EVALUATING THE USAGE OF WIRELESS BROADBAND HOTSPOTS

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Abstract: This paper will discuss the results obtained from testing and evaluating the performance of public Wireless local Area Network (WLAN) hotspots in real life. A fully detailed analysis of a specially constructed test-bed will be given. The construction was based on standard user equipments and provided near reality performance results. The paper will also present an overview of the bandwidth and quality of communication received by end-users. BT Openzone was chosen as the Hotspot provider to implement and carry out the tests. The results of these tests have shown the suitability of the public wireless networks in the United Kingdom to quality-critical applications.

1 INTRODUCTION

In recent years, many countries around the globe have started to deploy wireless broadband technologies. This allowed Internet users to have high speed Internet access over wireless networks (i.e. Hotspots). These are available in different places including public and private networks. Hotspots are wireless Internet access places which offer broadband Internet access. Using a wireless-enabled laptop or a Personal Digital Assistant (PDA), users can access the Internet and Internet associated services via hotspots in cafes, motorway service stations, conference centres, hotels, shopping centres and airports world wide at considerably higher speeds than conventional modems. Combined with other technologies such as Virtual Private Networks (VPN) , the concept of the office has been redefined for many of the businesses. With most of the information being digital a business deal can be made on coffee shop table or alternatively, the company's financial reports can be revised while waiting for a flight in the airport. The amount of possible application is massive if these Hotspots can deliver what they promise (Iyer et al. 2003)

2 BACKGROUND

2.1 Public WLAN Hotspot

As the demand for digital data increases the demand for methods to access this data anytime and anywhere increases. With the advancement of mobile technology, the perception of mobility has changed from user mobility across computers to the computer being mobile with the user. Subsequently, data access technologies have moved from wired to publicly available wireless networks. Several companies have started to deploy Public Wireless Local Area Network (WLAN) known as Hotspots around the globe. BT is one of the companies that started the implementation of Hotspots in the UK. Currently available BT public hotspots are designed to provide access to the internet at speeds of up to 500 kbps which is almost 10 times faster than a standard 56K modem. With such speeds, users can send and receive large quantities of information at broadband speed. A single access point can cover an area up to 100 meters away from it. BT hotspots are currently based on the IEEE 802.11b Wireless LAN protocol which used the 2.4GHz radio frequency. These can be used to wirelessly access public internet services in addition to private corporate

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networks using Virtual Private networks (VPNs) (Iyer et al. 2003)(BTOpenZone).

2.2 Virtual Private Networks (VPN)

Since the first deployment of data networks in corporations, the need for intercommunication between them has came into attention. Companies have historically used leased lines and ISDN internetworking solutions between its offices to make a Wide Area Networks (WANs). WANs had obvious advantages over dialup servers such as reliability, security and performance. Unfortunately, WANs had two main disadvantages; the first being is the inflexibility of such a solution. Access to such network is restricted from sites where the leased line is connected or where there is ISDN on that site. The second disadvantage is the overhead costs for maintaining such networks. This took WAN out of the solutions list for small and medium enterprises.

During the last few years, companies have started implementing their own Virtual Private Networks (VPNs). These are private networks that use public networks (usually the internet) as an intermediate communication medium. It creates a virtual tunnel between different company's sites. Every user is authenticated separately in a very secure manner. VPN security provides four different layers of security which makes it a very safe option for corporations. In general VPNs offeres a cheaper and more flexible alternative to WANs without jeopardising the security of the firm. It provides a lower cost of ownership and maintenance, which leads to a faster return on investment. It also provides flexibility on different levels. Once a VPN is established, the number of users can be easily increased according to the organization needs at a very low cost. Geographically speaking, a VPN using the Internet as a medium can theoretically be accessed from anywhere in the world at a very low cost. This became very useful for companies with a high global coverage, where connecting a WAN to hundreds of small offices and branches was financially unfeasible. Another major application came with the spread of mobile computing. Users can now connect to their corporate networks while they are travelling using Hotspots or widely available mobile phone networks (Strayer 2004) (Andersson 2001).

3 TESTBED

A testbed has been constructed as shown in figure using the available infrastructure of Brunel University network and BTopenzone in order to collect real results from a live network. A mobile terminal (laptop) running VPN client software was connected to a BTOpenZone hotspot access point via WLAN 802.11b network card. Access to Brunel University FTP and web servers was established via a VPN tunnel. The testbed setup has been chosen in a way to reflect a real-live scenario, covering a wide range of possible applications.

In order to evaluate the general performance of the network, test has been performed to assess the main link characteristics (Hunaiti et al. 2004)(Chakravorty, Pratt 2002)(Chakravorty, Clark & Pratt 2005), which include: upload throughput, downlink throughput, Round-Trip Time (RTT) and packet loss. These parameters can reflect the performance of the majority of applications. For measuring uplink and downlink throughput, Microsoft network performance analyzer was used. This allowed the capture of both uplink and downlink traffic between the mobile terminal and the FTP server. For measuring Round-Trip Time (RTT) and packet loss, ping command from DOS command prompt has been used. Pinging Brunel University web server "www.brunel.ac.uk" presented the round trip delay and the percentage of lost packets between the mobile terminal and the web server.

