

Shared Digital Infrastructure for 5G-IoT Ready Smart Cities

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Abstract -- The information and communication technology will play a critical role in creation of smart cities. In post Covid-19 scenario, the role of fiberisation is significant due to Work-from-home, video conference usage, e-learning, e-governance etc leading to huge surge in data consumption. Current fibre-to-the tower penetration of 31% needs to be scaled up further to 60-65% for readiness towards 5G/IoT related applications.

This paper emphasizes stellar role of the Tower industry and outlines financial models to implement Smart cities mission projects. Towers deployed are shared with the licensed operators on a non-discriminatory and transparent basis. General conditions, key essentials and expectations from authorities are highlighted for successful implementation.

Keywords: IoT/5G readiness, Common duct concept, Optical fibre connectivity, Integrated command and control centres, Intelligent poles, Broadband readiness index, Digital infrastructure benchmark requirement, Master Service Agreement

I. INTRODUCTION

TELECOM tower industry was conceptualised by Department of Telecommunications post the introduction of registration category (IP -1) for Telecom Infrastructure Providers in the year 2000. The registration allows the IPs to establish and maintain telecom infrastructure like towers, ducts, cables, fibre and right-of-way. The telecom tower industry has seen a tremendous growth with the tower count a mere 1,00,000 towers in 2006 to more than 6,20,000 towers in December 2020.

Infrastructure Providers started deploying towers based on a unique and innovative business model based on the objective of sharing, wherein the towers deployed are shared with the licensed operators on a non-discriminatory and transparent basis. The concept has advantages such as efficient use of capex, improved aesthetics, faster rollouts, energy savings, and better coverage quality. This model has been emulated worldwide.

II. THE STELLAR ROLE OF INFRASTRUCTURE PROVIDERS

India has been one of the most favourite destinations globally for the ICT sector. The industry ecosystem is increasingly

dependent on internet and connectivity for facilitating their services to consumers. This has set the ICT infrastructure as key to growth in various areas.

Infrastructure Providers majorly represent the telecom tower industry. Telecom towers have been a key element for proliferation of telecom services in the country. The tower industry which came into existence in 2006 have deployed nearly 6,20,000 towers since inception housing more than 22 lakh BTSs. The key highlights of the tower industry are

- Played important role in expanding affordable telephony in India
- Contributed towards the growth of provision of telecom services that today provide connectivity to over 1 billion subscribers
- Facilitated to carry wireless signals to connect cities, towns, and villages to connect every nook and corner of the country
- Wireless connectivity avoided huge cost and time in deploying u/g cables
- Tower base has increased six times since 2006.

The concept of 'Tower sharing' created a strong incentive in Indian Telecom market.

III. SMART CITIES

Government of India launched the Smart City Mission in 2015. It is an urban renewal and retrofitting program to develop 100 cities across the country making them citizen-friendly and sustainable. 100 cities have been already selected by the Government of India, however only a handful of them are under the implementation stage.

The objective of the Mission is to promote cities that provide core infrastructure and give a decent quality of life to its citizens, a sustainable environment and application of 'Smart Solutions'.

The Mission enables development by harnessing technologies and telecom services for creating smart outcomes. Smart cities

will involve smart infrastructure, smart governance, smart energy and environment, smart buildings and housing, smart mobility, and smart health. Information and Communication Technology (ICT) will play a critical role in creation of smart cities.

As more people shift to the urban cities, it is projected that urban India will contribute nearly 75% of the national GDP in the next 15 years. Thus, it is of immense importance that urban areas are planned in a manner so that they are well connected digitally and otherwise.

Thus, the realization of smart cities and digital India mission is of prime importance for the government and the industry and for transforming India into a digital empowered society as well as a knowledge economy.

In order to utilise various services and applications, the technology evolution to 5G can bring to a smart city, there is a need of developing utility common ducts to lay the fibre for fiberization of 5G poles as well so that the smart cities would be better equipped to support technology evolution as well as various other services possible on IoT/ AI/ ML/ AR/ VR etc. Additionally, it will add a revenue stream for infrastructure providers in terms of provisioning of utility ducts for other services providers.

Under the mission, setting up of integrated command and control centres (ICCC) for each city is a vital step. The ICCCs are designed to enable authorities to monitor the status of various amenities in real time. The centres will control and monitor online water and power supply, sanitation, traffic movement, integrated building management, city connectivity and Internet infrastructure.

