resulting into optimal and full utilisation of critical resources.

2. Vision of NDCP-2018, India regarding Digital Infrastructure Challenge:ⁱ

Item 1.1(c) of Govt. issued NDCP-2018 envisions creation of a National Digital Grid as below:(www.dot.gov.in)

- i. Creating a National Fibre Authority.
- ii. Establishing Common Service Ducts and utility corridors in all new city and highway road projects, and related elements.
- iii. Creating a collaborative institutional mechanism between Centre, States and Local Bodies for Common Rights of Way, standardisation of costs and timelines; and removal of barriers to approvals.
- iv. Facilitating development of Open Access Next Generation Networks.

2.1 Need for High-Speed Connectivity:

The increasing need for 24x7 high-speed connectivity and increased traffic flow from voice, messaging, emails, games, downloads, internet access, video streaming & other services have challenged the transport capacity of the existing backbone network. In view of this ever-increasing, unsatiated demand for ultra-high speeds specially in 5G era and 24x7 connectivity for

Work from Anywhere (WFA)), there is an urgent need to make the underlying transport network super-fast, robust, future proof and resilient.

Studies all over the globe have proved that higher Broadband penetration has helped the global economic status to move from recession to recovery and from under-developed to developing nation tag. Broadband access improves the competitiveness of an economy and is changing the way people lead their lives by creating new market segments of Industry, besides creating more jobs.

Broadband penetration also acts as catalyst for overall GDP growth, 10% increase in broadband penetration leading to 1.2- 1.3% increase in GDP, in developing world as below.

Impacts of ICT infrastructure on GDP growth

World Bank	2009	In high income economies a 10 per cent increase in broadband penetration yielded an additional 1.21 percentage points of GDP growth. A 10 per cent increase in broadband penetration yielded an additional 1.38 in GDP growth in low- and middle-income countries
OECD	2009	10% increase in broadband penetration raises per-capita GDP growth by 0.9-1.5 percentage points
ICRIER	2009	10% increase in mobile penetration delivers, on average 1.2 per cent increase in GDP
ICRIER	2012	10% increase in Internet subscribers delivers on average, 1.08 per cent increase in output. A 10 per cent increase in mobile penetration delivers, on average 1.5 per cent increase in GDP
ICRIER	2016	10% increase in internet subscribers results in a 2.4 per cent increase in the growth of state per capita GDP
ICRIER	2017	10% increase in global Internet traffic, delivers on average a 1.3 per cent increase in global GDP and a 10 per cent increase in global mobile Internet traffic, delivers on average a 0.7 per cent increase in global GDP. 10% increase in India's total Internet traffic, delivers on average a 3.3 per cent increase in India's GDP, and a 10 per cent increase in India's mobile Internet traffic, delivers on average a 1.3 per cent increase in India's GDP

As per a Mckinsey report, the country's GDP will be boosted by \$550 billion, pushing the GDP to \$1 trillion by 2025. E-Commerce firms are striving to bank on India's rural market in

Hon'ble PM Shri Narendra Modi Ji Quoted:

“Now that our digital connectivity ecosystem has scaled many peaks, it is now time to focus on self-reliance (Atmanirbharta) and security,”

“It would be great if we can brainstorm about a roadmap to achieve end-to-end self-reliance in connectivity infrastructure as well as ensuring greater security at all levels against threats,”

“The companies active in the ecosystem of digital connectivity are doing yeoman service to the poor and underprivileged by ensuring that connectivity reaches them”.

cooperation with the government's Digital India initiative.

3. Reality-Check of Digital Transport Infrastructure in India:

Many elements of digital infrastructure are available in the country in islands and silos and with fragmented ownership models in - Government, Public & Private Sector. Also the ambitious National Optical Fiber Network project (BharatNet) of Govt. aims to just bridge the middle-mile gap and will contribute only around 8 lakhs KM (25%) of incremental required OFC network throughout the nation limited by delayed implementation and suboptimal O and M, due to which stakeholders are not able to exploit it to its full potential to deliver the services to end-users in cost-effective, timely and affordable manner.

India is already lagging far behind its competitors in digital connectivity landscape, especially the OFC based connectivity. Currently ,the condition of telecom industry of India is not sound as telcos are struggling bleeding to sustain themselves though they still have lot of unutilised and unlocked Backhaul Infrastructure. On other hand nation has clear economic targets to be achieved in the form of GDP growth., Digital Economy of India alone has the potential to reach one Trillion USD by 2025 – as per NDCP-2018. The main and critical aspect which is to be considered here is that, the telecom sector with its underlying infrastructure can be pivotal and significant driver to this USD One Trillion pie. Hence, time has come now, to leverage this infrastructure which can happen from efficient utilisation of it, leveraging the innovative methodologies as in Gyan-Vahini concept.

Key reasons India is falling behind efficient, and quality digital connectivity include the bleak state of fiber network infrastructure, absence of productive and ROI oriented use-cases and a modest presence of household electronics plugged to the Internet, especially in rural areas. Financial stress in the industry is also one of the reasons, which demotivates the key players away from this segment.

Just to have 4G at all places in India, as per the worldwide optical fiber network requirements estimates 2 Route Kms of fiber per person, India shall require more than 270 Crore Route Kms of fiber installed which is almost at par with what China have, today.

The various elements of digital transport infrastructure consist of: Optical Fibre Cables, Radio Networks, Public Wi-Fi Hotspots, Satellite Communication system and diversified Submarine Optical Fibre Network, the major parts of which are generally fragmented, with no cooperative/consortium ownership and control. Currently, India boasts of about 36 Lakhs route Kms. of OFC, around 7 lakh Radio Towers and around 8 Lakh Wi-Fi Hotspots which are mushroomed all over the country. All these are the ideal starting ingredients for creation of a nation-wide Digital Transport Grid, by using proven concepts of Functional Separation, Blockchain Cooperative, Smart Contract, IRU and seed-funding through National Digital Infrastructure Finance Corporation, Infrastructure Investment Trust (InvIT), Special Purpose Acquisition Company (SPAC) & Crowd-Sourcing.

3.1 State of Digital Connectivity India:

In India just 15% households have access to the Internet, though mobile internet covers around 75% of connected population. India leapfrogged the first generation (1G) in telecom technology-going from no connectivity to over 600 millionⁱⁱ mobile Internet users-in less than two decades. The impending growth of digital infrastructure can offer the nation with many unique opportunities to leapfrog its traditional deficit in physical infrastructure. It will help enhance the economic conditions in remote areas, spur new businesses by enabling access for many micro small and medium enterprises (MSMEs), creating a strong digitalised visibility for the country. Above all, digital infrastructure growth will enable the government to embrace and encourage innovation, provide resources to help increase agricultural productivity as well as enable improved healthcare access for rural areas, potentially reducing mortality levels. It will also bring financial services to the unbanked rural and underprivileged communities and help fulfil the country's long-standing goal of education for all.

On the cusp of a revolution, digital payments are poised to become the new normal in India, and as more people transact online, India should see new taxpayers and better transparency in income in the days to come. India's crusade for a cashless economy seems set to speed into a gallop with government's measures designed to encourage more people to embrace digital transactions. Digital payments companies are giving the industry a big thrust.

India currently ranks below Global average in broadband penetration, even among developing countries. Internet access has grown, driven by a higher penetration of mobile handsets and wireless infrastructure in urban and tier I and tier II towns, but broadband penetration in the larger part of the country, remote and rural areas, is still bleak. As a Govt. initiative, the country aspires to create a 'Digital India' with a broadband highway offering a 100-Mbps connectivity to 250,000 Gram Panchayats. The enormous funds needed to create such a National Broadband Backbone and ensuring end-to-end 'last-mile connectivity' have not been supported by an evident underlying business case. The creation of 'Digital India 2.0' calls for radical changes to regulatory frameworks, needing the innovation for viable business models for inclusive broadband growth. There is significant public funding involved in making National Optical Fibre Network (NOFN), rechristened as Bharatnet, but Industry have so far seen little incentive in pursuing fibre deployment beyond the top cities and towns. This calls for the creation of robust

models of Public Private Partnership, driven by a combination of Rights of Way facilitation, Innovative Funding mechanisms and creation of a sustainable Business Model in Win-Win way.

Prime Minister Narendra Modi's, Digital India 2.0 initiative is a renewed push to address the delays plaguing flagship programs that focus on universal broadband access and mobile connectivity to be executed by BBNL (Bharat Broadband Network Limited). Direct selling via public-sector organizations like BSNL (Bharat Sanchar Nigam Ltd), RailTel, and PowerTel (Power Grid Corporation of India Ltd) will be limited, but significant indirect demand will result from many more of the 70% of India's population that lives in rural areas coming online.

The vision of Digital India 2.0 programme aims at inclusive growth in areas of electronic services, products, manufacturing and job opportunities etc. It is centred on three key areas –

- i. Digital Infrastructure as a ubiquitous utility to Every Citizen, Anywhere, Any time.
- ii. Governance & Services on Demand,
- iii. Digital Transformation and Empowerment of Citizens.

With the above vision, the Digital India 2.0 programme aims to provide Broadband Highways, Universal Access to Mobile Connectivity, Public Internet Access Programme, E-Governance: Reforming Government through Technology, eKranti - Electronic Delivery of Services, Information for All, Electronics Manufacturing: Target Net Zero Imports, IT for Jobs and Early Harvest Programmes. Digital India comprises of various initiatives under the single programme each targeted to prepare India for becoming a knowledge economy and for bringing good governance to citizens through synchronized and co-ordinated engagement of the entire Government.

3.1 India Telecom Network Scenario - State of OFC Connectivity:

India has an established backbone network connecting states with each other and centre. While OFC network is going to reach till the Gram Panchayat level, this backbone network is yet to be extended to Village level (4 Lakhs). Almost 70% tower backhaul connections are still on radio links, and they do not offer support for higher bandwidth capacities. The well-known feature of optical fibre network is that it has almost unlimited bandwidth potential, if managed and maintained properly. Besides, with increase in rural penetration, scarcity of spectrum is likely to increase further and consequently the demand of OFC for backhaul as well as BTS middle mile and fronthaul are on rise.

Route Km of Fiber presently laid by the various players-June,2023

Operator	Route Km of Fiber
BSNL	8 lakh Kms
Reliance Jio	11 lakh Kms
Vodafone-Idea	3 lakh Kms
Bharti Airtel	4 lakh Kms
Bharatnet	8 lakh Kms
RailTel	50,000 Kms
PGCIL(PowerTel)	40,000 Kms
GAIL (GailTel)	10,000 Kms
Others(IP1s, LCOs Utilities)	1 lakh Km
TOTAL	36 lakh KMs (Approx.)

4. Bridging the Rural-Urban Digital-Divide

India had 1.17 billion telephony subscriber base with 134% tele density in urban areas and 58% in rural areasⁱⁱⁱ. This rural urban divide has existed in India wherever the technology deployment has happened. To bridge this gap and provide more services, BharatNet was designed with limited objective to extend optical fibre network to Gram Panchayats (2.5 Lakhs).

A sustainably faster rate of growth can only be achieved by improving productivity, but underinvestment in infrastructure is a longstanding impediment in this regard. According to the Economic Survey, there was massive under-investment in infrastructure because of collapse of Public Private Partnership (PPP) especially in power and telecom projects. Revival of investment in Indian telecom is crucial, especially in underserved rural areas where digital connectivity remains low, particularly with respect to Internet connections. Currently, India has over 800 million internet subscribers of which only 40 per cent are in rural areas, though the majority population still resides in the rural geographies. In rural areas, the tele density is one-third that of urban areas though the former is home to two thirds of India's population. In other words, about 66 per cent of the people are covered by approximately 33 per cent of connections. As stated above, digital connectivity has vast growth impacts because it facilitates communication and commerce that propels economic growth. Individuals cannot transfer payments digitally, use e-governance portals to connect with the government, access information or make online purchases without continuous and reliable access to the internet.

Although great progress has been made in mobile connectivity, approximately 40,000 villages still do not have mobile coverage.

5. GYAN VAHINI (National Knowledge Transport Grid -NKTG)–An Innovative Approach to Digital Public Infrastructure Challenge in India:

5.1 Need for National Knowledge Transport Grid:

There's serious concern about bridging the digital access deficit, it can't happen unless we put a lot of investment in revamping and upgrading our existing infrastructure especially the optical fibre-based networks.

Key reasons for India slipping behind end-to-end efficient and quality digital connectivity include the dismal state of fibre network infrastructure, and Lack of fast ROI. Financial stress in the Industry with mobile only focus is also one of the another reasons.

At present, merely 30 % of mobile towers in India are connected on optical fibre cables, unlike other developed nations, where as much as 80% of the mobile towers are fiberized.

India currently has about 10 Crores cable TV connected homes using co-axial and a few FTTH connections using optical fibre. About 30% of mobile services towers are connected to Optical Fibre and about 36 lakh Km of backbone cable is criss-crossing the country, in a highly uncoordinated manner.

