

PM-WANI (Prime Minister’s Wi-Fi Access Network Interface) – Technology and Business Case for VLE (Village Level Entrepreneur)

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Abstract -- India has only 3 lac Wi-Fi hotspots in public, as compared to 10 million in America and 13 million in France. Business case of rolling out expensive traditional cellular infrastructure in rural area is unfeasible due to low revenue potential. This paper proposes Wi-Fi access using PM-WANI technology considered an economical and rapid way of connecting the unconnected.

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 can translate into tangible benefits to 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 unbundling of infrastructure to improve performance by different players under this ecosystem. It represents an exciting opportunity to do for data what PCOs did for long distance calling.

Keywords: Public Data Office, Public Data Office Aggregator, Wi-Fi Access Network Interface, PDO, PDOA, PM-WANI, Wi-Fi, Broadband, Rural Connectivity, Village Level Entrepreneur, ISP, DoT, Access Points, SSID, App Provider, Central Registry, Provider Registry, C-DoT

I. INTRODUCTION

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.

Currently, access to data in India is limited due to poor coverage of fiber/ telecom and high pricing of cellular data. Public Wi-Fi hotspots hold promise in last-mile delivery of broadband to users in cost-effective manner. As compared to adding new Long-Term Evolution (LTE) towers, Wi-Fi based

access is much easier to scale. It bolsters connectivity inside buildings, airports, railway stations and other places, where LTE penetration is found to be limited. It allows offloading data access from telecom networks to ease congestion. It will be useful with online coming of the next billion IoT devices. Yet, one finds there are about 3 lac public Wi-Fi hotspots in India, compared to 13 million in France, and 10 million in the United States of America.

Proliferation of broadband across the length and breadth of the country is an essential ingredient of Digital India. To achieve this aim, it is proposed to leverage public Wi-Fi network for providing broadband services. This can be facilitated by rolling out a new technique, termed PM-WANI (Prime Minister – Wireless Access Network Interface) infrastructure. It provides broadband services under distributed architecture [1].

The Covid-19 pandemic necessitated delivery of stable and high-speed broadband internet services to large number of subscribers for enabling WFA (Work from Anywhere). These include areas which do not have 4G mobile coverage. This framework is in tune with National Digital Communications Policy, 2018 (NDCP) of creating a robust digital communications infrastructure.

Since existing service providers are unlikely to deliver public Wi-Fi in remote areas, a new set of local entrepreneurs can be encouraged to be part of the Public Wi-Fi ecosystem in challenging terrains and rural areas.

To realize this goal, the Department of Telecommunications devised a Regulator- recommended model. This innovative and unique model to our requirements involves PDOA (Public Data Office Aggregator) to provide last mile Wi-Fi infrastructure. Here, local entrepreneurs would set up PDOs (Public Data Offices) for access by customers. Interestingly, no telecom license is needed to facilitate multiple PDOs providing public Wi-Fi services, as they work mainly as the reseller for ISPs. Also, PDOs who are venue owners who may not own or deploy any infrastructure and may not have the resources to actually

implement a seamless interoperable system on their own. This is where the role of a PDOA comes in, PDOAs will be registered with the DoT and there will be no limit on the number of PDOs that such a PDOA can aggregate.

II. PM-WANI FRAMEWORK

PM-WANI, is basically an open and de-centralised concept having following features:

- Any entity should easily be able to setup a chargeable public Wi-Fi Access Point.
- Users should be able to easily discover WANI-compliant SSIDs, do one click authentication and payment, and connect one or more devices in single session.
- Procedure to purchase, self-register, set-up and operate a PDO must be simple, low-touch and maintenance-free.
- The products available for consumption should begin from “sachet-sized”, i.e. low denominations ranging from INR 2 to INR 20, etc.
- Providers are unbundled to eliminate silos and closed systems, which allows multiple parties in the ecosystem to come together and enable large scale adoption.

Players in the Ecosystem of PM-WANI Architecture [2]:
 PDO/PDOA: Any Indian entity (companies, associations, small merchants) having a PAN number intending to provide WANI compliant Wi-Fi hotspots. They conform to TRAI rules under this framework.

PDOs will have commercial agreement with licensed Telecom Service Providers or Internet Service Providers for internet connectivity besides with PDOA for aggregation, authorization, accounting, and other related functions.

A PDO can establish multiple Wi-Fi access points and connect with different captive portals of PDOAs.

