GOVERNMENT OF THE DISTRICT OF COLUMBIA
OFFICE OF THE CHIEF TECHNOLOGY OFFICER

Suzanne C. Peck
Chief Technology Officer

February 20, 2006

Federal Communications Commission
Experimental Licensing Branch
MS 1300E1
445 12th Street, S.W.
Washington, DC 20554

Re. Experimental Radio Station Construction Permit And License
Call Sign WD2XHO
Fourth Progress Report

Dear Madam/Sir:

Pursuant to the special conditions included in the grant of the experimental radio station and construction permit and license for WD2XHO (FCC File 0042-EX-ML-2004), please find attached the Fourth Progress Report of this experiment.

Should any clarification be necessary, please do not hesitate to contact Guy Jouannelle at 202-727-7796.

Sincerely,

Robert LeGrande, II
Deputy Chief Technology Officer

Background

The District of Columbia has recently completed an analysis of its public safety wireless data network deployment options and has determined that the spectrum and technologies on which they are based do not fulfill the pressing need of first responders today, much less the increasingly complex environment envisioned for the near future.

In order to demonstrate that affordable technologies exist today to support the critical public safety applications, the District has decided to deploy a wide area (within Washington DC city limits) broadband wireless data network that will serve as a pilot for next generation of public safety applications. The intent is to specify technology and features that best suit public safety applications' requirements. To this end, the District has filed for an experimental license in January 2004. The FCC has granted this experimental license (Call sign WD2XHO) in February 2004. As the experiment will use the 700 MHz upper-band, an additional outcome of the experiments will be an evaluation of the impact of interference received from/created into TV stations broadcasting in this band.

The Office of the Chief Technology Officer of the District of Columbia (OCTO) selected Motorola and Flarion Technologies to provide, install and support a 12-site Flash OFDM broadband wireless network, WARN (Wireless Accelerated Responders' Network).

In order to allow the vendors to deliver the equipment on an expedited fashion, a modification of the experiment license was filed and granted in August 2004. The modification did result in swapping uplink and downlink frequencies.

In March 2005, the District filed for the licensing of two additional sites to enhance the coverage and capacity of the network. The FCC granted those licenses as well as an extension of the experimental license. At the time of the last report, the two additional sites were operational, and their benefits to the users demonstrated.

The Office of the Chief Technology Officer
of the
District of Columbia (OCTO/DC)

Fourth PROGRESS REPORT

on the

Construction and Operation

of the

Experimental Wireless Accelerated Responders' Network

Experimental Radio Station License
Call Sign WD2XHO

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Network Infrastructure

The network includes 12 transceiver sites, interconnected to two redundant data centers via an independent District operated fiber ring. This interconnection at the data centers provides access through the District's private WAN to other District agencies and the Internet for WARN users. Applications servers are either located in the WARN network or in the agencies' WAN. Proper security policies, appropriate firewalls' configurations, and dedicated links limit the access of those applications to the relevant end-users.

A detailed description of the network architecture is included in the second Progress Report of Experimental Radio Station Construction Permit And License (Call Sign WD2XHO) filed in February 2005.

Since the last report two sectors were added to a site located downtown, close to the White House, in order to increase the capacity in this key area.

Network Performance

Various tools have developed to monitor the performance of the network, and the activities it supports.

Those tools use the performance data recorded at each base station as well as using the traffic logs on both AAA servers. Those tools have allowed us to produce the reports and graphs below, and derive network usage trends.

This analysis show that although the number of users was still very limited (about 200 users), more than 72 Giga Bytes of data were transmitted on the uplink, and more than 85 Giga Bytes of data was transmitted on the downlink (see table below).