Optical fibre cable laid till date in India is equal to what China does in just one year. Not just the case with China but the countries like USA, Canada, Australia and many European countries are way ahead of India in OFC connectivity. This underlines the need for policies to promote big investments in fixed infrastructure. The National Digital Communications Policy (NDCP) - 2018 contains those set of policies and statements but we need to operationalise those to attract much needed investments.

The new digital communication policy — NDCP 2018 — that was cleared by the Govt. in September 2018 aims to create 4 million jobs, draw \$100 billions of investments into the industry by 2022 and boost the sector's contribution to GDP to 8% from 6% in 2017. Other key goals are ensuring universal broadband connectivity at 50 Mbps to every citizen, providing 1 Gbps connectivity to all Gram Panchayats by 2020 and 10 Gbps by 2022 and ensuring connectivity to all uncovered areas. All these ambitions as proclaimed in NDCP-2018 require some policy initiatives precise practical strategies for achieving these goals, creation of National Fibre Authority is one such initiative and need of the hour.

The strong backbone digital infrastructure in the form of fiberisation will enable leapfrogging inadequacies in the physical world, all of this can be overcome with the formation of National Knowledge Transport Grid and managing it with Decentralised control under the oversight of a cooperative based National Fibre Authority.

Also, sharing of Optical fibre Network is one of the key options for efficient utilisation of this network asset, there is an urgent need to unbundle services and infrastructure layers and this all could be possible only with the help of regulatory tool of Functional Separation.

What India requires is pooling of all fibre assets in a National Knowledge Transport Grid under the oversight of National Fibre Authority by using the governance model of cooperatives and Trusts.

5.2 What will Gyan-Vahini do?

Gyan-Vahini (NKTG) will act as a empowered cooperative for managing the pool of shared digital infrastructure - mainly the fibre networks used by service providers (Telcos & ISPs) and other players, including that of PSUs also. This means that Gyan-Vahini (NKTG) will not sell any equipment/device or broadband or any services directly to the end user (such as individuals). Instead, it will work on behalf of network and infrastructure owners (such as Telcos, ISPs, IP1s) to maintain and manage their shared pool of transport infrastructure.

When an individual takes out any service contract with a provider that uses the NKTG network (for example, the services of Telcos or ISPs), the contract will be with the retail provider (the service provider), on p2p basis not with NKTG itself.

And the National Fibre Authority (NFA) will establish self-executing rules that will facilitate Gyan Vahini (NKTG) to allow service providers to use the digital infrastructure pooled network to provide services to consumers. This will be like wholesale-local-access and will be intended to deliver a competitive retail telecom service to the consumers when the underlying common pool of infrastructure is owned by public at large and managed by Gyan Vahini (NKTG). Gyan Vahini (NKTG), being a Trust based Cooperative will treat all service and infrastructure providers and users equally.

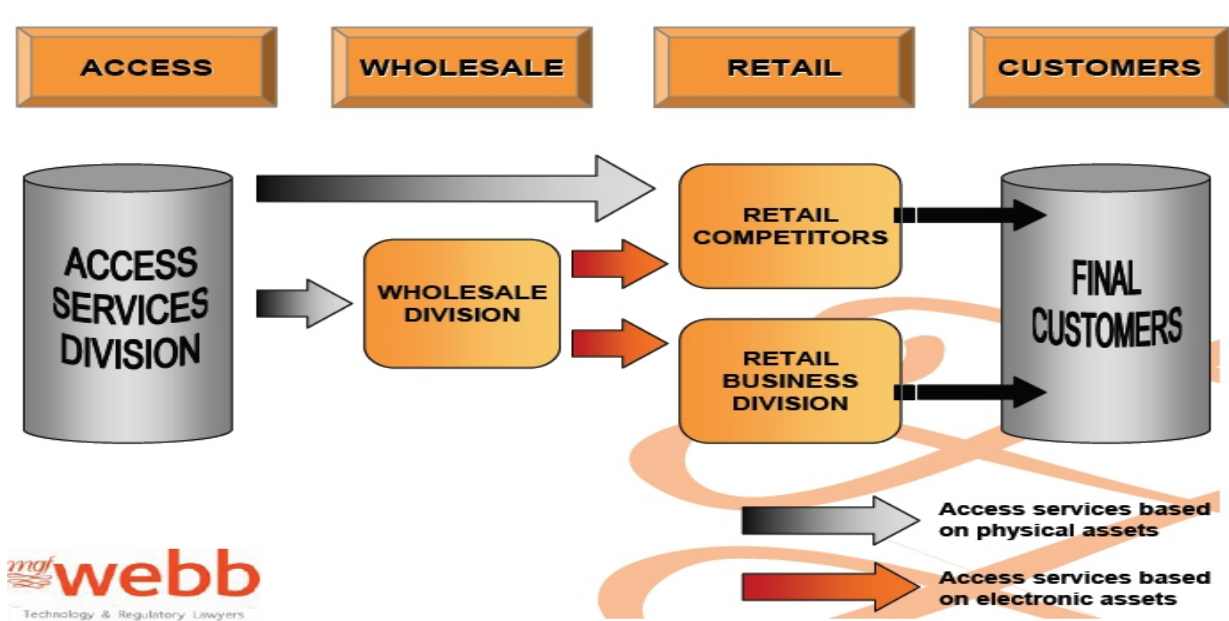
Retail communications providers will pay charges (called wholesale-local-access charges) to Gyan Vahini (NKTG) to use the common pool of infrastructure managed by it and National Fiber Authority will oversee the functioning.

This complex looking structuring will be facilitated with help of regulatory tools like Functional Separation, Indefeasible Right of Use (IRU), Smart Contracts, Data Spaces and Blockchain Cooperative Concepts, which are explained below;

5.3 The Functional Separation – Game Changing Concept:

Creation of a National Digital Infrastructure Grid which will be facilitated through mechanism of “Functional Separation” to unlock the potential of existing transport infrastructure by separating the service provision from underlying infrastructure through regulatory facilitation in a win-win mode.^{iv}

The convergence between IT, telecoms and broadcasting has led to the development of Next Generation Networks, where a variety of different services are carried over a common network. This calls for separation between the network layers and the services, which needs Functional separation in telecommunication networks – either companies see an interest in making these forms of division for unlocking the potential of spare capacities or because the regulatory authorities find it necessary in order to promote competition & growth. A conceptual diagram for this is depicted below:^v



5.4 Indefeasible Right of Use (IRU) – Lifelong leasing option in lieu of direct Ownership (Build or Buy Option)

Another learning which can be used in this project is the IRU (Indefeasible Right of Use) concept which is commonly used in consortium ownership and collaboration for submarine cable networks.

Indefeasible right to use is an irrevocable right bestowed upon the user by the owner. Hence, indefeasible right to use (IRU) is a contractual grant of usage rights or a contractual agreement between the user and the owner for an exclusive, unrestricted, irrevocable and life-long right to use the relevant facility for any legal purpose for a defined period.

An IRU is one of the most common methods of conveying right to use in assets in the telecommunication industry. IRU is granted by the company or consortium of companies (grantor) that builds the cable (usually optical fibre). The fibre optic networks or communication cables are largely capital intensive and involve huge capital expenditure. IRUs facilitate sharing of the expenditure by conveying the excess capacity to another service provider and sometimes swapping network capacities as well.

As per a Consultation Paper on “Access Facilitation Charges and Co-location Charges at Cable Landing Stations^{vi},” issued by Telecom Regulatory Authority of India, IRU means the right to use the reference capacity^{vii}:

- a) On long term lease for the period for which the submarine cable remains in effective use,
- b) acquired (including equipment, fibres or capacity) under an agreement entered between the capacity owner and an eligible Indian International Telecommunication Entity,
- c) in respect of which maintenance cost incurred becomes payable in any circumstances during the period of validity of the agreement.

IRUs are based on the concept of network sharing. The cables are subdivided into parts and indefeasible right to use a part is given as a whole. The part remains an independent part from usage perspective but is not independent on the whole. Hence there is sharing of capacity on the whole and independent usage of the part, yet the control over the entire asset is not passed to each of the users.

5.5 Data Spaces:

“Data Space” is an architecture, facilitating a secured and privacy preserving, IT management infrastructure to pool, access, process, use and share data. As per Open DEI it is defined as “a decentralised infrastructure for trustworthy data sharing and exchange in data ecosystems, based on commonly agreed principles”. It ensures Data Sovereignty, so that the creator and owner of data controls, manages and monetise and protects it. The main element for data Space is called a Connector which is used as the interface of the data provider and data consumer to the Data Spaces infrastructure after the authentication and validation of the users. It also employs the Smart Contract attribute of Blockchain to auto-implement the agreed rules and policy for data exchange between two users. Data Space actually, fortify the data of any owner in a totally democratised and decentralised manner so that the data owner has full control and self-protection of data.

5.6 Use of salient Blockchain attributes:

One of the emerging technology available and compelling for bringing, efficiency, resiliency security and trust to any critical infrastructure is Blockchain, which is an Open, Trusted, Distributed Ledger Technology for records of assets of any types and could be exploited for the implementation and creation of National Digital Infrastructure Grid, in India.

Also, by bringing in the concept of Blockchain-based decentralized framework a “Blockchain Cooperative”, using which a task can be solved by participation of all the stakeholders in lieu of relying on only few major players. It can use an Open-Access architecture and a commercial framework, which makes use of Smart Contracts to start with.

5.7 What is Blockchain Technology?

Blockchain Technology is a Distributed Ledger Technology (DLT) that enables transactions to be gathered into blocks and recorded immutably and cryptographically arrange blocks in chronological order and allows the resulting ledger to be accessed by Decentralized Servers/Nodes/Authorized Users. **It is also known as Internet of Values (IOV)**

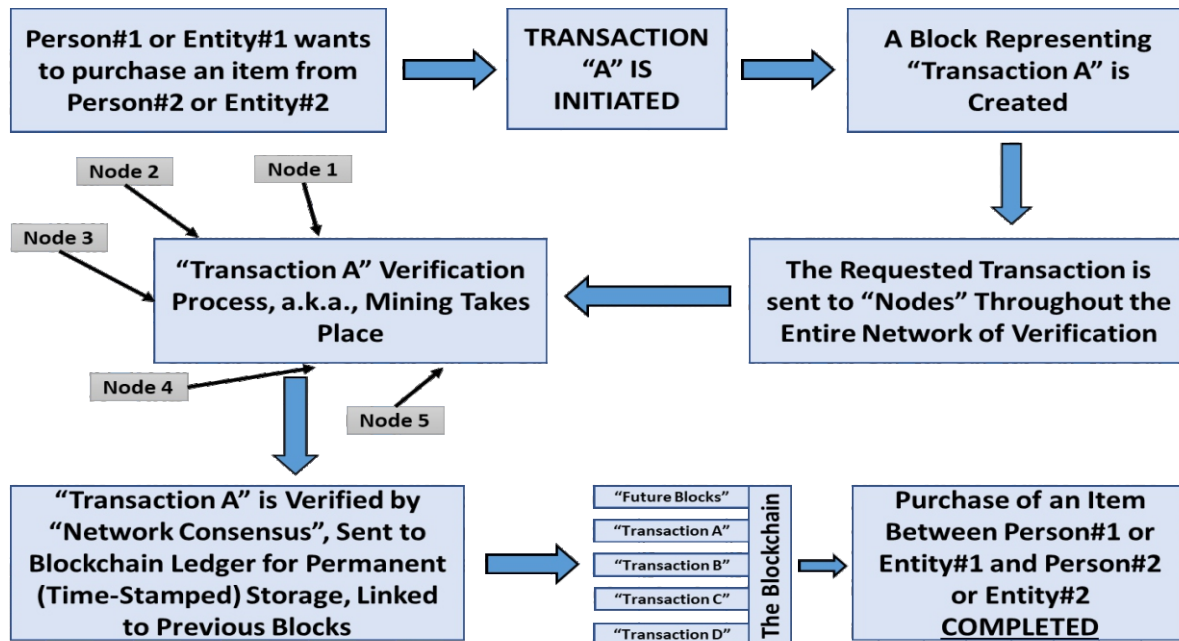
Blockchain technology has the potential to revolutionize a wide range of industries and sectors, including finance, supply chain management, healthcare, and more. It’s decentralized, secure, and transparent nature makes it well-suited for use in government and enterprise contexts, as well as for startups looking to disrupt traditional business models.

One of the key benefits of using blockchain in the enterprise contexts is the ability to improve efficiency and reduce the risk of fraud. By using smart contracts and other blockchain-based tools, organizations can automate processes and reduce the need for manual intervention, which can save time and resources. In addition, the use of blockchain can help to increase transparency and accountability, as all transactions and data are recorded in an immutable ledger.

Gyan Vahini also stand to benefit from the adoption of Blockchain technology. By leveraging the decentralized nature of Blockchain, Gyan Vahini can create new business models that are more resilient and flexible than traditional models. For example, Gyan Vahini in the business of sharing pooled infrastructure could use blockchain to facilitate peer-to-peer transactions without the need for intermediaries, and it could use blockchain to securely store and share infrastructure data.

