High Speed Wireless Data

Building the Business Case



Airvana

Accelerating • Access • Anywhere

Executive Summary

The convergence of the two fastest growing technologies of our times, the Internet and wireless communications, promises to dramatically reshape society. Mobile Internet services will help people work, entertain, and communicate at any time and from anywhere—using a variety of devices such as cell phones, Personal Digital Assistants (PDAs), and laptops. Confronted by the Mobile Internet's enormous potential and the declining mobile voice revenues per subscriber, wireless operators are pegging their future growth on 3G Mobile Internet services.

While there are a number of 3G technologies available today, most have voice-centric designs that are not suited to cost-effectively deliver mobile data services. Recently a global 3G standards organization known as the Third Generation Partnership Project (3GPP2) adopted a new 3G standard called CDMA2000 1x Evolution – Data Only (CDMA2000 1xEV-DO). CDMA2000 1xEV-DO is optimized for delivering high-speed wireless Internet services. Because CDMA2000 1xEV-DO can achieve a peak data rate of 2.4 Mbps and average rates of 600 to 1200 Kbps in only 1.25 MHz of spectrum, it can effectively deliver a broadband desktop Internet experience in a mobile environment. CDMA2000 1xEV-DO's speed makes it suitable for delivering even fixed wireless Internet services. From an economic perspective, recent studies have shown that CDMA2000 1xEV-DO has the lowest cost per bit of any 3G technology.

The choice of an air interface, however, is just one element in an operator's decision to offer 3G services. Ultimately, operators will create 3G services only if they can build and operate the entire wireless network cost-effectively and rapidly achieve profitability. Many believe that IP-based wireless networks will radically reduce operator's equipment and operating costs, while enabling them to deliver differentiated mobile and fixed data services.

Airvana has developed the following business case to demonstrate how operators can build a CDMA2000 1xEV-DO 3G network with an All-IP architecture to deliver new high-speed data services. As this model shows, operators who implement CDMA2000 1xEV-DO systems can expect to achieve positive EBITDA and cash flow in less than four years—a full year faster than the historical performance of the best wireless voice networks.

Why deploy a Wireless Data Network?

Like wire line long distance before it, wireless voice is fast becoming a low-margin, commodity business. Over the last 2 years, average revenue per user (ARPU) has shown little growth while actual usage has increased dramatically. With voice, service providers have little room to differentiate their services. To remain competitive, wireless service providers must either lower their prices or offer new, differentiated services that customers care about.

Broadband data provides a new growth opportunity for the wireless operator. Over the past few years, business users and consumers have begun to rely on broadband data access. Data traffic exceeded voice traffic on public wire line networks in 1998. Analysts expect more than 90% of all traffic on the public wire line networks to be Internet and data traffic by 2005. Where demand leads, revenue follows. Wire line service providers report that data revenues now represent a greater percentage of their total revenues than they did four years ago (see Figure 1).

Current indications point to data overwhelming voice traffic on the wireless network just as it did in the wire line world—creating a tremendous opportunity for wireless service providers. According to Jupiter communications, over 600 million people will be actively using the Internet wirelessly by 2005[1]. As the Internet grows, the demand for wireless access to it will increase. Although it has offered Mobile Internet services for less than a year, SK Telecom, a leading Korean wireless service provider, reports that mobile Internet services already account for 5.4% of its expected total sales.

Airvana has developed this business case to explore the benefits of deploying a high-speed wireless data network based on the CDMA2000 1xEV-DO standard. The remainder of this paper describes the business case and how the Airvana CDMA2000 1xEV-DO solution can help wireless service providers quickly deploy lucrative wireless data services.

Introducing CDMA2000 1xEV-DO

Based on Qualcomm's High Data Rate (HDR) technology, the CDMA2000 1xEV-DO standard is the next step in the evolution of CDMA networks. 1xEV-DO seamlessly interoperates with CDMA 2000 1xRTT voice networks to provide data rates that exceed those offered by W-CDMA—while using only 1.25 MHz of spectrum.

