

# WHITEPAPER

Remote Femtocell - Transforming Telecom Testing

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## Abstract

*Femtocell has emerged as a most exciting product in Telecom industry and a new class of cheaper In-Building-Solutions (IBS). This is a small cell with coverage less than 20m compatible with most mobile phones and networks. Femtocell can significantly improve the quality of voice for end user by giving Wireline-like quality through user's home Wireline internet connection. The idea of using Femtocell for testing arises from the fact that the network of interest might be available at a specific location where travelling on a short notice is not possible. Setting up a Femtocell in a local lab is a solution for the same. The Femtocell is provided by most of the major network operators for better coverage of their network in turn increasing the customer satisfaction index.*

*Remote Femtocell can be setup with the help of some hardware viz., network extender of the specific operator, GPS simulator/reply, laptop, RF enclosure shield box and internet connectivity. Once the GPS co-ordinates are externally fed to the network extender which is connected to internet, the home network will be available at the off shore location and can be used for system testing, carrier validation static test cases to name a few.*

*Once the remote Femtocell is setup and running, the user will have the similar experience that the user will have while actually being present in the home country. If we consider any testing that needs to be done in home network of US carrier in India, Femtocell is a solution since the testing environment will be similar to testing in live carrier operator in USA. Remote Femtocell can be setup for any particular carrier network. The tests conducted in Femtocell have been useful to improve the overall quality of the mobile handset that an operator plans to launch under its brand name.*

*Barring the initial investment for setting up the Femtocell locally, this can serve as an effective means of cost effective testing and a value add from service providing organization to its customers, OEMs (Original Equipment Manufacturer) and operators included.*

## INTRODUCTION

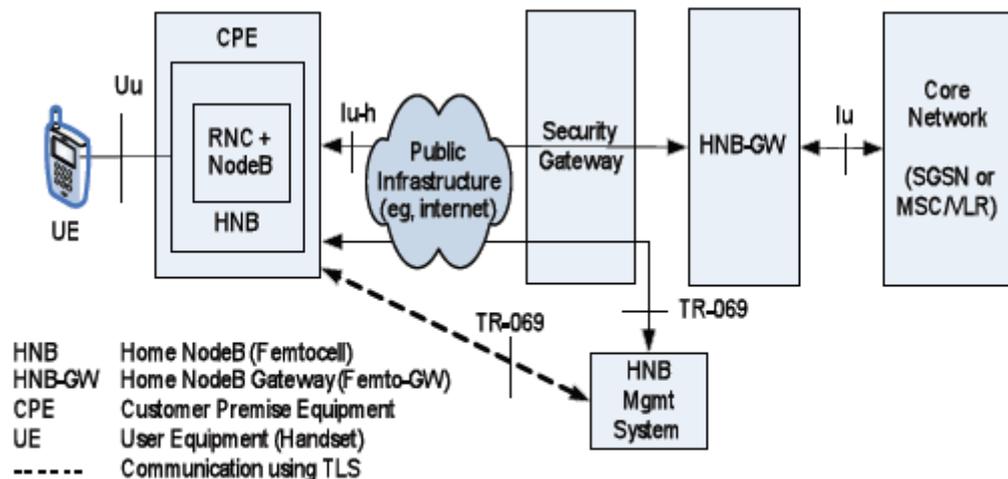
In this era, telecommunication has become one of the important parts of anyone's life. There will soon be a time when mobile phones will be the only phones with us. With this the Quality of service (QoS) that a carrier network provides determines the customer base of that particular carrier network. To keep up with this dynamic QoS the carrier network has to come up with a solution which is easy to deliver to the customer and profitable. There are times when customers face network issues, mostly indoors, where up to 20dB penetration loss reduces the outdoor to indoor signal strength leading to poor network availability. Increasing the number of macrocell sites is costly and ineffective. To address this issue, carrier networks have come with a solution which is cheaper and provides a better QoS to the customers in turn increasing the Customer Satisfaction Index (CSI) and their revenue. This In-Building-Solution is called Femtocell.