As we move towards Atmanirbhar Bharat, it is important for government and enterprises to explore the potential of Blockchain enabled Gyan-Vahini initiative and how it can be used to drive innovation, productivity and growth.

5.8 How Blockchain Technology Works?



5.9 Why Blockchain Technology?

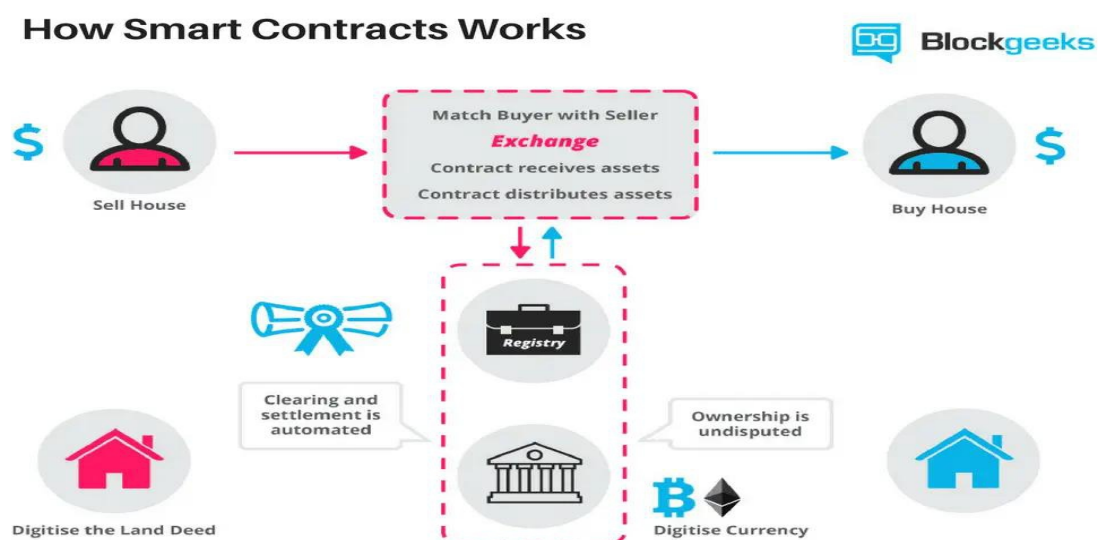
Blockchain Technology is a method of securely storing and distributing information,^{viii} it is the potential uses of blockchain technology that make it so empowering: sharing asset transactions between disparate agents with unquestionable transparency – all the while without a controlling central authority.^{ix} The blockchain technology can be applied in virtually any industry in which assets are managed and transactions occur. It can provide a secure chain of custody for both digital and physical assets through its functional characteristics that facilitate transactions through trust, consensus, security, and smart contracts.^x

The salient features of this technology which emphasises for its use in transaction of values, are:

- i. REDUCES COST by automating processes and removing intermediaries.
- ii. INCREASES SPEED & EFFICIENCY of transactions and settlements through immediate settlement and use of SMART CONTRACTS.
- iii. INCREASES SECURITY & TRUST through use of cryptography, transparency and immutability.
- iv. REDUCES FRAUD by time stamping entries and sharing a common immutable ledger across the network.

- v. REDUCES RISK of single points of failure and attack through distributed network nodes.

Given this potential for Distributed Ledger Technology and Smart Contracts to allow the distribution of any centralized computing infrastructure, this is considered suitable technology for creation of a Trusted Open-Access National Digital Infrastructure Grid. Also, the concept of Initial Token Offer (ITO) can be used for motivating the potential beneficiary of this Grid to become decentralised owners on prepaid basis.



5.10 Concept of Blockchain Cooperative:

A Cooperative is “an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a crowd-owned and democratically controlled enterprise”.

Blockchain frameworks offer a distinct one-on-one overlap with the underlying principles of a cooperative setup, as explained below:

1. **Voluntary Organization** — Blockchain offers the flexibility and operational readiness to adapt to an open and voluntary membership requirement. System requirements of identity management, membership referrals, social scrutiny and monitoring can be seamlessly built for purposes of verification and security. Blockchain offers the classic trait of being capable of end-to-end membership-management.
2. **Consensus in Governance and Protocol** — Distributed consensus is the core value proposition a peer-to-peer ecosystem like blockchain offers. In the past 9 years of public existence and several consensus models later we can confidently predict blockchain to be capable of deploying the “rule in the code” modifiable only through stakeholder consensus. Blockchain technology today also offers multiple formats of consensus mechanism, identifying and reflecting with the need of network.

3. **Peer-to-Peer Interaction** — Individuals in a cooperative can work together or exchange services, finances, value under the prescribed protocols set by the cooperative. Blockchain allows for free, open and transparent p2p transaction within the network through auditable ledgers which supplement the system through automatic book-keeping, reducing overheads of administration and monitoring.
4. **Collaborative Financial Structure** — Blockchain offers a transfer-of-value network with option to automate complex processes and functions through the use of smart contracts. Financial transactions, contributions, disbursal and book keeping can be managed, monitored and automated through simpler digital interfaces.
5. **Regulatory Compliance** — Blockchain network works on coded protocols, thus allowing for rules compliant with the law of the land to be implemented. On top of it, blockchain offers distributed, immutable and auditable ledgers of public transactions and interactions.
6. **On-Chain and Off-chain Collaboration between Cooperatives** — Different cooperatives employing blockchain for operation and administration purposes can work seamlessly within and amongst them through inter-network protocols which can help bring business relationships and transactions on the chain.

A Conceptual Business Model of ‘Gyan Vahini (National Knowledge Transport Grid - NKTG)’ to depict interplay of various stakeholders

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENTS
<ul style="list-style-type: none"> ✦ Govt. (BSNL, BBNL, RAILTEL, POWERTEL, GAILTEL) ✦ Pvt.Telcos (RJio, Airtel, Voda-Idea, Tata Communication, RCom) ✦ IP-1 Companies (ATC, VIOM, GTL etc.) ✦ ISPs ✦ Managed Service Providers ✦ USOF (Universal Service Obligation Fund) ✦ OEMs 	<ul style="list-style-type: none"> ✦ To form a Cross-Industry Joint-Stock Consortium (SPV) ✦ To take stock of the Existing Infrastructure (GIS map, Capacity Route.Km) ✦ To contribute existing capacity to the pool, utilisation & spare capacity data ✦ Create open-access National Digital Infrastructure Grid 	<ul style="list-style-type: none"> ✦ To offer Digital Connectivity Anywhere, Anytime, Any-Capacity to Telcos, ISPs, Enterprises, End Users. ✦ To make use of idling/under-utilised resources ✦ To create employments for especially skilled manpower ✦ To generate Entrepreneurs in rural-areas as VLEs & Franchisees 	<ul style="list-style-type: none"> ✦ Blockchain Based Smart Contracts ✦ Initial Token Offer (ITO) 	<ul style="list-style-type: none"> ✦ Telcos ✦ ISPs ✦ Enterprises ✦ Govt. Bodies ✦ End Users
	KEY RESOURCES		CHANNELS	
	<ul style="list-style-type: none"> ✦ Existing Fibre-based Ground Infrastructure ✦ Existing Radio Based Transmission Infrastructure ✦ Existing Tower Infrastructure ✦ Data Centres ✦ NOCs ✦ MSAN – Multi Service Access Nodes (Point of Presence) 		<ul style="list-style-type: none"> ✦ Franchisees ✦ Agents ✦ Digital Electronic Platform (Bandwidth Pool) ✦ VLEs 	
COST STRUCTURE		REVENUE STREAM		
<ul style="list-style-type: none"> ✦ Notional Valuation of the Spare Capacity contributed by the key partners, quantified through MIU*Km measure ✦ Network Upgradation Capex ✦ O&M Costs ✦ Specialised manpower including Blockchain Experts 		<ul style="list-style-type: none"> ✦ IRU pre-sale of capacity to Telcos, ISPs & Govt. Bodies ✦ Annual/Long-Term lease of capacity to Enterprises ✦ Retail sale of capacity through Channels 		

STRATEGYZER Business Canvas for Gyan Vahini

5.11 Gyan Vahini (National Knowledge Transport Grid - NKTG) entity will be a consortium of all such stakeholders who wants to be the part of common National Digital Infrastructure Grid. Infrastructure resource sharing will basically be related to the Optical Fibre Assets and all such assets will be shared based on their spare capacity and usage capacity. All the stakeholders will be allowed to use the allocated part of Network Infrastructure as per the ratio of their stake in the consortium entity. All the volunteering TSPs/ISPs/IP1s will be allowed to participate in the cooperative setup with all or the part of optical fibre infra they are owning with them and contributing to the common pool.

Although, the National Digital Communication Policy – 2018 proclaiming for the creation of Digital Infrastructure Grid by 2020, to lead the foundation of such common infrastructure, some good innovative strategy is to be prepared, which can positively facilitate the formation of that essential common grid, which is needed. India's fibre penetration, according to industry estimates is extremely low, despite high-speed broadband demand and 5G technology around the corner, only 30% of the 7 lakh telecom towers in India are fiberized, an essential backhaul requirement for high-speed data network deployments.

The government, as one of the key objectives of the NDCP-18, also aims to establish the National Fibre Authority (NFA) for which, the Ministry of Communications needs to initiate executive steps early, as Time is the Essence here. Gyan-Vahini initiative can guide towards this with its potential innovative ideas as described above. It is well known that most of the Optical Fibre Infrastructure is not utilized to its full capacity, not because of the inefficient ways of using it but because the optical fibres have very huge capacity and it has not always possible to use it to its full capacity. In that scenario, it is preferred that such huge unutilized capacity must be considered as the starting resource to be leveraged, and the best methodology which can make it feasible is by using the underlying concepts of Gyan-Vahini.

When fibre optic cables are laid, many companies will, in order to future-proof their networks from exponential data growth, overestimate the amount of infrastructure and cabling required. This overestimation coupled with technical advances in the way in which data is packaged means that many optical fibre networks have extra capacity that is not being used. As a result, Fibre networks have developed to take advantage of this extra capacity. The concepts of Gyan- Vahini will ease out the lease of unused strands of optical fibre cable to create their own privately-operated optical fibre network rather than just leasing bandwidth. The unutilized fibre network is separate from the main network and is controlled by the clients rather than the network provider.

As telecom carriers strengthen their fibre capability, topography remains a hurdle. To produce more data faster, a strong backbone is needed that can be built on fibre which is really important. We believe India should be more fiberized to be a digital leader tomorrow. India has embarked on the world's largest rural fibre roll-out under BharatNet and recommended policy initiatives in NDCP-2018, expected to expedite fibre roll-outs by implementing the following:

- i. According to Telecom Optic Fibre cables the status of "Essential Public utility".

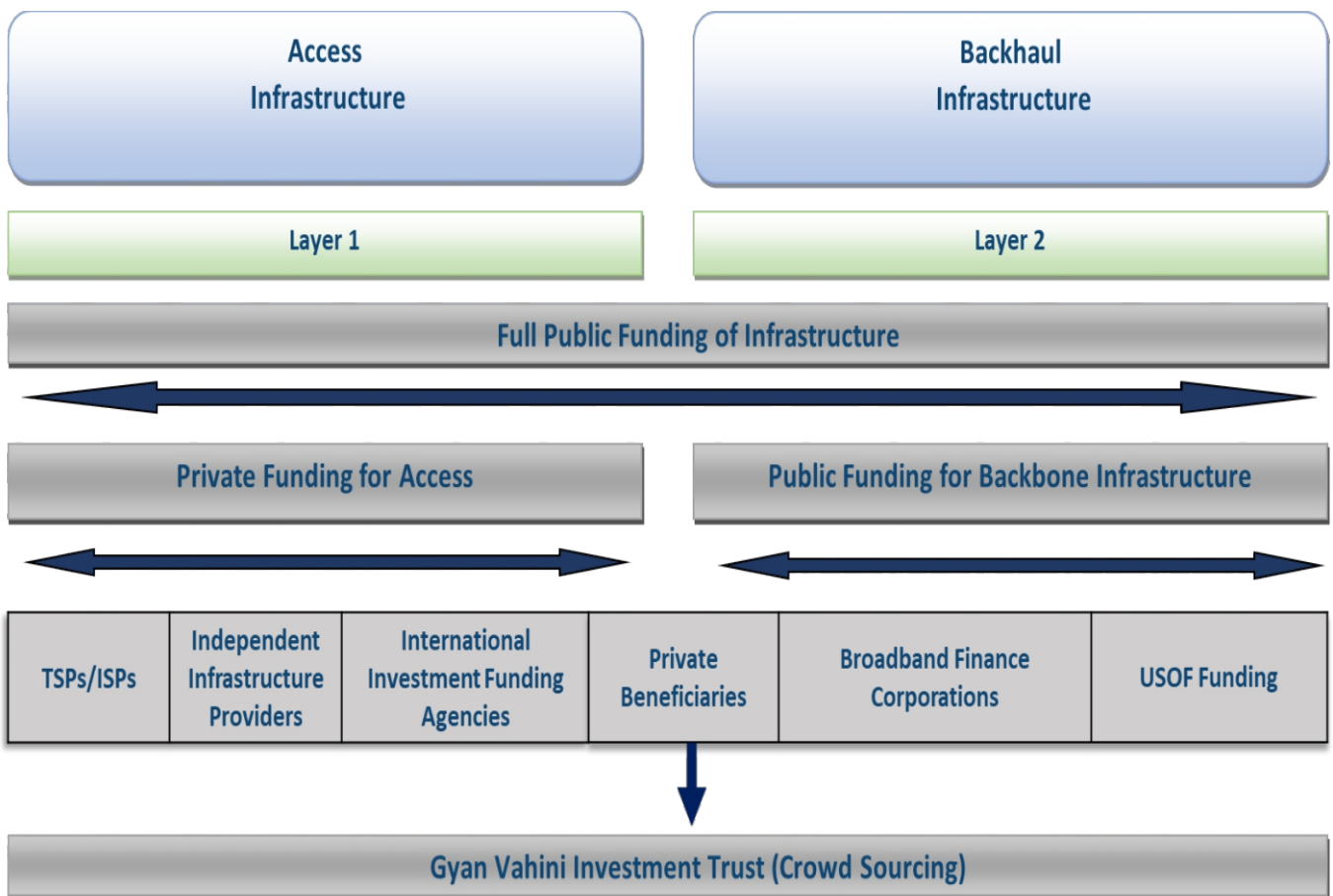
- ii. Promoting collaboration models involving state, local bodies and private sector as necessary for provision of shared duct infrastructure in municipalities, rural areas and national highways.
- iii. Facilitating Fibre-to-the-tower programme to enable fiberisation of at least 70% of telecom towers thereby accelerating migration to 4G/5G.
- iv. Leveraging existing assets of the Broadcasting and Power sector to improve connectivity, affordability and sustainability.