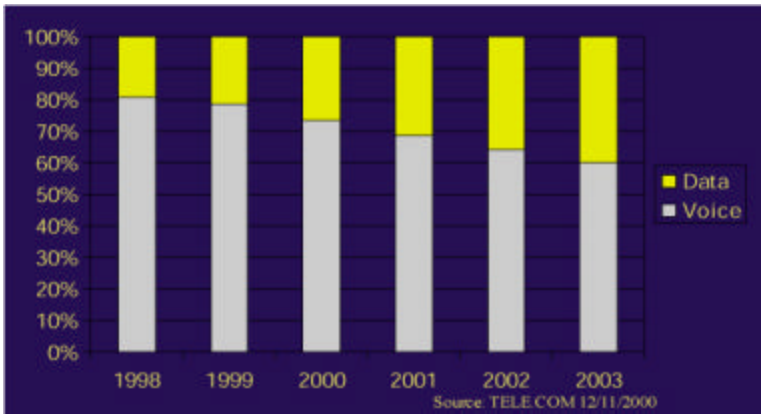

Figure 1: Data as a Percentage of Revenue for Wire line Service Providers

[1] Jupiter Communications – Global Wireless Model 9/2000

The Operator Business Case for 3G CDMA2000 1xEV-DO

Understanding the model
To demonstrate the attractive financial returns offered by a CDMA2000 1xEV-DO network, we analyzed how this network would be deployed and operated in a mid-size (490 square kilometers) metropolitan area with a population of two million. We estimated revenues, spectrum costs, capital expenditures, and operating expenses based on publicly available information from PCS network deployments and our own interactions with customers. The model uses conservative estimates for market penetration and ARPU, while relying on typical expenditures for cost areas, such as spectrum and network infrastructure equipment.

Even with this conservative approach, the business case clearly demonstrates that a typical CDMA2000 1xEV-DO network based on Airvana's All-IP infrastructure could become EBITDA and cash flow positive within four years, and have a Net Present Value (NPV) of $170 million.

- ***Anytime, Anywhere Internet Access***
- ***Streaming Audio and Video Services***
- ***Voice over IP (VoIP)***
- ***VPN Corporate Intranet Access***

Modeling Revenue

A wireless operator's revenue depends upon the number of subscribers using its network (market penetration) and the average revenue it generates per subscriber. As this section explains, we constructed this business case using modest estimates for both of these factors.

Estimating market penetration
Our model assumes that the operator would serve merely 1% of the market, or 20,000 subscribers, in the first year of its operation, and enjoy modest annual growth thereafter. By the fourth year of operation, the wireless operator will increase its market penetration to 4%, or 80,000 subscribers. As Figure 2 shows, these assumptions are more conservative than the actual market penetration Sprint PCS attained in the first four years of its operation.

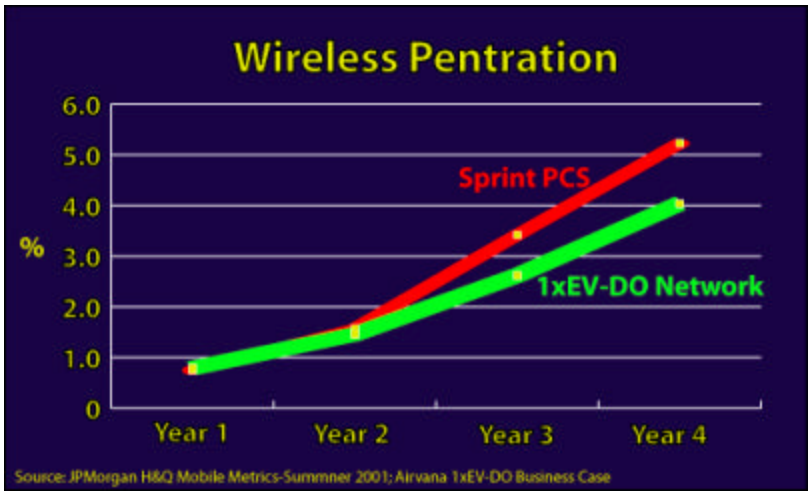

Figure 2: Market Penetration Assumptions

Estimating the average revenue per subscriber

To estimate the average revenue per subscriber, we analyzed three distinct customer segments that could be served by CDMA2000 1xEV-DO—namely the mobile consumer, mobile business user, and fixed residential segments.

Mobile consumers would typically use CDMA2000 1xEV-DO services for anywhere, anytime Internet access, chat sessions, and mobile-commerce. Service providers can combine CDMA 2000 1xEV-DO's broadband data capabilities with rich media devices such as color and multimedia-enabled phones and personal digital assistants (PDAs) to offer consumers streaming audio and video applications as well. Our model assumes that mobile consumers would be willing to pay wireless operators $13.50 per month to add a rich mobile broadband experience to their commodity voice service.

