
PM-WANI: A Disaggregated Wi-Fi Roaming Architecture to Connect the Unconnected

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Abstract

Providing seamless access to Wi-Fi through Public Data Offices (PDOs) using PM-WANI technology, could be an economical and rapid way of connecting the unconnected throughout India, especially given the unfeasible business case of rolling out expensive traditional cellular infrastructure in rural areas, plagued with a lower willingness to pay and revenue potential.

PM-WANI can provide significant boost to the government's digital ambition – ubiquitous connectivity, digital inclusion and enabling infrastructure. In addition, productivity improvements from Wi-Fi for the overall economy can also translate into tangible benefits to the economy.

Proliferation of broadband across the length and breadth of the country is an essential ingredient of Digital India. Towards this objective, it is envisaged to leverage public Wi-Fi network for delivery of broadband services. This is sought to be facilitated by rolling out PM-WANI infrastructure with the broadband services being provided under distributed architecture and

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unbundling of infrastructure to improve performance by different players under the PM-WANI eco system.

Keywords: Public data office, public data office aggregator, Wi-Fi access network interface, PDO, PDOA, PM-WANI, Wi-Fi, broadband, internet, rural connectivity, village level entrepreneur, department of telecommunications, ISP, DoT, access points, SSID, App provider, central registry, provider registry, C-DoT.

1 Introduction

The Internet is the single most self-empowering infrastructure available for masses in the 21st century. The World Bank observed that a 10% increase in internet penetration leads to a 1.4% increase in GDP (Gross Domestic Product). Access to the Internet is considered a basic human right by many countries today.

In India, access to data is still limited due to poor coverage of fibre/telecom and unaffordable pricing of cellular data, especially in rural areas. In this background, Public Wi-Fi hotspots hold significant place in the last-mile delivery of broadband to users in cost-effective manner. Wi-Fi based access is much easier to scale than adding new Long-Term Evolution (LTE) towers. It bolsters connectivity inside buildings, airports, Railway stations and other public places, etc. where LTE penetration is inherently limited. It allows for offloading data access from telecom networks to ease congestion, and will be crucial when the next billion IoT devices come online. Yet, there are only 300,000 public Wi-Fi hotspots in India, compared to 13 million in France, and 10 million in the United States of America [1].

Proliferation of broadband across the length and breadth of the country is an essential ingredient of Digital India. Towards this objective, it is envisaged to leverage public Wi-Fi network for delivery of broadband services. This is sought to be facilitated by rolling out PM-WANI (Prime Minister – Wireless Access Network Interface) infrastructure with the broadband services being provided under distributed architecture and unbundling of infrastructure to improve performance by different players under the WANI framework [2].

The Covid-19 pandemic has necessitated delivery of stable and high-speed broadband internet (data) services to an increasingly large number of subscribers in the country to enable WFA (Work From Anywhere). These include areas which do not have 4G mobile coverage. This framework takes forward the goal of National Digital Communications Policy, 2018 (NDCP) of creating a robust digital communications infrastructure.

As the existing service providers are unable to reach and have no incentive to deliver public Wi-Fi in remote areas, a new breed of players specially the smaller local entrepreneurs are required to be facilitated to be part of the Public Wi-Fi ecosystem in remote and rural areas.

2 PM-WANI Framework

Prime Minister's Wi-Fi Access Network Interface (PM-WANI), is basically an **Open and De-centralised** concept, such that;

- Any entity (company, proprietorship, societies, non-profits, etc.) should easily be able to setup a chargeable public Wi-Fi Access Point.
- In order to take advantage of PM-WANI Wi-Fi Hotspots, the users would have to go through these steps:
 - Download the PM-WANI Hotspot User Mobile App
 - Register themselves on the app
 - Complete an eKYC and verification
 - Connect to the nearest PM-WANI Compliant Wi-Fi Access Point (Hotspot)
 - Select a data plan from the PDOs Captive Portal through User App
 - Activate the plan and enjoy internet services over Wi-Fi
- The user should be able to discover all nearby PM-WANI compliant Wi-Fi Access Points in all areas.

