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## **AFBM™:**

# **A Copper Network Technology to Revive the DSL and Cellular Backhaul Markets**

- *Rural DSL Anywhere, Without Digging a Trench*
- *4-Wire Capacity Upgrades for T1 Cellular Backhaul*
- *Business Class DSL and Triple Play Services to Compete with Cable*

### **Abstract**

**AFBM™ (Adaptive Filter Bank Modulation™) is a signal processing breakthrough that will enable broadband ubiquity by extending DSL signals significantly farther than currently achieved, drastically increasing capacity on 4-wire T1 lines for the backhaul market, and providing high multimegabit connectivity to enable “Triple Play” services on today’s access networks. AFBM™ removes the dependence on population density for expansion of broadband services that has encumbered rural deployment in the US, and does so without the need for regenerators, network extension, wire bonding, or any of the other “stop gap” solutions used in today’s copper networks. AFBM™ is a modulation technique that can be integrated into DSL or T1 solutions, making upgrades of the network simply a line card and modem replacement.**

**This paper provides an overview of the technology and its impact on the backhaul and access copper network markets.**



## 1.0 Executive Summary

AFBM™ is a wavelet based modulation technology that enables increased rates and extended reach of broadband service to a greater percentage of existing wire-line customers without new build-outs, digging, or network re-engineering. The technology meets and exceeds customer and regulator demands for broadband ubiquity while increasing average revenue per user and the value of carriers' existing assets. By enabling service providers to monetize spare DSLAM slots by populating upgraded line cards in their existing access devices, AFBM™ assists service providers in extending the life and profitability of their investment in their access network.

AFBM™ enables today's service providers to face the following challenges:

- **Lagging Sales in DSL and Broadband Services**

The lack of technology breakthroughs for DSL has left the service provider with flat growth in sales while the cable networks continue to take additional market share via faster and more complete services. AFBM™ integration into DSL line cards would offer rates of 9 Mbps at 12,000 feet and 1.5 Mbps at 22,000 feet, with higher rates possible in the future through continued development.

- **High Churn and Customer Base Erosion from Cable and Wireless Companies**

Service providers face a unique market challenge in attempting to offer higher speeds for DSL without any significant breakthrough in solving the capacity and reach problems. But, with the advent of AFBM™ technology, the service provider can now match and even beat the best speed and distance offerings of the cable and wireless companies. Utilizing DSL line cards enabled with AFBM™ technology would allow high multimegabit speeds for Voice over IP (VoIP), Internet access, and even high definition TV to today's DSL customers.

- **Rural and Under-served DSL Markets in Limbo**

With the U.S. government funding broadband deployment to rural un-served and under-served areas, service providers are under pressure to build infrastructure in order to reach those communities. DSL line cards and modems with AFBM™ technology would be able to reach 95% of rural subscribers with broadband data rates without any other infrastructure change in order to serve those customers.

- **Cellular Backhaul Capacity Crisis for Existing T1 Networks**

Most cellular base stations rely on T1 technology for traffic backhaul to the Public Switched Telephone Network (PSTN) and Packet Data Service Network (PDSN). AFBM™ would drastically increase the capacity on backhaul networks, allowing the service provider to utilize the existing

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infrastructure to meet the growing demand for high bandwidth cellular voice, data and video services.

