



STEVENS
INSTITUTE *of* TECHNOLOGY
THE INNOVATION UNIVERSITY

Homework 2

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CPE-322, Engineering Design VI

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I pledge my Honor that I have abided by the Stevens Honor System.

Paul Di Santi x_____

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Abstract

Today, the average American household has many different land line based solutions for connecting to the internet such as cable, fiber, DSL, and in some cases, dedicated lines such as T1 connections. Despite this, many homes in rural parts of the country still don't have access to any land line based solution and are forced to resort to the slowness and outdated use of 56k connections or the high latency and limited bandwidth of satellite internet. With the rise of 4G LTE technology as well as the rapid roll out currently being implemented by America's #1 cell phone companies such as Verizon and ATT, new options for connecting these rural homes to the internet in a cheap and reliable manner are now becoming available. With an advertised 4G LTE coverage of over 95% of Americans by the end of 2013 for Verizon and 2014 for ATT (as well as a commitment from Verizon to rural America [1]), many people in rural America will now be able to connect to the internet faster, more reliably, and with a lower latency than ever before. Unfortunately, most consumer routers are designed for typical land line based solutions of taking Ethernet connections from modems and sharing the internet across a network of any size. The proposed product would be a custom router designed to take the input of a 4G LTE USB modem of any carrier and share its internet connection across a network of computers.

The Stakeholders

<i>Stakeholder</i>	<i>Requirements</i>
The Client <ul style="list-style-type: none"> • Wireless Carriers • Wireless Retail Outlets 	<ul style="list-style-type: none"> • Cheap product (after subsidy) easily marketed to customers in order to get them to subscribe to multiyear agreements • Easily marketable • Fully supports the use of LTE/CDMA/GSM/HSPA+ bands
The User <ul style="list-style-type: none"> • Customers that use product as primary home router • Customers that use product to distribute internet access over WAN 	<ul style="list-style-type: none"> • Built in wireless access point with support for AES encryption and WPA2 security protocol • At least 5 ethernet ports for wired connection use • Built in router • "Plug and play" out of the box functionality • NAT/DHCP/Firewall capabilities • Easy to track data counter software component
The Designer <ul style="list-style-type: none"> • Engineers 	<ul style="list-style-type: none"> • Smaller footprint – rectangular shape with plenty of space for internal Wi-Fi and cellular antennas. Wi-Fi antennas should be 3x3 configuration for

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maximum range

- Ability to use internal components between multiple products. (ie. Upper tier router/wireless access point and lower tier product that is a router only) to save on costs
- Must meet all FCC requirements and regulations
- Contain internal battery to remain self-powered for at least 12 hours in the case of power loss or if used in disaster area without electricity

Evaluation

From a cost standpoint, the initial implementation of this project would be relatively affordable. Needed hardware would include a LTE USB dongle as well as an x86 based machine to run the appropriate software to implement the routing and sharing of the LTE internet connection as well as DHCP, NAT, etc. The primary processor that can be used to power the machine would have to be relatively low power and have a low TDP. Based on the currently available products, Intel's Atom based CPU would be the best fit for this scenario. By buying an ITX motherboard along with a minimum of 1 GB of ram, and a 64 GB solid state hard drive, the total cost for the basic hardware could come in at under \$200. A case for the hardware (not needed) would be about \$50 extra plus the cost of the LTE USB dongle and the cost of service that goes along with the LTE dongle. With being at such a low cost, the project should be easily affordable for a group of students looking to build this project for Senior Design.

The skills needed to implement this project would be very basic hardware skills as well as programming skills. Basic hardware skills would be needed to put together the actual ITX motherboard along with installing the memory and USB LTE dongle. Additional skills would be needed to install a wireless network card for the WiFi access point implementation. The OS used to start with would be based on open based operating system such as Ubuntu Linux. From there, efficiency in using Linux command line to implement open source protocols such as DHCP and NAT will be needed to tie all the functionalities of the router together. Basic knowledge in C and Python would be needed as well.

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SWOT (Strengths, Weaknesses, Opportunities, and Threats)

Strengths	This idea has a huge potential for success in the mass market as there are currently millions of households that have no access to high speed broadband internet. With Verizon's commitment to cover all of these households with high speed 4G LTE data coverage, these households are going to need a product that takes the LTE connection and makes it available to all of their internet connected devices in their homes. This idea also has potential in the international market for developing countries such as parts of China and India using 4G LTE as the primary way to deliver high speed data access to the remote parts of their respective nations.
Weaknesses	The weaknesses of this product are the threat of carriers banning or prohibiting using their connections for multiple devices at once. In the US, the FCC forced Verizon, in exchange for spectrum, to allow customers to do whatever they wanted with their LTE connections (including tethering). This could be, however, an issue in other countries where regulation is not as strict or the LTE connections are not as reliable.
Opportunities	The product has the ability to be used in a variety of applications beyond its scope if modified to use older CDMA or GSM standards. Although the internet speeds would be slower, it would offer a much better latency than current satellite internet solutions. It would also open up additional markets that currently are not running LTE.
Threats	Threats to the product are mainly from regulatory bodies as well as carriers who may not pick up the product in their retail stores.

References

[1] - <http://aboutus.verizonwireless.com/rural/Overview.html>