



Data Analysis on Mobile Ad-Hoc Networks with Commercial Pre-WiMAX, EVDO and Wi-Fi Products

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Agenda

- Introduction
- Technology and Equipment Descriptions
- Topology and Configurations
- Comparison of Wi-Fi, Pre-WiMAX and EVDO
- Multiple-Unit Testing
- Secure Multiple VPN/PKI/SRA Connections
- Observations
- Conclusions



Introduction

- Wireless Ad-Hoc Mesh Networks
- Testing taken place in an office environment on fifth floor, at the Place du Portage Phase III Building in the National Capital Region
- Testing period: August – November, 2007
- Products available commercially for business applications



Technology and Equipment Descriptions

WiMAX

- Worldwide Interoperability for Microwave Access (WiMAX)
- IEEE802.16, IEEE802.16e
- Rogers
- Thin sliced modem unit
- Advertisement performance:
 - Download: 1.5 Mbps
 - Upload: 256 kbps
- Modem unit - \$100 a piece
- Subscription fee - \$50 per month with a max. usage of 30 GB



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EVDO

- Evolution Data Only (EVDO-Rev A)
- CDMA Technology
- Telus
- Sierra 595U USB
- Advertisement performance:
 - Download: 800 kbps
 - Upload: 300 kbps
- USB unit - \$50 a piece
- Subscription fee - \$70 per month with a max. usage of 1 GB



Wi-Fi

- Wireless Fidelity; Wireless Local Area Networks (WLANs)
- IEEE802.11b/a/g
- Linksys
- Model #WRT55AG
- Advertisement performance:
 - g: 11 Mbps at 2.4 GHz
 - a: 11 Mbps at 5 GHz
 - b: 2Mbps at 2.4 GHz
- Wireless router - \$30 a piece



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Topology and Configurations

- Wireless Ad-Hoc Mesh Networks

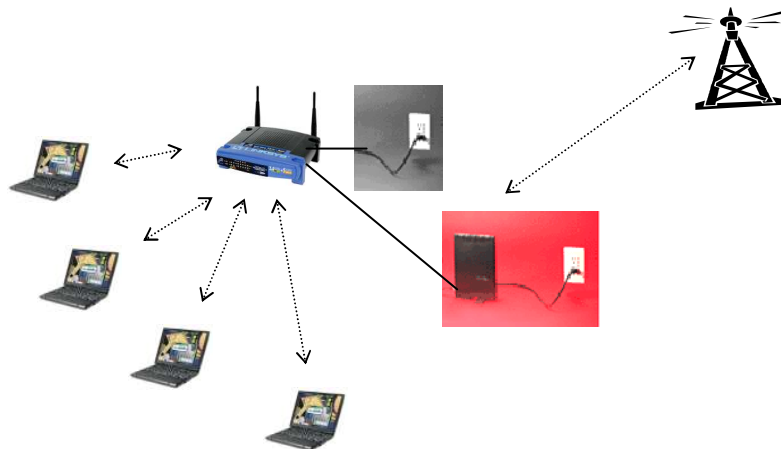


Figure 1: Configuration of WiMAX Ad-Hoc Network

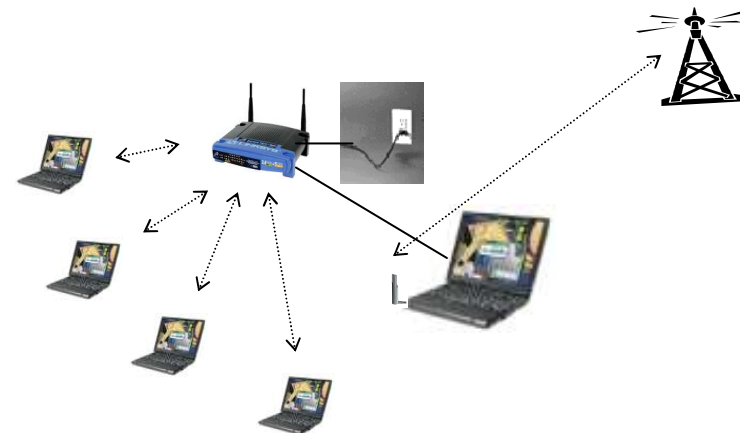


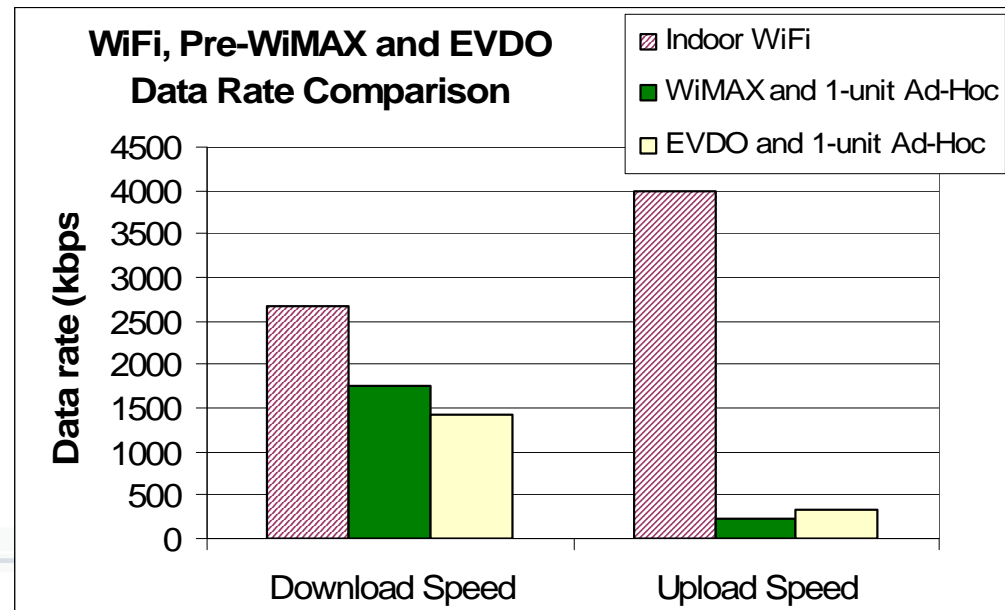
Figure 2: Configuration of EVDO Ad-Hoc Network