The Framework for PM-WANI primarily consists of 4 key entities:

- **PDO (Public Data Office)**
- **PDOA (Public Data Office Aggregator)**
- **App Provider (Third Party)**
- **Central Registry**

2.1 PDO (Public Data Office) [3]

Public Data Office (PDO) would be responsible for maintaining, managing and operating PM-WANI compliant Wi-Fi Access Points to deliver broadband internet services to everyday users.

2.2 PDOA (Public Data Office Aggregator)

These units would be PDO aggregators and will manage authentication and billing.

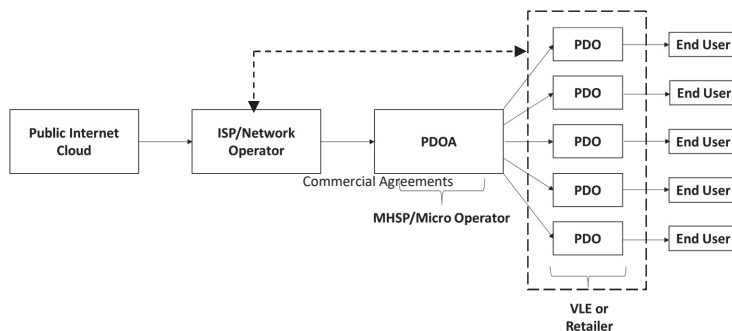


Figure 1 PDOA-PDO flow diagram.

2.3 App Provider (Third Party)

An application will be developed to help user find and connect to nearby PM-WANI compliant access points all across India. This app allows users to create a profile, do their KYC (mobile verification), and allow setting up preferences for MAC-IDs for various accessing devices and payment methods. In addition, App Provider must offer a backend user authentication service that is called by Wi-Fi Captive Portal software whenever user connects to obtain a signed user profile.

2.4 Central Registry

The central registry will be maintained by the Center for Development of Telematics or CDoT. The Central Registry will be responsible for maintaining the details of App Providers, PDOs and PDOAs in a digitally signed XML format. This is a relatively static registry where approved providers can manage their profiles [4].

3 PM-WANI Architecture [5]

3.1 High Level Flows in the WANI Architecture

One Time Flows One-time flows are depicted in red lines in the above figure.

- PDO/PDOA completes self-registration with Central Registry (or provider registry) using their public certificate. At Central Registry they have to register their Wi-Fi Access Points (Hotspots), SSIDs, and Geo-Coordinates.

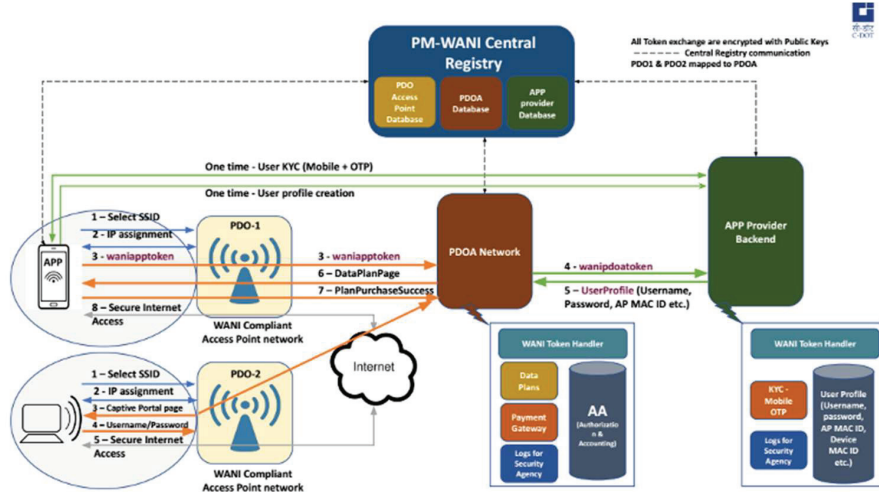


Figure 2 PM-WANI network flow.

