
# THE AIRWIN PROJECT

## REVITALIZING US WIRELESS INNOVATION

## Vanu, Inc. Whitepaper 1-12


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## I. INTRODUCTION

The U.S. is a country of 312 million with nearly constant access to technology and resources that enable us to communicate around the country, across borders and into the deep reaches of space. We have introduced whole industries and advancements in health, safety, education and commerce based on ubiquitous mobile communications throughout the nation. Yet in times of greatest national crisis, our first responders do not have the reliable, interoperable communications systems they need to adequately assist citizens in peril.

Despite the well-documented communications challenges faced by first responders on 9/11[i], 10 years later we still have not created an interoperable wireless network that meets public safety's needs, Moreover, we have failed to provide those with the most important communications needs—our first responders—with a fraction of the useful, time-saving and potentially life-saving applications a 12-year-old can download from the iPhone App Store or Android Marketplace for a consumer-grade smartphone.

The National Broadband Plan and legislation before Congress attempt to solve these problems by calling for the creation of a new national broadband network for public safety. The future of public safety requires significantly more advanced and capable wireless broadband networks that are flexible and adaptive—and that can evolve gracefully to take advantage of the continuing stream of innovative services and technologies. But at the same time, we see that year after year the U.S. sheds more jobs in the wireless communications industry. In fact, there are no major commercial wireless infrastructure manufacturers (e.g., CDMA, GSM, UMTS, LTE network equipment providers) headquartered in the U.S. today.

However, the task is far from impossible. Despite the industry's geographic shift, the U.S. has more than eight decades of wireless expertise that can serve as a foundation for groundbreaking research and new technologies. By leveraging this knowledge to build out a real-world wireless test bed, the U.S. can reestablish leadership in the wireless industry while at the same time creating the advanced networks needed for public safety communications.

The AIRWIN (American Innovation Revitalization in Wireless Infrastructure) Project, driven by Vanu®, Intel® and Commscope®, aims to establish a robust test network in Boston, Mass., utilizing the city's infrastructure as well as the area's world-class research expertise. This network will not only facilitate the development and deployment of new public safety apps in the Boston area; the lessons learned can be applied to apps for myriad other spaces, including education and health care, across the country. In the process, the AIRWIN Project will put the U.S. back on the cutting edge of wireless research—a position that's critical for the economy and security of the nation.

## II. THE RISE AND FALL OF THE U.S. WIRELESS INFRASTRUCTURE INDUSTRY

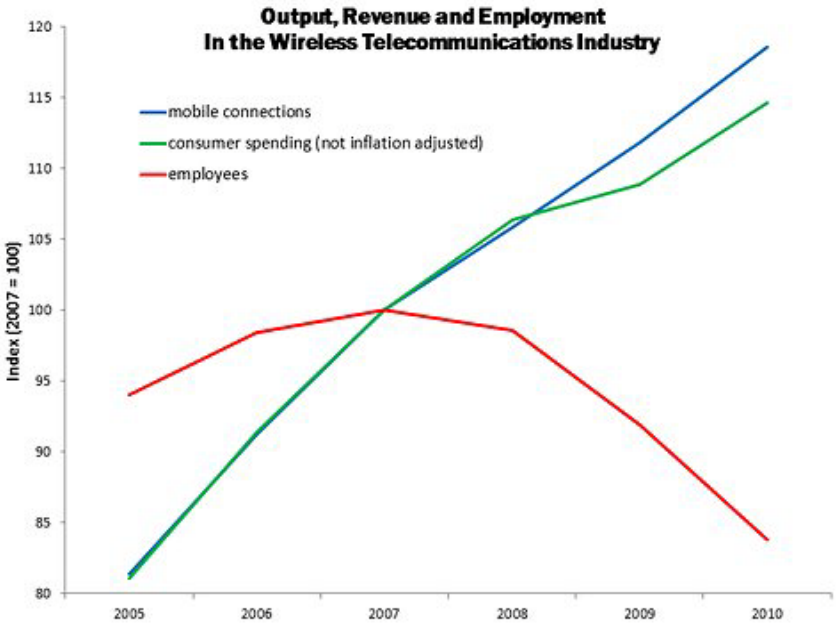
The U.S. created the mobile wireless industry, from Motorola's 1930 introduction of the first car radio (which had an early application in public safety through police radios) to "walkie-talkie" communications in World War II, 13 major communications units on board each Apollo manned space mission in the late 1960s, and the first handheld mobile phone in 1973. Starting with the launch of the first GSM system in Finland in 1991, the center of gravity for mobile research, technology and manufacturing has migrated off shore. Today, no major commercial its commercial network division to Nokia Siemens Networks, which is headquartered in Finland. wireless infrastructure vendor is headquartered in North America: Nortel filed for bankruptcy, Lucent merged with Alcatel and is headquartered in Paris, and Motorola sold its commercial network division to Nokia Siemens Networks, which is headquartered in Finland.