### What is Femtocell? <sup>[1]</sup>

Femtocells are personal miniature base stations installed on the subscriber's premises for providing cellular service within the home or enterprise environment. Typically Femtocells are connected to the Internet and the cellular operator's network via a DSL router or cable modem. Access to a Femtocell can be open to any subscriber, restricted to a limited set of users, or a combination of both with priority for preferred users.

Femtocells offer benefits for both subscribers and operators. The subscriber experiences better voice service coverage and higher data throughput. Special service plans can provide additional incentives for home use (e.g., free calls from home). The operator is able to off-load traffic from the macro cellular network, thus reducing infrastructure cost. Moreover, indoor coverage problems can be resolved without deploying expensive macro base stations. Recognizing these benefits carriers networks like Verizon and Sprint have launched Femtocell products nationwide in the U.S.

Figure 1 illustrates 3GPP Femtocell architecture. More details about this architecture can be found in [2]



**Figure 1 - 3GPP Femto Architecture**

The following sections of this paper we discuss the process of deploying a remote Femtocell by taking an example of Verizon carrier network which has been useful in testing of the handsets for OEMs based on their target global regions.

## 1. Deploying Remote Femtocell

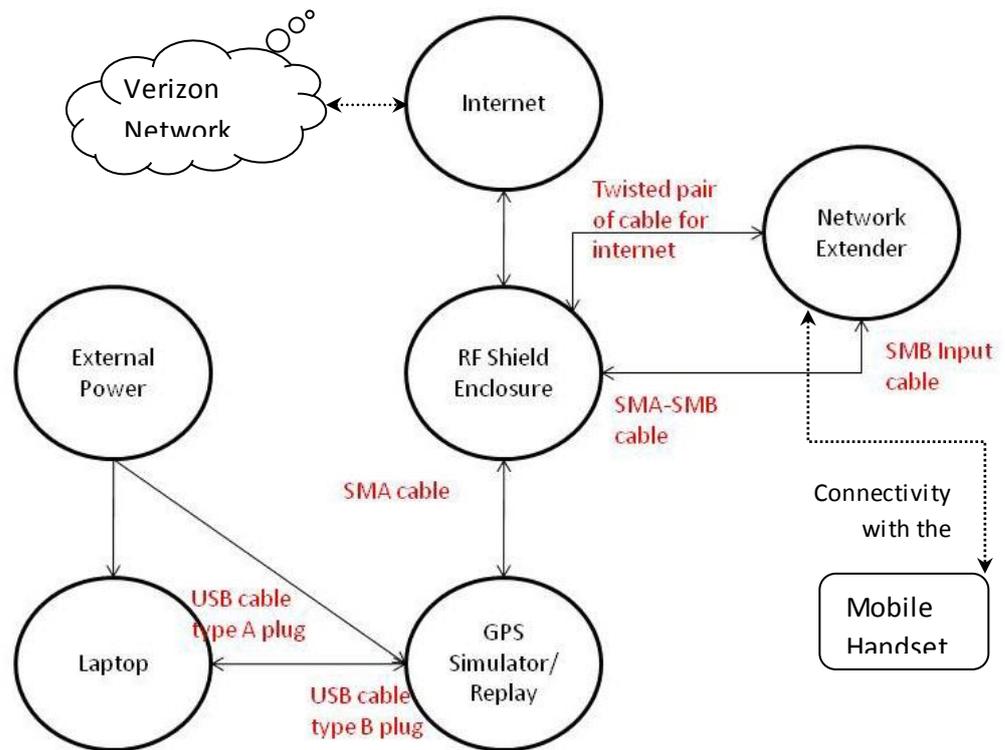
From time to time, a service providing organization has to provide new testing solutions to the existing clients and to attract new business venture. For an organization which is involved in mobile application, system and field testing for various OEMs globally testing the devices in operator which is the target market for the OEM, is an added incentive. Deploying Femtocell will help test the devices at off shore location which is helpful since at times sending resources onsite to the particular test location might not be feasible for the project. Femtocell implementation for the carrier network in office premises is one of the solutions that can be explored.

