Project Purpose

In this era of code orange warnings, the capacity to rapidly deploy wireless applications is absolutely essential in meeting the public safety and homeland security needs of the nation and its capital. These traditional challenges are further complicated as we face significant new threats to our national security in an age of extreme budget shortfalls.

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. Applications that could be deployed in the near term to improve public safety are not realistic options because there is insufficient bandwidth available and also because they are not economically viable. The use of video images to relay critical information between first-responders in the field, and the use of other technology for similar purposes simply cannot be deployed with the current allocation of public safety wireless spectrum and associated technologies.

The objective of this project is to provide a wide area (within Washington DC city limits) broadband (1.5Mbps per user) wireless data network that will serve as a pilot for next generation of public safety applications. The intent is to demonstrate that affordable technologies exist today to support the critical public safety applications detailed in this document, and recommend the specific technology and features that best suit public safety applications requirements. 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.

Background

The Public Safety Wireless Advisory Committee (PSWAC) report established in 1996 that in order to support their voice and data requirements (including video services), public safety agencies needed 74.5 MHz of additional spectrum.

This spectrum has not been yet allocated to Public Safety and as a result, the District of Columbia is not able to support applications such as PROTECT, or CapWIN (see below), and others that require at least 1.5 Mbps per user, and up to 10Mbps per site.

In 1998 the FCC allocated 24 MHz of spectrum to Public Safety, out of which 12 MHZ are dedicated to wide-band data. However the channelization plan of this spectrum (150 kHz per channel maximum), the scarce availability of channels in a dense multi-jurisdiction area such as Washington DC, and the performance (384kbs) of the technology (SAM) mandated to be used in this spectrum, do not enable the District to support those critical applications.
In addition this technology is not easily scalable: e.g., increasing the system capacity requires the availability of additional frequencies (which we know is very limited), or requires a major regional frequency coordination effort, coupled with costly frequency retuning and operations disruptions of several first responders communications systems in the Nation’s capital metropolitan area.

The FCC recently allocated 50MHz to public safety in the 4.9GHz band. The technologies to be deployed in this band are envisioned being similar to the 802.11 broadband wireless data communications standards. Those technologies satisfy most of the District's broadband data and scalability requirements, although high mobility is not supported. Furthermore, the 4.9GHz radio propagation characteristics are such that the deployment and the operations of a District wide network are not viable for the city: more than 400 sites are required to provide a ubiquitous coverage of the District.

Nevertheless, we believe that solutions to the wide area broadband data needs of the District do exist. The objective of this network pilot project is to demonstrate that several technologies exist and satisfy our technical requirements.

Therefore, should additional spectrum be available to Public Safety, those technologies could be deployed and at last, first responders would have access to tools at least as good as those the terrorists have access to.

Proposed Project

The pilot's short-term goal is to prove-in the capabilities of wide-area broadband wireless data for the public safety community in the District, and validate the performance of the technology.

To do so, a District wide infrastructure will be deployed, and District agencies will use the key applications described below in an operational environment.

The Network

The pilot system will cover the whole District. Ten sites the District is currently operating for its Public Safety voice network, will be used. The pilot network will be operational for fifteen months, currently planned from April 2004 to June 2005.

The high-speed wireless data system will use a flexible and scalable architecture. It will enable public safety users to access the Internet or their private intranets at data rates significantly higher than their current capabilities, and also support applications such as PROTECT, Capwin, as described below.

Up-to two technologies/vendors will be deployed for the pilot network. As of today, two possible technologies have been identified for this network: 1xEV-DO and Flash OFDM. An RFP has been issued to select the pilot's equipment vendors. Each vendor will support up to 400 packet data-only users with peak data rates of at least 1.5 Mbps on the downlink and 144 Kbps on the uplink over the air interface.

Figure 1 describes the 1xEV-DO network architecture. It consists in a Radio Access Network (RAN), comprised of ten DO-only base stations, a Controller and an Element Management System for operations and maintenance. The RAN interfaces to the IP network over an R-P Interface via a Packet Data Service Node (PDSN), which routes packets to the Internet. Either Simple IP or Mobile IP is supported through negotiation between the PDSN and the Access Terminal (AT).

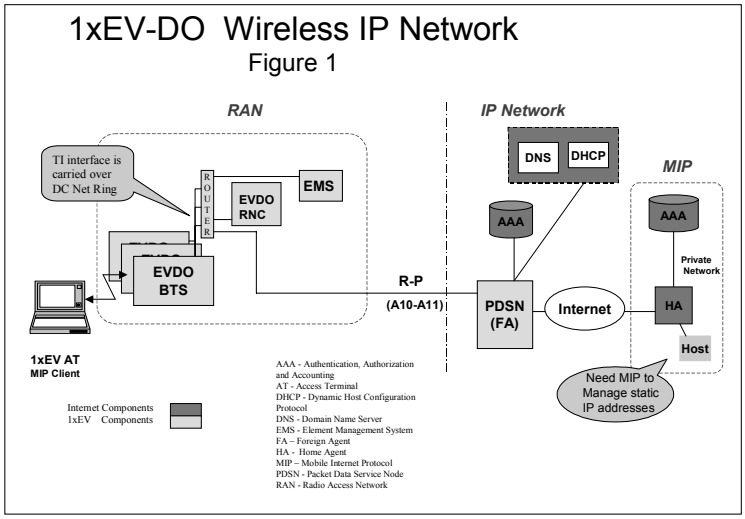
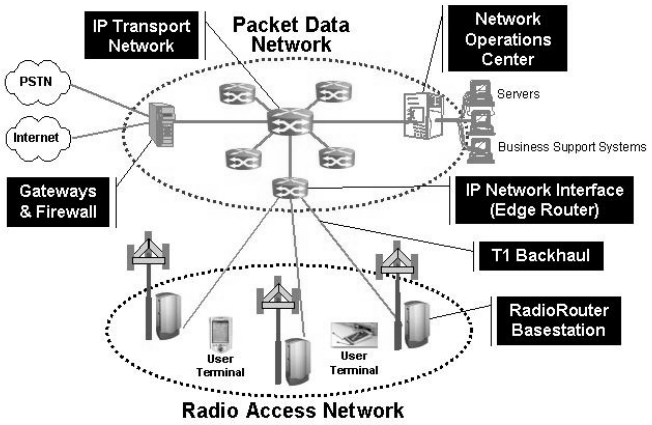


