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WHITE PAPER

Service Management Features "Plug & Play" Solution

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ASCEND

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1. Summary

The cost of managing a typical network far exceeds the cost of equipment today. In addition, the complexity of the network must be hidden from the end user if the service is to be offered to a wide range of consumers. The Ascend plug & play capability, inherent in its MultiDSL™ family of products, lets the service provider manage services in a central location and eliminates any user intervention in turning up a DSL service. Customers simply and quickly install the equipment needed at their end of the link (namely, Ascend DSLPipe™), and get online in a matter of minutes. By reducing the need for on-site installation and maintenance calls, "plug & play" enables the service provider to enjoy the benefit of reduced operational costs.

2. Introduction

The remarkable proliferation of Internet usage in recent years continues to bring enormous commercial opportunities and advantages to corporations, small businesses, and residential users alike. But it has also brought enormous challenges to the technical community involved in provisioning and implementing Internet access and other remote access services. These challenges stem, in part, from the diversity of new networking technologies and applications that have emerged as key elements of the Internet. As recently as the late 1980's, routers and the stack of TCP/IP protocols under which they run, were in their fledgling stages of implementation; ISDN was new, while Frame Relay and ATM layer 2 protocols were not yet conceived.

In the early years of the Internet and of corporate private networks based on TCP/IP (1990-94), many installation and operational problems arose as the result of incompatibilities among the various equipment manufacturers. Despite the existence of interface and protocol standards, different companies frequently interpreted the standards differently. There are many, many network engineers who today have vivid memories of sleepless nights spent struggling to resolve those incompatibilities, and who are thankful that today's challenges are somewhat less severe!

Concurrent with the evolution of the Internet, massive changes were also taking place in the structure of the telecommunications industry. Following the government's break-up of the AT&T monopoly in 1982, all voice and data traffic in the U.S. was carried by a relatively small number of regional and long-distance phone companies, plus a handful of private data networks. The terms CLEC (competitive local exchange carrier), ISP (Internet service provider) and national backbone operator (NBO) did not exist. In today's world, and especially as a consequence of the 1996 Telecommunications Act, the industry is becoming increasingly fragmented, with literally thousands of new local and national service providers emerging. The boundary between voice and data is steadily disappearing as more carriers move to pure digital transmission of both voice and data from customer premise to customer premise.

Although the deployment of digital subscriber line (DSL) services to end users is still in its infancy this year (1999), a study by Telechoice Inc. projects that the number of installed xDSL lines worldwide will approach 9.5 million by the end of 2003. Of this number, about 6.4 million lines will be in North America.

With all these changes, today's service provider is faced with the daunting task of selecting which of the new services to offer, and how best to implement them. Critical factors in making these choices include:

- Capital equipment costs
- Customer premises equipment (CPE) installation and service costs
- Network management costs

This paper focuses on the second issue – minimization of CPE installation and maintenance costs. It will show how Ascend has simplified the service provider's selection process with "plug & play" solutions that virtually eliminate the need for on-site installation and service calls.

3. Keeping the Costs Down

As previously noted, a major cost benefit of DSL technology is that it can operate over existing telephone lines without requiring any special line conditioning, provided that line lengths do not exceed the maximum distance allowed by the line code. This affects an immediate cost savings as compared to T-carrier services, by reducing the telephone company labor associated with link installation to the customer premise. However, there is another aspect to installing DSL service, which is that DSL units must be configured to meet the specific requirements of the network to which they are connected. Hardware and software vendors have learned in recent years that customers do not want to become experts on the inner workings of their computer and communications equipment. They simply want to be able to plug in, power up, and run their applications. DSL services will have little chance of widespread adoption if users are expected to understand networking protocols, and to configure their DSL units themselves.

This appears to leave the service provider with two choices: send a technician out to install each unit or pre-configure each unit before shipping it to the customer's site. Both of these choices are undesirable. The first re-introduces the high labor costs referred to previously, while the second exposes the provider to the risk of configuration errors. The second choice also fails to accommodate future configuration changes that may be necessitated if the customer makes changes to the attached PC or LAN system.

Ascend has a solution. DSLPipe products can receive their configuration parameters via the network. This is the essence of Ascend "plug & play" technology. All DSLPipe units can be shipped to customer premises with identical default configurations. Once plugged in and powered up by the customer, a DSLPipe will automatically request its specific configuration from servers at the service provider's point-of-presence (POP).