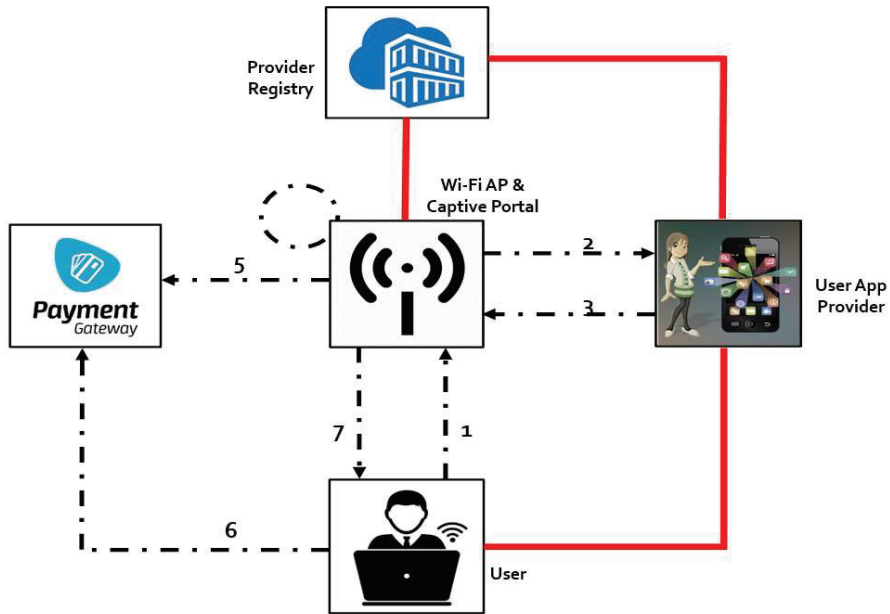


Figure 3 PM-WANI architecture [6].

- User App provider is also registered with Central Registry along with their authentication URL and public certificate as well to validate their digital signature.
- User completes one-time KYC (Know Your Customer) with App Provider through their App. User App caches trusted nearby SSIDs from Central Registry from time to time.

Usage Flows

Usage flows are described in dotted lines in above figure. Bullet number below corresponds to the number represented within the figure above.

1. Users access the App in which they have already registered and allows discovery and connection to PM-WANI compliant Wi-Fi access points. Within the app, user browses for nearby PM-WANI compliant SSIDs and then chooses one SSID to connect with for the internet access.
2. Wi-Fi Captive Portal of the PDO initiates user authentication with App provider in the backend.
3. App provider backend returns a signed user profile token back to Wi-Fi Captive Portal.
4. PDO Captive Portal displays data packs available with their charges. User selects desired data sachet and clicks to confirm the terms.
5. Captive Portal sends request for payment through their payment gateway.
6. User completes payment.
7. PDO activates all device MAC-IDs that were part of the signed profile and allows them to connect to the session without additional authentication. Pack is activated, and user can begin browsing.

3.2 Wi-Fi Access Point Discovery

Users are expected to use some software application (mobile/desktop/etc.) provided by the “App Provider” for user signup, KYC, and profile management. User Application (App) should provide the following key features during user signup and profile management:

- Users install an app from the App Provider.
- App MUST capture user mobile number and does a mobile number verification (via OTP or GSM Mobile Connect or any other mechanisms).
- App also allows creation of mandatory “username” which is unique within the App Provider system. This is shared with Wi-Fi provider during authentication and used for audit and traceability.

- User Application (App) should allow users to discover nearby PM-WANI compliant Access Points by detecting nearby SSIDs and verifying the MAC-IDs against the SSID Registry.
- App should also optionally allow users to save “favorites”, “most recent”, etc. for easy selection of regular connections.
- User App may also provide easy sorting and selection of access points based on the “Tag” attributes such as when AP is available, average speed, rating, etc. This allows users to select best AP out of the available selections.
- User App must provide a mechanism for users to rate the access points and providers.