4 EXPERIMENTS AND RESULTS

Throughput test: The throughput test was performed to investigate the real data transfer speed that can be achieved over a real life hotspot. Both uplink and downlink throughputs were tested. Throughput measurements were based on measuring the transfer speed between the mobile terminal (the

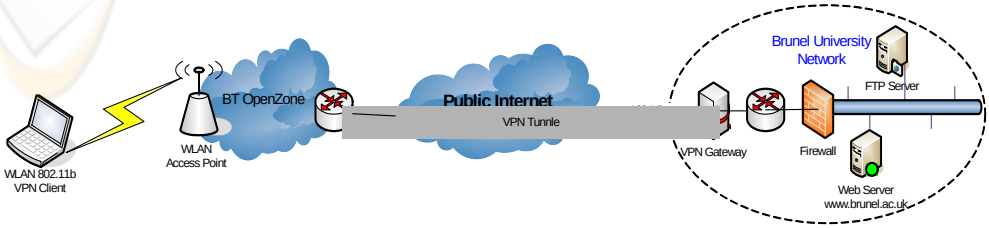

Figure 1: Testbed

laptop) and the FTP server. For uplink throughput test files were sent from the mobile terminal to the FTP Server. The sent data was captured by Microsoft network performance analyzer. As Figure 2 shows that uplink transfer speed ranged between 7669 to 28409 bytes/s with average speed of 19891 bytes/s.

In the second part of the throughput test, the downlink throughput was measured by downloading files from the FTP sever to the mobile terminal unit. The received data was captured by Microsoft network performance analyzer, downlink speed test results are shown in figure 3. The minimum recorded downlink speed was around 39868 bytes/s, the maximum speed achieved was 59632 bytes/s with an average of 56736 bytes/s.

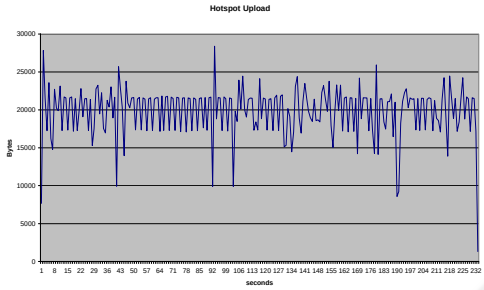

Figure 2:. Upload throughput

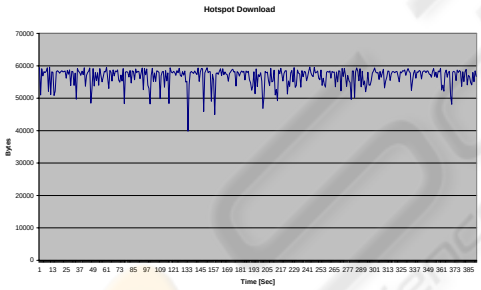

Figure 3:. Download throughput

Latency: For testing the latency Round-Trip Time (RTT) test was performed. RTT indicates the time that a message takes to get to the destination receiver and back again to the sender. RTT test was undertaken to measure the latency between the mobile terminal and Brunel University web server (www.brunel.ac.uk). RTT test was undertaken using the ping command from DOS command prompt under Windows XP operating system. Ping command basically sends an Internet Control Message Protocol (ICMP) to the destination server and awaits the results. This particular type of messages does not require any processing at the destination server, and the time that it takes to go back and forth should reflect the total time that it takes to travel that distance twice. The result in Figure 4 shows that latency was between 37 and 270ms with an average round-trip latency of 108ms.

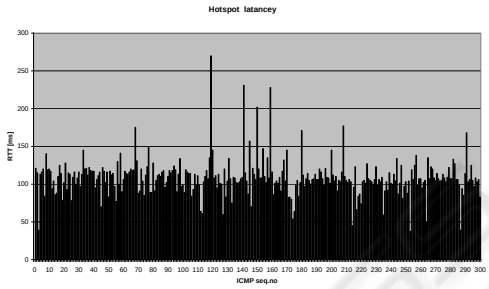

Figure 4. Round-trip latency

Packet loss: The packet loss test was conducted in order to find the amount of lost packets within the link between the mobile terminal and the web server. The test was performed in the same way as in the latency test. Once again ping commands was employed. In each ping command 100 packets were sent to the web server. The report includes the percentage of lost data. Our test resulted in no lost packets at all. This shows that the Hotspot provided an optimum communication medium. This result could be a result of the Hotspot being in an optimal scenario i.e. The distance to the access point was relatively close in addition to the low load on that particular Hotspot.

5 DISCUSSION OF RESULTS

The evaluated parameters of network performance were chosen on the basis of their importance of them to the majority of applications. Bandwidth tests, showed high enough average throughput for the majority of applications on both uplink and downlink channels. The results also show that fluctuation around the average is not very high. This indicates the reliability and the stability of these channels. The results from the latency test have shown that the incurred delays were reasonable. The average RTT was 108 ms, which could be considered a low delay for a wireless channel. This also shows the suitability of hotspots for real-time applications.

6 CONCLUSIONS

At this paper performance evaluation has been conducted on the commercially available BT WLAN hotspot. The outcome from tests has shown a highly appraisable performance of this technology. That makes it a very suitable solution for corporate applications. As it is demonstrated in the testbed, WLAN Hotspots can make a valuable extension for the corporate networks by using VPN technology access to the enterprise local network. This provides the employees with the extra freedom they need to accomplish their jobs wherever they are.

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