This offshore shift of the wireless industry has resulted in a loss of jobs in the U.S. and dampened prospects for future job growth in this large and growing sector of the global economy. In 2005 the trade association CTIA commissioned a study that concluded that at the time[ii]:

- 3.6 million jobs in the U.S. were directly and indirectly dependent on the U.S. wireless telecommunications industry.
- In 2004, the industry generated $118 billion in revenue and contributed $92 billion to the U.S. GDP.
- The industry and its employees paid $63 billion to the U.S. government, including federal, state and local fees and taxes.
- The use and availability of wireless telecom services and products created a $157 billion consumer surplus, which is the difference between what end-users are willing to pay for a service and what they are actually paying.

Since that time consumer spending and mobile connections increased, but the number of U.S. employees in the wireless telecommunications industry plummeted (see Figure 1). While wireless usage is rising, the jobs associated with designing and building the wireless equipment have shifted overseas. The number of mobile connections worldwide reached 5 billion in July 2010—an incredible milestone for an industry that has existed for less than a quarter century[iii]—and subscriptions per 100 people rose globally from 24.4 to 60.3 between 2003 and 2008 and are expected to rise to 86.5 by 2015.[iv] Without a major push for new wireless research and development, the U.S. will not be in position to capture a significant share of this growth market in the coming decade.

**Figure 1**




Source: Bureau of Economic Analysis[v]

Beyond pure economics, the loss of design expertise and manufacturing capability in this sector compromises defense and homeland security capabilities. The loss of this capability is a strategic defense concern, given the importance of wireless communications in all military missions. From an economic, defense and homeland security perspective, it is imperative that the U.S. regain leadership in wireless technologies.

Wireless technology is at an important crossroads. The industry is in the early stages of deploying radically more capable mobile systems and applications, most popularly associated with the mass market success of commercial 3G/4G mobile services and the ecosystem of smartphones and tablets. The next generation of smart vehicles and infrastructures is developing quickly (e.g., smart grids and sensor-enabled buildings). To fully realize the potential of all of this technology and entrepreneurial innovative culture that has been such a source of competitive advantage to the U.S. in the past, we need to enable better cross-fertilization across wireless technologies and development efforts. Positive feedback from a real-world laboratory is needed to propel the next revolution in wireless network and technology R&D and commercialization.