	UPLINK TRAFFIC VOLUME (BYTES)	DOWNLINK TRAFFIC VOLUME (BYTES)
Agency 1	3,101,715	33,297,925
Agency 2	31,937,547	134,327,186
Agency 3	10,782,799	125,411,157
Agency 4	16,777,196	72,831,402
Agency 5	231,856,225	602,597,825
Agency 6	1,318,342,455	888,890,146
Agency 7	1,060,562,049	4,178,276,921
Agency 8	12,569,084	104,567,821
Agency 9	3,983,747,646	26,715,398,639
Agency 10	37,209,223	2,523,129
Agency 11	588,046,623	3,007,039,623
Agency 12	34,143,360	343,447,435
Agency 13	18,686,490	95,333,924

Agency 14	7,827,578	88,741,851
Agency 15	33,283,169,300	6,051,959,905
Agency 16	133,482,754	1,029,295,815
Agency 17	7,413,318	41,779,171
Agency 18	512,945,689	632,683,039
Agency 19	279,502,872	2,702,691,557
Agency 20	138,888,450	610,319,508
Agency 21	655,459,655	1,555,709,728
Agency 22	16,366,364	139,835,943
Agency 23	16,794,728,189	431,080,735
Agency 24	591,629,142	5,079,945,548
Agency 25	7,825,179	34,012,703
Agency 26	879,948,744	3,240,537,731
Agency 27	12,032,676,159	27,548,542,895
Total	72,689,625,805	85,491,079,262

Table 1: Volume of traffic transmitted between Feb 20 2005 and February 10 2005.

Moreover, Figure 1 below depicting the evolution of the traffic volume shows that the daily usage of the network is increasing consistently.

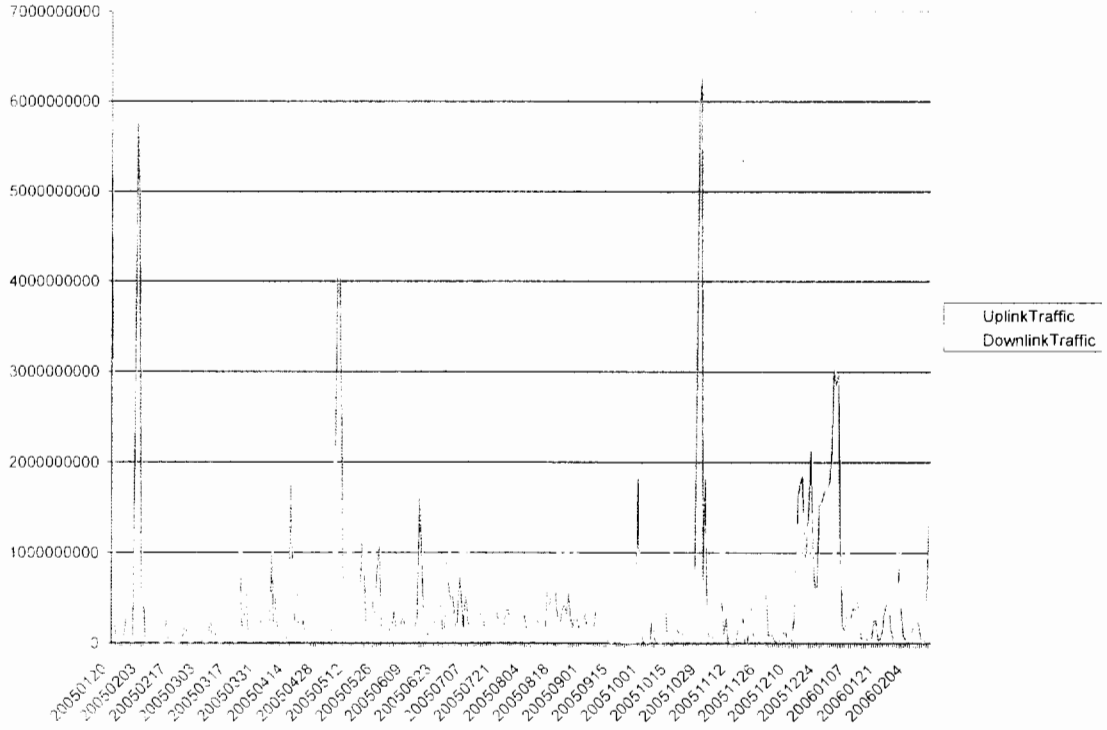

Figure 1 - Daily Traffic volume (Bytes), February 20, 2005 to February 10, 2005

The following graphs depict the geographical distribution of traffic on the week end of 27th of October to 29th of October 2005. The coverage of each cell is colored based on the traffic it carries. Those maps demonstrate the benefits of increasing the capacity of the White House site. Although this site has the smallest coverage area, it carries the most traffic. Those maps also demonstrate that, although only 12 sites are deployed, the network can carry several significant events simultaneously in the city.