4. The Mechanism of Ascend's "Plug & Play" Implementation

Figure 1 illustrates the relevant network system components involved in a typical service provider-to-customer link in which the Ascend "plug & play" capability is utilized. Two protocols that are a part of the TCP/IP stack are of particular importance in the procedure that allows the DSLPipe to acquire its configuration from the network service provider (NSP); they are Dynamic Host Configuration Protocol (DHCP) and Trivial File Transfer Protocol (TFTP). The factory-default configuration of the DSLPipe (table 2) supports a Frame Relay bridge connection, and hence the MAX TNT™ WAN access concentrator (the other side of the bridge) must be configured similarly.

Specifically, the DSLTNT must be configured to support:

- BOOTP Relay enabled
- A "nailed" xDSL connection to the DSLPipe
- A Frame Relay profile that makes use of the xDSL link
- A connection profile for each attached DSLPipe unit

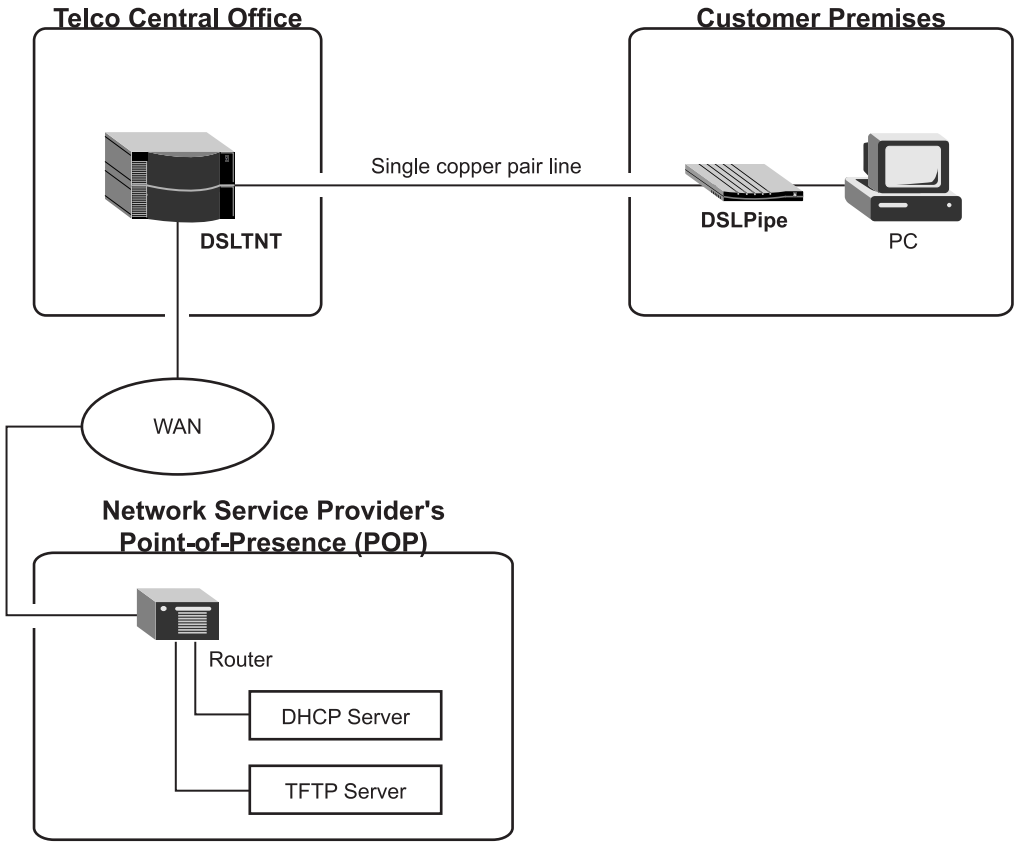

Figure 1 – System Components for "Plug & Play"

In This Menu:	The Default Values Are:
Configure	Route = No Bridge = Yes My Name = DSLPipe
Ethernet > Connections	Station = DSLPipe Active = Yes Encaps = FR
Ethernet > Connections > Encaps Options	FR Prof = DSLframe DLCI = 16
Ethernet > Frame Relay	Name = DSLframe Active = Yes FR Type = DTE Link Mgmt = T1.617D

Table 2 – DSLPipe Factory-Default Configuration Settings

When the DSLPipe is installed and powered up for the first time it detects that it has no IP address, causing it to transmit a DHCP request over the bridge link to the MAX TNT access switch. The MAX TNT forwards the request to the particular DHCP server specified in its IP-Global profile (Figure 2), and the server responds by sending back a (an):