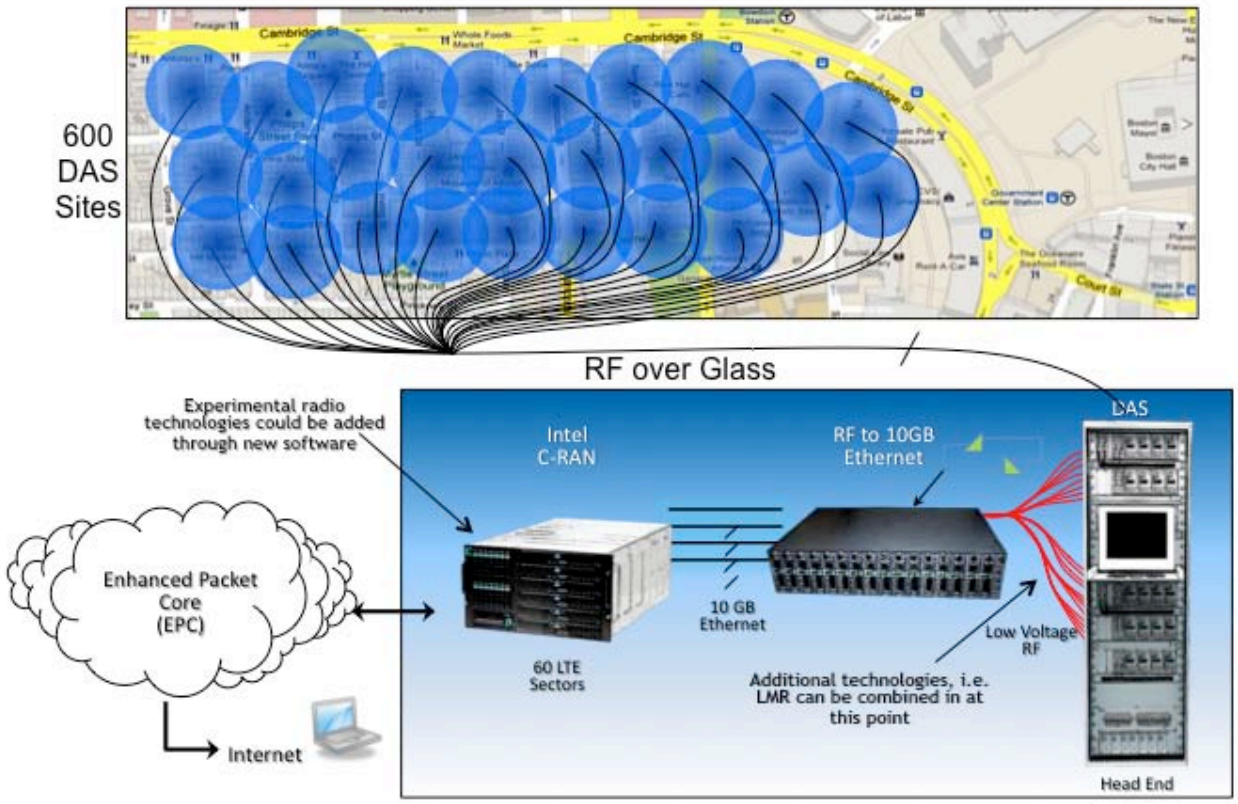
## III. The AIRWIN Solution

The AIRWIN Project is proposing to build a live urban network in the City of Boston that will serve as a test bed for new technologies, apps and services and provide the nexus for re-establishing U.S. leadership in wireless innovation. For the first time, it will be possible to experiment with novel technologies and business models for next-generation wireless radio networks with live users in a real-world environment. This will enable market demonstration of and trust-building for new public/private and commercial/government network- and spectrum-sharing models that are required to develop commercial services and accelerate a positive feedback loop from research to development to market realization. As a globally unique test bed platform, the AIRWIN Project will attract wireless innovation investment,

entrepreneurial ventures and high-quality, high-tech jobs. Because wireless is at the heart of all “smart” technology innovation—from smart grids to health care, from mobile e-commerce to smart manufacturing—locating this test bed in Massachusetts will leverage innovation in these other sectors as well.

The network will be built using a unique architecture that combines innovative technologies from Intel®, Commscope® and Vanu®, as shown in Figure 2. The architecture will consist of approximately 600 low-profile distributed antenna sites throughout the city, each digitizing up to eight separate RF bands. Each site is connected by fiber back to a dedicated cloud using Intel Cloud RAN (CRAN technology). Vanu software radio and virtualization technology will enable the simultaneous operation of multiple independent networks using different wireless technologies on the single system. This combination greatly improves the economics of building and running wireless networks, as the costs are shared across multiple users.

**Figure 2: Cloud RAN Network Architecture**




This software-based architecture will allow for rapid prototyping and deployment of new standards and services. The virtualization will not only enable simultaneous operation of independent networks, but will also allow for carving off a separate, live, experimental system that is isolated from the other networks for rapid prototyping of new wireless research.