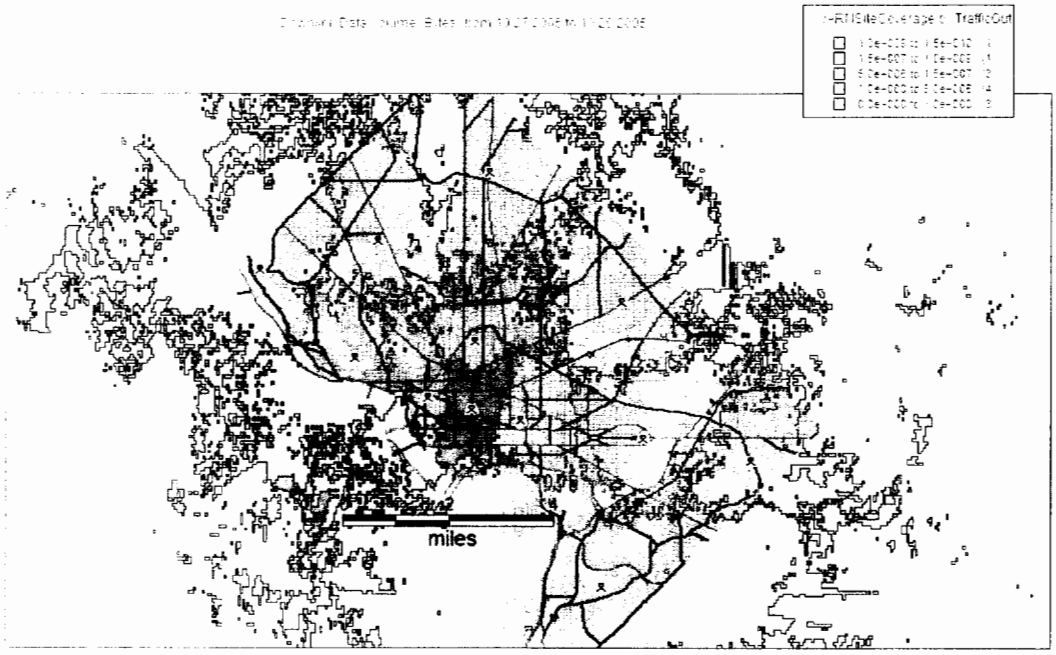

Figure 2: Downlink Data (Bytes) transmitted -10/27/05-10/29/05

The geographical distribution between uplink and downlink are also different as the requirements of various events across the city require the deployment of different applications with different communications needs and associated bandwidth requirements.