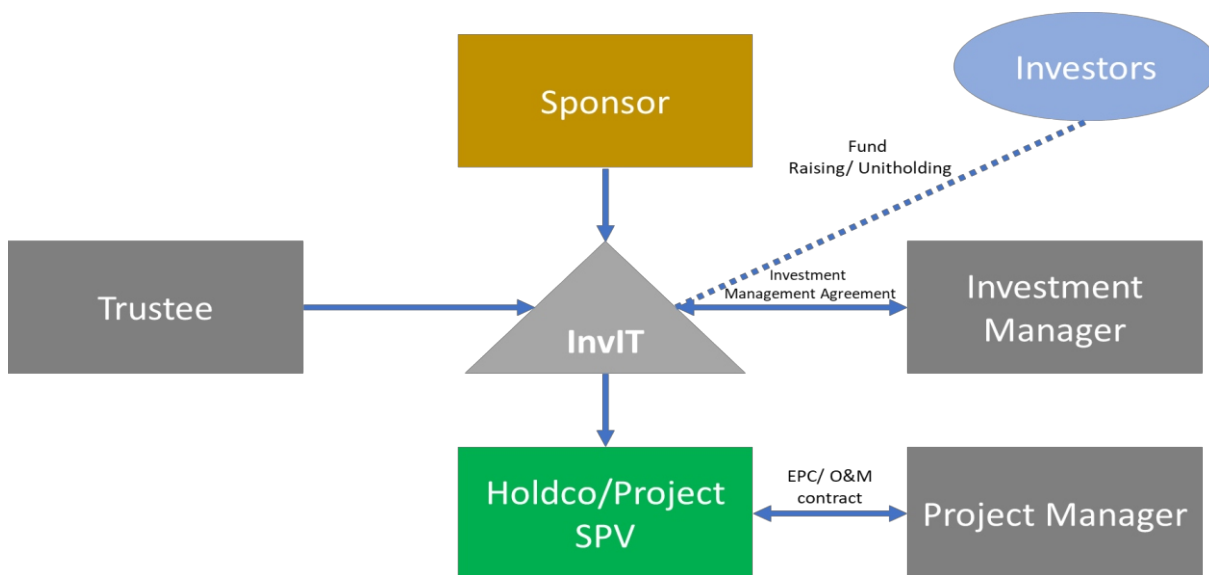
We believe, in order to make that happen some innovative game changing concept like Gyan-Vahini (NKTG) is one idea, whose time has come.

5.12 Funding Options for Gyan-Vahini (NKTG):

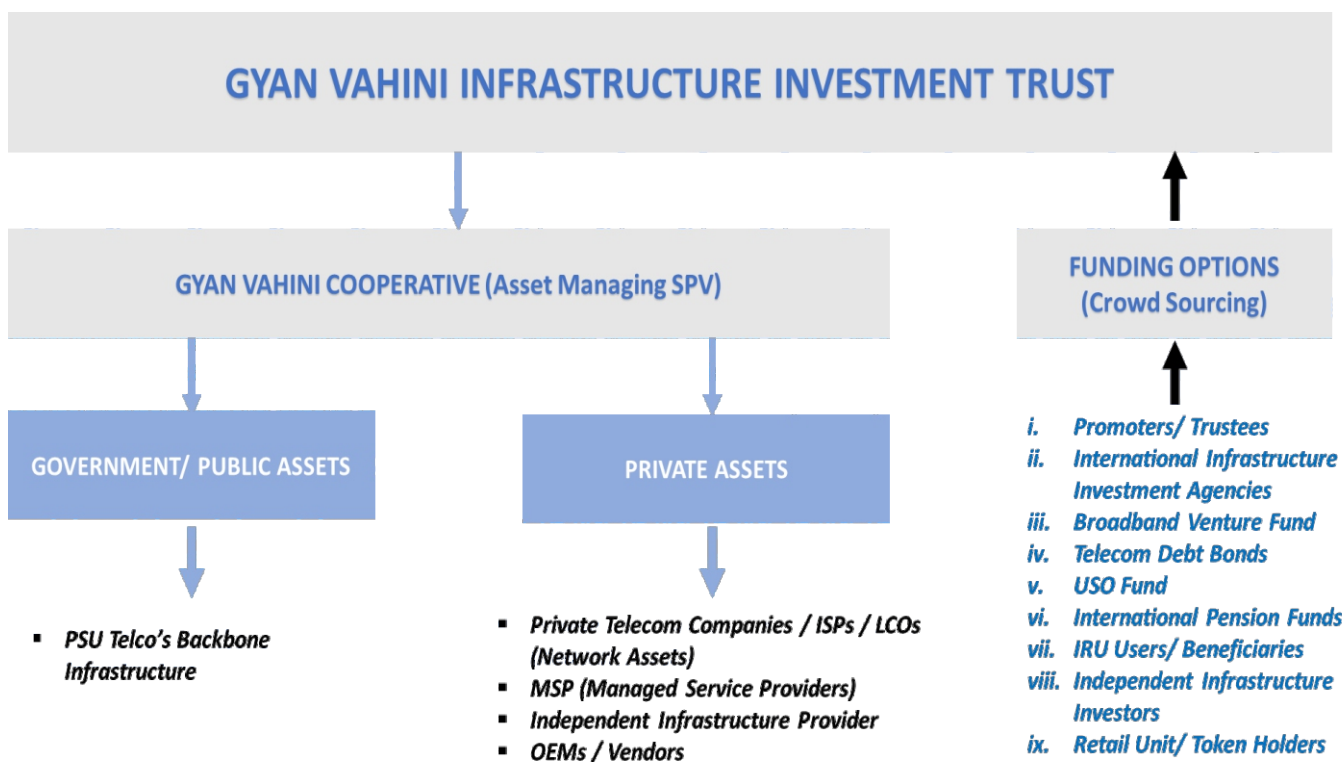
A generic, proven and worth taking note of modus-operandi for huge funding requirements of this nation-building project is depicted below;

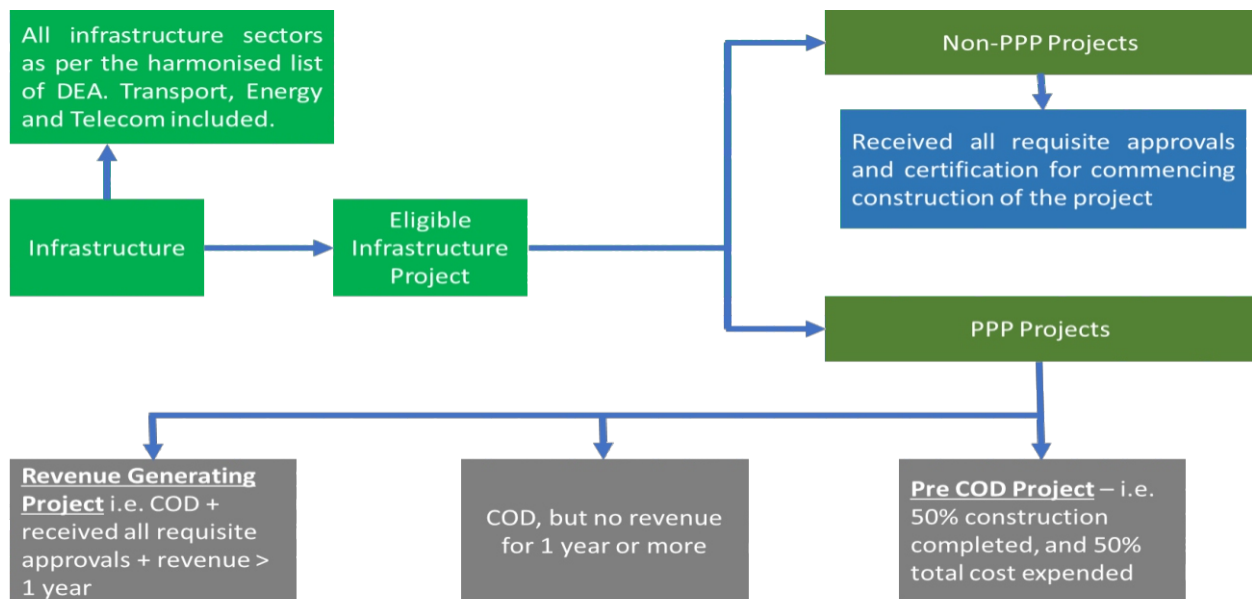
Prospective Funding Options for Gyan-Vahini on Analogy from Alberto - Emerging models of Public-Private interplay & Crowd Sourcing:





5.13 Concept of Gyan Vahini InvIT –A Formidable Funding Option:





The InvIT is a funding vehicle to raise funds from investors – individual and institutional public and private in cash or kind for the capital-intensive infrastructure sector. It also facilitates to attract foreign investment to the infrastructure sector and stakeholders, managers interact closely in a cooperative manner.

The funds so raised are used to upgrade and enhance the existing assets. Funding can also be done in the form of debt which in turn is used to deleverage the existing balance sheet of the underlying asset owners.

In turn, the upgraded assets will be used to generate operating cash flows to the InvIT to contribute towards principal repayment, interest on the ‘debt’ and dividends to shareholders.

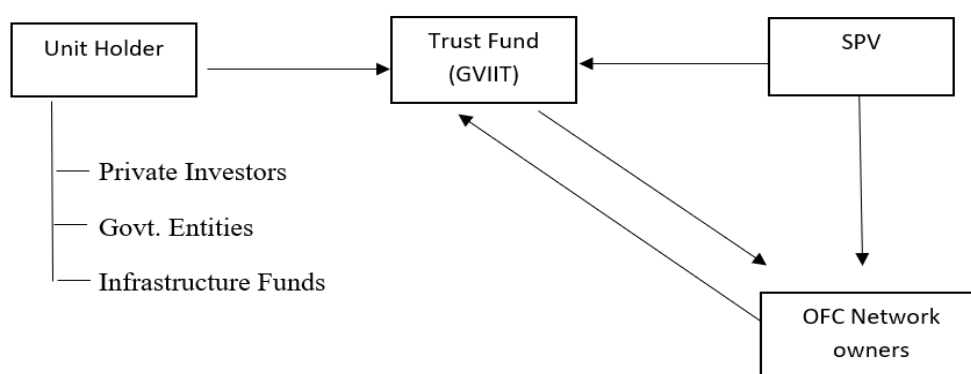
In case of Gyan-Vahini, the trust can be named eg. Gyan Vahini Infra Investment Trust (GVInvIT) which can facilitate a steady inflow of public, private and foreign investments, and thereby augments the capital base available for the growth of the sector as well as its own infrastructure in a sustained manner.

The InvIT is normally designed as a tiered structure with Stakeholders (Sponsor) setting up the InvIT which in turn invests into the upgraded existing infrastructure either directly or via Special Purpose Vehicles (SPVs) which in our case will be Gyan-Vahini Cooperative.

