

# *White Paper*

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**NG-IADs: Providing**

**Business Class**

**Voice and Data**

**Services over DSL**

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## **NG-IADs: Providing Business Class Voice and Data Services over DSL**

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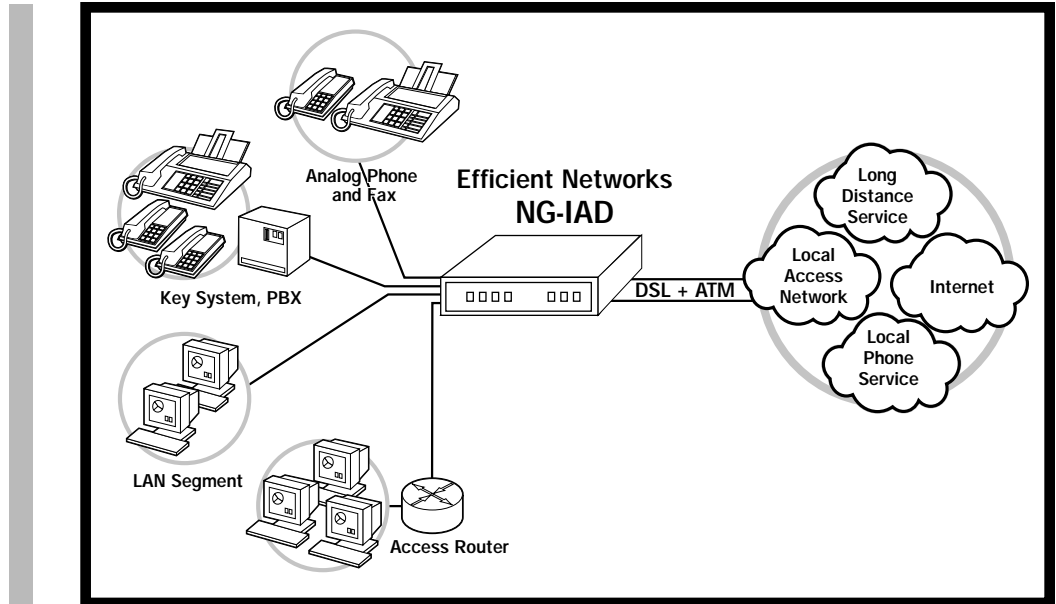
### Introduction

Companies that can afford access to a T1 line or a comparable high-speed broadband communications medium are well served with voice and data solutions. But in cases for which a T1 line is overkill, from either a technology or economics perspective, a complete and integrated communications solution has been unavailable. This has left a considerable gap in the customer base for providers and in communications options for many small-to-medium businesses (SMBs) and residential customers.

Of the new products that attempt to fill this gap, the best solution is offered by next generation integrated access devices (NG-IADs). NG-IADs offer true service integration that provides customers with multiple toll-quality voice lines and high-speed data access to the Internet and other networks, all over a single copper pair. Moreover, NG-IADs offer this level of functionality with no modification to customers' existing telephone or computer equipment, and operate with providers' existing equipment infrastructure.

NG-IADs provide this level of service by building on existing digital subscriber line (DSL) technology and an associated protocol called asynchronous transfer mode (ATM). ATM is designed specifically to carry simultaneous voice and data, easily supplies multiple voice lines, and dynamically prioritizes traffic to optimize performance. Built-in dynamic bandwidth allocation provides for additional data throughput when voice usage is low, restoring voice capacity only when it is actually needed. The result is that NG-IADs deliver integrated service similar to that previously available only to the largest customers, in a way that is flexible and affordable.

FIGURE 1:



A typical customer premises NG-IAD configuration.

Integration of communications services through an NG-IAD has a number of significant advantages. Service providers gain a competitive advantage and benefit from reduced customer turnover and lower operating costs. Customers benefit from the additional services provided by their already installed copper lines and by having a single point of contact for installation, maintenance, and support.

This paper examines NG-IAD features that classify it as a "next generation" device, enable it to deliver its high level of performance, and ensure that it remains a solid and reliable component of the communications solution. The intention is to serve as a guide to integrated communications providers (ICPs), local exchange carriers (LECs), Internet service providers (ISPs) and others who are responsible for making communications equipment and technology decisions.