By employing a large number of low-profile sites rather than a few larger macro cell sites, the network architecture can provide better coverage in an urban environment, consume less power per site and lower the environmental impact compared to traditional cell towers. In addition to lower energy costs, the

CRAN technology allows for centralized management and operation, less site support, and reduced backhaul traffic, meaning capex and opex are lower than they would be in a traditional RAN architecture though capacity, efficiency and user experience are higher.[vi]

**Testing in an Urban Environment**

It is essential that a test bed such as AIRWIN's be located in a busy urban environment. While remote test labs serve a purpose for early validation of technology in a clean RF environment, the concerns and risks can only be fully addressed in a crowded environment with live users. The City of Boston is an ideal location because of the area's leadership in education, science, and research and development across a wide range of core technology sectors that are at the heart of future growth opportunities for our national economy.

The AIRWIN Project will draw on critical early adopters (public safety users and tech-savvy consumers, both of whom are in abundance in Massachusetts), industrial partners, and vendors of services, equipment and complementary hardware/software technologies, as well as the basic and applied research expertise of the multiple world-class universities in the greater Boston area. In return, the project will provide critical infrastructure for the Massachusetts innovation economy and contribute to regional economic development and growth.

The benefits of the innovations, measurements, test results and usability/deployment lessons learned will be applicable to enhance the design and quality of public safety systems across the U.S. and around the world.

AIRWIN addresses several challenges of introducing new wireless technologies and capabilities in the commercial and government spaces:

***Risk aversion*:** Incumbent users are justifiably averse to experimenting with new technologies that may compromise their ability to address their mission. The AIRWIN network will serve as a complement to, not a replacement for, existing networks, so testing can be completed during normal operations. Testing can also focus on new services that will add value but are not currently available, ensuring that reliability is not an urgent concern.

***Budget constraints*:** Both commercial and government users are subject to significant budget constraints and "silo"-based industry supply and budgeting. Ownership of the AIRWIN network is shared, meaning costs are lower for each player involved. Deployments are also impeded by concerns over interoperability with legacy equipment and the costs of new technology. The Project's CRAN architecture is far more cost-effective than legacy builds, and the wireless test bed will provide experimental data and proof points on interoperability.

***Unaware of benefits*:** There is a general lack of appreciation of how dynamic spectrum access may benefit commercial carriers or the public safety mission, as well as how applications enabled by new wireless technologies can improve the efficacy and economics of public safety. What can be done on a tablet today vastly exceeds the capabilities of ruggedized mobile computers of a few years ago—not to mention the ease of use enabled by current touch screen interfaces. An appropriate pilot project could help educate the community and generate demand.

***Bridging architectural and practical gaps:*** Any new program faces the challenge of bridging two gaps: one between wired IP data network architectures and wireless architectures, and one between research and robust field-tested products. The AIRWIN solution creates a low-profile, efficient combination of fiber and wireless technologies to allow rapid prototyping and deployment in a live environment.

***Spectrum regulation:*** Identifying new ways of using spectrum is often driven by business opportunity. However, investment in a new spectrum technology is stymied by the lack of a regulatory environment that permits the use of the new technology. The spectrum-sharing model pioneered by the AIRWIN solution will serve to reduce costs and improve efficiency. Test applications will provide real data to inform future regulatory decisions and encourage technological developments.

## IV. First Application: Public Safety

The first application of the proposed network will be a wireless broadband system for Boston public safety. A 700 MHz LTE-based broadband system will be deployed on the cloud system. This will be made available to public safety users in the city as a complement to their existing radio system. With today's systems, introducing new services and migrating to new platforms or vendors is more difficult and

expensive than it should be. The AIRWIN Project will provide a vector for design and experimentation to provide an open development platform to address this challenge.

