Gyan Vahini - Creation of an Open Access National Digital Infrastructure Grid through Functional Separation Using Smart Contracts and Blockchain

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Abstract – **India's mobile penetration witnessed an impressive growth during the past few years, but same is missing for data access, resulting into a digital divide in the form of Digital Access Deficit. To address this issue, National Digital Communications Policy-2018 envisions creation of a National Digital Grid.**

This new digital infrastructure - some of it is hybrid infrastructure that integrates both passive, active and digital aspects - is critical for delivering the next wave of communications, innovation and economic growth to all.

One of the emerging tools available and worth trying to implement is Blockchain, which is an open, trusted, Distributed Ledger Technology for records of assets of any type. Paper elucidates how Blockchain is suitable technology for creation of a trusted Open-Access National Digital Infrastructure Grid.

Forming a Blockchain Cooperative using Smart contracts is an idea, whose time has come.

Keywords: Digital Infrastructure Grid, Next Generation Networks, Blockchain, Smart Contracts, Internet of Values, Indefeasible Right of Use, Network sharing, Initial Token offer.

I. INTRODUCTION

THE most critical element of a robust digital ecosystem is the underlying digital infrastructure, which has become critical to nation's economic growth and all-inclusive well-being. Today, economy is rapidly changing with advances in information and communications technology (ICT). This new digital infrastructure - some of it is hybrid infrastructure that integrates both passive, active and digital aspects - is critical for delivering the next wave of communications, innovation and economic growth to all.

India's mobile penetration witnessed an impressive growth during the past few years, but same is missing 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 Digital Infrastructure Grid in the country, given India's highly diverse geographies with many remote and inaccessible regions. Such infrastructure demands a holistic approach, a long-term vision and innovative technological initiatives for its creation.

II. VISION OF NDCP-2018, INDIA

Item 1.1(*c*) of recently issued NDCP by government envisions creation of a National Digital Grid as below [1]:

- Creating a National Fibre Authority,
- Establishing common service ducts and utility corridors in all new city and highwayroad projects, and related elements,
- 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,
- Facilitating development of Open Access Next Generation Networks.

In addition, there is a target to establish, 10M public Wi-Fi Hotspots by 2022 for the last mile access.

III. CURRENT SITUATION OF DIGITAL INFRASTRUCTURE IN INDIA

Many elements of digital infrastructure are available in the country in islands and silos and with different ownership models in - government, public and private sector. Also, the ambitious National Optical Fiber Network project (BharatNet) just bridges the middle-mile and contributes only around 3.5 lakhs Km (15%) of national OFC network. Due to this, stakeholders are not able to exploit it to its full potential to deliver services to end-users in cost-effective, timely and affordable manner. The creation of a Digital Infrastructure Grid will help in reducing the dependency on a single owner asset and make switching of traffic between infrastructures available, easier and resulting into optimal utility of critical resources.

Various elements of digital infrastructure consist of: Optical Fibre Cables, Radio Networks, Public Wi-Fi Hotspots, Satellite Communication system and Diversified Submarine Optical Fibre Network, the major part of which is fragmented, with nocooperative/consortium owner and control. Currently, India boasts of about 15 Lakh kms. of OFC, around 5 Lakh Radio Towers and 1 Lakh Wi-Fi Hotspots which are mushrooming all over the country. All these are ideal ingredients for