3.3 Connecting to Access Point and Usage in WANI Architecture

- Whenever users want to connect to public Wi-Fi hotspot using this WANI scheme, they can open their App, browse WANI compliant Wi-Fi hotspots, and click connect.

4 PM-WANI For Village-level Entrepreneurs

Developing a culture of village-level entrepreneurship has been a longstanding goal of the Indian Government. PM-WANI brings an opportunity for entrepreneurship to villages [7]. It is described below.

- In rural areas, low-income tier families still do not have access to the internet.
- An initial capital investment in WANI compliant hotspots will boost entrepreneurship and last-mile connectivity.
- The rural entrepreneur can set up a number of Hotspots around the village, and start distributing internet bandwidth over them at costs reasonable to the consumer base in the area.
- Over time, these hotspots recover the initial amount invested, and start generating profit.
- There are many beneficiaries through this approach: The village, the people residing in it, and the rising entrepreneur who wants to see a developed community and country.

To facilitate ease of doing business and encourage local shops and small establishments to become Wi-Fi providers, the Government has not kept any requirement of license or registration for becoming a PDO and no fees are

<p>Key Partners</p> <ul style="list-style-type: none"> • ISPs • Govt. Telco's - BSNL • Pvt. Telco's (Reliance Jio, Airtel, Vodafone-Idea) • WANI Compliance's manufactures and Application / software 	<p>Key Activities</p> <ul style="list-style-type: none"> • Providing Seamless Data • Aggregate a Broadband services • Managing PDO Data and Customer Authentication Data segments 	<p>Value Proposition</p> <ul style="list-style-type: none"> • Low cost, Low power & Low maintenance (3L) • Environment Friendly • No need for License Authorization 	<p>Customer Relationships</p> <ul style="list-style-type: none"> • VLE's Shop • Customer Care Centre 24x7 	<p>Customer Segments</p> <ul style="list-style-type: none"> • VLE • End Users • Enterprises • Government area • Highly rush Public areas
	<p>Key Resources</p> <ul style="list-style-type: none"> • Investors • Company Management 		<p>Channels</p> <ul style="list-style-type: none"> • Micro Operators/ VLEs • Partnership Telecoms/ISPs • Direct Sales 	
<p>Cost Structure</p> <ul style="list-style-type: none"> • WANI Compliant Software & Application Cost • Cost for the creation of PDOA infrastructure • Aggregation of Bandwidth Cost • PDO Wi-Fi Hotspot funding, Deployment, Operation and Maintenance • Employees and office Cost • Sales and Marketing Cost 		<p>Revenue Streams</p> <ul style="list-style-type: none"> • End users /customer • Advertising 		

Figure 4 The business model canvas – PDOA [8].

required to be paid to DoT. In fact, PDOAs, who aggregate the last-mile providers (PDOs) also do not require any licence. These PDOAs will only have to register, for which no fees will be charged. Unlike licensed TSPs/ISPs who pay a certain percentage of their revenue as licence fee, PDOAs or App providers are not required to share their revenues with the government.

More than 93 PDOAs and 47 APP Providers are already registered in the ecosystem and around 100,000 Access Point radios have been deployed in a very short span of time. This number is expected to grow exponentially in the near future.

There is a tremendous opportunity in India for the proliferation of public Wi-Fi hotspots. PM WANI (PM Wi-Fi Access Network Interface) can result in rapid scale-up of the internet in rural areas, which will be transformative given the low level of penetration (there) compared to urban areas.

The PM-WANI scheme would enable small shopkeepers to provide Wi-Fi service. This will boost incomes as well as ensure our youth gets seamless internet connectivity. It will also strengthen Digital India mission.

India's appetite for data appears to be insatiable, with the country now having over 750 million broadband connections. However, the growth potential is still very high. Probably over 500 million more to be connected, especially in rural areas.

The main objective of this, apart from creating connectivity, and access for all is also job creation. In the new policy, the government has outlined the vision of creating 4 million additional jobs in the telecom sector. And when we look at the kind of potential that WANI platform and the public data office and data office aggregator concepts alone represent. We can, indeed unleash huge employment potential, if we are able to put in place this architecture and make it available for people across the country.