A critical component to the affordability and practicality of a nationwide broadband public safety network is public-private partnership. Public safety cannot afford to build and run a nationwide network solely for its own use, so some form of sharing with commercial operators must be enabled for the network to become a reality. Several notions of sharing have been suggested, ranging from sharing only the towers to public safety users running completely on commercial networks. Sharing only the towers does not provide enough cost savings, and full operation on commercial networks is not practical or desirable for either public safety or commercial operators. The solution must lie somewhere in between. A primary goal of the first application of this network is to test and validate various proposed methods of sharing, including but not limited to:

- Commercial operators using excess public safety capacity in non-emergency times for data offload from their networks
- Use of public safety spectrum to allow commercial users to make emergency calls
- Public safety users roaming onto commercial networks in rural and other areas where it is not cost-effective to build a dedicated public safety network
- Sharing a virtualized network infrastructure to support both parties while providing public safety and commercial operators with independent management control

Public safety apps will be built on top of this system and deployed to get users' feedback. Just as downloadable consumer apps have driven new and innovative uses of cell phones, downloadable public safety apps connected to existing databases and combined with smartphone capabilities can greatly enhance public safety effectiveness. For example, the FBI is testing a missing children app that allows an agent to take a picture of a child with a smartphone and query the NCMEC database for a possible match, providing a rapid verification directly to the agent in the field in a situation where time is critical to success.

The goal is to gather feedback from actual users to drive future app deployments without impacting existing communications systems or compromising emergency response. An open API will be available to encourage public safety communities and third parties to develop innovative applications and services with regional and national flavors—for example, an integrated Fourth of July app that provides information on safety, traffic rerouting data and important locations. Virtual machines will ensure these applications have appropriate privacy and security barriers are in place.

## V. Summary

There is a critical need for a national metropolitan test bed to support development and gain essential operational test data from real public safety users on deploying new radio technologies for use by public safety. Establishment of the AIRWIN Project will provide a platform for the U.S. to be the first mover in the drive to design and deploy a state-of-the-art, next-generation public safety communication network and validate technologies for future commercial use.

But public safety is just the first of many possible use cases for this vital test bed. Its broadband capabilities can be used to test innovative technologies for education, health care, public transportation, spectrum sensing and more. The AIRWIN Project build serves several important purposes:

- Provides a mechanism for overcoming the challenges in getting new wireless technologies proven and adopted.

- Brings together a consortium of U.S. companies to build the network and lead the effort to bring wireless expertise back to the U.S.

- Allows users to test deployments and provide suggestions for improvement without compromising existing mission-critical communications systems.

- Creates an environment to prototype new technologies that will influence future spectrum policy with demonstrated results in an urban environment.

- Accelerates the path from research to deployment by facilitating rapid prototyping in a live environment.

- Serves as a catalyst for the creation of new technologies, companies and jobs.

The economic cost of our wireless networks in terms of capital expenditures, operating and maintenance costs and the indirect costs to the U.S. economy of not having the preeminent centers of excellence and innovation in wireless telephony on our shores are too great. It is time to think holistically about commercial wireless communication and public safety wireless communication needs and the role we want the U.S. to play in a growing industry in which we have lost our lead to European and Asian manufacturers. It is not too late to regain leadership in wireless communications engineering and innovation—but this requires national leadership with support of both the public and private sectors.

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## I. NOTES

[i] National Commission on Terrorist Attacks upon the United States. (2004). The 9/11 commission report: Final report of the National Commission on Terrorist Attacks upon the United States. Washington, DC: National. Commission on Terrorist Attacks upon the United States.

[ii] http://files.ctia.org/pdf/Report_OVUM_Economy.pdf

[iii] "Snapshot: Global Mobile Connections Surpass 5 Billion Milestone," *Wireless Intelligence*, July 8, 2010, https://www.wirelessintelligence.com/print/snapshot/100708.pdf.

[iv] Adisa Banjanovic, "Special Report: Towards Universal Global Mobile Phone Coverage," *Euromonitor International,* December 8, 2009, http://www.euromonitor.com/Articles.aspx?folder=Special_Report_Towards_universal_global_mobile_phone_coverage&print=true.

[v] http://economix.blogs.nytimes.com/2011/10/12/growing-businesses-cut-payrolls-too/

[vi] C-RAN The Road Towards Green RAN, White paper, China Mobile Research Institute. http://www.scribd.com/doc/50292032/CRAN-white-paper-v1-14

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