IP address and netmask for the DSLPipe

- Default gateway
- DNS server address (if any)
- TFTP server hostname
- Full path to a complete configuration file on the TFTP server

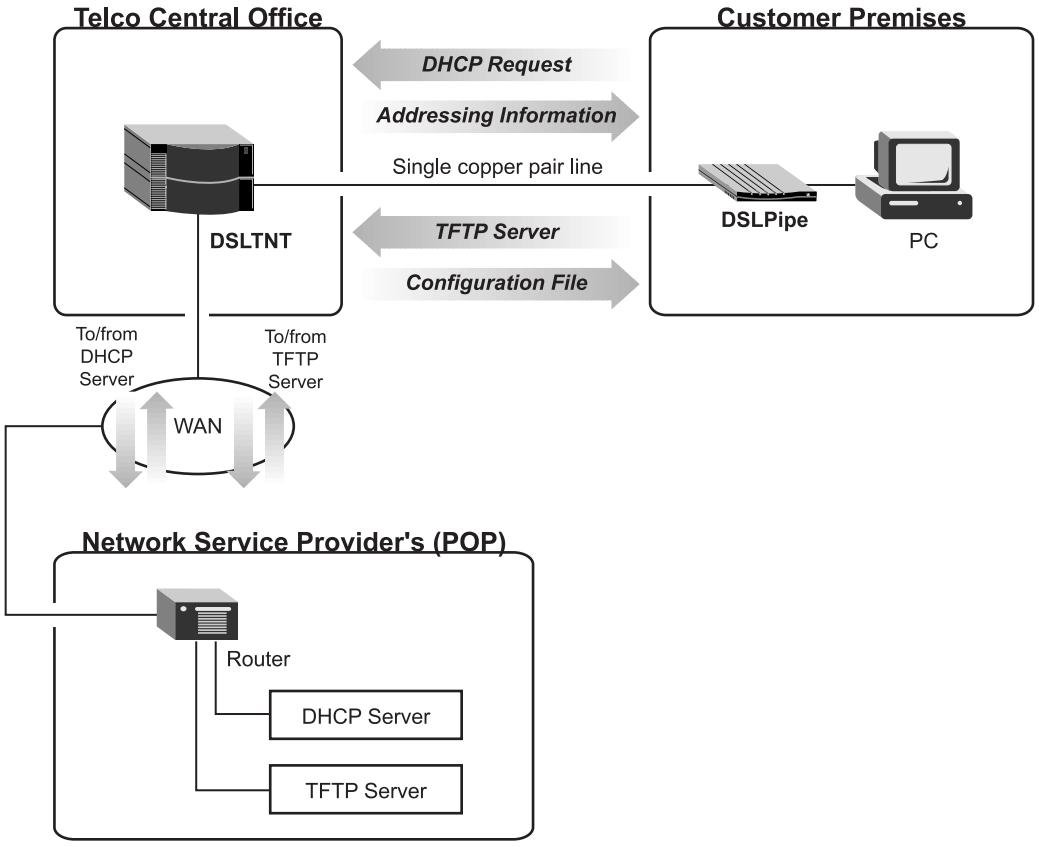

Figure – 2 The Mechanism of "Plug & Play"

The MAX TNT forwards this response to the DSLPipe (i.e. the DHCP client), which then uses it to access the specified TFTP server. The DSLPipe continues the procedure by sending its own unique serial number to the TFTP server because serial numbers are used as the filenames of corresponding configuration files stored on that server. The selected file is downloaded to the DSLPipe that completes the process by re-initializing itself using the newly acquired configuration data.

Although this procedure requires careful set up of the two servers at the network service provider's POP, it eliminates the requirement for on-site installation by the NSPs technical staff. Furthermore, if subsequent configuration changes are required, they can be downloaded to the DSLPipe, again eliminating the cost associated with sending technical staff to the customer's premises.

5. "Plug & Play" for the Public Network Service Provider

In figure 1, generic terminology is used to identify the physical locations of equipment – namely, the Telco and NSP facilities. In reality, deregulation has brought about several new categories of provider and new roles for the traditional ones. The local exchange carriers (LECs) that once dealt only with line provisioning are now actively promoting their own Internet services, in competition with the original Internet service providers (ISPs). The incumbent LECs in turn are facing increasing competition from competitive local exchange carriers (CLECs) who are not only encroaching on their traditional circuit-switched voice business, but are also offering innovative new services such as voice-over-IP (VoIP), virtual private networks (VPNs), etc. And now, even the ISPs are joining in the fray with Internet telephony.