### Components of the setup

- One shielded enclosures: Ramsey STE3000B [3]
- One Verizon EVDO Network Extender [4]
- One GPS simulator: LabSat GPS Replay System [5]
- One Laptop
- Good Wireline internet connectivity

The investment needed for deploying remote Femtocell is high since the components needed are expensive. The approximate amount of the components is approximately around \$16,000 - \$17,000

Setting up a Femtocell will enable the testers to do the testing in the carrier network within the office premises. Following is the schematic representation of the setup of the remote Femtocell:



**Figure 2 - Deployment of Remote Femtocell**

### Setup of the shielded enclosure

- The box provides lighting inside the shielded room.
- Connect the external power chord for the light system.
- Connect also a DC power supply inside the box.
- Plug it into the multi-plug on one side and the small connector on the left side of the top cover of the box on the other side.
- Internally, the lights can be controlled using the switch on the right side of the top cover of the box.
- Lowering the switch will switch on the lighting.

### Outside network connection

- The Femtocell communicates with the VZW network via the Internet.
- It uses a standard Ethernet connection to connect to the Internet.
- Connect a standard twisted pair DSL cable to the outside of the enclosure.
- The Femtocell relies on DHCP to retrieve an IP address.
- Connect the other end of the DSL cable to a router or a similar system that provides Internet access and runs a DHCP server.

### Setup of the Femtocell inside the enclosure

- The Femtocell requires **power**, **GPS signal**, and **network connection**.
- Connect one of the other two DC power supplies to the network extender in order to provide power to the Femtocell.
- Connect another twisted pair cable inside the enclosure in order to connect the Femtocell to the Internet.
- Finally, connect the SMA-SMB cable to the upper SMA-connector inside the box and the SMB-input of the Femtocell

### Installing the RF power and connecting the GPS simulator to the laptop

- Connect the GPS simulator to the plugs and connect the SMA cables to plugs in RF shield enclosure.
- Connect the USB cable type B plug to the GPS simulator. Connect the other end (standard type A plug) to the laptop.
- Switch on the power for all equipment

### Setting up the laptop

- Boot up the laptop.
- Connect LAN cable to office LAN and power up the laptop
- Additionally, the laptop runs a piece of software (LabSat software) to replay a specific GPS file and to remote control the GPS simulator.
- Start the LabSat software
- Choose “Replay GPS file” and open the GPS file available on the system (as shown on below screenshot).
- During the replay you can configure the signal level applied by the GPS simulator. We recommend 20dB
- Wait approximately 15 minutes before the starting the tests

## **RESULTS & DISCUSSION**

The testing that has been performed using this setup has helped improving the overall end product for an OEM in terms of carrier validation, system and field testing. For example, there is a scenario where you need to go the home carrier network (Verizon) from international roaming. Before powering up the device tester has to send an SMS, Email and Voicemail. Once the device is in home network, after power up, the device should receive the SMS, Email and Voicemail correctly and without any discrepancies. It has been noticed that there were issues with respect to the voicemail received. To retest this scenario, we would need a resource both at off shore and on-site location which might be difficult. The alternative solution is to send the devices back to an international market and resend it back to US which is time consuming process.

To avoid all these logistic delays which might impact the product launch in turn impacting the profitability of both carrier network and OEMs, Femtocell deployment at off shore location is the best suited option.

The only potential hurdle that can be faced is the permission that we would need from the particular carrier network for the usage of the Femtocell outside the home network. Also great care has to be taken into account that no Emergency calls should be made in the Femtocell.

## **CONCLUSION**

Barring the initial investment for setting up the Femtocell locally, this can serve as an effective means of cost effective testing and a value add from service providing organization to its customers, OEMs (Original Equipment Manufacturer) and operators included for testing across various fronts, viz., system, carrier validation, field testing.

## **FUTURE WORK**

An example of deploying a remote Femtocell for carrier network, Verizon, has been discussed in this paper. Similarly, for other potential carrier networks which provide Femtocell, similar solutions can be implemented for testing.

## **ACKNOWLEDGEMENTS**

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