PUNE RESEARCH SCHOLAR ISSN 2455-314X
AN INTERNATIONAL MULTIDISCIPLINARY JOURNAL VOL 3, ISSUE 2

A Study on Extending Digital India To Rural Areas using UHF-TV White Spaces

DR. D. SIVAKUMAR**
Department of IT
Easwari Engineering College
Chennai, India
dgsivakumar@gmail.com

H.AMRA JEELANI BIJLI*,
S.KEERTHANA SUNDARAVALLI*
Department of IT
Easwari Engineering College
Chennai, India
amra.ajb06@gmail.com, keerthuselva1524@gmail.com

***Abstract*— The emergence of Information and Communication Technology (ICT) has proved to be a vehicle for faster and better communication, retrieval of data and utilization of information to its users.e-Governance is basically the application of ICT to provide government services to the citizens through internet. In other words, e-Governance involves ICTs, especially the internet, to improve the delivery of government services to citizens, businesses and government agencies. The use of internet not only delivers the services faster but also brings more transparency between the government and the citizens. Latest surveys show that internet penetration into the rural population of India is a meagre 10% than current digital market in India. Our objective is to extend the e-Governance of Government of India (GOI) to digitally cornered rural areas,so that India can be transformed into a digitally empowered society and knowledge economy. Our idea put forth the design of Broadband Infrastructure that exploits the cutting edge technologies of Wi-Fi and TV UHF for providing rural broadband connectivity. This idea ensures to provide the sustainable infrastructure to every citizen so that the Governance and Services can be provided on demand which will pave the way for digital empowerment of citizens.**

Keywords*— *e-governance; Wi-Fi; UHF-TV white spaces; GOI

I. INTRODUCTION

Over the past years, India has witnessed a tremendous increase in wireless telecom connectivity. Telecommunication has supported the socio-economic development of India and has played a significant role to narrow down the rural-urban digital divide to some extent. India is the world's fastest growing industry in the world in terms of number of wireless connections after China. India has the world's second-largest Internet user-base. The total number of broadband subscribers, including wireless data plan subscriptions and wireless dongle users, is 120 million. Of this, only 16 million users are subscribed to wire line broadband services. The rural India scenario is even worse. With this wireless telecommunication connectivity, a wide range of e-Governance services are provided by the Government to the people, thus increasing the reach of government both geographically and demographically.

In E-Governance, government makes effective use of internet technology to communicate and provide information to common people and businessmen. All are dependent on internet and when citizens depends on government internet services all that come is E-Governance. Despite the successful implementation of many e-Governance projects across the country, it has not been able to make the desired impact and fulfill all its objectives. Though in developed countries like USA, UK, China the e-Governance was initiated long back and now it is successfully practiced. But in developing countries like India, it is still in growing phase. Fiber connectivity in terms of backhaul is limited in India and only some designated points in the town or city can be reached while rural areas were not provided connectivity. The problem of connecting the Wi-Fi clusters to the optical fiber points can be addressed using a TV whitespace backhaul.

II. E-GOVERNANCE IN GLOBAL CONTEXT

With the advent of ICT, many governments have taken steps to use this as a tool to modernize their workings and as a result, it has impacted both the service provider i.e. government and the recipient (the citizen). The government officials have adopted the tools and technologies like Internet, www, servers, browsers etc., as a normal part of their lexicon. The result of this impact has been that internal processes have been reengineered, delivery mechanisms have been streamlined and standardized, new approaches have been adopted for data privacy and security and unmanned delivery points have been accepted as normal, while validations have become automatic. It has ensured better transparency and efficiency thus encouraging the citizens to be enthusiastic participants instead of cynical users, thus making the complete

process more democratic. New benchmarks have been created in all the changes mentioned.

Gartner defines e-Government as "the transformation of public sector internal and external relationships through Net-enabled operations, information technology and communications, to optimize government service delivery, constituency participation and governance" (as in "Assessing e-Government Readiness: for Public Sector Agencies").