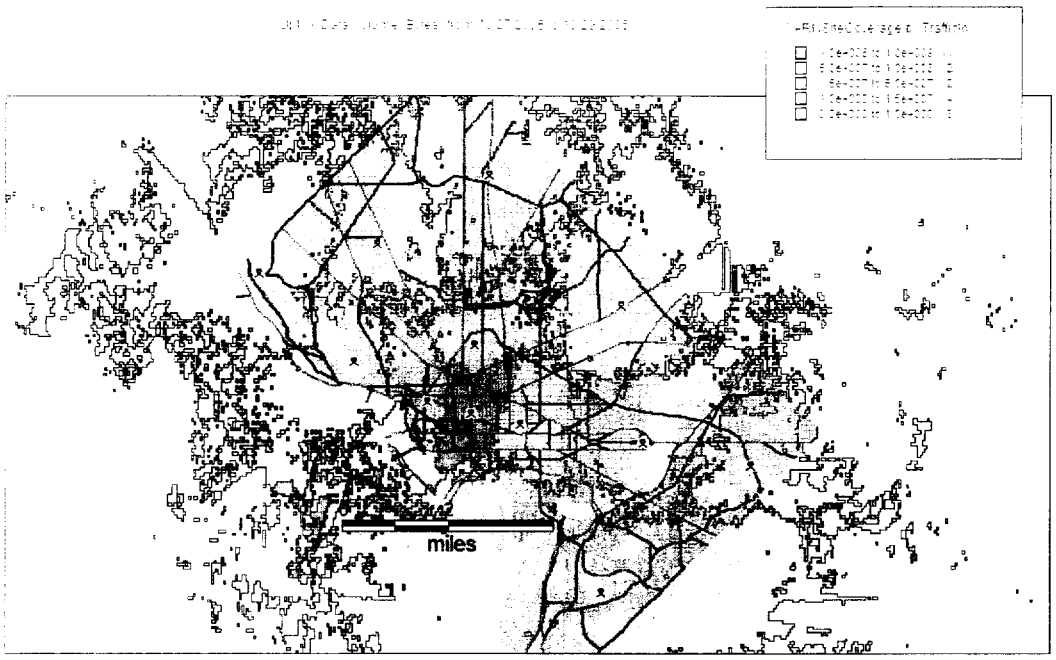

Figure 3: Uplink Data (Bytes) transmitted 10/27/05-10/29/05

The following graphs depict the load on the system, and the total throughput experienced on daily basis on the system. It is clear from those graphs that not only the daily traffic is increased as a whole, but its geographic distribution expands as the number of sectors heavily loaded increases. As agencies expand the usage of the network, traffic, load and throughput are expected to grow accordingly.

It is also confirmed that unlike the traditional internet traffic, those public safety applications require equivalent traffic capacity on the uplink and downlink.

In particular, the uplink traffic is principally generated by mobile cameras streaming high resolution video to remote command centers and/or other mobile first responders. Several agencies (DC-FEMS, DC-EMA, USSS) are operating such uplink video applications. As most cellular technologies, the link budget of the Flash-OFDM is uplink limited and the growing usage of uplink streaming high resolution video drives the need to improve that end of the link budget.
Both improvement of the applications (by implementing multicast) and improvement of the infrastructure (fine tuning of RF parameters) are investigated to address this issue.

