

The Wireless Last Hop

WHITE PAPER

What is it?...and why is it important?



BADU
networks

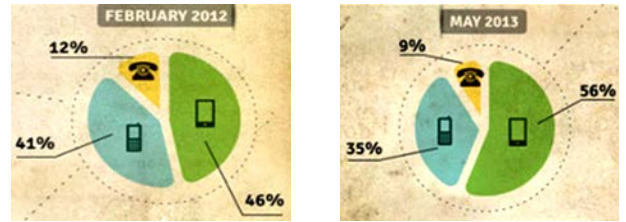
- Improving the way the world connects -

Background

Today's Internet is wireless. Comcast, Level 3 and AT&T may provide the connections into your home, but the last hop to your device is more often than not a wireless one, whether it is the last mile, the last 20 feet or, the last inch. 70% of today's Internet users connect across a Wi-Fi or mobile network.

This number is growing rapidly because of the proliferation of wireless devices like tablets and smart phones and user preference for anytime, anywhere access. Travelers and mobile workers connect through Wi-Fi networks at coffee shops, airports and free Wi-Fi hotspots around the world. Wi-Fi networks are commonplace in businesses, campuses, stadiums and an increasing number of public places. Your phone isn't just connecting to a distant carrier's tower. It and your laptop hop on your home Wi-Fi router whenever they are in range. All kinds of devices talk to your phone via Bluetooth. More devices – from TV's, to cars, to home appliances – are coming with embedded radios, demanding more capacity over our increasingly crowded airwaves.

SMARTPHONE OWNERSHIP



As of 2014, it is estimated that there are more mobile devices on earth than people.

WI-FI STATISTICS

- 86% of tablets require a Wi-Fi connection to access the Internet.
- 75% of smartphone owners use Wi-Fi on their devices.
- 63% of U.S. adults use the Internet wirelessly on a smartphone, tablet, laptop or e-reader.
- 90% of all iPads are used as Wi-Fi devices, compared to 64% for 4G enabled and 55% for 3G enabled iPads.
- 65% of tablet users only connect via Wi-Fi
- 79% of week 1 sales of Sony's PlayStation Vita in the UK were for the Wi-Fi version.

Wi-Fi Facts - Source: Factbrowser



This white paper describes the "wireless last hop" and the growing issue of poor performance when the wireless last hop is included in end-to-end performance measurements. It also discusses what can be done about it.

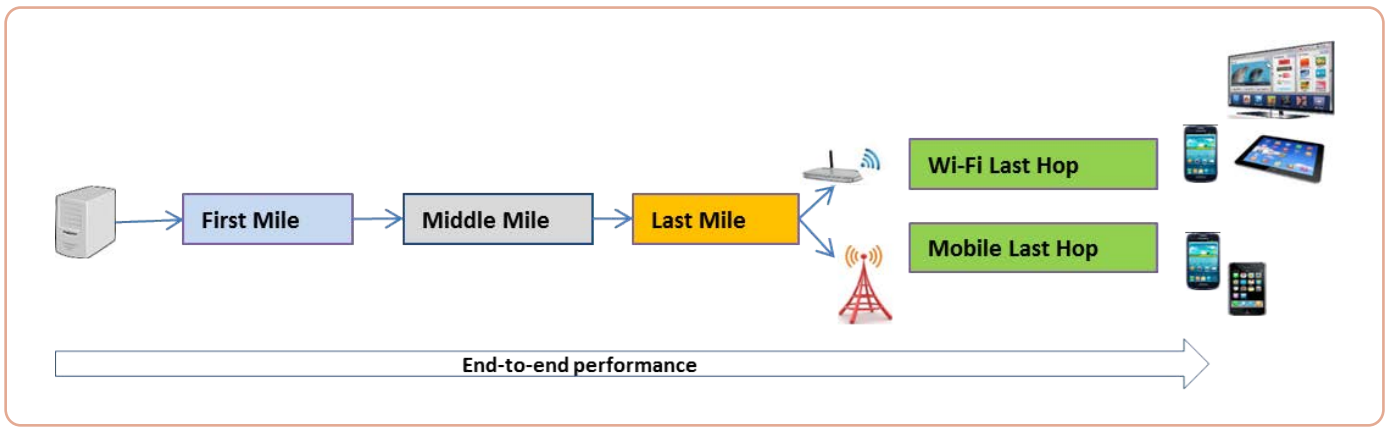
Traditional Performance Measurements

The traditional way of measuring end-to-end performance of a web page or a video file was to outsource the testing to 3rd party testing platforms like Keynote, Gomez, CatchPoint or Webpagetest.org. These automated testing platforms would have test agents deployed across the globe to download an object, web page or video file and record the performance results over time for whatever you were testing. The current testing platforms were designed to measure performance over the first, middle and last mile of the wired Internet – before wireless connectivity became the de facto standard.