Comparisons of WiFi, Pre-WiMAX and EVDO

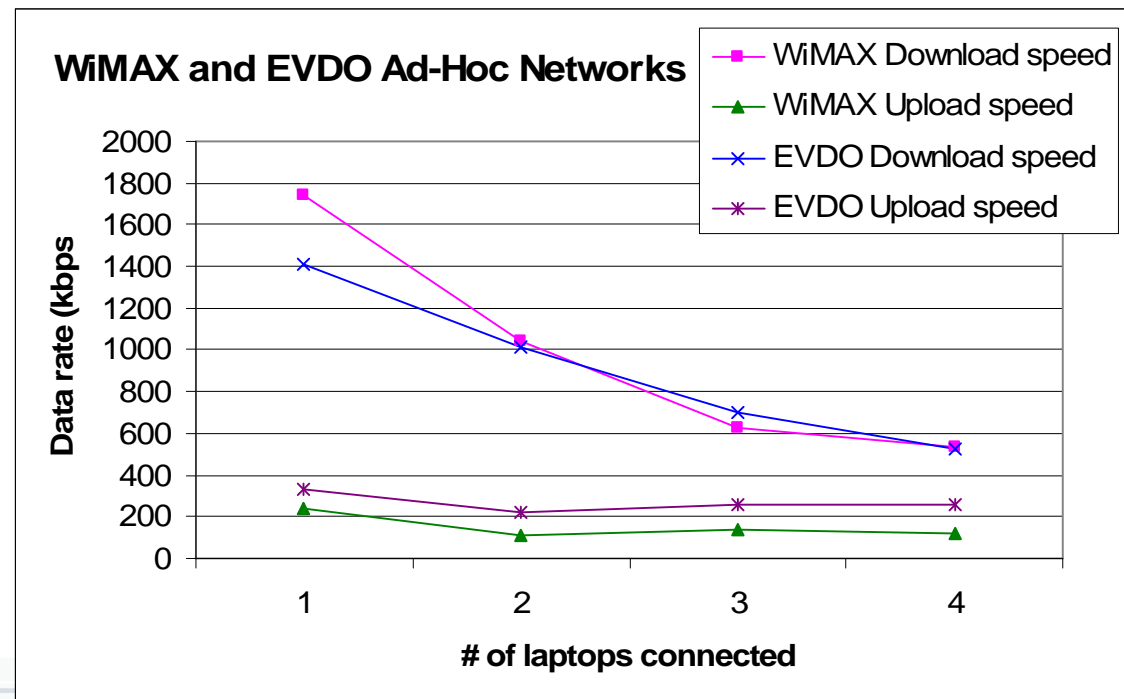
Comparison Testing (kbps)	Wi-Fi		Pre-WiMAX		EVDO	
	Download	Upload	Download	Upload	Download	Upload
Average	2670	3990	1743	241	1412	336
Standard Deviation	115	86	126	21	61	40
95.5% Lower confidence interval	2441	3819	1492	199	1290	257
95.5% Upper confidence interval	2899	4161	1995	283	1534	416

- Wi-Fi provides the highest data rate
- Pre-WiMAX and EVDO can be setup very quickly and low-cost at both the indoor and outdoor environment without any underlying Internet cables nor power supply
- Pre-WiMAX and EVDO offer a much higher download rate than upload rate as it is set and designed by the Telecom providers.



Multiple-Unit Testing

- Internet Voice Quality over these 4 laptops over Skype is acceptable
- Internet Radio Voice Quality performs well
- Overall Voice Quality is worse than cellular
- Simultaneously video-streaming webcasts from Radio-Canada News Website perform well in these 4 laptops.



Secure Multiple VPN/PKI/SRA Connections

- EVDO USB modem cannot provide secure multiple VPN/PKI/SRA connections because it requires to connect to a laptop which cannot provide multiple VPN-Pass-Through.

- Simultaneously video streamlining performs well

2-laptop VPN/PKI/SRA Connections Testing (kbps)	Pre-WiMAX	
	Download	Upload
Average	879	594
Standard Deviation	90	178
95.5% Lower confidence interval	698	237
95.5% Upper confidence interval	1059	951

- Internet Voice Quality is poorer over Skype



Observations

- Supporting more than one laptop connection requires a Wi-Fi Wireless Router, not an Access Point.
- Multiple VPN Pass-Through needs to be enabled on secure multiple VPN/PKISRA connections.
- The power inverter, which can be purchased from the Canadian Tire Store, is a good source to provide power supply to setup Wireless Ad-Hoc Networks anywhere.
- EVDO USB modem, unlike the WiMAX modem, does not require an external AC supply.



Conclusions

- Wi-Fi provides a higher data rate than Pre-WiMAX or EVDO
- Pre-WiMAX and EVDO Wireless Mesh Networks can be setup very quickly and easily with low-cost without overlaid Internet cables nor power supply in both the indoor or outdoor environment
- The Wireless Mesh Networks have been setup successfully with 4-laptop units with simultaneously video streaming
- Multiple secure VPN/PKI/SRA connections are possible
- Further research can be developed and compared with other high bandwidth commercial products, such as HSDPA, EDGE and UMTS.



Thank You 😊

Any question?

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