Figure 2 describes the Flash OFDM network architecture. It consists in ten radio-routers, an IP network interface and a network operations center. Mobile IP is supported.



Two paired 1.25 MHz channels are required to deploy the pilot network. Custom PCMCIA cards will be designed to operate at the upper 700MHz spectrum and will be available to users for the duration of the pilot.

The Applications

The pilot network will provide first responders with critical information needed to improve their decision-making. It will offer the opportunity to extend several functionalities to emergency response vehicles that are not currently available.

The majority of public safety agencies throughout the country are seeking the applications described below. Today none can utilize these applications due to lack of broadband wide area wireless network dedicated to public safety agencies. As a result lives are at risk.

In this pilot, the Metropolitan Police Department, the DC-Fire and Emergency Medical Services department, the DC-Emergency Management Agency, US Capitol Police, the US Park Police, and the US Secret Services are anticipated interoperability participating agencies.

Specifically, the following applications will be supported.

PROTECT
This application has been developed following the Sarin gas attacks that took place in Japan several years ago. Its objective is to protect our subways, and give early notification to the different agencies that would be affected by a bio- or chemical attack in the Metro tunnels system.

The Metro subway stations have chemical sensors and video cameras located at the platform levels, and throughout the tunnel area. The application of those sensors gives the Operations personnel at the communications center, the ability to remotely monitor safely what is going on in the stations.
Once there is activation on the chemical sensors, the system will notify the First Responders through this experimental wireless network, and will allow the incident commanders to view live video as they are approaching the scene.

Up to 16 different cameras in each station allows the incident commander to tilt the cameras, to pan them in and out, to be able to assess in details the situation. The application includes plume model projections. That information helps the incident commander to assess the situation and mitigate the incident itself.

The Argonne National Labs software experts, who developed this application, have indicated that a 1.2 megabit per second feed is required for each individual agent. The aggregation of the demand for this information, (six battalion chief vehicles, but also police officers who require information in order to cordon off the areas), leads to a 17 megabits per second net throughput requirement, throughout the District in the event of an incident.

CAPWIN

CapWin is an application that interfaces all the regional jurisdictions messaging systems together. It is an incident command system using a browser-based interface. It also provides cross-jurisdictional data base access. The per-unit throughput required for CapWIN is not high,

however the aggregate total throughput, because of the number of agencies and personnel involved, is anticipated to be roughly 25 megabits per second for a major event.

EMERGENCY MEDICAL SERVICES (EMS) APPLICATIONS

Today the EMS process is archaic as EMS providers are sent to the scene with a minimal amount of information about the patient, or the scene itself. Their support from external medical specialists also limits the level of care they can provide.

The integration of automatic vehicle locators, mobile data computers, along with portable cameras and apparatus, will enhance the quality and the efficiency of EMS services as closest available units will be sent to the scene, situation assessment will be performed en route to the incident (saving precious time), and patient care will be initiated on its way to the hospital, thanks to the video live support from medical control facilities.
The aggregated throughput requirements to support this application is estimated to be 2.5 Mbps.

Testing

The objectives of the testing are multiple:

- Validate the technical performance (coverage, latency, throughput and capacity) of the technologies under evaluation. Those tests could include on-site measurements as well as field measurements (drive tests). Radio performance tests will be performed both for downlink (forward link) and uplink (reverse link). Signal level effect on performance will be derived from drive tests. Capacity and loading effects on performance will be evaluated using a concentrated number of mobiles at a couple of sites.

- Demonstrate the technology can support the various applications listed in the section above.

- Assess the operational and maintenance viability of the proposed system/technology by tracking on going performance of the system during the pilot operational phase. The performance tracking might include statistics and data collected through the O&M system, data collected on a periodic basis through field measurements (drive tests, site tests), as well as documented feedback from the users.

- Evaluate the amount of interference created by the system in adjacent bands, as well as evaluate the effects of interference from adjacent band into the system. In particular the effect of interference created into/ received from TV stations broadcasting in the adjacent and co-channels will be evaluated. Results will be shared with the Wireless and Broadcasting industries, such the technical conditions of co-existence of Public Safety services and TV Broadcasting services may be fine tuned.

- Assess the impact of the implementation of this network on the operational efficiency of participating agencies. Results of the tests will be shared with the Public Safety community such that the lessons learned during this pilot will promote and accelerate the deployment of such networks and applications across the country.

Conclusion

This project will have a dramatic impact on the way Public Safety conduct business. The leverage of the commercial world's R&D efforts applied to Public Safety needs, will allow the public safety officers to access data in the field that will improve their capacity to make the right decision and enhance their responsiveness, accuracy and efficiency.
This project will also allow to assess through field measurements how TV stations are affected by LMR system, and vice versa.