U.S.Robotics

8000 Broadband Router White Paper

Broadband Routers: Sharing Networked Resources and Improving Productivity

As the need for increased data transfer and high-speed Internet access fueled the need for broadband technologies, so has the need to share the data and resources of a network to maximize productivity and information availability. Small offices and even home networks have become much more complex and many depend on being able to access common resources such as printers and Internet access.

With competing and emerging technologies that allow for increased bandwidth of all kinds, the home and small office markets have needed an inexpensive, reliable, and unobtrusive conduit to distribute data, entertainment, and communication. A broadband router can help make better use of network resources by allowing for a shared printer, shared Internet connection, and increased security measures to protect important proprietary files as well as personal and private information.

How Does a Broadband Router Work?

In general, a broadband router is designed to function as an intelligent interface between a local network and an Internet Service Provider's (ISP's) high-speed access network. It collects outgoing packets from computers on the local network and directs them to the access modem for delivery on the Internet. At the same time it sorts incoming data from the Internet, identifies the internal destination of each packet and forwards it to the correct destination, thus ensuring proper data delivery. By consolidating outbound packet flows and distributing those coming in, the router makes a single Internet connection available to all users on the LAN. The router itself can be either a piece of physical hardware, or in some instances, strictly a function of a computer's software.

But routers are capable of much more than simply sorting and forwarding packets, and some have added features that make shared access simpler, more affordable, and more secure. One of the most important of these features is the Network Address Translation (NAT) function.

NAT is a router function that allows outgoing traffic, regardless of its point of origin on the LAN, to appear as though it has been sent from a single source. This may let a small network avoid ISP surcharges on multi-user accounts, allowing multiple LAN clients to access the Internet connection simultaneously. Furthermore, it masks the true identity of internal machines and prevents the theft and misuse of their addresses for unapproved access to the network.

NAT takes advantage of the router's ability to examine and modify packets and to track all active sessions between internal and external hosts. When an internal user initiates a session with an Internet host by sending a request packet, the router logs the source and destination addresses in a table. It then rewrites the packet, replacing the source IP address with its own. When the Internet host responds with an acknowledgement packet addressed to the router, NAT consults the table to find the actual internal destination. It then replaces its own IP address with that of the internal client and delivers the packet over the LAN. All packets passing between the Internet and the LAN are similarly readdressed, effectively concealing the existence of a local network behind the router.

Open Systems Interconnection (OSI) Model

To better understand how a router functions in the overall scheme of network topology, it is helpful to refer to the Open System Interconnection (OSI) model of standard protocol definitions and the process of communication between two endpoints. The OSI model is made up of seven "layers," and each of the seven layers adds its own set of functionality to a telecommunications network.

The OSI model essentially begins with Layer 1 and works upward to Layer 7.

- Layer 1: Physical Layer – Provides the physical electrical and mechanical hardware used to transfer bits between devices.
- Layer 2: Data Link Layer – Synchronizes the Physical Layer (Layer 1) and "bit stuffs" where necessary.
- Layer 3: Network Layer – Routes both incoming and outgoing data.
- Layer 4: Transport Layer – Ensures complete transfer of data and allows for communication across a network.
- Layer 5: Session Layer – Specifies and coordinates process-to-process communications/dialogs between applications at either end.
- Layer 6: Presentation Layer – Converts incoming/outgoing data from one format to another and is commonly part of an operating system.
- Layer 7: Application Layer – Determines communications partners and protocols used for application connectivity (not the application itself).

Routers are associated with OSI Layer 3 (Network Layer), where incoming and outgoing data are disseminated throughout the network.

Typical Setup

A typical home or small office network setup might commonly consist of the following arrangement:

- Two to four computers – the computers comprising the network
  Note: The U.S. Robotics Broadband Router can network up to four clients (computers) in its standard configuration or, with the addition of more Ethernet hubs, up to 253 clients (computers).
- Broadband (cable and/or DSL) router – connects the local area network (LAN) to a cable or DSL modem through a single Ethernet link, allowing all LAN clients to use the broadband connection (with Internet connection and links to the networked computers, print server, hubs, and backup analog modem)
- Print server or dedicated computer – for handling print jobs
  Note: The U.S. Robotics Broadband Router contains an integrated print server, allowing multiple computers to share one printer without the need for a dedicated computer to act as the print server.
- Hubs (optional) – for adding clients (computers) to a router beyond the number of available ports on the router
  Note: The U.S. Robotics Broadband Router can network up to four clients (computers) in its standard configuration or, with the addition of more Ethernet hubs, up to 253 clients (computers).
- Analog modem (optional) – to maintain connectivity for backup Internet access
  Note: The U.S. Robotics Broadband Router includes a built-in serial port for just such a purpose.