The PM-WANI scheme has taken off well and it is expected to grow exponentially. For the scheme to pick up, many issues need to be resolved. As this is a new and innovative scheme, efforts are needed to create wider awareness about the novel scheme, its technical design, utility of Public Wi-Fi services and associated benefits.

5 Salient Features of PM-WANI Framework

- To facilitate EoDB (ease of doing business) and encourage local shops and small establishments to become the last-mile Public Wi-Fi service providers, it will require no license, and the providers will not need to pay any fees to DoT. Similarly, the PDOAs, who will aggregate the last-mile providers, will also not require any license. These PDOAs will only have to register, for which no fees will be charged.
- PM-WANI framework will also encourage App Providers who will offer services for registering and authenticating users.
- It is expected that with Public Wi-Fi Broadband, the user experience and Quality of Service for Broadband will be improved significantly.
- This service will be useful in rural areas, and the proliferation of Public Wi-Fi Hotspots will lead to increased employment for small and micro entrepreneurs, while providing them with an additional source of income.
- The telecom and internet service providers (ISPs) will also benefit due to the sale of bandwidth to PDOs.

6 Everything On Tower (EOT) – An Innovative & Techno Feasible Connectivity Solution for PM-WANI

Everything on Tower (EOT) [9] is an innovative concept which brings out a solution for creation of public Hotspots for use of the telecom service providers to enable them to provide much needed broadband access to rural

masses as a business case without any perpetual subsidy. It is based on the availability of subsidised internet backhaul as a part of Govt. subsidised national backbone project and making use of existing/abandoned/under-utilised telecom towers or some other existing structure of around 10–15 meters height. This makes use of an innovative rural access technology 5L principles of value innovation namely; Low cost, Low Power, Low Maintenance, Local Control, Local Content (Cloud).

EoT concept intends to use a totally decentralized, distributed and localized partnership model involving rural people, the local bodies and locally available infrastructure of the telco / ISP / Cable Operator/ MHSP, while making use of liberalized framework of PM- WANI and also making use of unlicensed spectrum as well as making use of various concessions given by the Govt.

For deploying telecommunication networks especially those supporting Broadband access, to the geographically large rural areas with the same architecture as in urban areas, per user cost of the infrastructure (CAPEX) and the additionally increased operating cost (OPEX) makes it economically unviable. Therefore, the penetration of the Broadband networks in such remote and rural areas demands new thinking and methods to make the Broadband network operations economically viable. Suitably modified deployment architecture needs to be explored to address the rural Broadband requirements, and innovative business model developed to operate in a sustainable modewith the synergy between the EoT concept and PM-WANI architecture is the answer. This calls for innovative partnerships between various stakeholders and balancing between various judicious mix of technologies & tariff plans which PM-WANI with innovative PDOA business model provides.

Normally the installation of a Wi-Fi Hotspot needs a building space/shelter, a power supply source, a tower on which the access network equipment is to be installed. In addition to the availability of reliable power supply and a backup source, it also requires a lot of cabling to carry the bandwidth from the backhaul termination point to the BTS and from BTS to the antenna. This involves a lot of work, expense and maintenance and contributes to pollution. Under the concept of “Everything on the Tower”, the solution does away with all the above mentioned heavy and costly requirements and physically puts everything on top of the tower in a secured manner. The various network elements which are mounted on tower are omni antenna, filter, backhaul dish, BTS (Controller, power unit, battery, local content server) and solar panel. Such an installation which will have no cable