In Gyan-Vahini Cooperative (SPV), the revenue generating asset such as unutilized backhaul and bandwidth will be transferred to the trust wherein the ownership of the SPV will be with the consortium of operators in the ratio of their Optical Fibre Network infrastructure contribution. The SPV will transfer the assets to the trust which will generate asset tokens on smart contract and issue retail tokens i.e., GV tokens against the value/capacity of services offered on Gyan Vahini on prepaid basis to wholesalers, retailers and end users.

5.14 Gyan Vahini Business Structure:

Below diagram depicts the business structure of the proposed model.



5.15 Structure of InvITs in India:

An InvIT is established as a trust and is registered with the SEBI. Typically, infrastructure investment trust SEBI comprises 4 elements, namely –

- ✦ Trustee: They are required to be registered with SEBI as debenture trustees. Also, they are required to invest at least 80% into infra-assets that generate steady revenue.
- ✦ Sponsor: Typically, a body corporate, LLP, promoter or a company with a net worth of at least Rs. 100 crore classifies as a sponsor. Further, they must hold at least 15% of the total InvITs with a minimum lock-in period of 3 years or as notified by any regulatory requirement. When it comes to a public-private partnership or PPP projects, sponsors serve as a Special Purpose Vehicle (SPV).
- ✦ Investment manager: As a body corporate of LLP, an investment manager supervises all the operational activities surrounding InvITs.
- ✦ Project manager: The authority is mostly responsible for executing projects. However, in the case of PPP projects, it serves as an entity that also supervises ancillary responsibilities.

The table below highlights the basic structure of Infrastructure Investment Trust.

Elements	Role
Trustee	Invest a minimum of 80% in infra assets.
Sponsor/s	Holds 15% of the total InvITs.
Investment manager	Manages investment and supervises operational activities concerning InvIT.

What is the Purpose of InvITs?

The purpose of InvITs is to enable Infrastructure Companies to repay their debt obligation quickly and effectively. Since infrastructure-oriented projects tend to take time to generate substantial cash flow, InvITs come in handy for paying off loan interests and other expenses conveniently

What are the Advantages of InvITs?

Though InvITs were regarded as one of the most expensive investment avenues previously, they tend to offer several benefits to investors.

The following highlights the most prominent benefits of infrastructure trusts in general.

+ Diversification

InvITs with multiple assets offer individuals an opportunity to diversify their investment portfolio. Such a feature directly helps lower associated risks and further allows investors to generate steady returns in the long run.

+ Accrues fixed income

The option to redistribute risks and accrue a fixed income serves as a potent alternative for generating fixed income, especially for retirees. Also, including such an investment tool would help those who intend to plan retirement effectively.

+ Liquidity

Generally, it is easy to enter or exit from infrastructure investment trust, which directly enhances their liquidity aspect. However, small investors may find it challenging to sell a high-valued property quickly.

+ Quality asset management

InvITs offers investors the opportunity to get their assets managed professionally. It not only ensures effective management and allocation of resources but also helps to prevent fragmentation of holdings.

Nevertheless, the pointers below help to understand how different elements tend to benefit by investing in an infrastructure investment trust.

+ Investors

Parking funds into this investment option allows investors to generate fixed returns on the same. For instance, an infrastructure investment trust has to distribute 90% of its total net cash flow to

its investors. It means that investors can generate steady earnings throughout the course of investment.

Additionally, investors also receive dividend income on their investment in case the InvITs have surplus cash flow.

✦ **Promoters**

By investing in InvITs, promoters would be able to lower their debt burden significantly via an asset sale. Further, promoters can use the proceeds to reinvest in other portfolio projects.

5.16 Indicative Structural Framework for National Fiber Authority:

The National Fiber Authority which will be the main entity to drive, facilitate and supervise the National Fiber Grid should not be created as another regulatory body or a controlling government agency. It will have to be a joint government and industry body Special Purpose Vehicle (SPV) with a facilitating role and accountability. It should have participation from all the stakeholders and should work in a fully autonomous, transparent participative professional and accountable manner. It should make use of the best brains of the country from the government, industry, academia and civil society.

6. Way Forward:

As the various concepts together has the potential to transform the traditional business and cross-industry cooperative trust-based operating models, it is suggested that;

A white paper is prepared by some think-tank or independent consultant to bring out the concept and framework for Public Digital Infrastructure Grid in India (Like this paper, augmented with more details in the form of a DPR).

All the relevant Actors (Operators, Network Provider, Software companies, Service Providers, Infrastructure Providers, System Integrators, etc.) within the digital Infrastructure value chain together with cross-industry players made to collaborate to jointly partner and contribute towards the creation of National Digital Infrastructure Grid.

Most importantly, the whole system is managed with utmost transparency, reliability and best quality and non-discrimination and is a win-win situation for all stakeholders including the consumers. Pooling and efficiently managing Digital Infrastructure through Public-Private partnership, Functional Separation and forming a Blockchain Cooperative using Smart Contracts should be the key beginning and can enable both new entrants, seeking to quickly build out coverage, and incumbent operators who seek to further increase coverage into underserved areas or to roll out additional service points to ease congestion or improve in-building coverage, as well as to develop and offer new innovative services. All the relevant players (operators, Network Provider, software companies, cloud service providers, system integrators, etc.) within the digital value chain together with cross-industry players made to collaborate to jointly partner and contribute towards the creation of National Digital Infrastructure Grid.

NKGTG will act as a trendsetter of network infrastructure rollout in a country and also play a vital role in facilitating ultra-broadband deployment in the country and also ensure effective and most economical utilization of Telecom Infrastructure. Above all the Telecom sector and GDP will get immense boost and further strengthen the investor confidence in our economy. This will also support the effort on the Hon'ble Prime Minister's Atmanirbhar Bharat to enhance the job opportunities in far-flung areas of the country, expanding operations from big cities to small districts and villages, and invest in up skilling and re-skilling the youth across rural India. NKGTs effort to involve the private sector to come forward and invest in this Gyan Vahini project will drive local economic growth in the country. This entire effort is a focus on being vocal for local products and services.

7. Conclusion:

Ascertaining pool of Digital Infrastructure through Public – Private partnership, Functional Separation and forming a Blockchain Cooperative using Smart contracts could be the key beginning and can enable both new entrants, seeking to quickly build out coverage, and incumbent operators who wants to unlock the potential of their existing infrastructure and seek to further increase coverage into underserved areas or to roll out additional service points, to ease congestion or improve in-building coverage, as well as to develop and offer new innovative services.

The establishment of a robust and reliable National Digital Infrastructure Grid in India requires the pooling of digital infrastructure through public-private partnerships, functional separation, and the formation of a Blockchain Cooperative using Smart contracts. This collaborative approach will enable both new entrants and incumbent operators to expand their coverage, unlock the potential of existing infrastructure, and provide innovative services to underserved areas. The time is ripe for this idea to come to fruition. By working together, we can make it happen and usher in a new era of digital connectivity and economic growth for the nation. Let us join hands and turn this vision into reality.

While risks and obstacles exist in any innovative national-scale project, Gyanvahini can overcome these challenges by adopting a proactive and strategic approach. By building alliances with independent Think-Tanks, aligning interests with competitors, diversifying funding sources, engaging with regulators, and investing in technological expertise, the project can address these risks and obstacles. The societal and wealth creation potential of Gyanvahini makes it worth pursuing, as it can significantly contribute to bridging the digital divide and driving economic growth.

Gyanvahini's vision to revolutionize national digital connectivity through a blockchain cooperative demonstrates a promising solution to the fragmented ownership and under-utilization of infrastructure in the Telecom market. By consolidating infrastructure, upgrading it, and leveraging economies of scale, Gyanvahini aims to provide affordable and reliable connectivity throughout the nation. With a cooperative approach, the project operates in the best interest of all stakeholders, creating a win-win situation for the industry and the general public.

Gyanvahini aims to bridge the digital divide by establishing an Open Access National Digital Grid. This ambitious project will address the pressing issues in the Telecom market by

leveraging blockchain technology, consolidating infrastructure ownership, and providing professional management. By doing so, Gyanvahini will offer nationwide end-to-end connectivity, with a focus on high reliability, superior QoS, and affordability. The initiative will ensure that both urban and rural areas have equal access to the benefits of the digital economy

In conclusion, the establishment of a Digital Infrastructure Grid through a collaborative effort involving public-private partnerships, functional separation, and the utilization of blockchain technology can pave the way for new entrants and incumbent operators to expand coverage, unlock the potential of existing infrastructure, and provide innovative services. By pooling resources and leveraging the benefits of technology, we have the opportunity to bridge the digital divide, enhance connectivity in underserved areas, and improve overall service quality. The time has come for us to unite and transform this idea into a reality. Together, let us seize this opportunity and make it happen, ushering in a new era of connectivity and progress for all. This is an idea, whose time has come, now. Let us Make it Happen, together.

8. Annexure:

Extract from author's academic assignment for a Certificate Course in Blockchain Business Modelling by Prof. Dan Topscott, INSEAD:

Rationale behind choosing this Project;

8.1 Bridging the digital Divide: - *Gyan Vahini will be Bridging the Digital Divide with an Open Access National Digital Grid. Gyan-vahini can be an ambitious project aimed at addressing the challenges faced by customers in the Telecom market, particularly the lack of end-to-end connectivity anywhere in the nation on a plug-and-play basis, with high reliability and quality of service (QoS). These issues stem from the fragmented ownership of infrastructure and the absence of proper operation, maintenance, and customer service. To overcome these challenges, Gyan-vahini proposes the formation of an Open Access National Digital Grid as a blockchain cooperative, enabling the consolidation and upgrade of infrastructure for professional management and nationwide coverage at an affordable cost.*

8.2 Market Research: *A comprehensive market research study was conducted, utilizing a combination of secondary web-based research and validation through regulatory bodies and stakeholders' websites. Primary data from stakeholders further augmented the research. The findings reveal a significant digital divide between urban and rural areas, highlighting the limited digital connectivity available across the nation. Moreover, the existing infrastructure falls short of meeting the demand, and the quality of service provided is far from satisfactory. Additionally, underutilized physical infrastructure exists due to a lack of technological adoption and professional operation and maintenance practices.*

8.3 Competitive Landscape: *The competitive analysis identified three key competitors in the market, summarized without disclosing their names for strategic reasons:*

PSU Telco: *Strengths: Nationwide infrastructure presence and government support. Weaknesses: Outdated technology, inadequate finances for upgrades, poor maintenance,*

low QoS, unprofessional workforce, lack of customer empathy, and limited marketing capabilities.

Govt. SPV: Strengths: Government-funded special purpose vehicle. Weaknesses: Slow execution, lack of professionalism, outdated technology, weak operation and maintenance strategy, and limited marketing expertise.

Private Sector Digital Telco: Strengths: Professional management, secured funding, and advanced technologies. Weaknesses: Limited reach in rural areas (covering 70% of the nation), focus on digital all-inclusive services rather than connectivity alone, and targeting primarily high-paying users.

8.4 Opportunity Identification: Among the three analyzed ideas, the project chosen for Gyan-vahini is the creation of an Open Access National Bandwidth Connectivity Grid. This opportunity aligns with Gyan-vahini's mission to address the current challenges in the Telecom market by utilizing blockchain technology, consolidating infrastructure, ensuring professional management, and leveraging economies of scale.

Gyan-vahini has the capability to Revolutionise National Digital Connectivity through a Blockchain Cooperative. Gyan-vahini aims to consolidate the under-utilized and unutilized data transport infrastructure owned by fragmented stakeholders into a national digital connectivity grid. The project will be professionally managed and governed through a blockchain cooperative, utilizing smart contracts. By leveraging economies of scale, Gyan-vahini will address nationwide connectivity challenges and provide smaller infrastructure owners with an opportunity to fully utilize their assets. The cooperative structure ensures a distributed power model, solving a nationwide problem while operating in the best interest of the masses.

8.5 Project Rationale: The project was selected due to its cooperative nature and its potential to solve a nationwide issue affecting the general public. It offers a solution for smaller infrastructure owners who struggle to maximize their asset utilization due to limited scale. The concept of a blockchain-based cooperative aligns perfectly with Gyan-vahini's vision and objectives. By employing Blue-Ocean strategy and distributed powers, Gyanvahini.org seeks to establish a platform that addresses this problem effectively.

8.6 Business Model: Gyan-vahini will operate as a blockchain cooperative using smart contracts. The cooperative will consolidate the fragmented and under-utilized infrastructure capacities of various Telcos and infrastructure providers into a national digital grid. This infrastructure will be upgraded and professionally managed to offer cost-effective connectivity solutions to end users through economies of scale. Key activities include forming a stakeholder cooperative/trust, mapping existing capacities, creating a special purpose vehicle (SPV) for operations, fundraising, marketing capacities in wholesale and retail, and managing operations and maintenance.

8.7 Cost Structure and Revenue Streams: The cost structure of Gyan-vahini includes setup costs, fundraising expenses, asset acquisition costs, technology upgrade costs, operation and maintenance costs, and specialized manpower expenses. Revenue streams will be generated through pre-sale capacity to Telcos, annual lease rentals to government agencies and enterprises, and retail sale of connectivity through various channels.