Typical Features/Functions of a Broadband Router

The U.S. Robotics Broadband Router includes the following features:

- 10BASE-T wide area network (WAN) interface – Connection port from the broadband modem to the router. More often than not, a user's network will require that any broadband router—whether it is cable or DSL—have Ethernet bridging capability. Most currently available modems have this feature and can be identified by the presence of an Ethernet port.
- 10/100BASE-T switched LAN ports – Four autosensing, Fast Ethernet ports for routing local network traffic. These ports can connect client machines at transfer speeds of up to 10/20 Mbps (10BASE-T at half-/full-duplex) or 100/200 Mbps (100BASE-T at half-/full-duplex).
- Network Address Translation – Lets all internal users share a single IP address, making it appear as though all traffic from inside the LAN is coming from a single source. This may eliminate ISP surcharges for additional users and allows multiple users to share the Internet connection concurrently. It also masks the true identity of LAN clients from outside view—an essential security measure.
- Built-in print server – Built-in print server software that allows LAN users to share a single printer that connects to the broadband router through a parallel port. This eliminates the need for a dedicated computer to serve as the print server.
- A 10/100 Mbps uplink Ethernet port – Allows for more nodes (up to a total of 253 clients/computers) to be added to the LAN by connecting a hub to this dedicated uplink port. No special crossover cable is required.
- Internal Web server and browser-based management – An internal HTTP server and embedded management pages allow the router to be configured and managed from any client (computer) running a standard browser.
- RS-232 serial port – Allows the router to be connected to an analog modem for backup Internet access through a dial-up connection.
- Integrated DHCP server and client (computer) – Built-in Domain Host Control Protocol (DHCP) support lets the router automatically acquire IP addresses from the ISP (the client function), and supply addresses to LAN hosts (the server function).
- Embedded Operating System – The router features a firmware embedded operating system that can be updated via FTP.
- Built-in firewall – Static and dynamic packet filtering protects internal users against unauthorized access and tampering by hackers on the public Internet. Access Control can selectively block access to internal machines, and limit the ability of internal clients (computers) to reach certain services. VPN pass-through support for the common L2TP and PPTP protocols allows secure connections to be established between LAN clients (computers) and remote corporate networks.

Protecting Network Integrity: Firewall Security

Broadband Internet service provides "always-on" access that can expose a local network to online vandals (hackers) if left undefended. Even home networks are often probed by inexperienced hackers, and successful entry may lead to vandalism simply as proof of a successful "hacking." If information about the internal network can be acquired with common techniques like port scans and ping sweeps, follow-up attacks may attempt to take control of internal computers and their data.

To block unauthorized entry, the router performs static and dynamic packet filtering on all data flows. Packet filtering is the practice of discarding packets based on criteria; e.g., the origin and source IP addresses, destination port, or the

existence of an active session between the concerned hosts. In static filtering, the router examines data packets and compares key values with an Access Control table defined by the router administrator. Access Control allows the administrator to assign LAN hosts different access rights by either permitting or prohibiting the use of certain ports. For example, blocking port 23 might prevent hackers from establishing a Telnet session with an internal host. Any inbound packets destined for a blocked service or machine are simply discarded.

Dynamic filtering is the process of passing or discarding packets based on some temporary variable; e.g., the state of a session between the endpoint hosts. The router can use the NAT table described earlier to determine whether an inbound packet is related to a session initiated by an internal host. If it is, the packet is delivered. If not, it is discarded.

Conclusion

Broadband routers provide broadband network solutions to both small businesses and home users in delivering the multimedia entertainment, information, and services that are continually becoming a larger part of both our workplace and home environments. The right broadband router can offer an unbeatable combination of features, capabilities, and value for the homeowner or small office with multiple computers and a single high-speed Internet connection.

A brief recap of the advantages of incorporating a broadband router into your home or small office include the following key points:

- Print server functionality that allows all LAN clients to share a single network printer without burdening a single computer with print queuing responsibility and processing overhead.
- Shared Internet access to allow the computers on a shared network to connect to the Internet simultaneously. In a small office environment, e-mails, proposals, online research, office supply orders, travel arrangements, and sales reports can all flow over a single access line simultaneously among four users—or up to 253 users through the use of additional hubs.
- Firewall protection to prevent the intrusion of hackers and to safeguard important files and personal information through the use of static and dynamic packet filtering.
- Backup analog modem (optional) connectivity for backup Internet access. The U.S. Robotics Broadband Router includes a built-in serial port for just such a purpose.

The benefits of the U.S. Robotics Broadband Router and the convenience with which it can be applied to both businesses and residential households make it ideal for a variety of applications and solutions.

U.S. Robotics continues to develop solutions to provide data access to both the business sector and to home users. The U.S. Robotics Broadband Router is built on proven technology and backed by an organization that is completely committed to the highest standards of product quality and customer satisfaction and is just one of many of our latest developments in keeping people in contact worldwide – with information, entertainment, and each other.