IV. CONVERGENCE OF SMART CITY MISSION PROGRAM AND TELECOM POLICY 2018 OBJECTIVES

Digital Infrastructure Benchmark Requirements: For implementation of shared infrastructure, both for Greenfield and Brownfield development, Digital Infrastructure Benchmark Requirements need to be established centrally in alignment with Telecom Policy 2018 objectives and in convergence with Smart City requirements. The Government of India has initiated a benchmark study to measure Broadband Readiness Index (BRI) which will ascertain the states' competitiveness regarding creation/ readiness of robust and resilient telecom infrastructure. The Digital Infrastructure benchmarking is being proposed to meet following objectives:

- To implement the vision and mission including meeting the projected capacity requirements of digital infrastructure for the next 20 years for all stake holders (Infrastructure service providers, Telecom service

providers, Smart cities implementors, Other agencies etc.)

- Meet global standards on reliability
- Plug and Play on-demand availability of infrastructure (One touch make ready, OTMR) through a transparent process
- Minimum cost option for capital expenditure and operating expenditure: total cost of ownership
- Minimum inconvenience to citizens, service providers and cities (Dig once).

Creation of National Fibre Authority of India (NFAI) as envisaged under National Digital Communication Policy (NDCP 2018) should include regulation of common duct as proposed by DOT/TRAI. The common duct related functions can also be included in NFAI. The common duct concept needs to include poles and towers for IOT/5G readiness and need to include the needs of future smart cities. This should be joint initiative of Urban Development and Telecom ministry at the central and the state level, to create and enforce the common framework across all key land-owning agencies as well as establishing and executing the business and operational models standardized framework, enforceable with the following:

- Standardisation of costs for ROW/ Reinstatement costs/Timelines of grant in compliance of ROW rules 2016 (Free in case of DBR as discussed in later section). The NFAI may ensure that rules in this regard may be uniformly enforced by all States and Local Bodies.
- Policies and enablement of Shared duct and Tower infrastructure in municipalities, rural areas, and national highways.
- Leveraging existing public assets and co-trenching projects with other utilities and agencies, In-building solutions through NBC
- Identify/lay down technical and operational standards for laying and O&M of the shared infrastructure for OFC and Shared poles and towers in compliance with DBR.
- Investing in creation of common infrastructure and leasing out later to align the investment cycles of various utilities. Enabling participation from Financial investors, Collaboration models through consultations.

V. TELECOM INFRASTRUCTURE ECOSYSTEM

A city will be transformed to smart city by maximizing the reuse of existing infrastructure (ICT/Non-ICT), creating a backbone for smarter initiatives for the future and modernizing service delivery. The objective is to provide decent quality of life to the citizens.

Any smart city will have a mix of ICT and Advanced technologies for providing various services making the network architecture to be technology centric. The implementation strategy and framework could be different depending on the mix of services provided and the mix of focus attributes of the city, whatever framework is selected, whether Technology or Human, it should lead to sustainable and harmonious growth. Smart City will comprise of ready telecom infrastructure such as common ducts, intelligent poles connected on OFC to support various applications, Wi-Fi, FTTX, high speed broadband, and street level telecom infrastructure and 5G/IoT related infrastructure which will automate solutions making life easier.

Intelligent Poles (iPoles): Intelligent Poles are basically poles with multitude of smart components integrated with Central command and control Centre for aiding emergency management in case of any disaster or mishap, as well as monitoring city environment and disseminating public information. The smart elements that can be installed on i-Poles (as per Responsibility Matrix) are as follows:

- Mobile Antennas (2G/3G/4G/Small Cell/GSM/WCDMA/LTE)
- CCTV cameras
- Wi-Fi hot spots (AP)
- Smart Sensors (Environment / Weather etc.)
- Bill Boards
- Active Networking Components and OFC Connection
- Provision of Smart Lighting (Controller, LED lights etc.)
- Pollution monitoring
- Air Purifiers.

Further, IPs can also install telecom equipment (Micro/Macro cells) at following sites in a smart city:

- Water Tank/Metro or Flyover Pillars (above 9 meter)
- Bus Stops
- Public Utilities
- Government buildings
- Including Public Wi-Fi.

Optical Fibre: The role of Optical Fibre cable is very important as the OFC connectivity (Fibre to the Tower, Fibre to the Home etc.) enables Ultra low latency, limitless bandwidth, robust network, highly secure network apart from preparedness to 5G and IoT. In a post Covid-19 scenario, the role of fiberisation is particularly significant due to Work from home, video conference usage, e-learning, e-governance etc. which has led to huge surge in data consumption. Fiberisation provides uninterrupted network on 24x7 basis.

The fibre to the tower penetration in the country is 31% which

needs to be scaled up further to 60-65% for readiness towards 5G/IoT related applications.