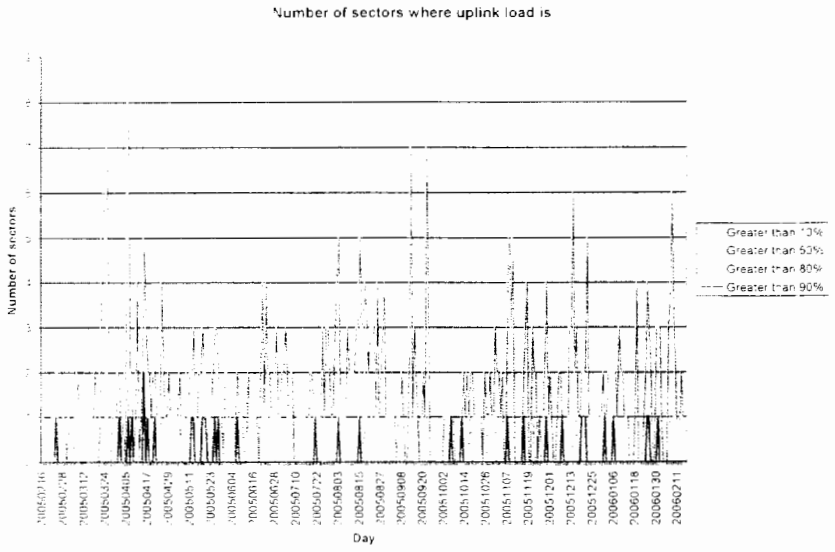

Figure 4: Uplink Load

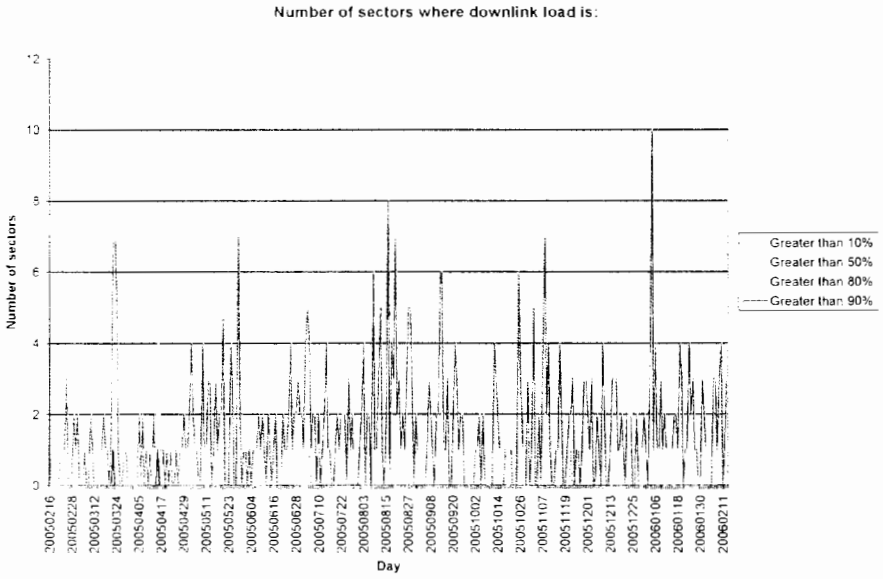

Figure 5: Downlink Load

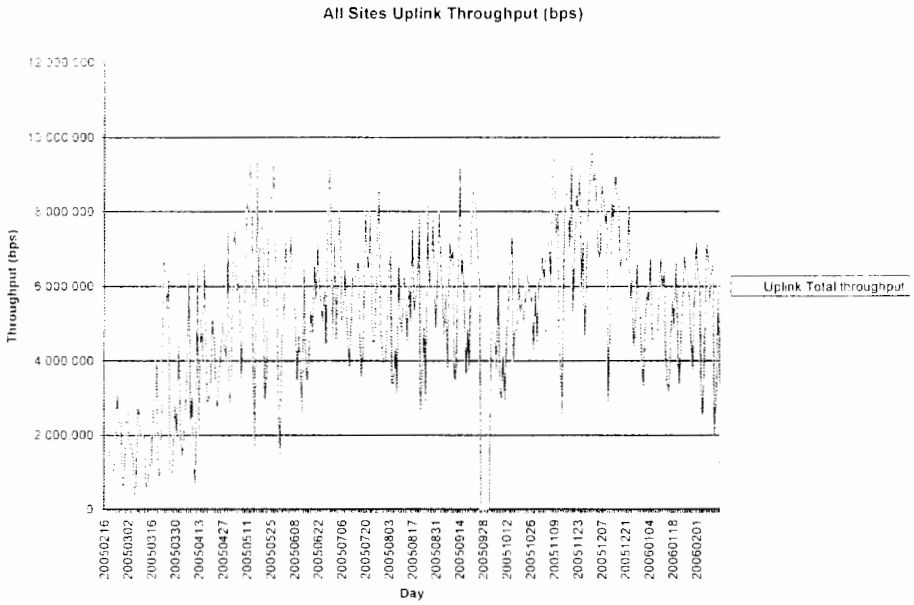

Figure 6: All sites Uplink Throughput

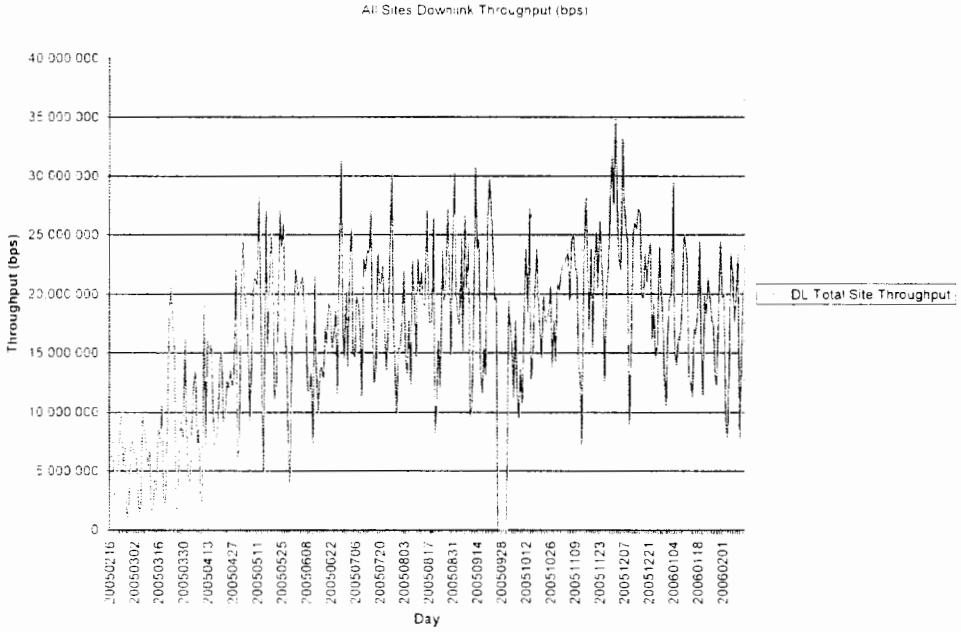

Figure 7: All sites Downlink Throughput

Network Operational Experiment

This section describes the operations of the WARN network from a user prospective.

Usage of WARN

Over the past six months, the WARN network was used to support Federal and District first responders and their agency command buses (United States Park Police, Metropolitan Police Department, Fire and Emergency Medical Services, and the District's Emergency Management Agency). The command buses were deployed for several large events in the District. These events included the 4th of July, the Million and More March, the World Bank and IMF demonstrations, anti-war protest marches, the Jamaican festival, video coverage at the DC Armory for hurricane Katrina evacuees and most recently for the President's 2006 State of the Union address. In addition to the video monitoring at the Armory, WARN enabled laptops were made available to Katrina evacuees to allow them access to the internet for email and web use.

During this period, the agencies have used a variety of applications enabling them to access remote CAD features to track vehicle fleet (I/Netview), transmit and receive across the city multi streaming video links (LiveWave, Greenhouse, TrafficLand, Kapturenet), access and share with other agencies and/or jurisdiction critical data (CapWIN, JUSTIS, WALES) and remotely access to vital information (internet, Cobra, GIS, CapSTAT).

User Survey Results

Monthly user surveys have been conducted since August, 2005. A graphical representation of the feedback is shown below in Figure 8. While the lowest rated element has consistently been antenna reliability (the PC card uses a small snap-in, easy to disconnect paddle antenna), users' perception of system benefit has been rated very high. Results from the latest month had users giving this element its highest rating (5 out of 5).

The second lowest rated element has been consistent coverage. Due to the limited bandwidth available for the pilot WARN network, more towers have not been deployed. We anticipate that these coverage issues will be resolved when the operational network is deployed, improved coverage will be achieved.