ICT, especially Internet, being a powerful tool, provides immense potential for the government to improve its servicing of the citizens ("The potential of Internet technologies: insights from the public sector"). However, this potential can be converted into results provided the hurdles like low quality manpower, absence of reward mechanism for the efficient are removed, and ICT tools and strategies are used appropriately (as in "Creativity, leadership and change", "Electronic service delivery in public administration: some trends and issues", "The potential of Internet technologies: insights from the public sector"). For example, lack of efficient and structured process and resistance to change them, lack of coordination among various departments for providing single window facility, which ICT tools make easy, and improper monitoring methodology remain major challenges for the governments adopting e-governance ("Organizational challenges to the development of electronic government"). National e-Governance Plan (NeGP) targets to provide all government services to the common man in his own locality, through state wide area networks SWAN. For the efficient e-governance of Government of India, ("A Case Study on VoIP over WMN based architecture for future e-Governance of Indian rural areas")puts forth a case study on VoIP over Wireless Mesh Networks in order to extend the low cost communications to the Indian rural areas.In addition to this, other enablers of e-governance will be skilled and motivated manpower to move continuously along the learning curve, an environment that encourages research and innovation to improve the system and hardware of correct specification like servers, broadband network etc., to facilitate the research by the manpower of right quality("Building the Knowledge Society: Report to government")

III. E-Governance in India

The governments, both at the center and at the states, in India have taken the e-governance seriously and have been continuously endeavoring to provide citizen services in a better manner. There have been several successful initiatives and many noteworthy case studies have been prepared on these.

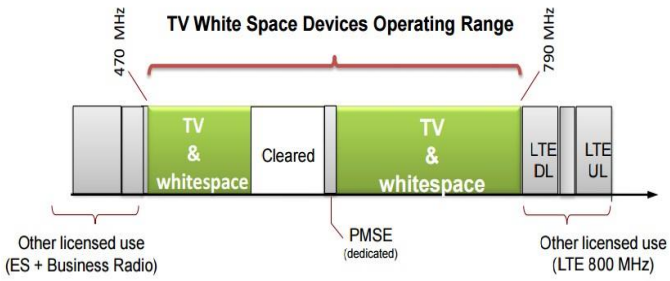
A. Scope of Study

During the era of a new industrial revolution, driven by the developments of Information and Communication Technologies (ICTs) and the Internet, which have considerably influenced patterns of working, living, socializing, producing, marketing, cooperating, interacting, etc. There is strong potential for ICT to advance the socio-economic well being of India's rural poor but this potential has yet to be tapped into the current existence. The success of ICT in rural areas will require many changes to the current landscape (e.g. increased availability of education, training, infrastructure, and affordable ICT capital). The whole world is moving towards e-governance, but India still lacks in the literacy department. The people need to be educated and made e-literate for e-governance to flourish.

The Digital India programme is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy. Government of India launched National e-Governance Plan (NeGP) in 2006. Despite the successful implementation of many e-Governance projects across the country, e-Governance as a whole has not been able to make the desired impact and fulfill all its objectives. The rural infrastructure existing presently is inadequate while deploying e-governance at full scale and needs to be improvised monumentally. Ultra high frequency (UHF) TV band spectrum has very good wireless radio propagation characteristics. Geo-location of UHF map to be produced important mirror server in gram panchayat will reduce traffic and has the open PAWS based DB. Wi-Fi enabled devices are available everywhere makes communication cheaper. The providing ICT will promote the life of rural people socially and economically. It brings every citizen of India under a single roof of e-Governance

B. Existing e-Governance framework in India

"White spaces" refers (shown in Fig.1)to geographical areas where the radio spectrum is not used by the licensee (because to do so would cause interference to the licensee's services elsewhere). Access to the UHF TV band by white space devices (WSDs) would be subject to the protection of incumbent licensees (mostly DTT). TV white space devices are location aware. They check with a central database what frequencies are safe to use in their location. India belongs to Region 3 of the ITU terrestrial spectrum allocations.TV UHF bands radio propagation characteristics are much better than those of unlicensed band such as 2.4 and 5 GHz.TV UHF band consists of 15 channels of 8MHz each.



Apart from 8-16MHz band depending on the location, the Tv UHF is not utilized in India.

Fig. 1. TV-UHF

TV white space (TVWS) geo-location database is being used for the protection of the terrestrial TV broadcast receivers, and the coexistence of secondary devices. To the best of our knowledge, though TV White Space calculations are available, an active online database does not exist for India. A standardized protocol to access the TVWS database on readily available hardware platform is implemented. A hardware prototype, which is capable of querying the TVWS database and operating in the TV band without causing harmful interference to the TV receivers in UHF TV bands, is developed.