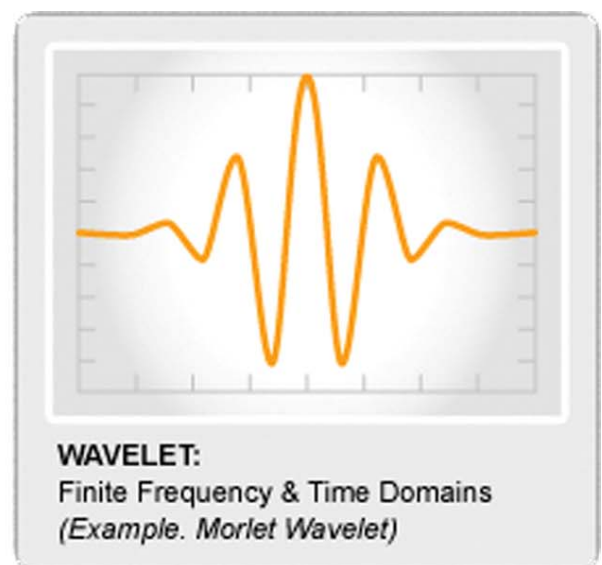
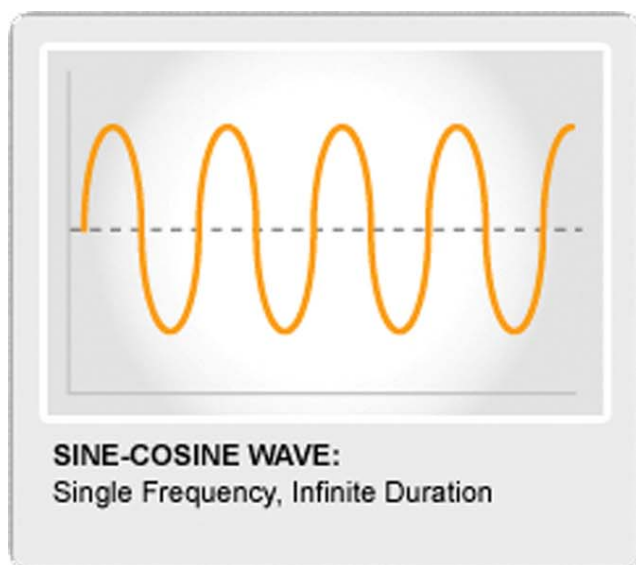
- **Lack of Competitive Business Class Service Offerings**

Enabling high-bandwidth symmetrical services on existing DSL lines has proven a challenge, as the required upstream bandwidth for businesses, small and large, strains the capacity of today's copper networks. With the addition of AFBM™ technology, the service providers will have a solution capable of supporting symmetrical services by provisioning the equipment to the appropriate band plan.

## 2.0 What is AFBM™?

AFBM™ is a modulation technology that provides significant rate and reach improvements for wired or wireless media. AFBM™ utilizes wavelets, which have been historically utilized in oil exploration, medical image processing and audio, image and video compression. Recent improvements in processor speed and increases in silicon gate densities, combined with our proprietary AFBM™ algorithms, have made wavelet modulation realizable.

- Wavelets are waveforms that are bound in both frequency and duration.
- Wavelet transforms provide an efficient alternative to traditional Fourier transforms used in communications modulation.
- Whereas Fourier transforms convert a signal into a continuous series of sine waves of constant frequency and of infinite duration, most real-world signals have a finite duration and contain a range of frequencies more efficiently represented by wavelets.
- In communications, wavelet transforms enable more efficient bandwidth utilization (packing bits per Hertz) and improved immunity to noise and crosstalk.





AFBM™ technology is fundamental physical layer technology that enables products through intellectual property integrated into chip solutions produced by broadband chips suppliers and populated in infrastructure equipment. Since AFBM™ is media agnostic, it can be applied to copper, cable and wireless solutions, and provides for additional revenue and higher profits for carriers, equipment manufacturers, and chip suppliers who incorporate AFBM™ enabled products. The technology achieves superior throughput and performance without relying on wire-bonding, power boosting, compression, or other methods. All that is required is to substitute an AFBM™ enabled product on each end of the loop - a simple modem and line card upgrade using the existing backplane. This means the service provider can use existing equipment and plant, with no need for external repeater devices.

### 3.0 Who has AFBM™?

AFBM™ is a patented technology of Xtendwave™ which was founded in Dallas Texas in 2001 by industry executives with semiconductor and energy exploration experience. It is from these seemingly disparate fields of work that the use of wavelets was contemplated for use in the extension of rate and reach in telecommunications. The timing was fortuitous in that the increasing processing speed and power of semiconductor technology made it both practical and cost-effective to use wavelet-based modulation in place of traditional Fourier-based methods to increase the physical layer throughput in communication systems for every communications medium. The Xtendwave™ breakthrough was in applying wavelet based technology to DSL chips adaptively and efficiently, resulting in AFBM™.

