# Everything On the Tower (EOT) - Creating a Green Public Hotspot on Unwired Rural Tower

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*Abstract* - **As part of Digital India mission of the government to make "Broadband for All" a reality in the near future, there is a great buzz about WiFi everywhere specially in urban areas wherein people are expecting free WiFi access in times to come. Though there is not much talk about rural WiFi. EOT concept appears to be the only solution to provide broadband access to rural masses in a cost effective, timely affordable and sustainable manner.**

**For making delivery of high speed broadband access in the hands/ homes of rural people some very low cost, low power & low maintenance technical solution is required which can reduce the cost to minimum possible by making use of existing infrastructure and unlicensed spectrum which is free. Also in many villages of rural India, there is acute shortage of grid power supply which is also highly unreliable. In addition, there is unavailability of suitable indoor space for installing the network equipment and keeping it safe and secured. Due to all the above challenges, there is a perceived lack of a business case for rural broadband access and that is why not many players are talking about it. This paper brings out an innovative concept which can lead to a sustainable business model of hand delivery of broadband access to rural masses.**

*Keywords: Broadband, Everything on Tower, 5L Principle, BlueTown, National Optical Fibre Network*

## I. INTRODUCTION

EVERYTHING On the Tower (EOT) is an innovative concept which brings out a solution for creation of a 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 NOFN project of government and making use of abandoned /discarded telecom towers of MARR legacy or some other existing structure of around 10-15 metres 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.

Normally, the installation of a 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 lot of cabling to carry the bandwidth from the backhaul termination point to the BTS and from BTS to the Antenna. This involves lot of work, cost and maintenance and also creates pollution.

Under the concept of "Everything On the Tower", the solution does away with all the above mentioned cumbersome and costly requirements and physically puts everything on top of the tower in a secured and safe 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 installation which will
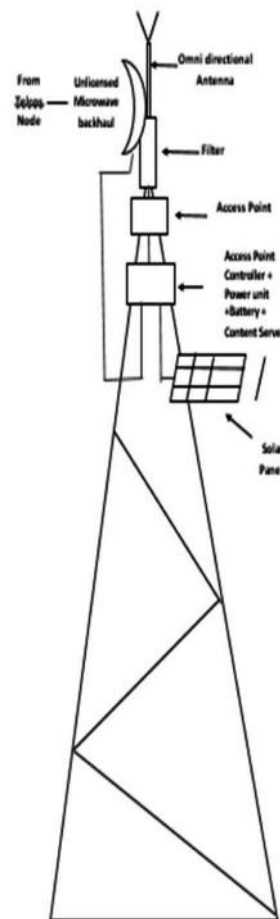


Figure 1. Everything on Tower (EOT) – A schematic.

have no cable connected to the tower has the potential to convert a small village into a hotspot to provide WiFi based broadband access in a very cost effective manner. The advantage of such solution is 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 country during the coming year.

## II. THE LIVE CASE STUDY

A Proof- of Concept (POC) conducted at Arian block of Ajmer District (BBNL Pilot site) made use of low-cost solution to provide the last-mile access using unlicensed (Wi-Fi) band of 2.4 GHz, existing infrastructure of public Telco and local Access Point Controller to provide public access through managed Hot-Spot. This pilot is being run by M/s BlueTown, a Denmark based innovative technology company in association with BSNL, the Public sector Telco.

BlueTown provided all the Wi-Fi network equipment such as antennas, Access Points and Controller while utilizing the BSNL towers and shelter infrastructure. The special contribution of BlueTown is an integrated, miniaturized, low-powered and low-cost Wi-Fi Access Point Controller powered by solar panel and rechargeable Lithium-ion batteries. The power requirement of 3APs and a Controller being less than 20 Watts only, the system can work up to 30 hrs without any charging.

The AP Controller provides the functionalities of power control, charge control, RF control, bandwidth management, quality, security and authentication management as well as POE for APs. In its functionality, it is similar to BSC of a cellular network and facilitates the creation of a managed Wi-Fi Hot-spot, while utilizing off-the-shelf outdoor APs. The backhaul bandwidth of 10 Mbps is provided by BSNL in partnership with BBNL on trial basis. BlueTown has also installed their billing

and authentication server at BSNL Broadband NOC at Ajmer which also has the capability of generating pre-paid coupons for distribution to consumers while authenticating their credentials.