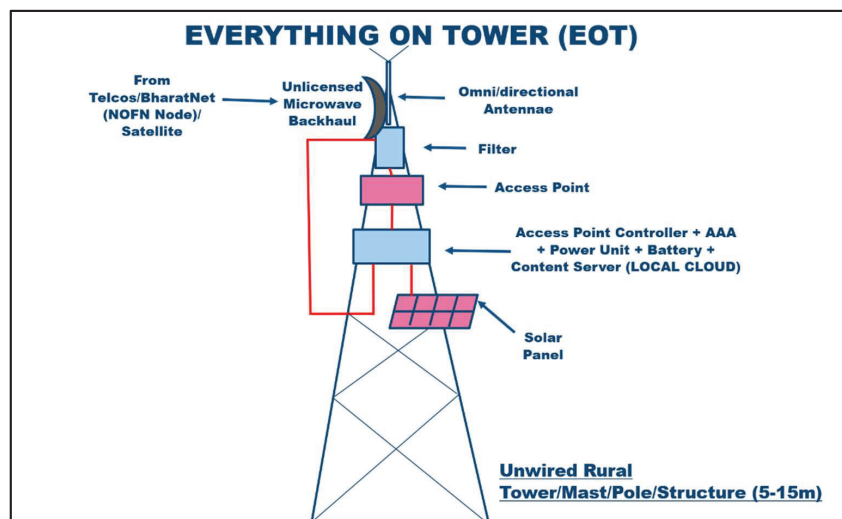


Figure 5 Everything on tower schematic.

connected to the tower has the potential to convert a small village into a hotspot to provide Wi-Fi based broadband access in a very cost-effective manner. The advantage of such solution is that it does not require indoor space, no cabling from building to the tower and no grid power supply connection and more than anything else it is totally green. Such solution can work for more than 30 hours without charging and free from any requirement of external power supply. It is certain to be a reality in many villages of the country during the coming year.

7 Conclusion

The PM-WANI aims to offer a seamless experience to end users, both residents and tourists. To provide a simplified and consistent experience across hotspots from various providers means unbundling authentication, payment and accounting from hardware and software running on the Access Point.

The availability of a robust and reliable broadband connectivity is most critical for the successful implementation of some of the key social sector schemes and programmes in rural areas by the Central and State governments on e-governance, education, health, employment and financial inclusion.

The benefits of the broadband connectivity to the rural population are immense with the convergence of voice, data and video.

As the time and cost are two critical elements for the implementation, the key question is how we can rollout the broadband connectivity to the rural areas in the quickest and most cost-effective manner. The government is highly dependent on the speedy implementation of broadband connectivity for the success of its ‘marquee’ Digital India programme. The concept PM-WANI based Public Data Office (PDO) Wi-Fi hotspots with “Everything on Tower” solution, enables, the creation of hotspots for use by the telecom service provider / internet service providers to enable them to provide much needed broadband access to rural masses as a business case without any perpetual subsidy.

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Biography



Satya N. Gupta, FIETE is an international expert in NGN technologies, Regulation, Interconnection and Broadband with 40 years of experience in all aspects of Telecom, including 25 years with the Govt. and the Regulator. Satya N. Gupta is publicly recognized as an Analyst, Author, Advocate and Advisor on ICT related Policies, Projects and Business. After his post-graduation from the Indian Institute of Science, Bangalore, he joined ministry of Communication in 1981 and Ministry of railways in 1983 and rose to the level of Additional Secretary in the Govt. He is a recipient of coveted Minister of Railways award for outstanding performance for the digitalisation project.

A triple master in Electronics Design Technology, IT Management and Telecom Policy and Regulation, he is globally known as “NGNguru”. He is a trainer and coach for telecommunication technologies, policy and regulation and a Regulatory advocate. He is an author of “Everything over IP – All you want to know about NGN”. He also published a concept called “Job Factory – Converting Unemployment into Intrapreneurship”. His recent 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 mentored a consulting start-up named SAAM Corp Advisors providing Government Affairs as Managed 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 above work on innovating a business model “Hotspots-as-Managed Service”, he has been awarded a Ph.D. (HC) by the Commonwealth Vocational University.

He is Honorary Secretary General of ITU-APT Foundation of India. Additionally, he is Vice-President and Trustee of PTCIF, and Chairs BIF committee on Rural Digital Infrastructure. He founded NGN Forum in India to spread awareness and capacity building in the field of emerging technologies. As a member of Expert panel of Commonwealth Telecom Organisation,

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