8.8 Team Composition: Given the importance of execution and speed, Gyan-vahini will require highly experienced domain specialists as team leaders. These include a CEO with expertise in government relations, investor trust, business model concepts, and team building; a COO with knowledge of operations and supply chain in emerging technologies such as blockchain; a CFO experienced in fundraising techniques including crowdsourcing, and token offerings; a CMO with expertise in digital era marketing and sales; and a CHRO responsible for recruiting, training, and retaining talent in blockchain and operational technologies. Additionally, strategic allies such as government bodies, regulators, and industry organizations will be required, along with partners such as government Telcos, private Telcos, smaller infrastructure providers, and investors interested in funding innovative digital infrastructure projects.

8.9 Risk and Obstacle Mitigation in Gyanvahini Project:

Perceived lack of Government Support and Political Will: To mitigate the risk of insufficient government support and political will, Gyan-vahini needs to obtain buy-in from credible independent Think-Tanks. These Think-Tanks can help in advocating for the project's benefits, highlighting its potential impact on the digital divide and economic growth. Engaging with policymakers, demonstrating the social and economic value, and aligning the project objectives with national development goals can help secure government support. It will very well synch with the AtmaNirbhar Bharat and Made in India.

Perceived Competition and Stakeholder Resistance: To address concerns from perceived competitors who may view Gyan-vahini as a threat, it is essential to adopt a collaborative approach. By involving these competitors as stakeholders in the cooperative, their interests can be aligned with the overall objective of bridging the digital divide. Demonstrating the benefits of a cooperative model, such as shared infrastructure, cost savings, and market expansion opportunities, can encourage their participation and turn potential adversaries into collaborators.

Financial Closure and Seed Capital: The risk associated with financial closure and securing seed capital can be mitigated by exploring alternative funding mechanisms. While the Infrastructure Investment Trust (InvIT) route is evolving, it may be beneficial to diversify the funding strategy. This could include seeking support from impact investors, venture capitalists, and strategic partnerships with established players in the telecommunications industry. Demonstrating the viability and long-term profitability of the project through robust financial projections and clear revenue streams which will attract potential investors.

Regulatory and Legal Challenges: Navigating through regulatory and legal frameworks can present obstacles in a project of this scale. It is crucial to engage with regulators early in the process, seeking their guidance and involving them in the project's development. Working closely with legal experts who specialize in the telecom industry

and emerging technologies can help ensure compliance and address any legal challenges that may arise.

Technological Implementation and Adoption: *Adopting disruptive concepts and technologies may pose challenges in terms of implementation and user adoption. It is important to invest in a strong technical team that has expertise in blockchain technology, data transport networks, and operational technologies. Conducting pilot projects and engaging with early adopters can provide valuable insights and help refine the implementation strategy. User education and training programs should also be developed to facilitate smooth adoption of the new digital connectivity solutions.*

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Igniting Transformation: A saga of Innovation, Unity, and Vision- 5G and Blockchain.
By Dr .K.V.Damodharan and Venu Borra*

"The future belongs to those who innovate and integrate tradition with technology, paving the way for a harmonious progress."— Dr. APJ Abdul Kalam

Numerous studies bear witness to the huge disparities that persist between the privileged and the marginalized in this age of information. A paramount force in rectifying this imbalance is the gateway of Telecommunication access. The march of Technology offers a celestial ascent via wireless technology, a ladder that lightens the burdens and surmounts the obstacles faced by developing communities, bridging the infrastructure divide and opening avenues to global connectivity.

As the custodian of resources, the Government of India has undertaken a series of strategic initiatives, including flagship endeavors like Digital India, Smart Cities, Make in India, Start-up India, and Skill India. The nation has embarked on the grandest rural fiber rollout through BharatNet, while policy endeavors within NDCP-2018 have been put forth. The foundation for a future-ready digital infrastructure, fortified by a robust fiber backbone, not only propels the confluence of cutting-edge technologies such as 5G, the cloud, IoT, and data analytics but also nurtures the burgeoning startup ecosystem and fosters profound digital engagement. This virtuous progression heralds a new era – one marked by digital, economic, and social transformation.

In the pursuit of a \$5 trillion economy, the imperative of bridging the digital divide looms large. 5G emerges as a catalytic enabler in this endeavor. The impending 5G revolution holds the potential to orchestrate transformative shifts that will reshape the very fabric of our existence. Beyond its remarkable mobile download speeds, 5G's true prowess lies in its capacity to interlink devices, craft intelligent systems, and revolutionize industries. With its low latency and remarkable throughput, 5G becomes the key to unlocking opportunities across domains like autonomous transportation, remote healthcare, and intelligent manufacturing. However, the realization of these possibilities hinges upon investment and collaboration.

With the introduction of 5G, blockchain technology can be further empowered, enabling faster and more secure transactions, greater scalability, improved interoperability, and enhanced privacy and control for users. The integration of Distributed Ledger Technology (DLT), such as blockchain, with 5G technology opens up a world of possibilities in terms of security, micropayments, IoT, scalability, and smart contracts.

DLT, particularly blockchain, has already gained recognition for its ability to ensure secure transactions without the need for a central authority. This means that even in the event of a compromised or inaccessible central server, the decentralized nature of DLT would continue to process and maintain transaction records. This is of great significance for both the under-banked and unbanked populations, as blockchain-based payment solutions can provide accessible and secure financial services.

One key advantage of 5G is its ultra-low latency, which refers to the minimal delay in transmitting data over a network. This low latency is crucial for blockchain applications as it ensures quick verification and

validation of transactions. With 5G, blockchain networks can process a higher volume of transactions within a shorter timeframe, making it more feasible for real-time applications and high-frequency trading.

Moreover, the high data speeds and capacity of 5G allow for a larger number of devices to connect simultaneously, supporting the exponential growth of the Internet of Things (IoT). Blockchain technology, with its decentralized nature and ability to securely record and verify data, can provide the necessary infrastructure for managing and securing IoT devices and their interactions. This combination opens up possibilities for various sectors, including supply chain management, logistics, healthcare, education, and smart cities.

Furthermore, the integration of 5G and blockchain can address the limitations of centralized IoT models. Currently, centralized IoT systems rely on a single entity to manage and control the devices, posing risks in terms of security, privacy, and scalability. By leveraging blockchain's decentralized architecture, combined with 5G's capabilities, IoT devices can operate autonomously, securely communicating and interacting with each other without the need for a central authority. This enhances data privacy and gives users full control over their personal information.

Significance of blockchain in 5G ecosystem the collaboration of 5G and blockchain holds immense potential and significance for the development of a robust and secure 5G ecosystem. The integration of blockchain technology can provide several benefits that enhance the capabilities of 5G networks and enable new possibilities across various sectors.

Overall, the integration of blockchain technology into the 5G ecosystem has significant implications for security, micropayments, identity management, business models, and data privacy. By leveraging the strengths of both technologies, we can create a more secure, efficient, and trusted 5G ecosystems that unlocks new possibilities and drives innovation across various sectors. Let us examine the igniting transformation in the harmonious convergence of Blockchain, 5G, and IoT.

We commence an exceptional journey through the expansive and infinite landscapes of technology and the dynamic interplay of tradition. Be prepared to be captivated as we navigate the intricate pathways of Indian public utilities, where the grand fusion of Blockchain, 5G, and IoT orchestrates a symphony of progress.

A Majestic Unison:

The harmonious convergence of Blockchain, 5G, and IoT is poised to reshape public utility management in India, ushering in a new era that marries innovation with tradition. This triumvirate of technologies acts as the cornerstone of this transformation, offering practical implications that hold immense promise for efficiency, transparency, and sustainable resource management.

Enhanced Transparency and Trust:

At the heart of this transformation lies Blockchain, a technology celebrated for its transparency and immutability. Imagine every transaction, whether it involves the equitable sharing of solar energy or the distribution of water resources, being etched into an unalterable ledger. This real-time tracking not only ensures accuracy but also strengthens the bond of trust between citizens and utility providers. The age-old values of transparency and trust, deeply ingrained in India's cultural fabric, are translated into a digital realm.

Seamless Connectivity and Empowerment:

The rapid connectivity of 5G acts as a bridge that connects not just people but also devices. With the instantaneous insights offered by 5G, IoT devices can revolutionize resource management. Consider a scenario where a rural farmer receives real-time data on his field's irrigation needs, optimizing water

usage through IoT devices. The potential for efficient energy consumption and resource allocation becomes tangible, thanks to the fluidity of 5G connectivity.

Empowerment at the Core:

IoT devices, scattered across active markets and tranquil rural landscapes, breathe life into communities. These devices offer real-time data, empowering both local communities and urban planners alike. Picture a marketplace where vendors adapt their offerings based on real-time demand, guided by the rhythm of IoT data. This empowerment resonates deeply with India's community-centric ethos, setting the stage for a future powered by knowledge and technology.

Resource Optimization and Sustainability:

The innovative synergy of these technologies reverberates in resource optimization. Imagine a city where solar-powered vendors share their excess energy with neighboring households, creating a ballet of efficiency. This vision of resourcefulness aligns perfectly with India's tradition of mindful resource usage, seamlessly woven into a technological tapestry.

In essence, the convergence of Blockchain, 5G, and IoT paves the way for a new era where the past and the future find common ground. This transformation is a tale of trust, connectivity, empowerment, and resource optimization. As we conclude this journey, let's carry forward the promise of this era, envisioning a future where innovation and tradition coalesce, intended for by the harmonious symphony of technology and the strength of India.

Blockchain: Anchoring Trust and Transparency:

In a nation precipitous in ancient wisdom, trust is cherished above all. Like the threads of a traditional saree, Blockchain meticulously weaves transparency into public utilities. Every transaction, whether it's shared energy among neighbours or water consumption, finds its eternal place in an immutable ledger, fostering an unbreakable bond of trust between citizens and utility providers.

5G: The Essence of Connectivity:

Just as the sacred rivers flow and merge across the land, the threads of 5G seamlessly intertwine throughout our lives. With its swift velocity and minimal latency, 5G transmutes our connections. Visualize a rural farmer monitoring his fields' water levels through IoT devices, instantly receiving insights to optimize irrigation – a feat made possible by 5G's seamless connectivity.

IoT: Breathing Dreams to Life:

The heartbeat of India resonates with the unity of communities. IoT sensors, much like the collective spirit of our nation, sprawl across bustling markets and serene rural vistas, gathering real-time data. This data empowers local communities with insights and aids urban planners in precise resource allocation. Just as the echoes of ancient history linger in our temples and palaces, these IoT devices quietly script a future rich with promise.

The Choreography of Efficiency:

Envision a vibrant street, where vendors powered by solar panels offer their wares while surplus energy flows to neighboring households, a dance orchestrated by the rhythm of 5G and IoT. This choreography of efficiency jubilantly celebrates India's spirit of resourcefulness, where every droplet of water and every spark of energy resonates as a celebration.

Synchronise Challenges and Triumphs:

Yet, every stride toward progress encounters challenges, akin to India's myriad cultures. The labyrinth of regulations, the symphony of collaboration required among stakeholders, and the safeguarding of data sovereignty weave a complex narrative. But history's pages affirm that India's spirit rises valiantly to surmount any challenge that dares to impede progress.

Dreams of Tomorrow:

As our technological saga unfolds, dream of a future where the cadence of tradition seamlessly merges with the rhythm of innovation. Visualize cities where resources are meticulously utilized, rural landscapes where IoT devices empower communities, and every Indian stands as a guardian of progress.

As you bid adieu to this enchanting Indian odyssey, carry with you the harmonious melody of Blockchain, 5G, and IoT as they metamorphose public utilities. The future, a vibrant tapestry woven with the threads of technology, unfurls ahead, and India stands poised at the crossroads of this exhilarating expedition.

Uniting Innovation and Wisdom:

As the rhythmic beats of tradition intertwine harmoniously with the melodies of innovation, this forum stands as a sanctuary where experts gather, pouring forth their wisdom, experience, and fervor to serve the community. The unity of these threads, akin to India's diversity, weaves a drapery of progress.

Empowering Transformation:

The resonance of this vision echoes through corporate halls and government meeting rooms, transcending boundaries. This vision heralds the fusion of ancient wisdom and cutting-edge technology, envisioning an India where the upliftment wrought by Blockchain Technology becomes a beacon of progress.

Catalysing Collaboration:

As vibrant as India's festivals, this forum aims not only to disseminate knowledge but to kindle collaborations, bridging academia, business, and policy-making. Just as our unity is our strength, so is this vision's extension beyond borders, reaching experts across the globe through partnerships with academic and business entities.

A Harmonious Symphony:

In the tradition of India's trade routes, connecting the nation to the world, this forum promises a symphony of collective contributions. Each note played is a step towards the future, a brighter India woven from the fabric of collaboration, knowledge-sharing, and innovation.