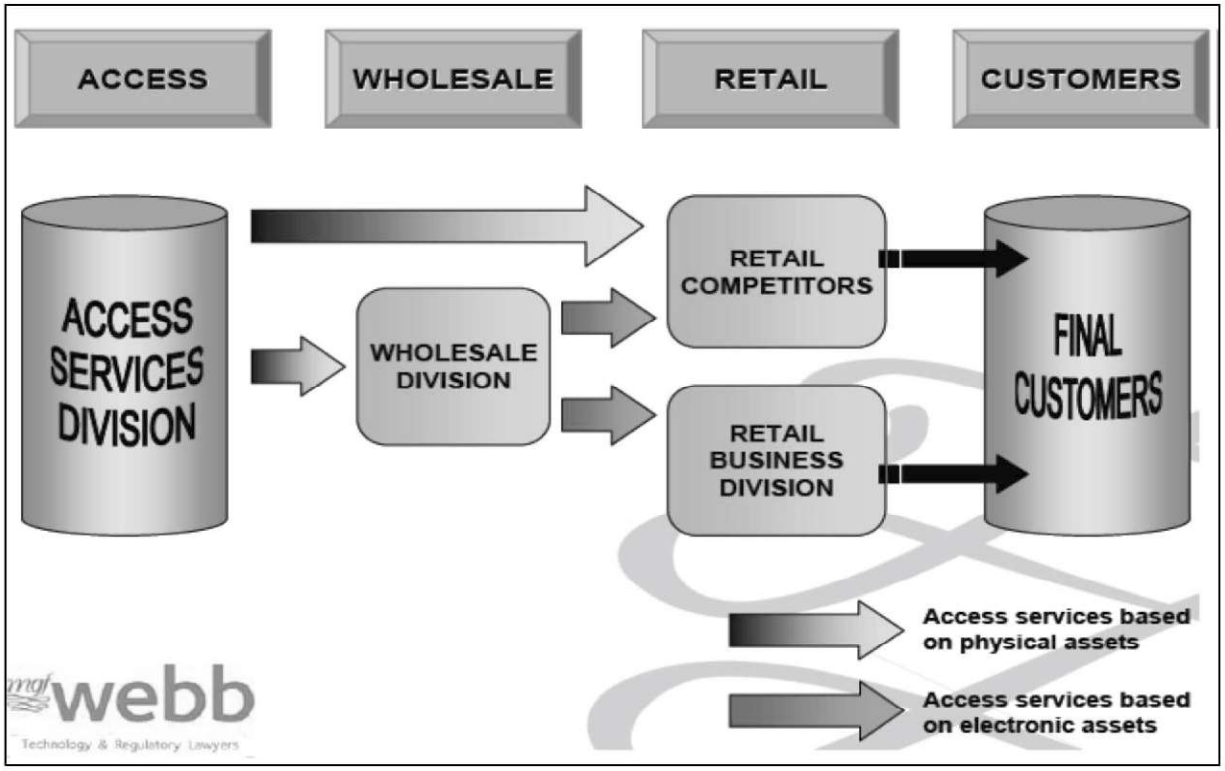

Figure 1. Separation between the network layers and the services.

creation of a nation-wide Digital Infrastructure Grid, by using Crowd Sourcing, Functional Separation, Active-sharing and Blockchain Cooperative concepts.

IV. FUNCTIONAL SEPARATION: GAME-CHANGING APPROACH

A future proof, all-inclusive solution to this could be the creation of a National Digital Infrastructure Grid which will be facilitated through mechanism of "Functional Separation" to separate the service provision from underlying infrastructure through regulatory facilitation in a win-win mode [2].

The convergence between IT, telecom 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 leads to functional and structural separation in telecommunications – either because companies see an interest in making these forms of division, or because the regulatory authorities find it necessary to promote competition and growth. A conceptual diagram for this is shown in Fig.1 [3].

V. USE OF BLOCKCHAIN CONCEPTS

One of the emerging tools available and worth trying to implement is Blockchain, which is an open, trusted, Distributed Ledger Technology for records of assets of any type 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 for "Crowd sourcing", using which a task can be solved by a host of stakeholders in lieu of relying on only the few players. It can use a Open-Access architecture and a commercial framework, which makes use of Smart Contracts [4] to start with.