The challenge with these testing platforms is that they do not include the newest leg in the end-to-end performance

calculation – “the wireless last hop”. The tests were not designed to emulate congested wireless networks which are the reality of today’s Internet.

End-to-end performance is only as good as the slowest link on the way to the end user. The wireless last hop is a term that we use to describe the last segment of the path to the end user that passes across a Wi-Fi or mobile network. In most cases the slowest link is this wireless last hop. Your Internet connection can be blazing fast from where the content is originating, across the Internet to your wireless router, BUT if performance is poor across your wireless network then all the user sees is a poor user experience.



Why is the “wireless last hop” so slow?

Wi-Fi and mobile networks become congested and slow down for many reasons but one of the main reasons is latency that changes radically and constantly. When multiple devices access content across a Wi-Fi access point, the router becomes congested and normal TCP collapses. The current version of TCP was not designed to handle radically and rapidly changing network conditions. Mobile networks have the same problem with constantly changing latency and there is also the added latency of switching towers as you move out of range. Moreover, traffic across these networks is increasing much faster than the infrastructure to handle the added volume, so this problem is getting worse.

Wireless router companies and mobile carriers are constantly trying to improve their products to address rapid and constant latency changes and packet loss but this is still an ongoing problem. There needs to be a unique approach that seamlessly handles increasing traffic loads across these wireless infrastructures without TCP collapse.



The **BADU** unique differentiator

Badu can increase the end-to-end performance – all the way across the mobile last mile to the smart phone you are holding or to the tablet or laptop running on your Wi-Fi network at home or at your local coffee shop. For the first time you can impact not only the first, middle and last mile but also extend this across the “wireless last hop”. Imagine delivering better performance all the way to the end device regardless of whether there was a wireless network or not. The other benefit that Badu *Warp*TCP delivers is the ability to support more devices across a Wi-Fi network with consistently good performance.

How is **BADU** deployed?

Badu can offer either a server-side or client-side implementation. The server-side implementation accelerates the traffic (20% - 300%) all the way across the Internet to the end user including the wireless last hop. The client-side implementation sits in front of the wireless router and accelerates the traffic across the Wi-Fi network (20% - 60%), increases the number of devices that can be connected and accelerates uploads (up to 500%) as well.

What impact does fixing the wireless last hop have on everyday life?

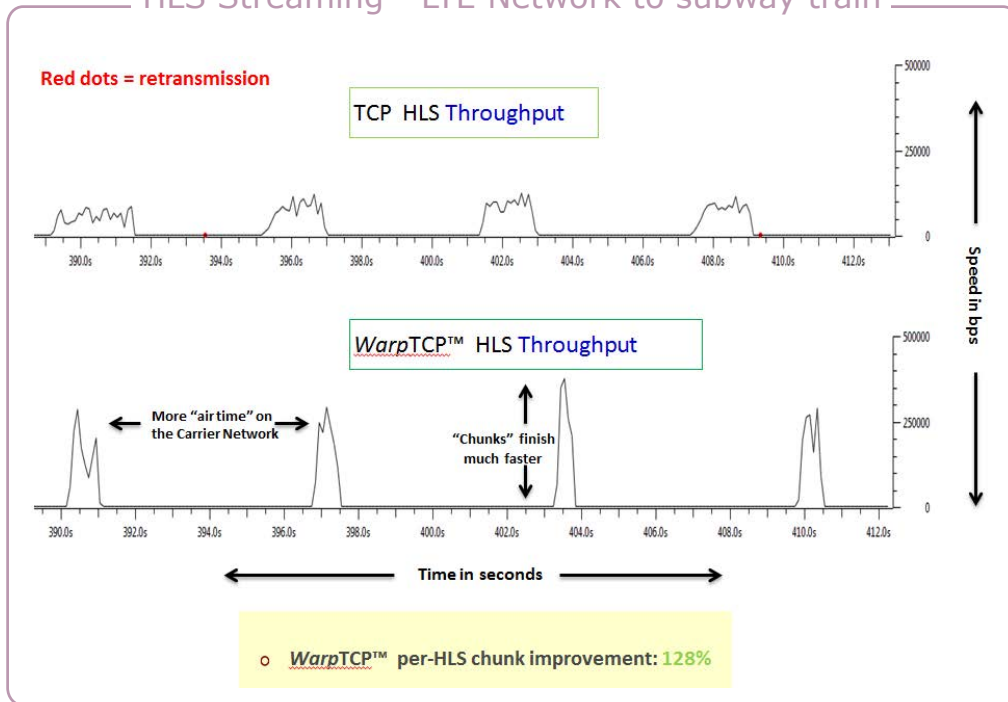
1. Downloads happen much faster.
2. Videos are delivered at higher resolution with no buffering.
3. Uploads are faster.
4. Web pages can be delivered faster.
5. More people in a household can have a good user experience.
6. More Internet of Things (IoT) devices can be supported in a household.
7. Cellphone resources are used less often - increasing battery life.

