

The Hotwire® MVL™ System

High-Speed Access For Residential, Small Office/Home Office, and Branch Office Services

Paradyne's MVL overcomes deployment issues with unmatched functionality, lower operating costs, increased market coverage and FCC approved to register under Part 68

Highlights

- First DSL product permitted to register for FCC Part 68 status – “MVL causes no harm to the telephone network”
- Transforms one copper phone line into multiple high-speed data lines + POTS
- Loop reach of up 30,000 feet (9 Km)
- Customer installable modem, no truck roll
- No POTS splitter required
- Lifeline POTS services - always active
- 768 Kbps upstream or downstream
- Superior spectral compatibility <100 KHz
- Compatible, at all speeds, with ISDN, T1/E1 and ADSL in the same cable binder
- Works under the ISDN Power Spectral Density (PSD) mask standard T1.601
- Intelligent, application driven bandwidth
- Deployable in seamless Nx64 data rates
- Industry's highest port densities
- 2,000 foot bridged taps do not effect MVL's robust performance
- Works over existing in-home wiring
- Works over un-twisted in-home wiring
- Simultaneous access by multiple PCs
- Unique Hotwire HomeLink LAN feature
- Commercially deployed since April 1998
- Dissipates only 1.12 watts per port
- Scales to over 10,000 MVL ports on one ATM OC-3 or OC-12 connection

Background

Paradyne has long been a pioneer and leader in the high-speed Digital Subscriber Line (DSL) access market from its inception in early 1993. Paradyne has subsequently revolutionized the industry with the Hotwire MVL System as a new product platform using MVL technology to overcome all of the issues which have slowed full-rate ADSL deployment short of its promised high-speed delivery.

In mid 1996, Paradyne was heavily involved in market trials and deployments of ADSL (asymmetric DSL) and RADSL (rate adaptive DSL) systems. At that time, Paradyne recognized two major deployment issues. First, that the application shift from video dial tone to data applications, such as Internet access and remote LAN access, would be better served through development of a new technology. This new technology needed to be optimized around current data applications, new applications being used on the Internet and those being used by small businesses requiring economically robust data connections. Secondly, they also recognized the numerous expensive and time consuming truck-rolls encountered during ADSL trials which prevented services from being offered in the

residential mass market, and which were certain to limit full-rate ADSL deployment.

The Hotwire MVL System represents the solution to these challenges and opens the door to the next exciting chapter in high-speed service deployment over existing copper wire subscriber lines!

Overview

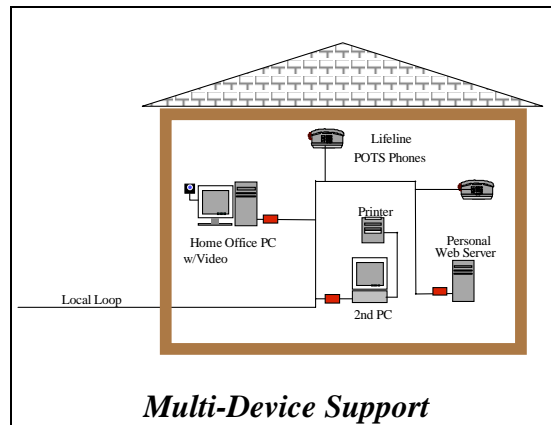
Based on Paradyne’s patented MVL technology, the Hotwire MVL System was designed and optimized for mass residential, small office/home office (SOHO), and branch office markets.

Designed from the ground up by Paradyne, MVL creates a whole new class of service capabilities for both

end users and service providers. Hotwire MVL Modems deliver 768 Kbps throughput upstream as well as downstream for highly efficient file upload and file download capabilities. Hotwire MVL’s high-speed modems offer service providers greater functionality, lower operating costs, and increased customer densities in comparison to alternative splitterless technologies.

The Hotwire MVL Modems look and feel like traditional dial modems because of their size and the ease of installation. However, they differ radically from dial modems because they

provide more than 26 times the throughput of a 28.8 Kbps dial modem without tying up the phone service. This allows the customer to make or receive phone calls while high-speed data services are being accessed, on the same phone line. In addition, the Hotwire MVL System takes Internet access and remote LAN access traffic off the switched telephone network and directly onto wide area network services for improved performance, while off-loading the telephone company switch.



These high-speed MVL modems solve the in-home distribution challenge by plugging directly into any standard telephone jack and operating over twisted or untwisted wire. Users can simultaneously make or receive phone calls while surfing the net.