PDOA will aggregate multiple WANI enabled Wi-Fi Access Points being operated by individual PDOs and authorize the

subscribers, authenticated by the App Provider, to access data services

For payment, PDOA will integrate the captive portal with various digital payment service providers like UPI, e-Wallets, cards, online banking etc.

PDOA will declare tariff structure and keep account of subscribers’ usage of data.

PDOA to maintain details of usage of individual subscriber, internet traffic will route from Wi-Fi Access Point of PDO to the network of interconnecting service provider.

Hotspot Hardware/Software/Service Provider: It comprises a software or service provider, providing software, hardware, services, support for PDOs to set up WANI-compliant Wi-Fi hotspot. Such providers will offer a Wi-Fi-in-a-box solution for PDOs. Their software will need to be compliant to specifications laid out. Additionally, they will also integrate with a bank or a payment gateway for collecting payment from user.

User App Provider: Any company providing a software application and backend authentication infrastructure for users to signup, discover WANI-compliant Wi-Fi hotspots, and do single-click connect from within the app. This app allow 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. This app should allow users to discover WANI compliant hotspots and connect to it. 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.

Central Registry of Providers: A central registry managed by DoT/TRAI or an entity approved by DoT/TRAI containing information about the PDOs/PDOAs, and User App providers in a digitally signed XML format. This is a relatively static registry where approved providers can manage their profiles [3].

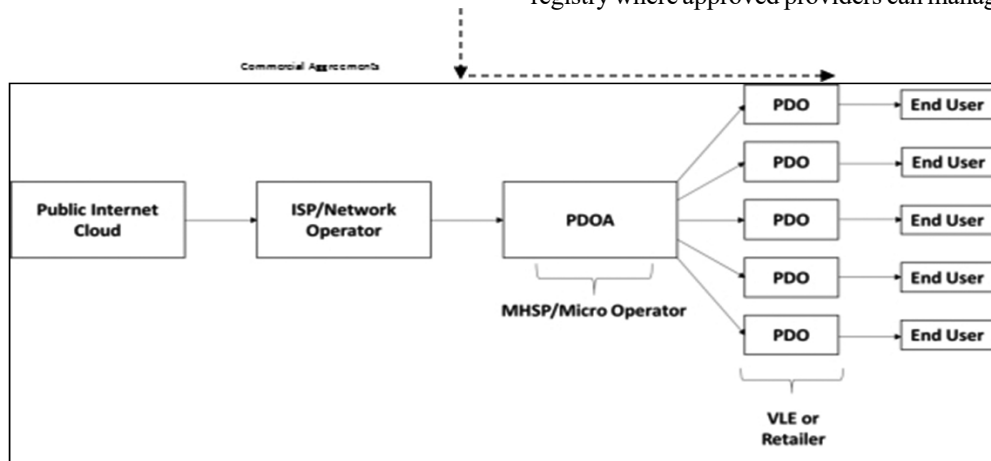


Figure 1. PDOA-PDO Flow Diagram.

III. PM-WANI ARCHITECTURE [4]

High Level Flows in the WANI Architecture:

One Time Flows

- These flows are shown as thick lines in Fig.2. PDO/PDOA completes Self-Registration with Provider Registry using their public certificate (for signature validation). They also register their Wi-Fi Access Points, SSIDs, and locations.
- User App provider is also registered with Provider Registry along with their authentication URL and public certificate (to validate their digital signature). User completes one-time KYC with App Provider through their App.
- User App caches trusted SSIDs from Provider Registry from time to time.

Usage Flows: These are shown as dotted lines in Fig.2. Bullet number below corresponds to the number depicted within the diagram .

1. User opens the App in which user has registered and allows discovery and connection to WANI compliant Wi-Fi access points.
2. Within the app, user browses for nearby WANI compliant SSIDs and then chooses one SSID to connect to. Wi-Fi Captive Portal of the PDO initiates user authentication with App provider backend using the token passed from the app.

3. App provider backend returns a signed user profile token back to Wi-Fi Captive Portal.
4. Wi-Fi Captive Portal displays data packs available with their charges.
5. User selects desired data sachet, click to confirm the terms. Wi-Fi 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.