What can **BADU** do for mobile networks?

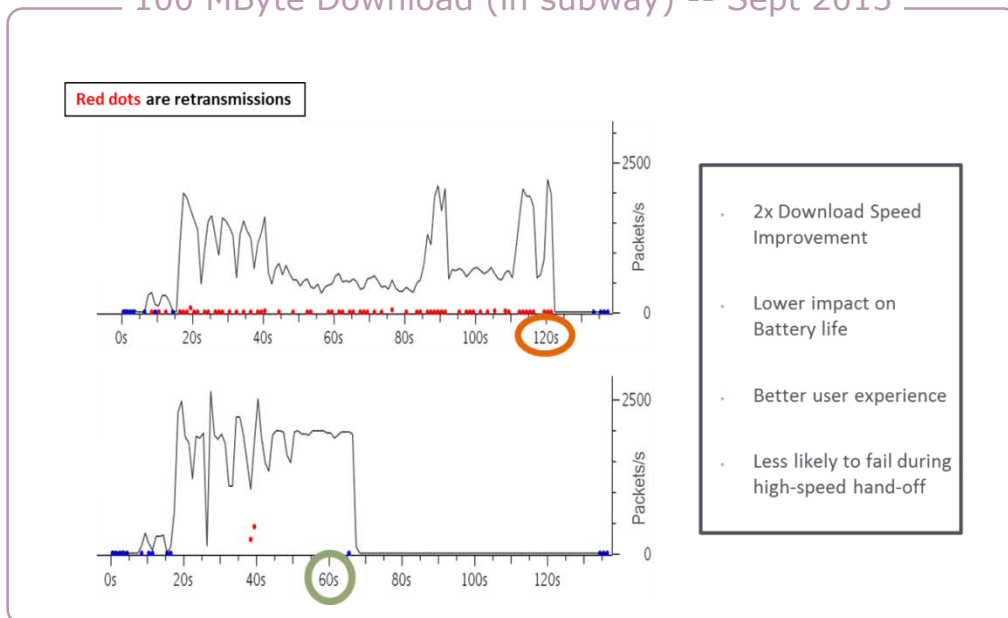
Any mobile application will benefit from the end-to-end optimization approach of Badu. *Warp*TCP will accelerate any type of content being delivered over the mobile last mile or even to a smart phone using a Wi-Fi network. Regardless of what happens before the content gets to the radio towers on the mobile network (caching, FEO, etc.) the content will be accelerated over any 2G, 3G or 4G network (either the mobile last mile or Wi-Fi network) to the mobile device. The result is a much better user experience on the mobile device.

Commercial LTE-A Network

HLS Streaming - LTE Network to subway train



100 MByte Download (in subway) -- Sept 2013



These tests results were from a wireless service provider core network to a moving train. As you can see, almost all retransmissions were eliminated. The video played with no delays or re-buffering.

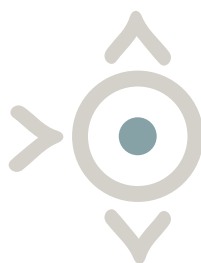
Summary

It is not very often that a technology comes along that can be easily deployed in a large network **AND** can deliver a better user experience to the massive audiences that view content across that network, especially wireless and mobile networks, with nothing required at the receiving end. The same technology can be deployed in front of your wireless router at home or at the office and deliver a much better user experience.

The **wireless last hop** has become the slowest link between the content and the end user. The slow last hop has become a major problem to end-to-end performance. Companies are trying many different ways to improve the rapidly changing latency on their networks to try and correct this problem but it is getting worse instead of better because the volume of traffic is increasing faster than the infrastructure to support it.

A unique approach is needed. Badu technology was designed from the ground up to address the wireless last hop problem across Wi-Fi and mobile networks at the transport layer from anywhere on the network.

Contact Badu today for more information and to discuss a free trial.



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