By enabling multiple lines, one to four Hotwire MVL Modems can concurrently operate on the same local telephone loop, allowing multiple PCs to share access to the network or communicate with one another in a LAN-like mode.

With multiple PCs simultaneously running different applications, the Hotwire MVL Modem is well suited for a wide range of services and applications, including transparent LAN services, video conferencing, and Internet access, as well as file serving and Web hosting. This new approach to high-speed modems will quickly change the way services are delivered to the

mass residential, small office/home office, and branch office markets.

Not Just Splitterless DSL!

The Hotwire MVL Modem System was conceived and designed to overcome the mass-market deployment challenges associated with cable modems and ADSL modems -- namely installation truck-rolls.

A number of technology and equipment providers gathered together forming the UAWG and recognized two requirements for mass-market deployment:

- (1) Elimination of the POTS splitter, and
- (2) Operating over the existing in-house wire.

The UAWG and G.lite committee announced plans to support these

features and have tried to scale down existing DMT technology. Their plans are intended to reduce some of the technical limitations that prevented current DMT products from working well in a home environment. Market trials and feedback suggest that these downsized G.lite offerings will be far less effective than Hotwire MVL solutions.

MVL technology represents the correct approach to these deployment hurdles because existing technology did not have the attributes necessary for mass deployment. Even when ADSL was

tested in a scaled down fashion, the spectral compatibility remained an issue. G.lite is still a high frequency data signal prone to cable binder interrupters, cross talk, and high probability of POTS splitters required at the customer premises (truck roll).

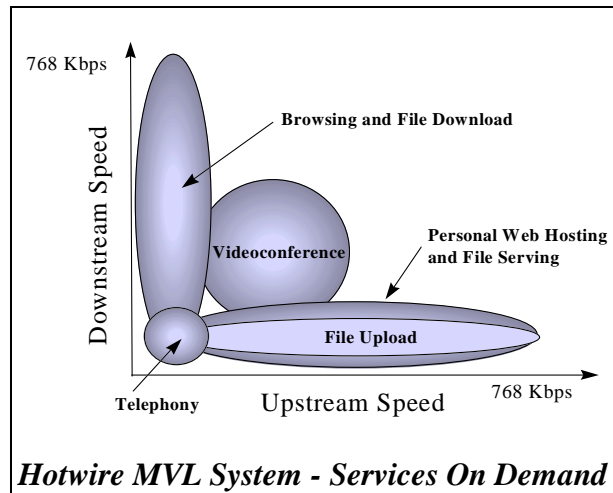
Hotwire MVL is an efficient transport system that was conceived and designed to not only operate reliably over longer loops and the wide variations of in-house wire, but also to have improved spectral

compatibility with other services, increased port densities, decreased power and cost.

One Network . . . Many Services

As the number of households with two or more PCs and the number of people working

from home continues to increase, the Hotwire MVL System adds even more significant benefits for subscribers and service providers with features such as Services- On-Demand and Hotwire HomeLink. Hotwire HomeLink, enables peer-to-peer print and file sharing between PCs on the same MVL connection using utilities included in Windows 95/98. This option is controlled by the Hotwire MVL Modem located in the central office DSL access multiplexer (DSLAM). These features provide incremental service capabilities that will generate additional revenue



opportunities for the service provider with minimal capital expenditures.

The Hotwire MVL System incorporates significant improvements in performance as well as cost for both subscribers and service providers over other products. The Hotwire MVL System provides a true “plug and play” solution. End users can install the system without the telephone company having to send a truck to pull new wire and install costly voice/data splitters. MVL provides a solution with one of the industry’s lowest cost per line -- for both the endpoint modems

and the corresponding telephone company equipment, coupled with reduced service provider installation, administration and maintenance cost. The Hotwire MVL System also provides dramatic benefits to service

providers in the central office. Initial system deployments will average only 1.12 watts per port of power dissipation, with up to 1,728 ports in a 7’ equipment bay.

Paradyne’s Hotwire MVL Modems empower service providers to seize a true mass-market opportunity, today. MVL features support a broad range of applications. Additional features include a customer installable modem, spectrally compatible with other existing services in the binder, and allows for multiple PCs on the same phone line. These features add up to an extremely cost effective service offering that provides a

value-added differentiation strategy for service providers.