The second market segment, mobile business users, would primarily use the service to access corporate e-mail and Virtual Private Networks (VPNs) using their laptops, PDAs, and cell phones. To some extent the pricing for this segment depends upon the subscriber device used to access the data services. In general, however, we expect business users to be heavy users who access everything from e-mail to sales databases from the road. We assumed that customers in this segment would be willing to pay $29.95 and $45.95 for broadband mobile access for their PDAs and laptops, respectively.

Finally, service providers can use CDMA2000 1xEV-DO to deliver always-on broadband Internet service to desktop computers. Unlike most other broadband services, including cable, DSL, and fixed wireless (Multichannel Multipoint Distribution Service or MMDS), providing CDMA2000 1xEV-DO service does not require the service provider to send installation personnel to the subscriber premises. With CDMA2000 1xEV-DO, new subscribers simply purchase a modem from a retail store or the Internet and provision the service themselves over the air. We assumed that customers in this segment would be willing to pay a competitive price of $39.95 per month for this type of broadband wireless service.

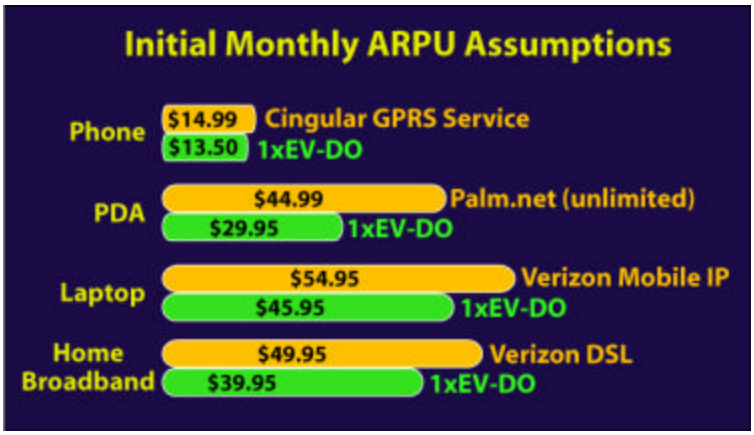

Figure 3: Initial Monthly ARPU Assumptions

Modeling Capital Expenditures

Operators constructing wireless data networks should expect significant capital expenditures for spectrum licenses, network equipment, and network deployment. This section outlines our expense estimates in each of these three areas.

Acquiring spectrum

The business case assumes a spectrum cost of $10 million per 1.25Mhz CDMA channel. This price is consistent with the actual spectrum cost in mid-size metropolitan areas such as Boston, Dallas, and Philadelphia.

Although we included the cost of spectrum in our analysis, new spectrum is not necessarily a requirement for deploying a CDMA2000 1xEV-DO system. Service providers require only 1.25 MHz[2] of unused radio spectrum to deploy a CDMA2000 1xEV-DO system. Most cdmaOne and CDMA2000 1xRTT operators already have more than 1.25 MHz of unused spectrum in their major markets, which means that they can add CDMA2000 1xEV-DO services using their existing spectrum.

TDMA and GSM operators can also use a portion of their existing spectrum for 1xEV-DO services. Since CDMA2000 1xEV-DO is a data-only technology, it uses Mobile IP for roaming, and does not need to interact with the ANSI-41 or MAP roaming networks used in cdmaOne and GSM deployments respectively. Consequently, if they can clear 1.25 MHz from their existing spectrum, TDMA and GSM operators can offer 1xEV-DO service to their customers without buying new spectrum.

Building the network

To build their network, service providers must purchase a variety of equipment, including outdoor radio nodes, radio network controllers, power cabinets, management servers and databases, cables, antennas, routers, and switches.

[2] 1.25 MHz is the unit of spectrum in cdmaOne (IS-95) networks and is also known as a “CDMA channel”.

Our model indicates that service providers can construct a green-field CDMA2000 1xEV-DO network based on Airvana's All-IP network for $10 per POP for infrastructure equipment. This cost-savings is largely due to the fact that the Airvana solution incorporates widely available IP technology and bypasses the Mobile Switching Center (MSC).

Incorporating IP technology into the network enables operators to use off-the shelf IP routers, switches, management systems, and other applications in their networks with little or no changes. The price-performance ratio of the IP layer of the network is improving at 52 percent per year—a rate that will double performance per dollar every 20 months.[3]

All-IP

The *All-IP* network architecture relies on IP—the same communications protocol used by the Internet. Because of its global acceptance and widespread use, IP benefits from a rapid technology improvement curve and a price-performance ratio that increases at a rate of 52 percent per year—making it a solid foundation for the 3G wireless data network.