After years of testing and refining the algorithms, Xtendwave™ applied for and received 4 key patents for the implementation of AFBM™ for all communications media and has additional patents pending. With these core patents issued, proof-of-concept testing completed, and working cooperatively with key industry players, Xtendwave™ is seeking funds from the Broadband Technology Opportunities Program (BTOP) and other related federal programs to expedite the delivery of the first AFBM™ based products.

Today, the company is funded at a level that would allow it to deliver lab and field trial solutions for testing and validation by mid-2010, which would lead to commercial product availability from the equipment manufacturers by mid-2011. However, additional funding will accelerate the company's delivery schedule.

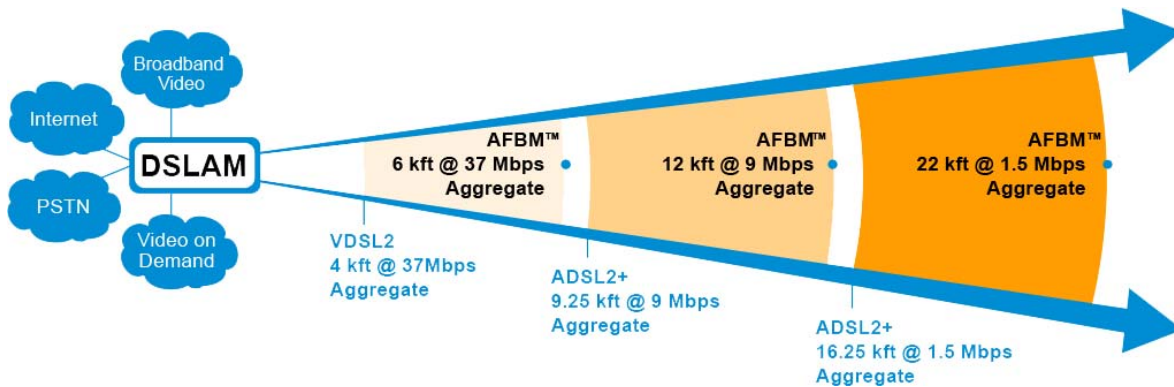
### 4.0 Benefits of Xtendwave™ Partnership for the Service Provider

In the U.S., there are over 20 million rural locations that cannot receive DSL or any broadband service. The stimulus package passed by the U.S. Congress in 2009 included significant funding for BTOP, much of the money intended to help DSL service providers defray the high costs of building out their networks to reach these potential customers.

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*Were Xtendwave™ to receive funding sufficient to accelerate product development completion, then such costs for network build-out would be significantly reduced, as the company believes it can participate in the delivery of a commercial product by late 2010 from that funding.*

This claim is based upon our AFBM™ technology's proven ability to transmit DSL signals a much farther distance than is possible with today's fastest DSL technologies, ADSL2+ and VDSL2. The current capabilities of Xtendwave's™ technology versus these two technologies are shown below:



Xtendwave™ AFBM™ Significantly Increases the Reach of Existing DSL Technologies

In addition, Xtendwave™ technology allows for an increased rate at an equivalent distance when compared to ADSL2+ or VDSL2. This is a key benefit to the DSL service provider, who is looking to offer bandwidth-intensive services such as Internet Protocol Television (IPTV) to its customers. Xtendwave™ increases both the number of services that can be offered and the distance over which those services can be offered, a key breakthrough for the DSL service providers whose markets are challenged by other broadband solutions.

Another benefit of Xtendwave™ technology is that it is achieved without adding additional equipment or regenerators. In an attempt to boost DSL signal strength and reach, there has emerged a niche market for signal regenerators. These devices are external to the DSL equipment, and require separate monitoring and power sources. The technology has had only limited success, in large part because of the high incremental costs of buying a new device, separately installing, powering, and maintaining it. The key benefit of Xtendwave's™ technology is that it is simply a new chipset integrated into new DSL line cards and modems.

Our technology would go beyond rural broadband and help DSL service providers to:

1. Reach over 95% of potential customers in the US, thereby removing distance as a service limitation;
2. Provide business class DSL service over existing infrastructure, with speeds of 9 Mbps at 12,000 feet;
3. Increase the speed of 4-wire T1 lines allowing for higher capacity traffic backhaul for cellular networks on the existing copper plant.