Key benefits of the MVL Modem include:

- *Greater functionality* - Service delivery to any standard premises telephone jack, allowing multiple Hotwire MVL Modems to have simultaneous access to a variety of services as well as provide LAN-like communication over the in-house wire

In-home wiring is a major issue with cable modems, DSL “lite” modems, and ADSL systems, and in most cases requires the premises wiring to be upgraded . . .

Hotwire MVL works everywhere there’s a phone jack!

- *Lower operating costs* – Eliminates truck rolls by being customer installable and boasts the industry’s best performance by working over premises wiring. MVL technology

yields very low power dissipation allowing for much higher port densities in the central office. MVL also produces the highest degree of spectral compatibility with existing services, which helps to eliminate time consuming loop qualification. All these factors combined produce the lowest total cost, high-speed access system in the industry.

- *Increased market coverage* - Offers the maximum possible reach of up to 30,000 feet (9,000 meters), high-speed upstream/downstream capabilities, and true customer installation, which adds up to

increased service offerings and more connected customers.

Based On Unique Technology

The Hotwire MVL System is based on Paradyne’s patent-pending MVL Technology. MVL Technology represents a quantum leap in functionality allowing multiple virtual lines to be provisioned in a home, SOHO, or branch office environment at the lowest cost points in the industry. Its flexible, non-blocking, software-defined architecture easily supports upgrades to new enhancements.

Another benefit of operating at MVL’s lower frequencies is the avoidance of bridged tap performance issues, which are common with higher frequency solutions. MVL Technology-based devices are virtually unaffected by bridged taps, permitting a line reach up to 30,000 feet (over 9 Km) and operation over multi-outlet house wiring (twisted or untwisted) even in the presence of common household noise sources, such as light dimmers and electrical motors.

Downstream is Not Enough

It is estimated that over 30 million Americans own a home business, contract out their services, or telecommute to work on a regular basis. In Europe, where telecommuting is rapidly gaining acceptance, the European Commission has created a telework development initiative to increase awareness. Work at home users

are demanding not just higher access speeds, but the type of services that will allow them to effectively use today’s applications.

Applications that the SOHO and branch office markets typically use have extremely diverse requirements. As shown in the table, it is not unusual to have the need to receive large files from the corporate office as well as upload (upstream) multi-megabyte files such as Microsoft PowerPoint presentations.

Some small businesses require large upstream speed capabilities as well as a large amount of downstream bandwidth. As an example, a growing number of small businesses create their own content on Web servers located at remote hosting services. Uploading this data at 28.8 Kbps or even 128 Kbps can take an unacceptably long time when

many pages are sent on a regular basis. Hotwire MVL Modem’s high upstream bandwidth makes this a snap, while simultaneously allowing high-speed Internet

browsing and speaking on the phone.

Services-On-Demand

The Hotwire MVL System responds to the application’s demand for speed and instantaneously optimizes the bandwidth. This capability, known as Services-On-Demand, satisfies the many diverse bandwidth needs of any subscriber base and allows network

<i>Speed Requirements Of Applications</i>		
	<u>Upstream</u>	<u>Downstream</u>
Internet Access	Low	High
File Upload	High	Low
File Download	Low	High
Videoconference	Mid - High	Mid - High
Web Hosting	Mid - High	Low
Telephony	Low	Low

providers to offer flexible, tiered services.

The Hotwire MVL System overcomes the limitation of asymmetric services that deliver 80 percent or more of their bandwidth in one direction only -- downstream. MVL operates similar in operation to local area networks without the packet collisions inherent with Ethernet. Each Hotwire MVL Modem drop (up to four) on a telephone line efficiently operates as a separate system with the DSLAM.

The MVL DSLAM effectively manages up to four MVL modems on a single copper pair, allowing each one to simultaneously support both upstream and downstream transmission.

All Homes Are Not The Same

It is generally agreed that one of the greatest cost benefits of splitterless modems is the elimination of telephone company personnel going onsite (truck roll) to install a voice/data splitter. The truck roll is required for full rate DMT. ADSL can operate in the presence of bridged taps, with each tap effectively lengthening the line and creating line impairments due to signal reflection. Even a single bridged tap a few hundred feet long is a major issue on long loops for ADSL, while not affecting MVL at all.

