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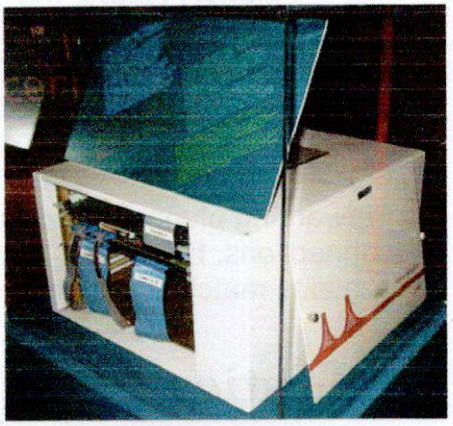
ANNEXURE-3

Router (computing)

A **router**[a] is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. Data sent through the internet, such as a web page or email, is in the form of data packets. A packet is typically forwarded from one router to another router through the networks that constitute an internetwork (e.g. the Internet) until it reaches its destination node.[2]



A Cisco ASM/2-32EM router deployed at CERN in 1987

A router is connected to two or more data lines from different IP networks.[b] When a data packet comes in on one of the lines, the router reads the network address information in the packet header to determine the ultimate destination. Then, using information in its routing table or routing policy, it directs the packet to the next network on its journey.

The most familiar type of IP routers are home and small office routers that simply forward IP packets between the home computers and the Internet. More sophisticated routers, such as enterprise routers, connect large business or ISP networks up to the powerful core routers that forward data at high speed along the optical fiber lines of the Internet backbone.

Contents

Operation

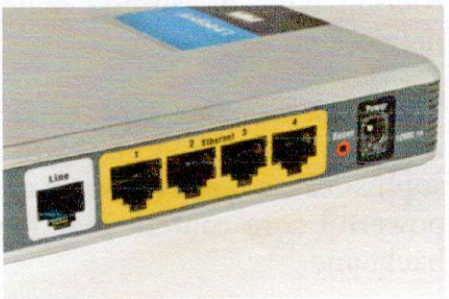
When multiple routers are used in interconnected networks, the routers can exchange information about destination addresses using a routing protocol. Each router builds up a routing table, a list of routes, between two computer systems on the interconnected networks.[3]

A router has two types of network element components organized onto separate processing *planes*:[4]

- Control plane: A router maintains a routing table that lists which route should be used to forward a data packet, and through which physical interface connection. It does this using internal pre-configured directives, called static routes, or by learning routes dynamically using a routing protocol. Static and dynamic routes are stored in the routing table. The control-plane logic then strips non-essential directives from the table and builds a forwarding information base (FIB) to be used by the forwarding plane.
- Forwarding plane: The router forwards data packets between incoming and outgoing interface connections. It forwards them to the correct network type using information that the packet header contains matched to entries in the FIB supplied by the control plane.

Applications

A router may have interfaces for different types of physical layer connections, such as copper cables, fiber optic, or wireless transmission. It can also support different network layer transmission standards. Each network interface is used to enable data packets to be forwarded from one transmission system to another. Routers may also be used to connect two or more logical groups of computer devices known as subnets, each with a different network prefix.



A typical home or small office DSL router showing the telephone socket *(left, white)* to connect it to the internet using ADSL, and Ethernet jacks *(right, yellow)* to connect it to home computers and printers.

Routers may provide connectivity within enterprises, between enterprises and the Internet, or between internet service providers' (ISPs') networks. The largest routers (such as the Cisco CRS-1 or Juniper PTX) interconnect the various ISPs, or may be used in large enterprise networks.[5] Smaller routers usually provide connectivity for typical home and office networks.

All sizes of routers may be found inside enterprises.[6] The most powerful routers are usually found in ISPs, academic and research facilities. Large businesses may also need more powerful routers to cope with ever-increasing demands of intranet data traffic. A hierarchical internetworking model for interconnecting routers in large networks is in common use.[7]

Access, core and distribution

Access routers, including small office/home office (SOHO) models, are located at home and customer sites such as branch offices that do not need hierarchical routing of their own. Typically, they are optimized for low cost. Some SOHO routers are capable of running alternative free Linux-based firmware like Tomato, OpenWrt or DD-WRT.[8]

Distribution routers aggregate traffic from multiple access routers. Distribution routers are often responsible for enforcing quality of service across a wide area network (WAN), so they may have considerable memory installed, multiple WAN interface connections, and substantial onboard data

processing routines. They may also provide connectivity to groups of file servers or other external networks.

In enterprises, a core router may provide a collapsed backbone interconnecting the distribution tier routers from multiple buildings of a campus, or large enterprise locations. They tend to be optimized for high bandwidth, but lack some of the features of edge routers.[9]

A screenshot of the LuCI web interface used by OpenWrt. This page configures Dynamic DNS.

Security

External networks must be carefully considered as part of the overall security strategy of the local network. A router may include a firewall, VPN handling, and other security functions, or these may be handled by separate devices. Routers also commonly perform network address translation which restricts connections initiated from external connections but is not recognized as a security feature by all experts.[10] Some experts argue that open source routers are more secure and reliable than closed source routers because open-source routers allow mistakes to be quickly found and corrected.[11]

Routing different networks

Routers are also often distinguished on the basis of the network in which they operate. A router in a local area network (LAN) of a single organisation is called an *interior router*. A router that is operated in the Internet backbone is described as *exterior router*. While a router that connects a LAN with the Internet or a wide area network (WAN) is called a *border router*, or *gateway router*.[12]

Internet connectivity and internal use

Routers intended for ISP and major enterprise connectivity usually exchange routing information using the Border Gateway Protocol (BGP). RFC 4098 (https://tools.ietf.org/html/rfc4098) defines the types of BGP routers according to their functions:[13]

- *Edge router* (also called a *provider edge router*): Placed at the edge of an ISP network. The router uses Exterior Border Gateway Protocol (EBGP) to routers at other ISPs or large enterprise autonomous systems.
- *Subscriber edge router* (also called a *customer edge router*): Located at the edge of the subscriber's network, it also uses EBGP to its provider's autonomous system. It is typically used in an (enterprise) organization.
- *Inter-provider border router*: A BGP router for interconnecting ISPs that maintains BGP sessions with other BGP routers in ISP Autonomous Systems.
- Core router: Resides within an Autonomous System as a back bone to carry traffic between edge routers.[14]
- Within an ISP: In the ISP's autonomous system, a router uses internal BGP to communicate with other ISP edge routers, other intranet core routers, or the ISP's intranet provider border routers.
- Internet backbone: The Internet no longer has a clearly identifiable backbone, unlike its predecessor networks. See default-free zone (DFZ). The major ISPs' system routers make up what could be considered to be the current Internet backbone core.[15] ISPs operate all four types of the BGP routers described here. An ISP core router is used to interconnect its edge and border routers. Core