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### Principal NG-IAD Features

#### **Compatibility**

A variety of NG-IAD subscriber- and provider-side ports ensure compatibility with existing customer equipment such as telephone systems, computers, and local area networks (LANs). Multiple subscriber-side analog foreign exchange station (FXS) ports connect the NG-IAD to telephones, key systems, PBXs, or fax machines and provide feature transparency for such services as call waiting.

NG-IADs can effectively accommodate existing LAN equipment, or start a LAN from scratch. Modular ports for LAN connectivity allow NG-IADs to function as the customer premises router or bridge, or can provide a V.35 serial interface to existing LAN equipment (thereby functioning as a CSU/DSU). A standard 10BaseT/100BaseTX Ethernet port supports Routing Information Protocol (RIP), network address translation (NAT), dynamic host configuration protocol (DHCP), and domain name server (DNS) services.

The WAN side of the NG-IAD connects to a variety of provider-side standards. Many high-speed, cell-based transport options are available, including SDSL, ADSL, and T1/ATM for more demanding applications.

#### **Reliability**

The overall design and deployment philosophy for NG-IADs takes into account that service providers will consider it an integral part of the voice network. To deliver continuous service, NG-IADs may feature a redundant power supply option. When so equipped, the alternate power supply operates automatically and provides undisturbed communications if the primary unit should fail.

Independent voice and data processing modules within NG-IADs provide maximum reliability and ensure that periodic changes in the data service configuration do not impact voice service availability. This approach allows, for example, for reconfiguration of the router (data side) of NG-IADs without impacting critical voice services.

"Always-on" communication between an NG-IAD and a voice gateway at the CO ensures optimum and seamless interoperability with provider-side equipment. The NG-IAD and gateway continually exchange information on network status, and the NG-IAD uses this information as part of its dynamic bandwidth allocation function.

#### **Modularity and Scalability**

Few installations remain static, and business-quality equipment must scale to meet growing provider and customer needs. NG-IADs are both software and hardware on-site upgradeable for capacity as customer requirements dictate. Modular port upgrades in NG-IADs can extend the number of subscriber-side telephony ports for voice, fax, and other telephony connections, giving customers the option of starting with as few as four ports and scaling up in 4-port increments to a maximum of 24 analog FXS ports.

On the provider side, connectivity options scale to support additional DSL variants and other services such as ATM over T1. These options enable a single NG-IAD to function in a variety of CPE applications without modification.

A codec function for each voice channel on the subscriber side allows NG-IADs to convert voice signals into ATM cells using AAL 2. To ensure the voice experience remains unchanged for users, signaling information is also embedded into the cell stream to indicate common conditions such as off hook or ringing. In addition, NG-IAD functionality preserves toll quality for all supported voice lines and has complete feature transparency for such features as call waiting and caller ID.

For data traffic, the NG-IAD provides a complete set of routing and IP address management functions and provides a gateway into a remote ISP or a corporate network. The NG-IAD converts IP packets into a stream of ATM cells using ATM Adaptation Layer 5 (AAL 5). Any of several methods for encapsulation of packet data over ATM and AAL 5 are supported.

#### **Flexibility**

NG-IADs can be deployed as either customer located equipment (CLE) or customer premises equipment (CPE), allowing the devices to be provisioned according to provider preference and market needs.

LEC-specific flexibility features ensure NG-IADs work with a wide variety of branded CO equipment. For the communications provider, these features ensure ease of installation and compatibility with existing equipment.

Traditional IADs use static bandwidth allocation so that space reserved for a connection cannot be used by other traffic, even when the connection is periodically inactive. To achieve greater efficiency, NG-IADs employ dynamic bandwidth allocation so that no bandwidth remains unused. The result is increased data throughput when voice usage is low, without loss of quality for voice traffic.

The NG-IAD accomplishes dynamic bandwidth allocation via ATM, a high-performance networking architecture engineered to carry multiple voice lines simultaneously with data traffic. The ATM Adaptation Layer 2 (AAL 2) in particular provides this functionality and multiplexes multiple calls onto a single ATM virtual circuit connection (VCC). AAL 2 also provides the dynamic bandwidth allocation that makes for efficient use of available bandwidth.

Options for PCM or ADPCM voice provide pricing flexibility for both the NG-IAD and the accompanying service offerings. The PCM option provides entry-level functionality but uses greater bandwidth because it is not compressed. Future upgrades to ADPCM can increase the density of voice ports within the same bandwidth and services can be tiered accordingly.