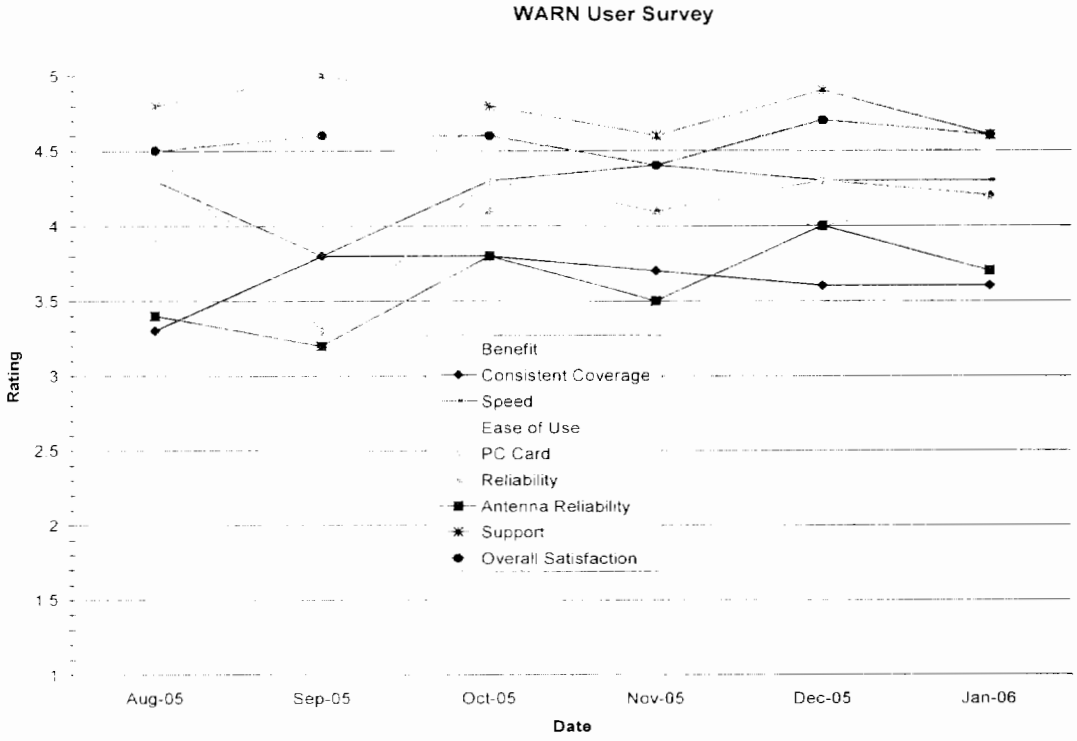

Figure 8: User Survey Results

User Comments

"WARN has had a tremendous impact in our ability to access and transfer critical information to and from our mobile command center. It has provided our mobile units with a fast, simple, and reliable means through which to send and receive digital information. The ability to transmit live streaming video or access our GIS server from the field, has proven invaluable to senior management in their decision making process. We look forward to the day WARN has expanded throughout the NCR."—DC Emergency Management Agency

"For F/EMS users, it should be expanded to all EMS Operations Supervisors"—DC Fire and Emergency Medical Service

"This system continues to be an asset to our agency. Without it, there are times we would be much less efficient in our operations—DC Fire and Emergency Medical Service

"Mobile Command HQ used/relied on our WARN connection HEAVILY during the recent IMF/World Bank and Anti-War Demonstrations. The system worked flawlessly in spit of our "difficult" location (adjacent to the West Wing).—U.S. Park Police

"WARN has helped me as an F/EMS planner in numerous ways. I attend many meetings throughout the city. In these meetings, I access files via WARN that allow me to make video and graphic presentations and to access other people's information in ways that would not be possible without it. This ability has made my work more efficient.

I have also used the WARN network on multiple National Security Events, special events, and emergency responses to track unit status information in real time, to access the METRO Protect System, to compile data, and access the internet and send and receive emails."—DC Fire and Emergency Services

"During the month of January, 2006, the United States Park Police, in coordination with the DC Office of the Chief Technology Officer, installed a WARN connection at the USPP Anacostia Operations Facility. This connection now enables the United States Park Police Command Center, designated as such for large-scale incidents and events, to have direct access into District of Columbia databases, allows for extensive data interoperability with District of Columbia government and public safety partners, and provides a robust platform for continuity of operations should an incident result in the loss of the United States Park Police backbone. This is an outstanding partnership.—U.S. Park Police

Applications

A new version of the Greenhouse (a streaming video application deployed in its current version by several District's agencies) is currently undergoing final testing. There are several major upgrades to this version of Greenhouse.
The first is the addition of new codecs. MJPEG and H-264 have been added to the existing MPEG4 codec. Evaluation of those codecs by the users will enable to rank their merits and select the most appropriate for a public safety use.
Second, users now have the option to select, not only the codec to be used, but also the transmitted bandwidth. It will both bring some flexibility to the users to still transmit at a lower quality level when the network is saturated or the radio conditions are not optimal.
Third, and most importantly, the new version of the software has implemented multicast on the uplink of the communication. As a consequence, when there are multiple viewers of a video stream transmitted by a mobile terminal there is no requirement to occupy as many radio channels, but only one as the application server will distribute the unique uplink as necessary to the various viewers. This feature obviously optimizes the use of a scarce spectrum resource. However, should several receivers downloading the same streaming video transmission be located in the same cell, as many radio links resources will be occupied as the multicast feature is not implemented on that side of the

communication. In addition to the saving in uplink bandwidth (the most limited resource in the network). the load on the encoding PC processor has been greatly diminished.

Next milestones

In the coming months. OCTO intends to further improve the performance of the network and the service to the Capital first responders.

- Review. test. optimize. and deploy additional applications. in particular video applications.
- Investigate and implement as possible improvement of the reverse link budget
- Investigate and quantify benefits of multicasting