The conceptual diagram of such a solution which has also been deployed in rural areas of Africa is shown in Figure 2.

## III. SALIENT FEATURES

Salient features of the POC results of such trials at 2 GPs in Ajmer District are following:

1. Range of 1 Km radius with 25 meter tower and 0.5 Km radius with 5 meter (rooftop) tower is achievable, while restricting the APs power to permissible limits.
2. System can sustain for 30 hrs without availability of any electricity and can charge itself through solar panel beyond that.
3. All the requirements of Authentication can be achieved through pre-paid coupons or authentication through mobile connection.
4. Users experience has been better than 3G Data connection.
5. Use of miniaturized Lithiumion batteries in the project having 30 hrs capacity without charge.
6. Miniaturized, integrated and PCB based WiFi access point controller powered by solar power and supporting the functionality of Web Camera.
7. Extremely low voltage (16V) and power consumption (20W) of access point controller and outdoor access point.
8. Use of existing infrastructure of BSNL/BBNL/CSC to reduce the CAPEX.

## IV. HOTSPOT- AS- A- MANAGED SERVICE

The Access point (AP) controller provides functionalities of power control, RF control, bandwidth management, quality security and authentication management as well as POE for APs. In its functionality it is similar to BSC of a cellular network and facilitates it is similar to BSC of a cellular network and facilitates the creation of a managed Wi-Fi Hot-spot, while utilizing off the shelf outdoor Aps**.**
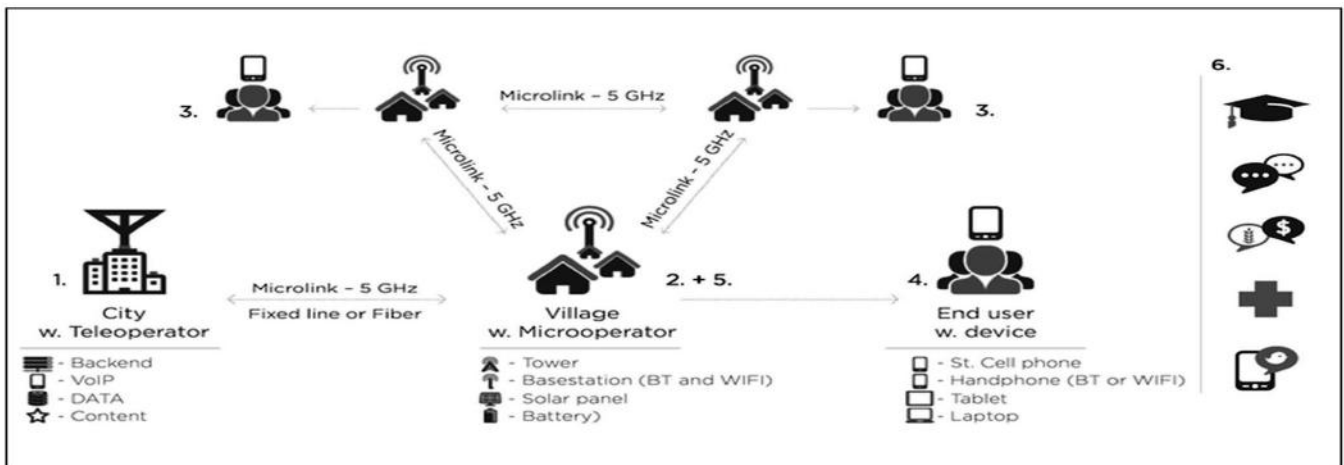


Figure 2. Communication-solution deployed in rural areas of Africa.

National Optical Fibre Network (NOFN) project which constitutes one of the nine pillars of PM's "Digital India" mission aims to connect 250,000 Gram Panchayats (GP) with 100 Mbps backhaul through optical fibre. Though the progress on this mission mode project of national importance is happening in its own style, there is not much talk about the Last-Mile access to end-users which may become a missing-link in end-to-end connectivity. This paper illustrates a technical solution and way forward to plug this gap in a speedy, cost-effective and sustainable manner.

As per the national broadband plan, bandwidth of 100 Mbps will be terminated in every GP of the country at a location working as Common Service Centres (CSC) which provide citizen services like e-mitra, e-seva, birth/death certificate, land records, computer training, etc. to the people living in the rural areas. This will be a very limited and restricted use of the valuable Internet connectivity reaching the GPs through a capital-intensive NOFN.