As our expedition draws to a close, carry with you the essence of this vision, a guiding light that unites tradition and innovation. Embrace the promise of a tomorrow where harmony reigns, where unity propels progress, and where the "**Blockchain for Productivity Forum**"(BFPF) paves the way for a symphony of transformative change. . In order to effectively reach its goals, the forum strives to involve inviting Expert speakers, hosting panel discussions, or organizing workshops , demonstrations and holding international conferences.

Just as the threads of these technologies intertwine seamlessly, so too do our collective aspirations for a brighter tomorrow. We invite you, esteemed readers, to extend this journey beyond these pages. The "Blockchain for Productivity Forum" stands as a testament to our vision – a forum of experts and pioneers dedicated to enhancing lives through Blockchain Technology.

Let us come together, unite our insights and experiences, and contribute to the symphony of progress. By networking with the Blockchain for Productivity Forum, you join a community driven by the spirit of innovation and collaboration, aiming to shape a future where technology bridges the gaps and transforms lives.

As you depart from this conference, let the echoes of our journey inspire you to connect, collaborate, and contribute to the vision of a technologically empowered India. Join hands with the "Blockchain for Productivity Forum," and together, let's weave a future that resonates with the harmonious chords of progress. The future beckons, and our collective efforts will shape its melody.

* Dr .K.V.Damodharan is the CEO of BFPP and Venu Borra is a BoardMember of BFPP

"Seizing the Opportunity: India's Journey towards 'Aurium Virtualis' - Becoming the Epicentre of Metaverse and Blockchain Innovation

Dr. Akhil Damodaran ,Dr. KV Damodharan

In the present dynamic global landscape characterized by economic volatility, technological sector layoffs, and uncertainties surrounding emerging technologies, the trajectory of anticipated technological advancements remains notably uncertain. Consequently, this juncture provides India a unique opening to position itself as the quintessential "Aurium Virtualis" city – a term derived from the Latin "autonomous," signifying self-governance and independence in the virtual realm, combined with "Virtualis," highlighting its digital essence. The imperative for India is to grasp this pivotal moment and propel itself as a distinguished global hub of self-governing virtual environments.

To reshape the technological industry's narrative holistically, India must transcend its technological prowess and burgeoning startup ecosystem, focusing instead on nurturing exceptional use cases within the domains of blockchain and the metaverse. This emerges as a paramount challenge that demands immediate attention.

The question arises: What hinders the development of compelling use cases, and what factors impede our ascent to global leadership? The answer lies in recognizing a misalignment between potential solutions and prevailing challenges. While institutions in the banking and transaction sectors acknowledge the efficiency and transparency that blockchain can offer, they often overlook the direct enhancements it can deliver to customer experiences. The recognition of blockchain's potential is widespread, but its seamless integration into customer-centric experiences remains underexplored.

Enhanced industry-university collaboration stands as an imperative pillar in this pursuit. While Indian universities are actively researching emerging technologies, an increased engagement with industry partners is pivotal. This collaborative synergy bridges academia's insights with industry requirements, steering research towards impactful outcomes, particularly within emerging domains like blockchain and the metaverse. The pioneering role of Stanford University in shaping Silicon Valley's early development serves as a potent illustration.

In the emergent technology ecosystem, visionary leadership transcends mere titles. Founders of startups may hold impressive designations, yet true leadership extends beyond product creation to the legacy established. This legacy-building journey spans decades, requiring steadfast commitment, vision, and resilience. In this context, the presence of leaders akin to JRD Tata, Ratan Tata, Narayana Murthy, and Dhirubhai Ambani becomes pivotal. Such leaders envision the future two decades hence, steering organizations comprising tens of thousands of individuals worldwide. This enduring pursuit necessitates ambition, diligence, and an unwavering commitment to guiding teams towards enduring goals.

The essence lies in unlocking the product's potential, extending beyond the realm of technology itself. The internet's fame was not confined to its existence, but rather embodied in transformative products like Google, Facebook, Netflix, and Amazon. The crux is to focus on the product, be it tangible or intangible, catering to genuine customer needs and aspirations. A customer-centric approach underscores the importance of aligning products with discerned needs.

In summary, India harbors the latent potential to emerge as the epitome of the Metaverse and Blockchain, symbolized by the visionary term "Aurium Virtualis." To seize this unprecedented opportunity, swift and focused progress is imperative. The confluence of India's innovation, commitment, and visionary endeavors can shape it into a global exemplar of technological transformation.

Blockchain for High Performance and High Availability of Content Delivery Network

*Dr Shiv Kumar, DG Blockchain for Productivity Forum
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The content delivery network (CDN), online network of connected computers that distribute high availability and high-performance web content quickly to users, market is valued at USD 15.04 billion, and it is expected to reach a value of USD 36.51 billion in 2028, at a CAGR of 16.3%. OTT video consumption and Covid 19 has contributed a lot in expansion of the market apart from online gaming. With an increase in usage of the internet and smart devices companies are facing challenges due to bandwidth and network allotment, particularly in rural areas.

Content delivery networks (CDNs) are built on top of the public internet to accelerate website performance, leverage high-layer network intelligence, and efficiently manage data delivery. CDN providers are organizations that are devoted to hosting the content of third-party content providers on their servers.

The Content Delivery Network (CDN) Market is Segmented by Solution and Service (Media Delivery, Cloud Security, and Web Performance), End User (Media and Entertainment, Advertising, E-Commerce, Healthcare, Business and Financial Services, Research and Education, and Other End Users), and Geography (North America, Europe, Asia-Pacific, Latin America, and Middle-East and Africa).

The world population using the internet stands at 56.3%, which is responsible for the growing online content. The advent of 4K/UHD televisions, high-definition content supporting smart gadgets, and improving connectivity raise viewers' expectations for high-quality content.

Availability of mobile devices has shifted the network traffic from traditional linear broadcasting services (TV channels) to streaming services, such as YouTube and NetFlix. Internet traffic is also increasing with video quality, i.e., 3D, 4K video, Virtual Reality etc., which eventually results in increased bandwidth requirements for both the core and access networks. On one hand Telcos face bottlenecks as this put pressure on their existing network while on the other hand CDN operators are not able to provide high availability and high performance to its customers.

According to Dragan Sutevski providing high performance, access to content through all devices, scaling, reaching global audience, and organic growth are biggest challenges being faced by companies.

High performance is something being taken care of by caching servers ie CDNs provide high performance and high availability services by creating many replicas of the core server to fulfill requests faster. These replicas are distributed spatially to provide content to customers very fast as it is very near to user eg Cloudflare create a CDN starting from an Origin server and replicate, distribute content to end-users from the best server normally geographically nearest. This scenario has three trust issues:

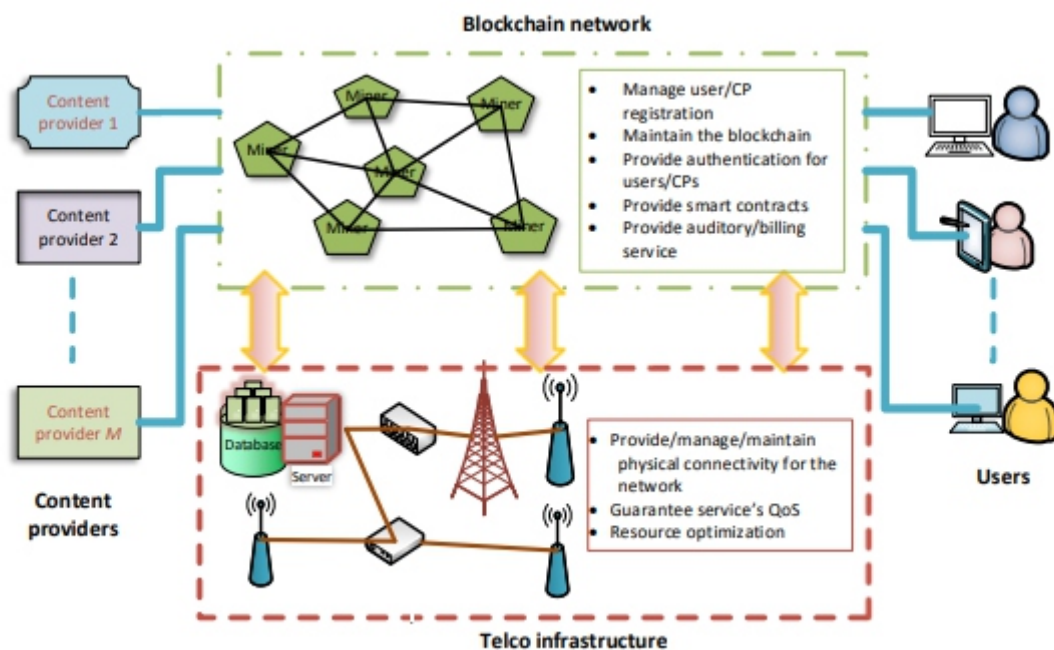
1. An attacker could modify the content sent from the Origin server to the Edge server. If such Edge server inadvertently serves that modified content, it will be labeled a misbehaving replica. Second,
2. If the Origin server owner does not directly manage an Edge server, the Edge server can serve different content, such as stale or outright modified content, e.g., adding ads.

3. Origin server is a single point of failure. If the Origin server is compromised, all the servers misbehave

Thus, solution to the problem of both Telco and Content provider can be resolved with closer partnership and collaboration but because lack of secure and efficient sharing platform available to content provider it is not taking off.

Blockchain is a fastest merging technology based on concept of decentralized management and data security. Though this technology was introduced as the core technology of cryptocurrency, e.g., Bitcoin. There is no fixed controlling node in the blockchain based network (BCN) which is 180 degree out of phase to centralized methods. A consensus mechanism is implemented, whenever any new block to be added to the chain, to vote a temporary controlling node. There are majorly three types of consensus mechanisms used namely PoW (proof-of-work), PoS (proof-of-stake) , PoC (proof-of-capacity). These mechanisms are nothing but the search for the answer of a difficult computational puzzle. A miner (blockchain node) who gets the first answer is called a nonce and the same node broadcast the nonce to the network and this new nonce is validated by all other nodes in the existing blockchain. A block in the blockchain carry a hash code of the previous block as well. And hence , any modification in a block will destroy the integrity of the chain as a consequence, it is not possible to change or delete any block of the chain without recalculating all blocks above. In short, the nature architecture of blockchain offers key features of security, temper-proof, and decentralization. In financial sector Block chain has proven its worth and blockchain has shown a great capability in wireless networks, with particular potentials in IoT and mobile networks.

Block chain architecture by Thang X Vu et al, 2019 proposed is as under:



Blockchain based content delivery network provide benefits to all the stakeholders. Benefits to CPs: The proposed B-CDN provides a number of benefits to the CPs. Firstly, tracking the transaction history in the ledger available in the BCN's database, allow a CP to establish the global information on popularity of the content and user preference. This helps the CP in minimizing its operating expense and while improving

user quality of experience. Secondly, as BCN is doing the user registration and management, therefore, CPs save on owning resources for creating, and maintaining infrastructure for in-house data and its authentication.

2) Benefits to users: The first and foremost users get the privacy because each user in the BCN is represented by its virtual identity and BCN guarantees for the true mapping of the physical address with virtual identity. Additionally, with virtual identity, the user is not required to register multiple times while using services from different CPs. Some users' common information available in BCN allow users in getting efficient services from CPs based on users' preference.

3) Benefits to BCN: the BCN provides an efficient way to connect CPs and users. And BCN can also receive incentives out of transaction fees etc.

4) Benefits to Telco: the Telco gets benefit from other stakeholders As the infrastructure provider, e.g., users, CPs, and BCN .

A promising solution combining content delivery and blockchain has been done by Noia by using distributed systems to cache content closer to the end user. It works like a distributed PoP (Point of Presence) over multiple machines.

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How Blockchain Can Transform the Healthcare Industry

Kalyanjit Hatibaruah

Blockchain technology has the potential to profoundly impact healthcare. The decentralized and transparent nature of blockchain lends itself well to solving critical challenges plaguing the current healthcare system. From securely managing medical records to eliminating inefficiencies in administrative processes, blockchain offers promising benefits.

This article explores major ways blockchain could revolutionize healthcare and provide examples of real world implementation.

Securing Health Records

Medical records contain extremely sensitive personal information. But current systems for managing patient data are vulnerable to security breaches, which occur frequently. According to the US Department of Health and Human Services, health data breaches affected over 113 million people in 2021 alone. Blockchain provides a novel approach to enhance health data security. Patient records can be encrypted and stored on blockchain ledgers in a decentralized manner. This avoids centralized databases which are prone to attacks. Blockchain's inherent cryptographic protection also secures data integrity.

Access to health records would be tightly controlled through private keys. Patients could grant permissioned access to selected providers or insurers. All interactions with health data are immutably logged on the blockchain, providing a comprehensive audit trail. This prevents records being altered or deleted without authorization.