The 1996 Telecommunications Act compelled the incumbent LECs (the seven Regional Bell Operating Companies, and a few others) to open up their central office (CO) buildings to allow CLECs to colocate their own switching equipment at the POP of local loop circuits. One restriction of the Act, however, is that any networking equipment providing functionality higher than layer 2 (switching) may not be colocated in the COs. Regardless of whether the NSP is a LEC, CLEC or ISP, the router and servers shown in figure 1 must, for the moment, remain located elsewhere.

From the customer's perspective, no matter who the service provider, the advantages of the Ascend "plug & play" solution are very clear – easy installation, no software configuration required, and the ability to bring up a high-speed link in just a matter of minutes. So, for the service provider searching for differentiation in a highly competitive world, Ascend DSL "plug & play" systems provide a clear, customer-driven answer.

6. "Plug & Play" for the Corporate/Campus Network

In a private environment, there is no restriction regarding the location of routing and higher layer functionality. Figure 3 illustrates how "plug & play" may be used in a corporate or campus private network. In this example, the routing functionality for accessing the TFTP server is performed directly in the DSLTNT.

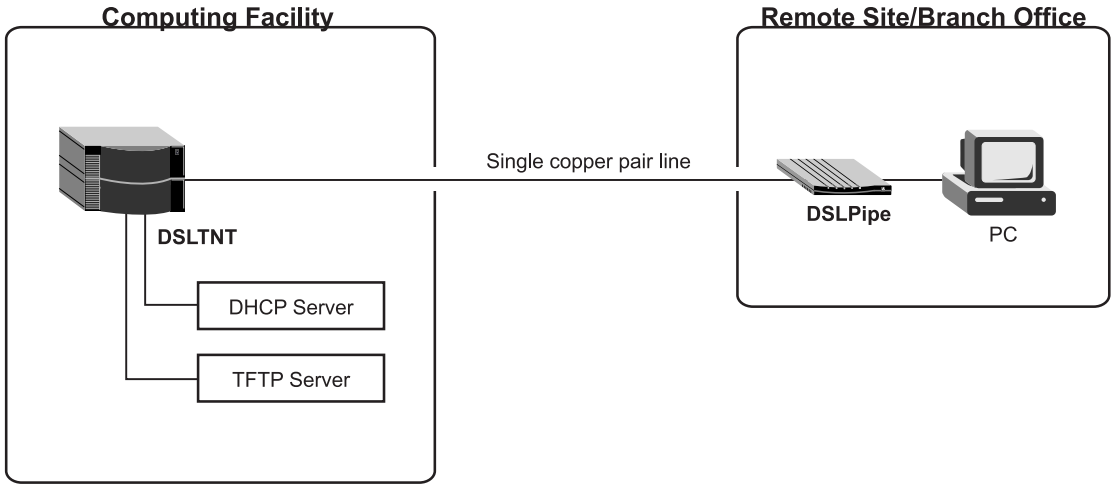

Figure 3 – "Plug & Play" in the Private Network

Again, the advantages of “plug & play” lie in the ease with which DSLPipe units may be installed and brought online at new remote sites, as well as the ease with which they may be subsequently reconfigured, all from a single central site.

7. Future Directions

Ascend is committed to reducing the cost of managing DSL services. Moving forward, the MultiDSL family will provide new products and features that automate many of the DSL service options and provide easier methods for offering large-scale DSL services. The following capabilities are planned:

1. RADIUS-based service definition and management
2. DSL wholesaling options
3. DSL service selection and management
4. Service Level Agreement

8. Conclusion

The Ascend family of DSL products is the most comprehensive available. Offering integrated support for all classes of DSL service that operate over copper-pair lines, the NEBS compliant MultiDSL products are suitable for central office operation under the most rigorous requirements of global carrier networks. In a single seven-foot telco rack, the MAX TNT can support up to 1,344 IDSL ports, 1,440 SDSL ports, 540 RADSL ports or a combination of these various port types.

By adding “plug & play” support to the MultiDSL products, Ascend has made large scale deployment of DSL a cost effective reality. This paper has shown that the Ascend implementation of “plug & play” offers several advantages for service providers. The centralized configuration management simplifies the procedures for installation and maintenance, and substantially reduces service provider costs by virtually eliminating the need for on-site service calls. By Implementing this feature over industry standard protocols, Ascend has maintained an open architecture thus allowing cost-effective, multi-vendor network implementations.

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