To make the best use of this national infrastructure, it needs to be distributed outside CSC for various purposes such as providing internet access to the government institutions like hospital, post office, schools, etc. as well as to deliver it to homes and the rural masses through Last-Mile access as a sustainable business case.

To provide such Last-Mile access in speedy, cost effective manner and affordable manner, some innovative technical solution and business proposition is required as the conventional technologies cannot help the conventional ROI based business case.

A Proof- of Concept (POC) underway at Arian block of Ajmer District (BBNL Pilot site) makes use of low-cost solution to provide the last-mile access using unlicensed (Wi-Fi) band of 2.4 GHz, existing infrastructure of public Telco and local Access Point Controller to provide public access through managed Hot-Spot. This pilot is run by M/S BlueTown, a Denmark based innovative technology company in association with BSNL, the Public sector Telco.

## V. NEED FOR MORE LICENSE-EXEMPT SPECTRUM AND LAYERED APPROACH

Figure 3 depicts an innovative solution for next generation spectrum management, in the form of a tiered approach (Divide and Rule) which has been exploited by Internet and NGN to make the network and system efficient. Going by the learning that "One Size does not Fit All" the spectrum management can be done in a Pyramid mode dividing the allocations in separate layers of Exclusive Allocation, Dynamic need-based Allotment and Licence- Exempt usage to get best of both the worlds. This can result in meeting the QOS requirement of Basic services and super-efficient

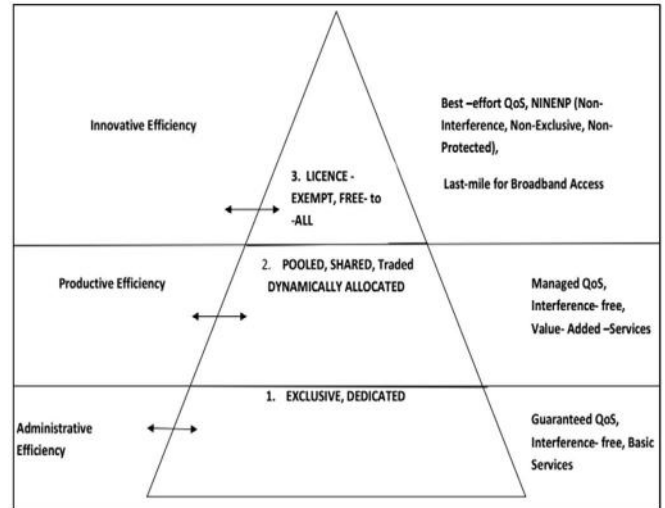usage for value-added services including Broadband and emerging innovative applications.



Figure 3. Layered Approach for Spectrum Allocation.

As per the above structure, the spectrum allocation can be divided into 3 distinct layers as following:

*Exclusive, Dedicated Allocation:* This layer makes use of conventional way of spectrum allocation which is generally done through auction. This should be used for start-up spectrum to an operator for providing QOS based basic services wherein degraded quality as well as Interference is not tolerated *e.g.* 2G and 3G voice services Major part of the upfront revenue requirement of Govt. can be met through this chunk, but the optimum utilization of spectrum in this method is not ensured.

*Dynamic Spectrum Exchange:* This is the main theme of the paper based on the principals of Spectrum sharing. Any requirement of additional spectrum beyond start-up spectrum by an operator should be met through dynamic allocation from Pooled spectrum which should be demand assigned (DAMA, Demand-Assigned Multiple Access, used in space communications). For this use of Public Switched Spectrum Pool (PSSP) could be made on dynamic allocation basis. Generally, a major chunk of popular spectrum at 'sweet spots' in 800, 900, 1800, 2100 MHz band amounting to around 300 MHz needs to be allocated through this route. Actually, the most efficient allocation and usage of radio spectrum for QOS-oriented services can be done through dynamic sharing basis by creating a Common Pool of Add-on spectrum, allocated based on need and demand for Add-on spectrum by existing operators and charged based on usage without any upfront payment. As the operators are made to pay per usage based, they are saved of 'Winners Curse' which is countered in Auctions, but eventually the government ends up earning more due to payment linked

to usage which becomes multiple time than the dedicated allocation. Any additional chunks of spectrum, being vacated fully or partially by public, state and defence forces are the ideal candidates for this approach. To start with, this concept can be tried for about 100Mhz chunk coming out of "Digital Dividend" band in 700 MHz.