In addition, the average subscriber premises is essentially a collection of bridge taps with multiple jacks and dead end runs because each unterminated phone jack is a bridged tap. Unknown elements such as different wire gauges and untwisted wire pairs also cause

impairments, in addition to turning the wires into antennas, and radiating and receiving stray signals. Other splitterless DSL modems operate in frequency spectrums that make them susceptible to interference from external household noise sources that generate energy of varying frequencies and amplitudes. Interference from noise sources in premises such as electric motors, light dimmers, microwave ovens, and AM radios are very common.

These are all major issues with most other technologies that operate in higher frequency spectrums. In-home wiring in many cases is old and of unknown condition and it is not unusual for service providers to replace or pull new wire pairs in order to deliver these services.

This is not so with the Hotwire MVL System. Operating at frequencies below 100 KHz, better attenuation performance is achieved and interference from adjacent wires (data or electric) and radiation sources are virtually eliminated. Because Hotwire MVL Modems run in almost any premises over twisted or non-twisted pairs, it truly eliminates truck rolls to rewire sites or install splitters.

The Hotwire MVL System was designed from the very beginning to meet specific performance objectives:

- *Works within a frequency spectrum below 100 KHz* - This enables the Hotwire MVL System to reliably operate at low signal power levels (typically less than 1/16th that of ADSL); does not interfere with

existing service offerings; is not affected by other service offerings; operates on twisted or untwisted in-home wiring; has very low power dissipation; is not affected by bridged taps less than 2,000 feet; provides lifeline POTS service without the need for a POTS splitter; and very impressively operates within spectral standards including T1.601 (Basic Rate ISDN) and T1.413 (ADSL).

- *Allows Services On Demand -* Hotwire MVL Systems dynamically allocate bandwidth in 64 Kbps increments, beginning at 128K, and seamlessly supports mixed downstream and upstream applications, as well as true symmetric applications.
- *Extremely low power dissipation -* allowing for much higher port densities in the central office and remote terminal equipment, further reducing costs.
- *Offers the maximum reach -* by avoiding the use of higher frequencies; resulting in less signal attenuation or signal degradation from other services in the binder, as compared to other transmission products.
- *Non-blocking architecture -* allowing sharing of DSP resources, further reducing costs while eliminating the problems associated with modem pooling over-subscription.
- *Dynamic rate adaption across multiple active applications-*

providing the maximum flexibility possible. Known as Services On Demand, Hotwire MVL Systems allow applications that have entirely different bandwidth requirements to simultaneously use the MVL link. Examples include file uploads and personal Web hosting (large upstream speeds), high quality video conferencing (symmetric 384 Kbps speeds), and high-speed Internet access (large downstream channel).

- *Works over most existing local loops and virtually any type of premises wiring, even untwisted.-* Designed to avoid interference from sources such AC power, AM radio, light dimmers, microwave ovens, bridged taps, unshielded cable or other NSP services.
- *Provides the highest degree of compatibility with existing NSP services -* As a result, Hotwire MVL Modem-based network services will not interfere with other existing services such as POTS, ISDN, T1/E1, or even ADSL-based services.
- *Multiple simultaneous access of Hotwire MVL Modems sharing access to the same local telephone loop, simultaneously -* These are attached to standard telephone jacks so that multiple PCs can simultaneously transmit and receive on the same wire pair.
- *Allows multiple PCs in the home to share printers and files with the in-house wire providing LAN-like connectivity -* The Hotwire Modem

System uses intelligent time division duplexing (ITDD) that dynamically and seamlessly allocates frames in 64 Kbps increments. Each Hotwire MVL Modem drop on a telephone line operates as a system with the DSLAM Hotwire MVL Modem. This is one of the reasons why two, three, or more applications with asymmetric and symmetric requirements can share the line at the same time. This innovative approach is key to both functionality and performance, enabling support of new high-speed services while minimizing attenuation and cross talk with other services.