Medical chain is one company using blockchain to securely store and share electronic medical records. Its distributed network of nodes verifies patient identities and enables access to health information. Records are encrypted and the platform is HIPAA and GDPR compliant.

Improving Supply Chain Tracking

Pharmaceutical supply chains have numerous vulnerabilities that allow counterfeit drugs to infiltrate the system. The WHO estimates that 10% of drugs worldwide are counterfeit, which leads to hundreds of thousands of deaths annually.

Blockchain's ability to provide end-to-end traceability can significantly improve drug supply chain security. Each drug packet or bottle could have a unique digital identifier and data like timestamps, GPS coordinates, and transaction records can be documented on the blockchain at each step along the supply chain.

This makes it nearly impossible for counterfeits to pass through undetected. If a suspicious product surfaces, blockchain data helps pinpoint where in the process fakes were introduced. Drug authenticity can also be easily verified by patients and healthcare providers along the chain.

Chronicled runs a blockchain network in the pharmaceutical industry that links physical drugs to digital identities. It provides real-time monitoring of supply chain integrity from raw materials to the pharmacy shelf. This helps eliminate circulation of counterfeit drugs.

Clinical Trial Management

Managing clinical trials is a complex, data-intensive process. There are numerous inefficiencies in coordinating activities across sites, tracking outcomes, regulatory reporting, etc. Blockchain has emerging applications to optimize clinical trials.

Clinical trial data like patient consent, lab results, site credentials, and records of drug delivery can be recorded transparently on a blockchain ledger. This provides a permanent, immutable history that is consistent across sites. The data is also cryptographically verifiable, preventing record tampering.

Smart contracts can automate site payments upon completion of trial milestones and deliveries. Integrity of patient data and outcomes are maintained throughout the trial and reporting process. Overall, blockchain offers the security, transparency, and coordination needed for more efficient clinical trials.

Several life science companies including Boehringer Ingelheim, Pfizer, and Genentech are collaborating to identify ways blockchain can improve clinical trials. Applications range from patient recruitment to supply chain tracking.

Medical Billing and Claims Processing

Billing and claims processing in the US healthcare system is exceedingly complex. Manual verification and communication between providers, insurers, and patients leads to delays and errors. Blockchain is well suited to making this process more efficient.

Smart contracts can automate verification of policies, required approvals, and payment transfers between parties. This prevents time consuming back-and-forth communication and saves administrative costs. All transactions are auditable on the blockchain ledger to resolve any disputes.

For patients, out-of-pocket costs and required documents can also be handled through smart contracts. Patients can easily authorize payments and share records like proof of insurance from their smartphone. This simplifies the billing experience for patients and improves transparency.

Startups like Hashed Health and PokitDok are bringing blockchain-based solutions to market for healthcare administration and claims processing. Early pilots demonstrate significant time and cost savings compared to current systems.

Medical Credentialing and Licensure

Credentialing of physicians and providers involves highly manual verification processes. Doctors submit applications and primary source institutions need to validate education, training, legal histories, and practice eligibility. This occurs across states and institutions.

Blockchain can simplify credentialing through immutable, easily verifiable records. Academic credentials, training certificates, licensure documents, and work histories can be uploaded to blockchain profiles. Hospitals and healthcare organizations can seamlessly verify credentials on the blockchain rather than performing manual verification.

For physicians, this allows seamless mobility across different healthcare systems. It also reduces administrative time spent on duplicative credentialing applications. Medical registry projects like Healthchain and Professional Credentials Exchange aim to use blockchain in this capacity.

Improving Health Research

Critical health research is often siloed across institutions and drug companies. Progress could accelerate if researchers had wider access to aggregated anonymous medical data. But privacy concerns prevent wider data sharing.

Blockchain enables decentralized data platforms where individuals can contribute their health information for research purposes, while retaining control over data access rights. Patients decide what data to share, with whom, and for what duration.

Researchers can access wider datasets to uncover public health insights while maintaining participant privacy. All data interactions are tracked on the blockchain ledger to maintain transparency. Potential exists to unlock medical discoveries and improve evidence-based care.

Startups like Shivom and Nebula Genomics are building blockchain-powered platforms for voluntary genomic and health data sharing to drive innovation in medicine.

Population Health Management

For health systems and payers, managing care and risk for patient populations is key. But fragmented systems make it difficult to get a unified view of individual patients and population-level insights.

Blockchain's ability to integrate health data across disparate systems shows promise for population health management. Patients can selectively share diverse medical records, wearable data, and social determinants of health to their blockchain health ID.

Analytics can identify risk factors and care insights at both individual and population levels while maintaining privacy. Platforms like Gem and BurstIQ are bringing this vision of blockchain-powered population health management to life.

Consumer-Controlled Health Records

Today, health records remain stubbornly siloed across doctors, hospitals, insurers, and patients themselves. This leads to repeated tests, medication risks, and fragmented care.

Blockchain empowers patients to take control of their health records. It provides one secure, consolidated view of medical history where patients authorize access to providers. Health information can be stored in the cloud or on the user's device for privacy. Smart contracts enable paid access by insurers or medical researchers if the individual consents.

Startups like Healthereum and RoboMed are pioneering consumer-controlled health records on blockchain. It promises to shift power to patients when it comes to health data sharing.

Tokenized Incentives

Blockchain also opens up new possibilities for tokenized incentives and gamification in healthcare. Patients could earn tokens for behaviors like medication adherence, completing care plans, and sharing health data. These tokens can be redeemed for rewards.

Providers may also receive tokenized incentives for performance outcomes. For example meeting targets for patient satisfaction, preventing hospital readmissions, or managing chronic illness successfully. This ties incentives directly to measurable health outcomes.

Insurers are experimenting with blockchain-based incentives platforms. Companies like Anthem and UnitedHealthcare have pilot programs to reward healthy behaviors using tokens. While still early stage, incentivization models are being explored.

The blockchain healthcare industry is still young but the use cases highlighted above showcase the technology's tremendous potential to address systemic issues of efficiency, cost, data silos, transparency, and security. As blockchain solutions advance, healthcare could see revolutionary improvements in protecting sensitive medical data, securing pharmaceutical supply chains, accelerating clinical research, and putting patients at the center of the health record system.



Mr. Kalyanjit Hatibaruah

Kalyanjit Hatibaruah is an accomplished technology professional with diverse experience in technology across multidisciplinary domains. He is a well-known public speaker on Web3/Metaverse and its adoption. He is the Chairman of Flugelsoft Group, which comprises a portfolio of companies in different tech and management domains.

Mr. Hatibaruah holds a BTech degree in Electronics & Communication from NIT Kurukshetra, Haryana, and an MBA from Pune University. He has extensive experience in different technology stacks, starting from Ecommerce, Distributed Applications, AI/ML, and Web3. He is recognized as a pioneer in Blockchain Applications and is involved as an Advisor or Lead Tech teams in various Financial Projects related to Tokenization(Crypto).

Mr. Hatibaruah is associated with numerous Startup Incubators/Accelerators and is well connected with the VC Network. He takes workshops and has a number of E-learning courses to his credit on diverse topics.

He also runs a podcast - "Web3 Unleashed" in partnership with Pod One Entertainment. He is invited as a Judge in Technology and Management events Pan India including State/Central Universities and IIT's/IIM's.

With his extensive knowledge and experience in the industry, he is an asset to anyone seeking to explore or excel in the field.

He is also into Acting part time and has acted in a few Assamese blockbuster films.

Using Blockchain to Rethink Car Ownership

Pratibha Das Hatibaruah

The traditional model of car ownership, where individuals buy and maintain their own vehicles, has dominated for over a century. But with emerging trends like ride-hailing, car sharing, and autonomous vehicles, blockchain technology could disrupt car ownership as we know it.

Blockchain, with its ability to enable transactions through smart contracts without middlemen, can facilitate new models of shared mobility. Cars could be communally owned and shared among many different users according to their usage needs. Payments and usage could be tracked on the blockchain. This provides benefits like reduced congestion and emissions as fewer cars are needed overall.

Ride Hailing Services

Ride hailing apps like Uber and Lyft have already changed how we think about car usage. But there are still inefficiencies in the model. Drivers must shoulder the costs of vehicle ownership themselves in order to participate. And ride pricing surges when demand spikes.

Blockchain opens up new possibilities for ride hailing. Vehicles could be part of a communally owned fleet on the blockchain, where drivers can access and pay for usage as needed without traditional ownership. Smart contracts can determine optimal pricing based on demand algorithms, providing fair prices for riders.

Driver identity and reputation can be tracked on the blockchain to build trust and safety. Payments can be made instantly and seamlessly with cryptocurrencies. Overall, blockchain can make ride hailing services more efficient and affordable on both the supply and demand sides.

Car Sharing Platforms

Car sharing programs like Zipcar and Car2Go are gaining popularity, especially in urban areas. Blockchain could help scale car sharing globally and manage it more efficiently.

Usage tracking and payments for car sharing services can be automated with smart contracts. This reduces manual work needed to run these platforms. Vehicle availability and locations can be monitored in real time using IoT and oracle networks. This provides better visibility to users trying to locate and book shared cars.

Reputation systems for vehicles, owners, and renters can be implemented on blockchain to build trust and accountability into car sharing. Partnerships with insurers can also be enabled by smart contracts, simplifying insurance for car sharing programs.

Overall, blockchain offers the transactional framework and coordination layer for the next generation of car sharing at scale.

Autonomous Vehicle Fleets

Autonomous vehicle technology is advancing rapidly. But questions remain about how self-driving cars will be coordinated and used. Blockchain could provide solutions.

Coordination of autonomous fleets can be programmed through smart contracts. This includes managing vehicle distribution, directing vehicles where they are needed, and determining optimal routes and vehicle usage.

Usage-based billing can track journeys and bill for vehicle usage automatically through smart contracts. This is especially useful for autonomous vehicles spread across a city or region.

Insurance and liability management can also be integrated using blockchain. If any collisions occur, blockchain data provides transparent insights into causes. This accelerates claims and resolutions.

Ultimately, blockchain provides the critical network to optimize autonomous vehicle fleets and manage coordination at scale as the technology matures.

Electric Vehicle Charging

Electric vehicles are growing in popularity. But a major limitation is the availability of EV charging stations. Blockchain could incentivize and track EV charging infrastructure buildout.

EV charging station providers can receive incentives or payments for installing new chargers, with funding pooled into cryptocurrencies. Usage tracking then pays providers for electricity consumed at their stations based on blockchain transaction records.

This benefits drivers who have a seamless payment experience to charge EVs and expands the charging network. Utilities can also better manage EV load on the grid with transparent charging data.

Peer-to-Peer Car Sharing

While commercial car sharing services are expanding, true peer-to-peer car sharing is limited. Owners may be reluctant to rent their personal vehicles to strangers. Here too, blockchain can provide solutions.

Smart contracts can enable peer-to-peer car rentals, with rental terms, deposits, and payments managed automatically. Profiles for both owners and renters can be linked to blockchain transaction histories to build reputation and trust.

Owners can set customized rental terms and pricing for their vehicles. Renters can search for options tailored to their needs and budget. Geo-tracking of vehicles and built-in IoT devices provides monitoring and protection.

Insurance coverage can be coordinated on blockchain as well. Overall, it opens the door to safe and efficient peer-to-peer car sharing at scale.

Changing Car Ownership Mindsets

For blockchain to truly transform car ownership, consumer mindsets have to evolve. People need to become open to sharing vs sole ownership. Young, urban populations are generally more receptive to these changing mobility models.

But it requires customer education. Mobility platforms should provide dashboards showing overall usage costs under different models. Comparisons to sole ownership and traditional rental can demonstrate potential savings and convenience benefits.

Gamification also helps. Reward programs or tokens that provide benefits for sharing vehicles and resources could entice users. Over time, the incentives of shared mobility models become clearer.

Blockchain enables the transactions and coordination to make new mobility systems work. But user experience and trust will determine mainstream adoption. Fostering a collaborative economy mindset is key.

Real World Examples

Several companies are already exploring blockchain applications for new mobility and car ownership models:

- **Dovu** - Uses blockchain to create a global platform for peer-to-peer car sharing and ride hailing services. Helps build user reputation profiles to facilitate trust in the community.
- **Car eWallet** - Building a tokenized network for shared transport and mobility services. Users can manage bookings, payments, and usage via decentralized apps.
- **Cubic Transportation** - Partnered with transportation agencies to launch a pilot for mobility-as-a-service with blockchain infrastructure.
- **ShareRing** - Active in the sharing economy. Current offerings include peer-to-peer car sharing along with other transport sharing services, all tracked via blockchain.
- **Joyride** - A mobility company leveraging blockchain to create incentives and build a community around sustainable transport, ride sharing, and public transit usage.

Conclusion

We are likely just scratching the surface of how blockchain could overhaul car ownership and reshape the transportation landscape. As with any emerging technology, there will be challenges to work through like regulations, security, and mass adoption. But the foundation is being built for blockchain to disrupt mobility in innovative ways that benefit consumers, service providers, and the environment.



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