While the company is funded at a level that will allow it to reach market by mid 2011, we are seeking partnerships with service providers, equipment manufacturers, and chip manufacturers to expedite the company's delivery through stimulus funding for rural broadband.

## 5.0 Partnering with Service Providers - a Symbiosis

Xtendwave™ is not seeking direct funding from the service provider, but is seeking service provider sponsorship in the following ways:

- Recommendation of Xtendwave™ for broadband stimulus funding via BTOP;
- Introduction to American DSLAM and backhaul equipment providers.

For this assistance, Xtendwave™ can offer the service provider:

- Expedited delivery of all Xtendwave™ solutions;
- Initial product delivery to service provider sponsor's service territory;
- Tax credits versus capital used to purchase final product;
- Industry and stimulus program leadership for partners.

Xtendwave's™ technology has been proven in lab testing, has been patented, and has been developed with the guidance of a major equipment provider. However, as the funding for rural broadband is based upon service provider sponsorship, Xtendwave™ is actively seeking these partnerships.

## 6.0 The Management Team

*Xtendwave's™ management team consists of telecommunications equipment and service provider veteran executives with a combined 100+ years in the telecommunications industry...*

### Morton C. Aaronson - Chairman

Mort Aaronson has over 25 years of senior management experience in telecommunications, technology and energy industries; with start-ups, public and private companies. Highlights include VP of Market Management, MCI Business Markets responsible for all MCI's business channels, President, COO KN Energy responsible for deregulating the first US utility in Wyoming and Nebraska. Mr. Aaronson also served as President and CEO of en.able, LLC, a joint venture between KN and PacifiCorp, where he is credited with pioneering consumer service bundling with Simple Choice™. As President, CEO Aerie Networks Mr. Aaronson assembled a 21,000 mile real estate investment from a consortium of pipeline companies to build a fiber network. Mr. Aaronson also served as CEO Ricochet Networks where he purchased the assets and IP of Metricom from bankruptcy, to provide broadband where it was not previously available.



### **Marc Landry - CEO**

Marc Landry has over 18 years of experience in the technology industry, beginning with Texas Instruments and then continuing on in the semiconductor memory sector with companies such as Kingston Memory and Visiontek. He has extensive experience in analyzing market trends, expertise in design and software engineering for business solutions and persistence for excellence. Before Xtendwave™ Marc founded Go Figure Technology, a manufacturing and distribution sell-side e-commerce company.

### **Dennis Robbins - Senior Technology Advisor**

Dennis I. Robbins, Ph.D., has 32 years experience in the semiconductor and technology industries and held a variety of management and executive roles at Texas Instruments. As a Vice President of Texas Instruments, he managed the worldwide manufacturing operations for TI's analog and mixed-signal products, with ten factories worldwide. More recently he has co-founded startups in the biomedical field and in technology commercialization.

### **Ian Dix - Chief Marketing Officer**

Ian Dix has over 20 years experience in the telecommunications industry where he has served as the top marketing executive for both multinational and early phase companies, including having served as the Chief Marketing Officer of Safenet, Cincinnati Bell, EVP of Marketing for Qwest, and SVP of Marketing for LCI. Ian also served as VP of Marketing for XLConnect, a successful early phase company that achieved a large IPO and was later sold to Xerox.

### **Aaron Lancour - Product Development Manager**

Aaron Lancour has over 10 years experience in technology development particularly DSL line cards and CPE modems for start-up companies and major corporations. He designed numerous line cards and modems for Fire Networks, Reltec Communications, Marconi Communications, Accelerated Networks and Siemens Home and Office Communication Devices.

### **Pradeep Shah - Senior Technology Advisor**

Pradeep Shah, Ph.D., with 35 years of industry experience, was a Texas Instruments Fellow on TI's Technical Ladder and managed positions in R&D and operating groups. He pioneered TI's CMOS development, and has direct hands-on total product line management experience from concept to market and revenue, leading worldwide teams in the creation of innovative and profitable solutions with direct revenue impact exceeding over \$ 2.5-3B. He is currently CEO of Texas MicroPower, winner of Texas ETF funding and NSF SBIR funding and has served as an advisor to Xtendwave since 2003.

**A complete technology overview white paper is available upon request.**