Access Point Discovery:

- User App should allow users to discover nearby WANI compliant Access Points by detecting nearby SSIDs and verifying the MAC-IDs against the SSID Registry.
- In addition, optionally user App can provide location specific searches and allow users to discover “nearby” Wi-Fi hotspots without being the Wi-Fi range. SSID registry can be cached locally by app smartly for doing location level searches.
- App should also optionally allow users to save “favorites”, “most recent”, etc. for easy selection of regular connections.
- Also, App may also provide easy sorting and selection of access points based on the “Tag” attributes such as when

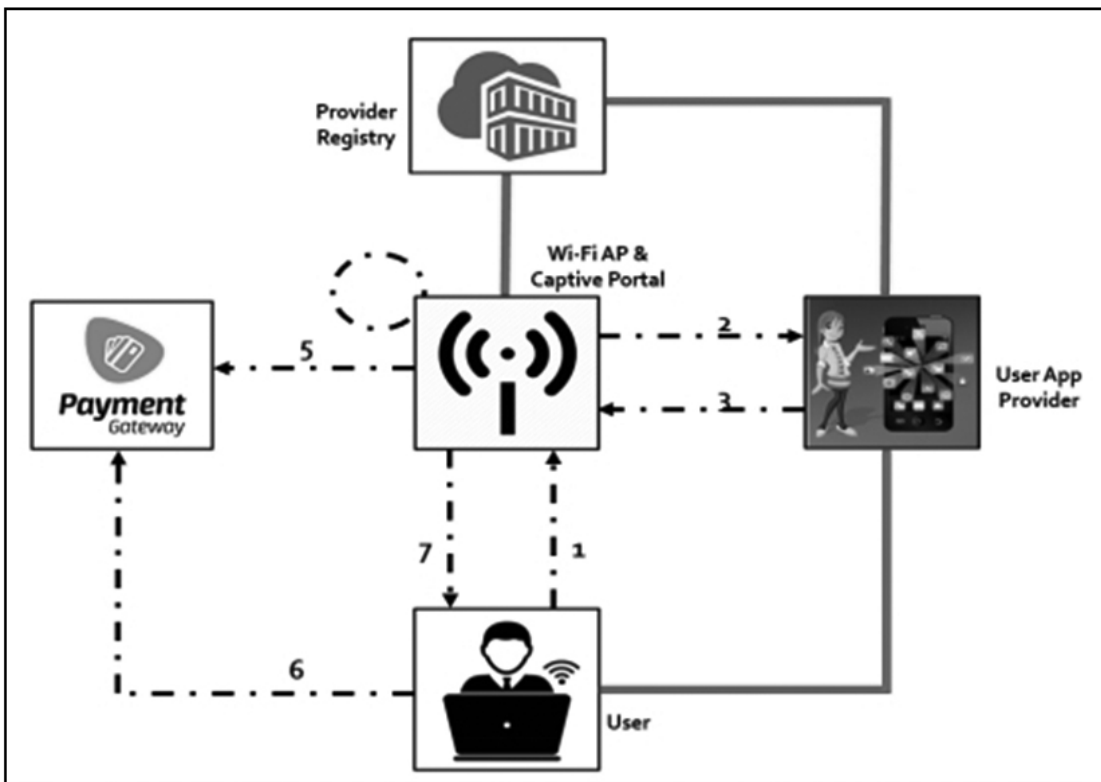


Figure 2. PM-WANI Architecture [5].

AP is available, average speed, rating, etc. This allows users to select best AP within available selections.

- App must provide a mechanism for users to rate the access points and providers.

User Sign-Up and Management in WANI Architecture: Users are expected to use some software application (mobile/desktop/etc.) provided by the “App Provider” for user sign-up, KYC, and profile management. User App should provide following key features during user sign-up 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.
- App should allow user to setup profile with additional *optional* attributes:
 - i. Email – user should be able to optionally setup email for getting alerts, etc.
 - ii. Preferred payment address – This is ONLY for capturing UPI or Wallet address in the form upi://vpa/token (VPA is Virtual Payment Address for UPI collect transaction) or wallet://acc-no@ppi/token. App provider MUST NOT capture or store ANY sensitive information such as credit card number. All other types of payment will be directly handled by Wi-Fi Captive Portal.
 - iii. If the User App is also a payment app (like UPI/Wallet app), then additional optional token string can be used to provide auto-deduct/offline/other additional payment functionalities.
- App MUST also allow users to easily add/remove devices (MAC-ID and a name) which they want to connect to various Wi-Fi hotspots.

IV. WANI COMPLIANCE REQUIREMENTS

For Wi-Fi Provider:

- Captive portal must allow standard connection and authentication as per this specification.
- Wi-Fi Provider must provide choice to user to select a package with clear details of the package.
- Captive portal should respect and handle preferred payment scheme for users and allow seamless collection of payment once the package is selected.
- Wi-Fi provider must comply and be certified with regulatory and security rules for payment transactions, auditing, and storage/handling of any sensitive payment information.