Deploying an IP-based, data-only network also circumvents a huge capital cost of wireless voice networks, the Mobile Switching Center (MSC). In many cases, operators can outfit an entire city with an Airvana CDMA2000 1xEV-DO network for what they would have spent on a single MSC.

Finally, although we assumed a green-field deployment for our analysis, existing cdmaOne and CDMA2000 1xRTT subscribers can further reduce costs by reusing their existing cell sites, antennas, and radio frequency (RF) systems. Because the RF coverage and link-budget of CDMA2000 1xEV-DO is almost identical to that of other CDMA networks, existing cdmaOne and CDMA2000 1xRTT operators do not need to perform forklift upgrades to add high-speed data services. And, because vendors are building dual-mode subscriber devices that can use both CDMA2000 1xRTT and CDMA2000 1xEV-DO, operators who own CDMA2000 1xRTT networks can spread deployment costs over time. Thanks to these dual-band devices, when a broadband wireless subscriber roams out of 1xEV-DO coverage, the 1xRTT network will pick up the data session—albeit at a reduced speed. This architecture enables wireless operators to roll out high-speed CDMA2000 1xEV-DO services regionally while still offering a nationwide data service.

Deploying the network

Of the total initial capital expenditures in this business case, seventeen percent were incurred in initial network deployment. This model assumed that the network was deployed using leased tower space, and deployment costs included site acquisition, construction, RF design, installation, commissioning, and network optimization costs.

Modeling Operating Expenses

Over time the ongoing operating expenses will dwarf the initial capital expenditures—which means that containing operating expenses is critical to achieving long-term profitability. As this business model demonstrates, using the Airvana All-IP network dramatically reduces data backhaul transport and customer acquisition expenses.

Reducing the costs of backhaul transport for data services

Backhaul refers to the connection between the radio node and the radio network controllers in a wireless network. Operators use this connection to carry user data traffic and signaling information. Since each sector in a CDMA2000 1xEV-DO system can deliver a peak rate of 2.4 Mbps, the backhaul link between a typical three-sector radio node and the radio node controller may have to support a peak data transfer rate of 7.2 Mbps (the average data rate is significantly lower). In our analysis, we assumed that

[3] Business Communications Review, "Why Circuit Switching is Doomed", Peter J. Sevcik, September 1997.

operators would provision four T1 links with a peak data transfer rate of 6 Mbps for the backhaul connection. Each of the links would cost $500.

Our model uses dedicated T1/E1 links for the backhaul connection because this is the way most wireless voice radio nodes are connected today. However, operators that deploy Airvana CDMA2000 1xEV-DO equipment are free to use a variety of low cost IP transport networks — including optical, Metro Ethernet, frame relay, ATM, and unlicensed wireless instead of expensive T1/E1 lease lines. This flexibility can reduce an operator's backhaul expense by as much as seventy percent (see Figure 4).

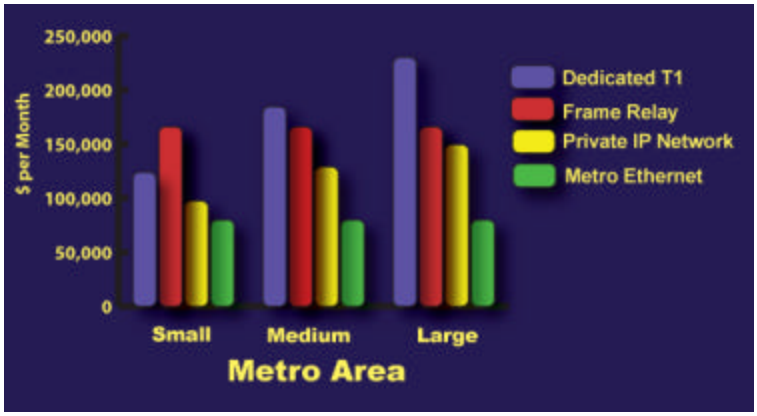

Figure 4: Metro Area Backhaul Cost Comparison[4]

Source: Verizon, Yipes, MCI Worldcom

Acquiring new customers

The cost of attracting new customers, activating services for those customers, and subsidizing the purchase of subscriber devices makes customer acquisition an expensive proposition for wireless operators. Many wireless voice operators still spend an average of $360 to attract each new subscriber.