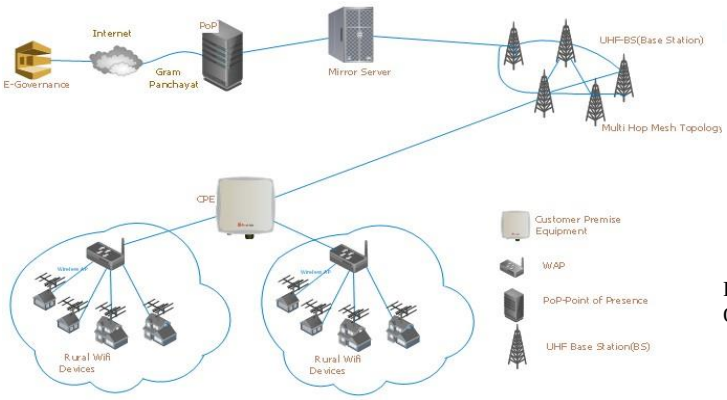


Fig. 2. Sustainable e-Governance using UHF TV White Spaces

Our idea puts forth the design and implementation of Sustainable Broadband Infrastructure that exploits the cutting edge technologies of Wi-Fi and TV UHF for providing rural broadband connectivity. While the broadband through optical fiber based Pop will connect the Gram Panchayats, the connectivity between the Gram Panchayat and the village users is a tedious task. The UHF TV Whitespaces which is capable of providing broadband services are heavily underutilized in India which has been recently proved to be a sustainable solution for broadband connectivity in villages. A UHF base station operating at 54 MHz-790 MHz that forms mesh backhaul will be used for connecting the Gram Panchayat's Pop and the village Wi-Fi AP. The UHF base station that consumes 5-10 watts can be powered up by solar panels. The IEEE 802.11af Long Range Wi-Fi that operates 2.4GHz/5GHz ISM bands is the potential solution to provide the low cost internet access. UHF customer premises equipment (UHF-CPE) acts as middle station between UHF-BS and Wi-Fi AP. The mirror server is hosted in gram panchayat office which includes TVWS online Database and e-Governance Local Database. The TVWS online database gives the geo-location information of TV white spaces, so that it will not interfere incumbent devices. The e-Governance Local Database gives the local access to the officers and minimizes the data traffic.

PAWS categorizes a White Space device as either a Master or a Slave device. The PAWS protocol defines a Master device as a "device that queries the database, on its own behalf and/or on behalf of a slave device, to obtain available spectrum information". The PAWS server is a web server located at a remote location. This server hosts the White-Space database. This is a MySQL database listing out all possible channels available for transmission corresponding to a particular geo-location.

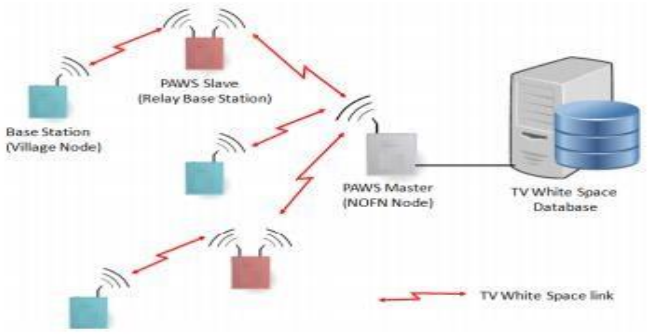


Fig. 3. Architecture for database assisted operations Overview of OpenPAWS protocol

The protocol specifies a sequence of procedures to be followed by the PAWS Master device, PAWS Slave device and the database, are outlined below:

1) During bootstrapping, the Master device locates or discovers the regulatory domain for its location and the Uniform Resource Locator (URL) for the database to send subsequent PAWS messages.

2) The Master device then establishes an Hypertext Transfer Protocol (HTTP) session with the database.

3) An optional initialization message (INIT REQ) is sent to the database by the Master device.

4) The database responds to the initialization message with an initialization response (INIT RESP).

5) Based on the regulatory domain, the Master may have to register itself with the database using the registration request (REGISTRATION REQ) message.

6) If the database receives a registration request, it registers the Master device and sends a response (REGISTRATION RESP) to the Master device.

7) Once the initialization and registration procedures are completed, the Master device can query the database for a list of available channels using an available spectrum request (AVAIL SPECTRUM REQ) message to the database. This process is shown in Fig 7.

8) The database sends the list of available channels at the Master device's location using the available-spectrum response (AVAIL SPECTRUM RESP) message.

9) The Master can send the AVAIL SPECTRUM REQ message by itself, or for a Slave. If the Master queries the database for a Slave, the Slave device may be validated by the database using the DEV VALID REQ and DEV VALID RESP messages.

10) The Master device can use spectrum use notify (SPECTRUM USE NOTIFY) message to inform the database about its decision to operate on a particular channel. The database notes this and sends a spectrum use response (SPECTRUM USE RESP). This message is optional as PAWS does not concern the interference between secondary users .