For App Provider:

- App provider must provide an App to user (for any device/OS based on market needs) and comply with user sign up, profile management, and authentication specifications as per this document.
- App provider must ensure user data is strongly protected to ensure user privacy and data security is ensured.
- App provider must have a mechanism to allow regular app update and improvements.
- App is encouraged to provide good user interface for consumers to easily discover, search, find best access points, and connect to it with single-click.

V. PM-WANI FOR VILLAGE-LEVEL ENTREPRENEURS

Developing a culture of village-level entrepreneurship has been a longstanding goal of the government. PM-WANI brings an opportunity for entrepreneurship to villages [6]. Here’s how:

- 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 10 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 profits.
- There are many beneficiaries through this project: The village, the people residing in it, and the rising entrepreneur who wants to see a developed community and country.

More than 93 PDOAs and 47 APP providers are already registered in the ecosystem and around 1 lakh 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 can result in rapid scale-up of the internet in rural areas, which will be transformative given the low level of penetration compared to urban areas.

The PM-WANI scheme will boost incomes as well as ensure our youth get 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 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.

TABLE 1-- THE BUSINESS MODEL CANVAS - PDOA [7]

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
ISPs Govt. Telco's - BSNL Pvt. Telco's (Reliance Jio, Airtel, Vodafone-Idea) WANI Compliance's manufactures and Application / software	Providing Seamless Data Aggregate Broadband services Managing PDO Data and Customer Authentication Data segments	Low cost, Low power & Low maintenance (3L) Environment Friendly No need for Licence Authorization	VLE's Shop Customer Care Centre 24x7	VLE End Users Enterprises Government area Highly rush Public areas
	<i>Key Resources</i> Investors Company Management		<i>Channels</i> Micro Operators/ VLEs Partnership Telcos/ISPs Direct Sales	
Cost Structure 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			Revenue Streams End users /customer Advertising	

VI. SALIENT FEATURES OF PM-WANI FRAMEWORK

- To facilitate ease of doing business and encourage local shops and small establishments to become Wi-Fi providers, it has been approved that the last-mile Public Wi-Fi providers will require no licence, no registration and will not need to pay any fees to DoT.
- PDOAs, who will aggregate the last-mile providers will also not require any licence. These PDOAs will only have to register, for which no fees will be charged. The registration process will be completed within 7 working days of the receipt of applications.
- PM-WANI framework will also encourage App Providers who will offer services for registering and authenticating users.
- The potential user who wants to access broadband through Public Wi-Fi will need to download the relevant App, get authenticated, and thereafter access broadband at any Public Wi-Fi hotspot. When the user reaches a Public Wi-Fi hotspot, the App on the mobile phone will show various available networks. The user can then choose the Public Wi-Fi network of choice, pay an amount – either online or through voucher – and use the network till the balance is exhausted.
- 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 especially useful in rural areas where public Wi-Fi hotspots are also being created under BharatNet. Proliferation of public Wi-Fi hotspots will lead to increased employment for small and micro entrepreneurs, and provide them with an additional source of income.

- The telecom and internet service providers will also benefit due to the sale of bandwidth to PDOs.
- Made in India Wi-Fi access points are envisaged to be encouraged for use in PM-WANI, thereby encouraging Atamnirbhar Bharat.

VII. CONCLUSION

The PM-WANI offers a seamless experience to end users, both residents and international travelers. To provide a simplified, consistent experience across hotspots from various providers essentially means unbundling authentication, payment and accounting from hardware and software running on the Access Point [4].

This will allow small entrepreneurs such as tea shops, to set up and maintain Access Points. Device manufacturers, payment companies, ISPs/ Telcos and Consumer Internet companies can provide the remaining pieces to set up Public Data Offices (PDOs).

The Wi-Fi Access Network Interface represents an exciting opportunity to do for data what PCOs did for long distance calling. It will give opportunity to a new generation of entrepreneurs to bridge the need of last mile connectivity. The project will benefit 100's of millions of users in India waiting to get affordable access to internet but data security issues and setting up of such a huge infrastructure for Wi-Fi may create some problems.

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Dr. Satya N. Gupta, FIETE CEng, DIISc, DRP, IRSSE (VR) is currently secretary general of ITU-APT Foundation of India, chairman, Bharat IPv6 Forum, chairman, Bluetown India & BIMSTEC, S. Asia , chairman, Blockchain for productivity.

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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, 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. He is first Indian recipient of IPv6 Hall of Fame Award – 2019 by Global IPv6 Forum and also the Chairman of Bharat IPv6 Forum.

Presently, he is working as 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”.