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

Why Blockchain Technology: Blockchain Technology is just a method of securely storing and distributing information [5], 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[6]. The blockchain technology can be applied in virtually any industry in which assets are managed and transactions occur. It can provide a secure chain

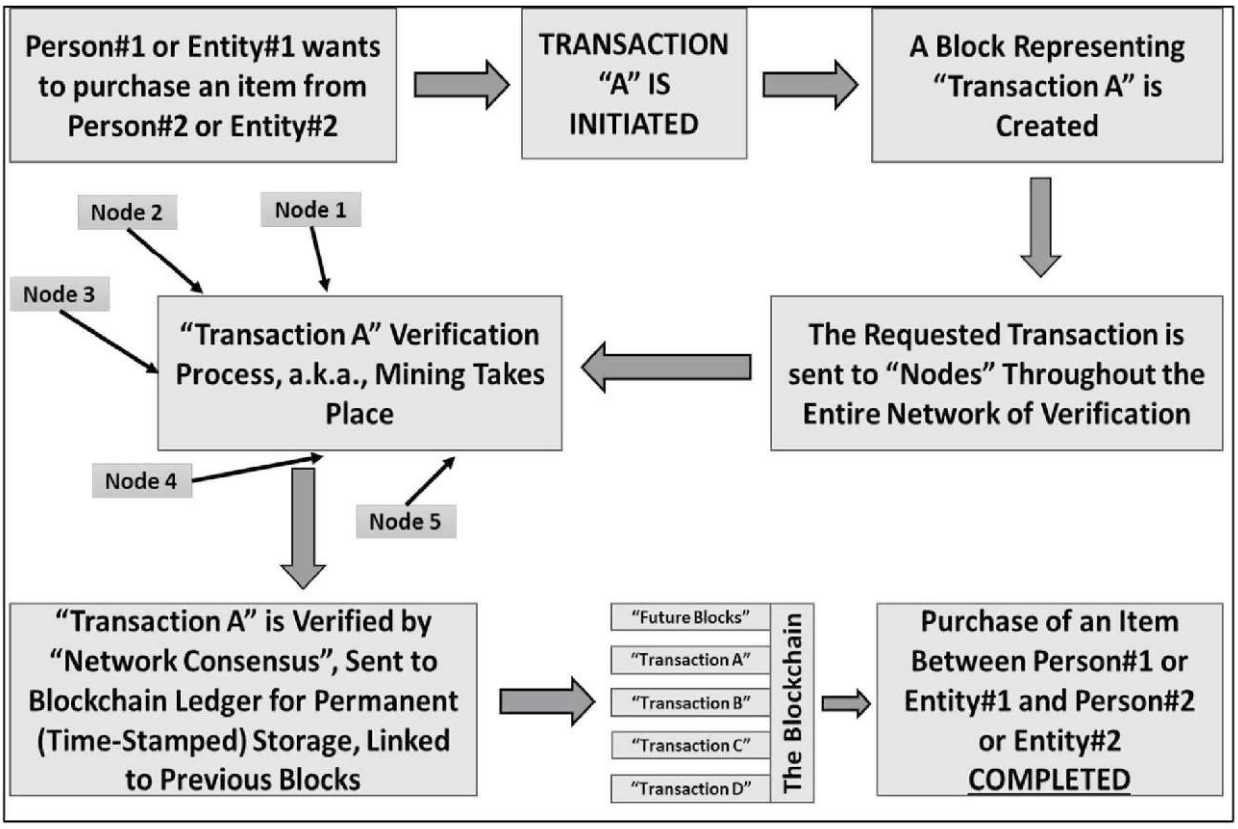

Figure 2. Working of Blockchain Technology.

of custody for both digital and physical assets through its functional characteristics that facilitate transactions through trust, consensus, security, and smart contracts [7].

The salient features of this technology that make it attractive for its use in transaction of values, are:

- REDUCES COST by automating processes and intermediaries,
- INCREASES SPEED AND EFFICIENCY of transactions and settlements through immediate settlement and use of SMART CONTRACTS,
- INCREASES SECURITY AND TRUST through use of cryptography, transparency and immutability,
- REDUCES FRAUD by time stamping entries and sharing a common immutable ledger across the network,
- 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 to be 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 involving the potential beneficiary of this Grid on prepaid basis.