Before operators can generate any revenue from their customer, they must activate services for those users. Fortunately, the wireless data network operator can use All-IP techology to dramatically reduce service activation expenses. With over-the-air service provisioning, new subscribers can purchase their access device in a retail outlet or off the Internet and sign up for high-speed data services over-the-air using their credit card. This 100% automated process eliminates the need for operator personnel to activate new services—freeing those personnel to focus on keeping the network running in peak condition. These advantages reduce the service activation costs for CDMA2000 1xEV-DO operators. In the business case, these cost were modeled at $200 per subscriber.

Subscriber devices or Access Terminals (AT) are critical to any wireless operator's business case. Historically, operators offer heavy subsidies to consumers for the phones they purchase. These subsidies typically range from $50 to $200 per subscriber. As more vendors develop subscriber devices, wider availability and increased competition will lower the price for them—and reduce the need for operator subsidies. Already, more than 50

[4] Assumptions:
Monthly costs for a Metro RAN with 1 IP-RNC, 75 IP-RN's
Small Metro: 500 Sq Miles Medium: 2000 Sq Miles Large: 5000 Sq Miles
Private IP Network: Owned and operated by Wireless Service Provider with 4 Hubs and 5 Router Trunks

companies have purchased licenses from Qualcomm to develop CDMA2000 1xEV-DO terminals. The impact of this increased competition is already being felt in Korea—where the price of Internet phones has fallen from $600 to $150 within a year. Our model includes an initial subsidy of $100 per subscriber in the first year and a reduced subsidy of $50 per subscriber by year eight.

The high costs associated with acquiring new subscribers makes retaining those subscribers essential to long-term profitability. Wireless operators can build customer loyalty by offering a diverse, high-value portfolio of high-speed data services.

Analyzing the business case results

Our conservative estimates for increased revenue and reduced capital and operating expenditures add up to one fact—network operators who implement a CDMA2000 1xEV-DO network based on the Airvana All-IP network can expect a Net Present Value (NPV) of more than $170 million. If this same network operator attracts more than the 1% market penetration modeled in this business case in the first year, or if that network operator intends to offer voice services in addition to data, the NPV becomes even more compelling.

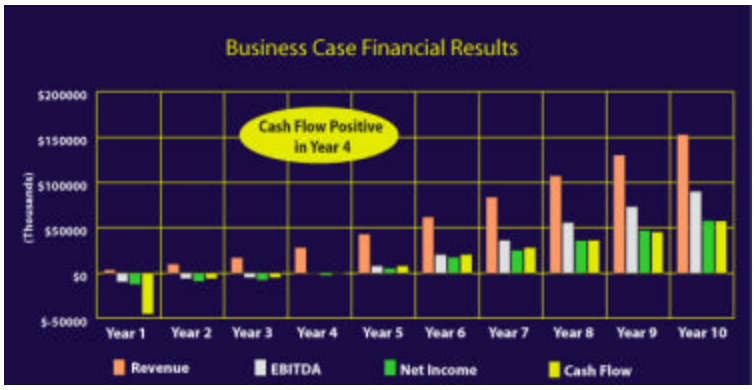

Figure 5: Business Case Financial Results

As modeled, the Airvana All-IP 1xEV-DO high speed wireless data network can become cash flow positive in its fourth year of operation. Historically, even the best wireless voice networks have required five or more years to achieve this.

This attractive return stems from the fact that 1xEV-DO enables operators to generate substantial revenues from differentiated mobile and fixed high-speed data services. At the same time, the Airvana All-IP network reduces capital expenditures, by enabling the service provider to:

- Use low cost All-IP equipment
- Choose the optimum technology for backhaul network from a wide range of low-cost IP transport solutions
- Reuse current network infrastructure
- Optimize the use of existing spectrum
- Reduce customer acquisition costs with over-the-air service activation

The Airvana Solution

Airvana is a mobile broadband wireless networking company that offers an All-IP CDMA2000 1xEV-DO network infrastructure that delivers all the benefits described in this paper and more. Architected from the ground up using an IP platform, the Airvana family of products include the IP-Radio Node 8000 (IP-RN 8000), IP-Radio Network Controller 8500 (IP-RNC 8500), and the AirVista™ Management System.