### **Manageability**

A number of NG-IAD local and remote device access capabilities ensure rapid installation, flexible configuration, and efficient ongoing management.

Locally, the NG-IAD may be managed through a dedicated serial port, an Ethernet port, or through the subscriber-side data interface. Remote management can be performed through a dedicated ATM VCC or through a VCC also used to carry subscriber data. Full SNMP functionality is a requirement for integration with existing management practices and Network Operation Centers (NOCs). MIBs for three network layers (DSL or physical, ATM or transport, and IP or application) should be included. The device should also include support for access via Telnet, a Web browser, or file transfer protocol (FTP).

Distinct access privileges can be assigned for local and remote users. For example, different access levels can be attributed to local customer premise administrators and to operators at the NOC, depending on whether the device has been deployed as CPE or CLE.

### **Value**

The next generation features of the NG-IAD discussed above represent great value for providers and customers alike. NG-IADs' ability to maximize the last copper mile means customers enjoy expanded service options at lower cost and with little to no impact on existing configurations. By building on existing ATM and DSL technology, NG-IADs protect providers' investment in networking equipment infrastructure.

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## NG-IAD Benefits

### **Benefits to the Provider**

As ILECs, CLECs, and PTTs have settled on ATM as the Layer 2 DSL transport protocol, the extension of ATM to the customer premises makes business and technological sense. Prior investment in infrastructure is protected, and voice and data services from a single, integrated platform are natural extensions of existing capability. A significant advantage of continued DSL use is that it capitalizes on the vast amount of existing copper service and the DSLAMs and switches already installed to support Internet access. ATM over DSL provides a common network for voice and data in an environment specifically designed to carry these traffic types simultaneously.

Competition for customers will increase dramatically as new ICPs emerge and existing providers increase the number of services offered. The ability to offer multiple services over existing copper pairs fosters customer loyalty and is very important to remaining competitive in the marketplace. As NG-IADs allow providers to offer the full range of services customers are likely to need, customers are less inclined to switch to a competitor. Moreover, NG-IADs and configurable service offerings enable providers to differentiate their services and attract new customers through package pricing incentives.

### **Benefits to the Customer**

The market for complete residential and small-to-medium business communications solutions is growing rapidly. As new services become available, customers naturally expect the new technology to retain the same high quality voice service they have received from the PSTN as well as provide high-speed, broadband access for data.

NG-IADs offer customers a cost-effective, reliable combination of toll-quality voice service-including multiple lines-and high performance data access, all from a single provider. Since the new services are provided over existing copper, any customer site that has existing telephone service is a candidate for the these extended services. In addition, NG-IADs retain the use of existing, standard business voice features such as three way calling, call waiting, and caller ID.

NG-IADs also feature compatibility with installed customer equipment. Multiple subscriber-side analog telephone and Ethernet ports ensure that connections to existing key system, PBX, LAN, and routing equipment remain intact and continue operating as expected. Optional expansion modules ensure the device easily scales with users' needs.

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### Conclusion

The NG-IAD fills an opportunity gap for communications providers and greatly extends the number of services that can be offered. By capitalizing on existing infrastructure and maximizing the last copper mile, NG-IADs provide these services rapidly and cost-effectively.

NG-IAD products were demonstrated at industry trade shows throughout 1999, and trials of the products began later in the year. Deployment of NG-IADs is expected to begin in 2000.

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## About Efficient Networks

Founded in 1993, Efficient Networks (NASDAQ: EFNT) is a leading provider of high-speed ATM and DSL networking solutions for the customer premises. Efficient's SpeedStream<sup>®</sup> products are distributed and supported worldwide, and the company is an active participant in the ATM Forum, the ADSL Forum, and the Universal ADSL Working Group (UAWG).

In 1999, Efficient Networks entered the Voice and Data over DSL market and introduced products that offer many of the benefits described in this white paper. For detailed information on this technology, how it compares to other approaches, and its implementation in the NG-IAD, refer to the Efficient Networks white paper titled, Integrated Services: Voice over ATM and DSL.

To learn more about Efficient's DSL or ATM products, visit our web page at <http://www.efficient.com>, contact us by email at [info@efficient.com](mailto:info@efficient.com), or call us at 888-ATM-XDSL (888-286-9375).

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