VI. FINANCIAL MODELS

Common Duct and establishment of standard Digital Infrastructure benchmark requirement: Establishment of Standard Digital Infrastructure Benchmark Requirement (DBR) will be carried out by the state for OFC duct and Poles/Tower future projected requirements to meet 5G/IOT ready smart city. The DBR for each city / municipal body should be published by State within specific timelines. DBR can be subsequently updated as per the evolving requirements of state. Broadband Readiness Index study report has been taken up by the Ministry of Communications to assess the state wise competitiveness for telecom infrastructure availability and policy environment and its implementation.

There can be various business models to execute the smart city mission program which will include OFC, common duct, intelligent poles, Optic fibre, and common duct as utilities, IOT and 5G infrastructure. Almost all the models can be categorised into following major classifications:

A. Engineering, Procurement and Construction (EPC) Model: Under this model, the Government pays the executioner/winning bidder for engineering, procurement and construction of intelligent poles, OFC etc. based on specifications given by the Government. The choice of executioner is through open tendering process and the lowest bidder (L1) becomes the winning bidder. The Government exercises control over the assets from the very beginning under this model.

Integrated Command Centres in some smart cities in AP and Orissa have been developed based on this model. Operations and maintenance of the project is with the Government from the very beginning.

B. Extended Engineering, Procurement and Construction Model: Under this model, apart from EPC, the Government also allots operations and maintenance of the project for the limited period, say 5 years.

Both these models are based on non-monetisation of assets by the executioner.

C. Public Private Partnership model on Revenue share basis: In such models, the Government brings in some value in the form of land, RoW permissions etc. to the project and the private bidder puts capex/ opex for the project for a certain period, say 20 years. Till this period, the winning bidder can monetise the assets. The winning bidder is selected on H1 basis, i.e. the one who commits highest revenue share for the agreement period, is chosen to execute the project. The Government in turn offers free right of way, permissions and

co location rights to the winning bidder.

D. Public Private Partnership Model on Viability Gap Funding basis: In such models, the basic principle is of partnership only wherein Government brings in some values like land, RoW permission and private bidder brings in the investments for capex and opex for say, 20 years. But the difference here is that instead of quoting highest revenue share, the private bidder quotes lowest viability gap fund (VGF) required from the Government to execute the project. The assumption is that the rights provided by Government are not sufficient for the bidder to monetise the project. There is some additional capex which he will have to invest and therefore, a VGF amount is quoted by the bidder. The selection would be based on lowest bidder *i.e.* L1, who quotes lowest VGF requirement.

VII. GENERAL CONDITIONS

- The land owning agency (state) brings in a private sector partner to a registered Infrastructure Provider in PPP mode, selected through open tender. The open tender can involve technical bid as well as financial bid.
- The land owning agency (state) shall give the Infrastructure Provider, Right-of-Way (RoW) “free of cost” over their infrastructure (*i.e.* land, bridge, road, footpath, offices) or infrastructure belonging to Municipal Corporation, for laying the Ducts, Optical Fibre Cable and Poles/ Towers and poles under the project, for entire Agreement period. RoW charges may be waived off in lieu of ownership of part of the common infrastructure developed by the implementing agency. The land-owning agency may utilize / monetize their part of the common infrastructure while the implementing agency may have the rights to monetize their part on basis of the market needs. The implementing agency shall have the long-term rights to monetize the common infrastructure.
- The respective policies for providing RoW on government owned land by various other departments and agencies (including Ministry of Railways, Defence, Forest and NHAI) may be waived off for inter-government department usage and for government projects. Further, the Government land agencies should also be mandated to adhere to Government of India’s Right of Way rules, November 2016 having been duly notified as Indian Telegraph Rules. The RoW “free of cost” includes exemption from payment of annual rent for putting up manhole or any other maintenance assets for digital infrastructure.
- The entire CAPEX and OPEX for laying of Ducts and Optical Fibre cable (OFC) for the OFC network and

Poles and Towers shall be borne by the implementing agency (Infrastructure Provider).

- The Infrastructure Provider would implement OFC network/Poles and towers as per designated plan (DBR), Spare ducts (as agreed) and Spare Right of usage of shared poles and towers assets would be available for any fair market requirement to City. Alternatively, smart city authority pays for the market rate fixed by infrastructure provider/ TSP.
- Infrastructure provider will fix the rental rates for the use of spare ducts or blow Optical Fiber Cable and shared RTU of shared poles and towers. The revenue earned will be shared with Infrastructure Provider on mutually agreed terms. City can fix the ceiling for rentals for the use of spare ducts.
- Any additional Optical Fibre Cable capacity and RTU of shared poles/ towers will be used by Infrastructure Provider to monetize its investment without any revenue sharing.