Network Management

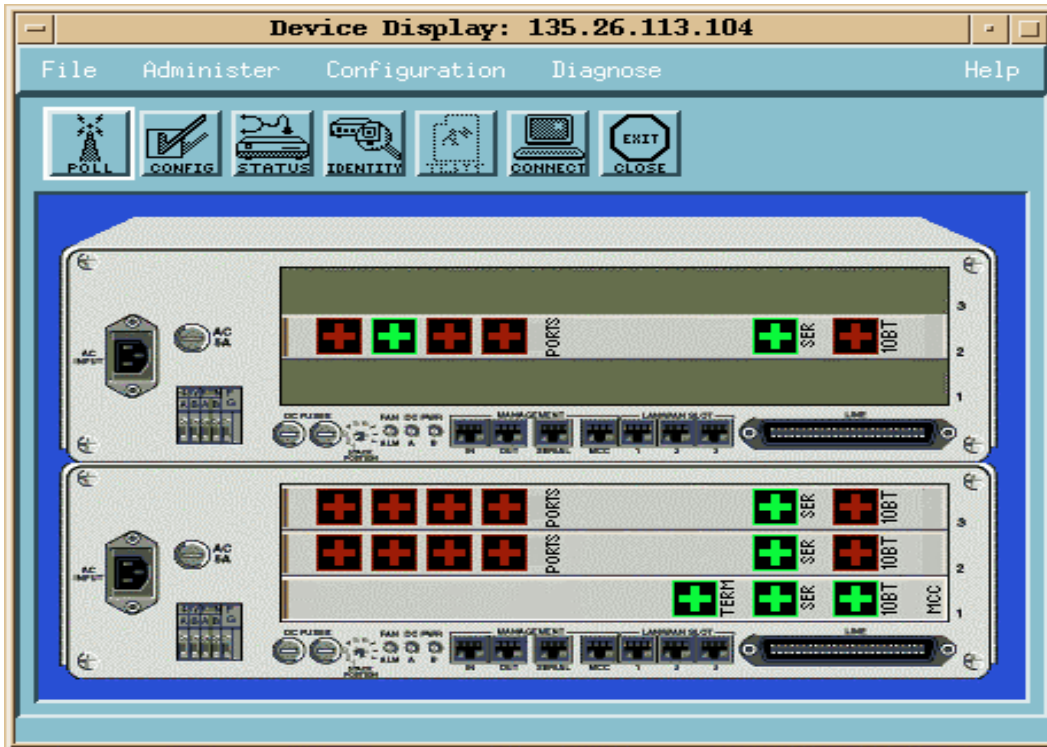
Paradyne's innovative leadership in delivering support for proactively managed networks dates back to 1978 when Paradyne introduced the industry's first management system for data modems. Continuing to lead the industry, Paradyne provides managed solutions for the Hotwire MVL System with the OpenLane™ Management Solution.

Paradyne focuses on developing the highest quality management applications for its network components. Use of industry platforms such as HP OpenView and industry standards such as the International Telecommunications Union (ITU) M-Series Recommendations provides customers with the ability to manage across their networks end-to-end. In addition, an SNMP element manager provides a single point of control for NSPs from a central location.

The OpenLane Management Solution provides an easy-to-use system for operation, administration, and maintenance of Hotwire MVL Systems. This includes configuration, fault, performance, accounting, and security management. In combination with the service management and service level reporting and verification features, OpenLane greatly reduces operating costs.

Paradyne's management philosophy and expertise allows customers to maximize network availability on a proactive basis:

- Identifies and fixes problems in real-time using a wide array of diagnostic capabilities.
- Simplifies network planning and management through tracking and reporting critical network information.
- Increases operator productivity and response via an easy-to-use format and color-coded graphic displays in key management areas such as alarm reporting, configuration management, and real-time performance monitoring.
- Collects and presents diagnostic, network utilization, and line code performance statistics through a feature-rich GUI enabling analysis of real-time and historical data.



- Hotwire MVL DSLAM cards and modems are firmware upgradable from a central location.
- Extensive diagnostic commands, automatic and on-demand, are available for testing the service.
- OpenLane’s DSLAM Configuration module provides GUI-based installation and efficient multiple node configuration.
- “Plug and play” discovery minimizes management system setup and maintenance.
- Full awareness and management of logical networks as well as physical networks.

Hotwire Family of Products

The Hotwire MVL System extends the Hotwire product line, allowing complete

customer coverage for service providers. The Hotwire Multiservices DSLAM architecture supports provisioning of MVL, commercial grade rate adaptive DSL (RADSL), symmetric DSL (SDSL), and multi-rate SDSL (MSDSL).

A single platform can now cost-effectively provide channelized Nx64 Kbps and packetized services. Also available are a variety of endpoints that meet any requirement and network connection to Frame Relay and ATM backbone networks at up to OC-3 or OC-12 rates. In addition, the OpenLane Management Solution offers a flexible and comprehensive end-to-end network-managed solution for all Paradyne products. ◆

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