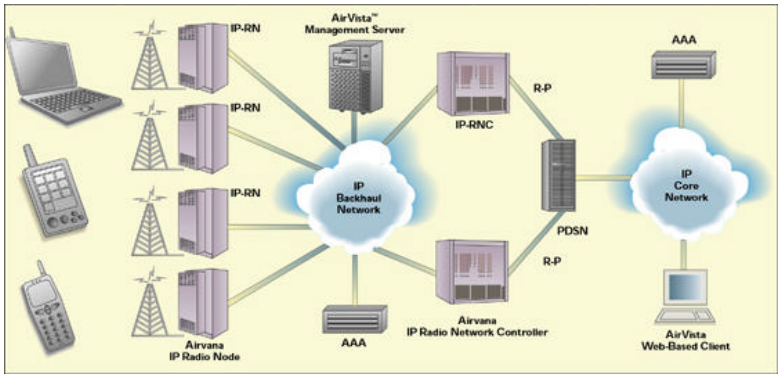

Figure 6: The Airvana All-IP CDMA2000 1xEV-DO IP-RAN

Airvana IP-RN 8000

The Airvana All-IP CDMA2000 1xEV-DO network provides the operator with a robust set of broadband wireless data services to offer their existing customers and to attract new subscribers. Unlike capital-intensive voice-oriented 3G deployments, the Airvana All-IP CDMA2000 1xEV-DO network deploys in a cost-effective manner—optimizing the use of existing network equipment, cell sites, and spectrum. Most importantly, an Airvana All-IP CDMA2000 1xEV-DO network can be deployed today—allowing operators to immediately begin differentiating themselves from their competition on the basis of high-value data services, not price.

Airvana has developed a planning tool that can be used to demonstrate the economic advantages of implementing an All-IP 3G network in your market(s). For more information about the Airvana Operator Planning Tool or about deploying a mobile broadband wireless data network, please contact Airvana at +1 (866) 344-7437 or +1 (978) 250-3000. Or, visit our web site at www.airvananet.com.

Glossary

1xRTT
A 3G Mobile Wireless technology based on CDMA that doubles the voice capacity of current CDMA mobile systems, and adds packet data capability.

3G (Third Generation)
Generic name for mobile wireless systems offering advanced voice and data services. The first two generations refer to existing analog and digital cellular networks respectively. W-CDMA, 1xRTT and 1xEV-DO are the most popular 3G standards.

3GPP (Third Generation Partnership Project)
A global standards body that is developing 3G standards based on W-CDMA technology to evolve current GSM networks.

3GPP2 (Third Generation Partnership Project 2)
A global standards body that is developing 3G standards based on CDMA 1xRTT, 1xEV-DO technology to evolve CDMA networks.

ATM (Asynchronous Transfer Mode)
A networking protocol capable of carrying multiple traffic types (voice, video, data) at various speeds.

BTS (Base Transceiver Station)
Radio equipment that cellular operators need to place at the center of each cell, usually simply called a base station.

BSC (Base Station Controller)
A wireless network equipment that controls Base Stations.

CDMA (Code Division Multiple Access)
A global Mobile Wireless technology based on a method of sharing available spectrum among many users by modulating each user's signal using a unique code.

Ethernet
The world's most widely deployed standard for Local Area Networking; it operates at 10, 100,1,000 and 10,000 Mbps.

Frame Relay
A widely used connection-oriented packet data networking technology.

IS-95
The industry standard name for 2G CDMA Mobile wireless technology.

Metropolitan Ethernet
A low-cost Metropolitan Area Network technology that transports user data as Ethernet frames over an optical network, typically in a metropolitan area.

RAN (Radio Access Network)
The part of a wireless network that includes the Base Stations and Base Station Controllers.

VoIP (Voice over IP)
A method of sending voice information over a packet-switched network, such as the Internet, using the Internet Protocol (IP).

VPN (Virtual Private Network)
A networking technology used to send data securely over public data networks.

WAP (Wireless Application Protocol)
A protocol stack for sending simplified Web pages to wireless devices. It replaces web protocols with its own, requiring that pages be written in WML, not HTML.

W-CDMA (Wideband CDMA)
A 3G CDMA system that is an evolution of the current GSM network. W-CDMA operates on a 5 MHz channel and supports voice and data services.

About Airvana Inc.

Airvana Inc. is a privately held company formed in March 2000 by a team of former senior executives from Motorola, Lucent, Cisco and Nortel. Based in Chelmsford MA, Airvana designs and builds All-IP 3G Radio Access Network (RAN) infrastructure equipment. Airvana employs some of the best data networking and wireless professionals in the world who are inspired by the belief that the Internet Protocol (IP) will change wireless networks as profoundly as it has changed wired networks.

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