VI. INDEFEASIBLE RIGHT OF USE

Another learning which can be used in this project is the IRU (Indefeasible Right of Use) concept which is used in collective ownership and collaboration for submarine cable consortium. The word *indefeasible* means something that cannot be revoked. Indefeasible right to use is an irrevocable right conveyed to 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 and indefeasible 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* [8]," issued

by Telecom Regulatory Authority of India, IRU means the right to use the reference capacity[1]:

- On long-term lease for the period for which the submarine cable remains in effective use;
- acquired (including equipment, fibers or capacity) under an agreement entered into between the capacity owner and an eligible Indian International Telecommunication Entity;
- 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.

VII. GYAN VAHINI CONCEPT

Gyan Vahini concept involves a synergistic Interplay Of Various Stakeholders as outlined in Table 1.

Table 1 -- STRATEGYZER Business Canvas for Gyan Vahini

<table>
<tr><th>KEY PARTNERS</th><th>KEY ACTIVITIES</th><th>VALUE PROPOSITION</th><th>CUSTOMER RELATIONSHIP</th><th>CUSTOMER SEGMENTS</th></tr>
<tr>
<td rowspan="2">▪ Govt. Telcos (BSNL, BBNL, RAILTEL, POWERTEL, GAILTEL)
▪ Pvt.Telcos (RJio, Airtel, Voda-Idea, Tata Communication, RCom)
▪ IP-1 Companies (ATC, VIOM, GTL etc.)
▪ ISPs
▪ Managed Network Service Providers
▪ USOF (Universal Service Obligation Fund)
▪ OEMs</td>
<td>▪ To form a Cross-Industry Joint-Stock Consortium (SPV)
▪ To take stock of the Existing Infrastructure (GIS map, Capacity Route.Km)
▪ To provide existing capacity utilisation & spare capacity data
▪ Create open-access National Digital Infrastructure Grid</td>
<td rowspan="2">▪ 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 specially skilled manpower
▪ To generate Entrepreneurs in rural-areas as VLEs & Franchisees
(VLE: Village Level Entrepreneur)</td>
<td>▪ Blockchain Based Smart Contracts
▪ Initial Token Offer (ITO)</td>
<td rowspan="2">▪ Telcos
▪ ISPs
▪ Enterprises
▪ Govt. Bodies
▪ End Users</td>
</tr>
<tr>
<td>KEY RESOURCES
▪ Existing Fibre-based Ground Infrastructure
▪ Existing Radio Based Transmission Infrastructure
▪ Existing Tower Infrastructure
▪ Data Centres
▪ NOCs
▪ MSAN – Multi Service Access Nodes (Point of Presence)</td>
<td>CHANNELS
▪ Franchisees
▪ Agents
▪ Digital Electronic Platform (Bandwidth Pool)
▪ VLEs</td>
</tr>
<tr><th colspan="3">COST STRUCTURE</th><th colspan="2">REVENUE STREAM</th></tr>
<tr><td colspan="3">▪ 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</td><td colspan="2">▪ IRU pre-sale of capacity to Telcos, ISPs & Govt. Bodies
▪ Annual/Long-Term lease of capacity to Enterprises
▪ Retail sale of capacity through Channels</td></tr>
</table>

[1] Reference Capacity is the submarine cable capacity which is to be purchased by the operator either on lease or ownership basis

VIII. WAY FORWARD

As the Blockchain has the potential to transform the traditional business and cross-industry cooperative trusted 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 Digital Infrastructure Grid in India.
- The regulator issues a consultation paper or pilot project to bring awareness and get stakeholders buy-in to the concept.
- All the relevant players (operators, Network Provider, software companies, cloud service providers, system integrators, etc.) with in 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.

IX. 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 that enables 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. This is an idea, whose time has come, now. Let us Make it Happen, together.

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