VIII. KEY ESSENTIALS

The challenges will vary from a City planned from upstart or retrofitting the existing infrastructure within the City; financing the project, implementation challenges, capacity building etc.

Key essentials:

Availability of Master Plan/ Development plan

Financing the Smart City project – Government Subsidy/ Private investments/ Public-private partnerships

Providing equal opportunities for all players within the segment *i.e.* Infrastructure provisioning; Communications services; Equipment manufacturers; etc.

Retrofitting existing city infrastructure and making it Smart

Effective coordination amongst various Departments/ Ministries for successful planning and implementation
Providing clearances in a timely manner – Single-window, time bound clearances

Reliability of utility services like electricity, water, telephone/ broadband services, etc.

In all, the projects being capital intensive, would also need help of the Government to be financially viable.

There is an urgent need for standard template for bringing out transparency and encourage public private partnership to bring in investments etc.

Sharing is an absolute must – needs to be mandated. It must be mandatory for all bidders to share the facility or service under the RFP with all “eligible” persons (e.g. licensees in case of telecom) on non-discriminatory basis.

It is suggested that the concessionaire be required to come up with a “Master Service Agreement” (MSA) transparently, based on which any eligible person can avail the services. If MSA is found ‘impractical’ or ‘unreasonable’ in terms of charges and other conditions by at least say two eligible persons of some minimum size, the same be referred to TRAI for their adjudication based on specific demands of aggrieved eligible persons.

Restricting Exclusivity: The RFPs initiated in the smart city projects should refrain from bringing any exclusivity clause to the winner of the project. Exclusivity clauses in the project, though acts as a great incentive for the successful bidder but will completely bar for any other IP 1 Company / operator for any ROW permission for future installations within the city. In other words, no other party other than the successful bidder will have any right for any ROW permission for OFC or Intelligent Pole.

IX. EXPECTATIONS

The Central Government/ State/ local authority/ corporation should provide the following assistance to the winner of the RFPs of the smart cities:

- Shall facilitate the concept, execution and coordination of the program mentioned
- Shall assist in addressing in any regulatory issues in achieving the objective in the RFP and assist the successful bidder in getting approvals from Government agencies.
- Shall provide 24x7 electricity to successful bidder. However, electricity bill shall be paid on actuals by successful bidders for the scope mentioned
- Shall form a project management group for smooth implementation of the project.
- Shall provide single window clearance for allotment and identification of street poles.
- Shall provide Right of way to establish and maintain infrastructure to be installed.
- Shall provide trench/ducts, permission of digging roads for laying fibre to fulfil the objectives.
- The route allotted to successful bidder for laying OFC shall not be allotted to any other party for the term of the contract
- Shall permit upgrade or replace existing light poles with state-of-art poles
- Only successful bidder will be allowed to share existing light poles / deploy new telecom sites for sharing with telecom service providers

- The street poles upgraded and replaced by successful bidder shall exclusively belong to it; shall not have any lien, claim or charge on such street poles. The successful bidder shall establish and maintain such street poles without creating any right, title or interest of whatsoever nature therein in favour of the Government.
- Any replaced or removed street poles shall be removed by Government for its location at its own cost immediately after receiving the intimation from successful bidder.
- Shall replace the poles which are not in good condition and may not be able to take the load of telecom equipment envisaged
- Free RoW for,
 - Deploying roof top and ground-based towers / mast / poles with adequate spaces
 - Deploying poles/use existing poles with 1.2 mtr x 1.2 mtr space
 - Deploying Access points/Antennas and other related Infrastructure in the premises/venue/area
 - Laying Optical Fiber Cables

Eligibility criteria: The Government suggestive eligibility criteria of the bidding company can be standardised based on size, experience, turnover, registration status with the Government.

Technical specifications: The technical specification for intelligent agencies for intelligent poles, OFC etc. be standardised based on Government approved agencies.



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Served as Deputy Director IAF - from 1967 to 1989, Director, Shyam Telecom Ltd. (Regulatory) – from 1994 to 2000, Director, Bharti Airtel Ltd. (Corporate Affairs & Regulatory) – from 2000 to 2005, Deputy Director General: COAI – from 2006 to 2011, Executive Director Augere Mobile Broad Band Wireless Pvt. Ltd. – 2011, Director General Tower and Infrastructure Providers Association: since Jan 2015 till date.

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