*Licence-Exempt Spectrum* - This is the top of the pyramid and most efficient way of spectrum utilization. It is ideally suited for "Best-Effort" services like Broadband (Wi-Fi). Though government does not earn any upfront revenue from this, but the societal returns on its wide spread exploitation are immeasurable. In addition to last- meters broadband access powered by FTTX, this can also be used for Data-offload (to spare the dedicated spectrum for Voice) and also the In-Building Solutions for Voice through FMC (Fixed Mobile Convergence). World over around 450 MHz of such spectrum in 2.4,5.1 and 5.7 GHz is unlicensed for such applications but in India around 150 MHz in 2.4 and 5.8 GHz band only is made available under this and that also with lot of technical restrictions. We also have to remember that consistent with what is happening around the world, and also consistent with the need of universal provision of all services to the entire populace, this layer of delicenced spectrum will be the norm and the dedicated spectrum allocation will be an exception.

*Recommendations for Way Forward*

- Deploy more and more managed Hot- Spots in rural areas and revenue – share basis by using existing infrastructure to provide carrier grade public broadband access.
- Make more WiFi spectrum unlicensed in 5.1- 5.3 GHz band
- Allocate trail spectrum for White – spaces (Digital – Dividend)
- Provide VGF (Viability Gap Funding) for rural access network in line with National Backbone Network (NOFN) and mobile telephony in NE/ LWE areas.
- Involve local bodies (GPs, Municipalities) as stakeholders.
- Facilitate "Make in India" of WiFi access point controllers and other modules
- Create a social business for "Blue -Collared Job Factory to train VLE.
- Let us "Make It happen" together (USOF, PSUs, Industry), PPP (Panchayat, Public, Private Partnership)
- Govt. should make more spectrum unlicensed in ISM bands as well as in other emerging bands for rural broadband access.
- USO Fund should come out with a scheme to fund the Capex for active access infrastructure in rural areas.
- 100 Mbps bandwidth at the GP level should be increased to 1 Gbps so that people can access the internet at a faster speed and better quality of service.

## VI. CONCLUSION

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 of "Everything on Tower" solution, pioneered by the author, enables, the creation of public hotspots for use of the telecom service provider 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 the subsidised internet backhaul as a part of NOFN project of government or through PSU telco like BSNL and making use of abandoned / discarded telecom towers of MARR legacy or some other existing structure of around 10 -15 meters' height in rural areas.

## VII. REFERENCES

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**Satya N. Gupta** An International expert in NGN technologies, Regulation, Interconnection and Broadband policy with 35 years experience in all aspects of Telecom, including 25 years with Govt. and Regulator, Satya N. Gupta is publicly recognized as an Analyst, Author, Advocate and Advisor on ICT related Policies, Projects and Business.

Globally known as "NGNguru" he is a trainer and coach for telecommunication technologies, policy and regulation and a Govt. Affairs and Regulatory advocate. Author of " Everything over IP-All you want to know about NGN" and "Bandwidth Factory- Last mile as a Managed Service". He also authored a concept called " Job Factory- Converting Unemployment into Intraprenuership" which is being used to create jobs in rural India. A public, key note speaker on most of the ICT events in India and Founder of NGN Forum in India to spread awareness about NGN all-over. He is triple master in Electronic Technology, ICT Management and Telecom Regulation and Policy.

Joined Ministry of Communications in 1981 and Ministry of Railways in 1983, through Indian Engg. Services after Post Graduation in Electronics and Communication from IISc, Bangalore.  During 25 years with Government he  worked in various capacities including Senior Project Manager (passenger reservations computerization) in Mumbai area, Prof. of Telecom Training at IRISET Secundrabad, Project Director ( GM) of IRCON International's OFC Project, Principal Advisor TRAI (In-charge of Converged Network, Broadband, NLD, ILD and Interconnection Division).

He was awarded the Railways Minister  award during 1995-96 for outstanding performance for Delhi area Digitalisation project of Indian Railways. He also pioneered the concepts of NIXI, NIR, IPV6, Unlicensed Spectrum, VOIP, Broadband Policy, NGN and Railtel in the country all these are up and running. As a freelancer, he established a mentoring and advisory company "SAAM CorpAdvisors", engaged in " Managing Govt. Affairs as a Service"

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