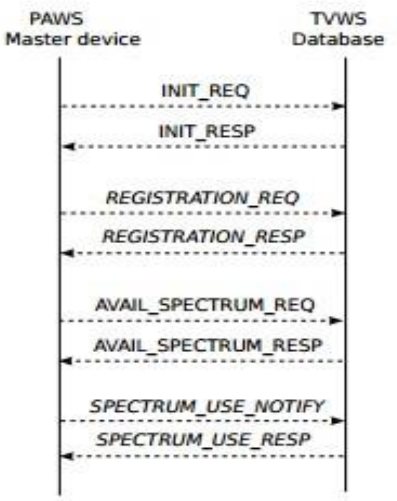


Fig. 4. Messages exchanged between PAWS Master device and the database

Customer-Premises Equipment (CPE) refers to communications equipment that resides on the customer's premises whether it is a home or business. Industrial-grade CPEs for enterprise networks deliver high-speed data services with a Web-based GUI for configuration and remote management. Offers a wide range of mobile access frequencies (1.8 GHz/2.3 GHz/2.6 GHz/3.5 GHz/3.7 GHz) to accommodate existing broadband resources. Features remote management for easy deployment of current and future broadband resources, centralized fault detection, and recovery. Suitable for common and harsh environments, complies with 3GPP LTE standards, and has an enclosure that provides lightning protection, is shockproof, and meets ingress protection IP65 standards, which means the unit is rated dust-tight and is protected against water projected from a nozzle.

A wireless access point (WAP) is a networking hardware device that allows a Wi-Fi compliant device to connect to a wired network. The WAP usually connects to a router (via a wired network) as a standalone device, but it can also be an integral component of the router itself. A WAP is differentiated from a hotspot, which is the physical location where Wi-Fi access to a WLAN is available.

a.

IV. Rural Focus and Conclusion:

In India, rural population constitutes 70% of total. However, the initial phases of e-government initiatives should be in urban areas for ease of environment management and moving up the learning curve towards stability in the framework. Rural India faces the problems of severe lack of infrastructure, patronizing attitude of government officials, low human content (illiteracy, rigid social structure, etc.) and low financial capacity of the users (to pay for the services).A country like India needs e-governance to provide the facilities to its citizens. Most of the projects are fulfilling limited needs properly, but they need a holistic approach to progress this to make it self-sustainable in the long-term.

References

[1] Animesh Kumar et al, "Toward Enabling Broadband for a Billion Plus Population with TV White Spaces," IEEE Trans ,vol 54,issue-7,Year-2016

[2] Gazi Zahirul Islam, Md. Ibrahim Khan, Md. Anas Boksh Mazady "Developing a model of E-governance for urban and rural areas of Bangladesh", Year – 2008

[3] Gaurang Naik et al, "Quantitative Assessment of TV White Space in India", proceedings of IEEE NCC , Year- 2014

[4] LIU Liu, LIAO Xiao-ming"On SHEL Model Analysis and Constitution --the Research on Chinese Government's E-governance System Based on the Concept of Good Governance" , Year – 2011

[5] S. Ghosh et al.,"OpenPAWS: An Open Source PAWS and UHF TV WhiteSpace Database Implementation for India," Proc. 21st IEEE Nat'l. Conf.Commun., Feb.2015, pp. 1–6.

[6] J. van de Beek et al., "TV White Space in Europe," IEEE Trans. Mobile Computing, vol. 11, no. 2, Feb. 2012, pp. 178–88.

[7] Aichholzer G. and Schmutzer R. (2000), "Organizational challenges to the development of electronic government", DEXA Workshop, pp. 379–383.

[8] Bichard M. (2000), "Creativity, leadership and change", Public Money & Management, vol. 20, no. 2, pp. 41– 46.

[9] Bekkers V.J.J.M. and Zouridis S. (1999), "Electronic service delivery in public administration: some trends and issues", International Review of Administrative Sciences, vol. 65, no. 2, pp. 183–195.

[10] Information Society Commission (2002), "Building the Knowledge Society: Report to government", Information Society Commission, Department of the Taoiseach, December; www.isc.ie

[11] McIvor R., McHugh M. and Cadden C. (2004), "The potential of Internet technologies: insights from the public sector", New Technology, Work and Employment, vol. 19, no. 1, pp. 63– 75.

[12] TiG/ MTW, Inc. (2003), "Assessing eGovernment Readiness: for Public Sector Agencies", Assessing eGovernment Readiness, TiG/ MTW, Inc.; www.mtwcorp.com.

[13] B. D. Loyd and D. Sivakumar, "A case study on VoIP over WMN based architecture for future e-Governance of Indian rural areas ,"2015 IEEE Technological Innovation in ICT for Agriculture and Rural Development (TIAR), Chennai, 2015, pp. 66-71