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A Comprehensive Guide to Network Routing



7 min read

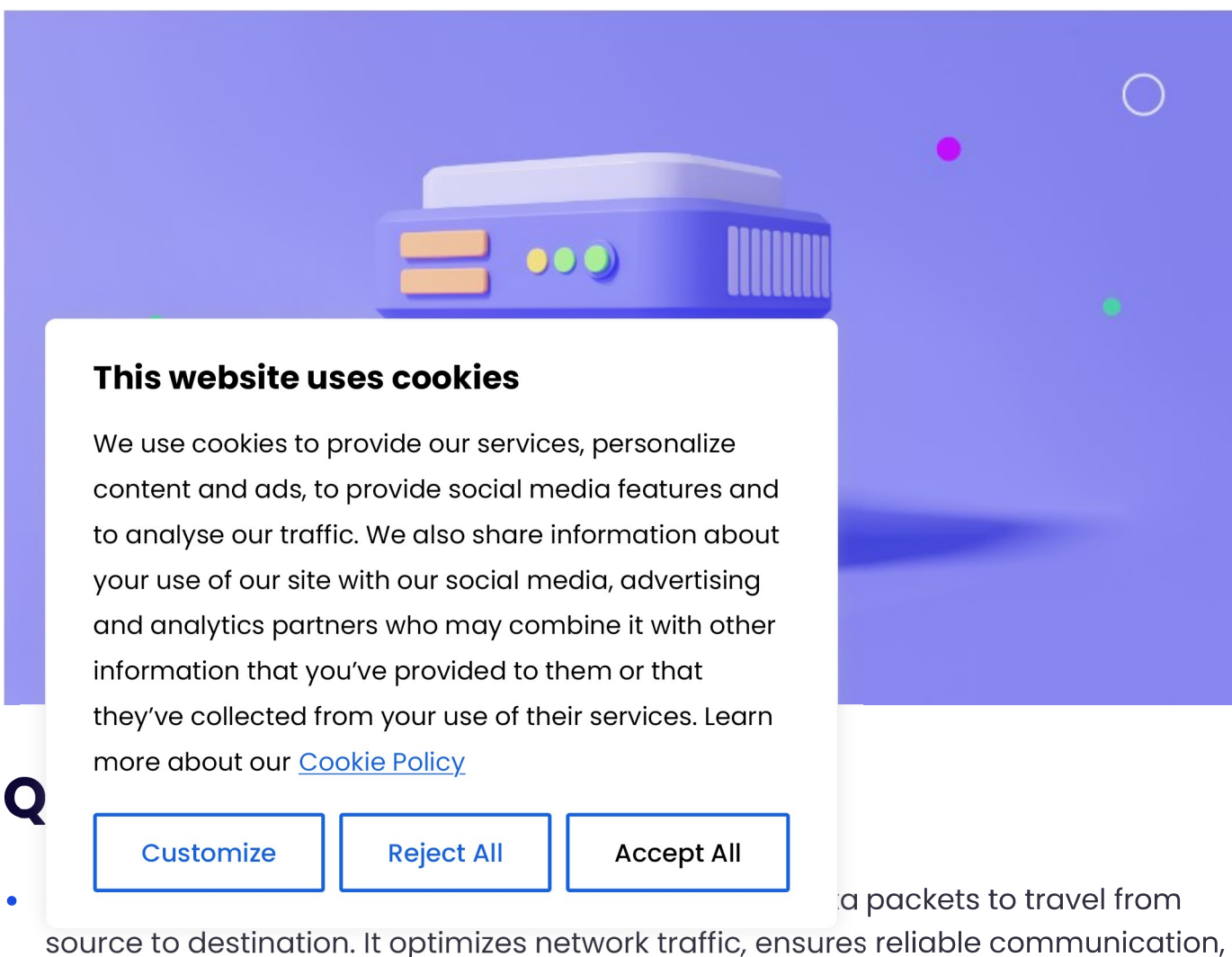


26 August 2024



Ignas Anfalovas

What is networking and how does it work? What is a routing table and the main routing protocols? We've got the answers.



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...a packets to travel from
source to destination. It optimizes network traffic, ensures reliable communication,

and maintains security by preventing data interception or loss.

- Static routing is manually configured and suited for smaller networks, while dynamic routing uses protocols like OSPF and BGP to automatically update routing tables, making it ideal for complex, scalable networks despite added implementation challenges.
- Protocols like RIP (hop-based), OSPF (link-state), and BGP (path-vector) rely on specific metrics to determine the best routing paths. These protocols address different network needs, from small-scale environments to inter-domain, global Internet routing.

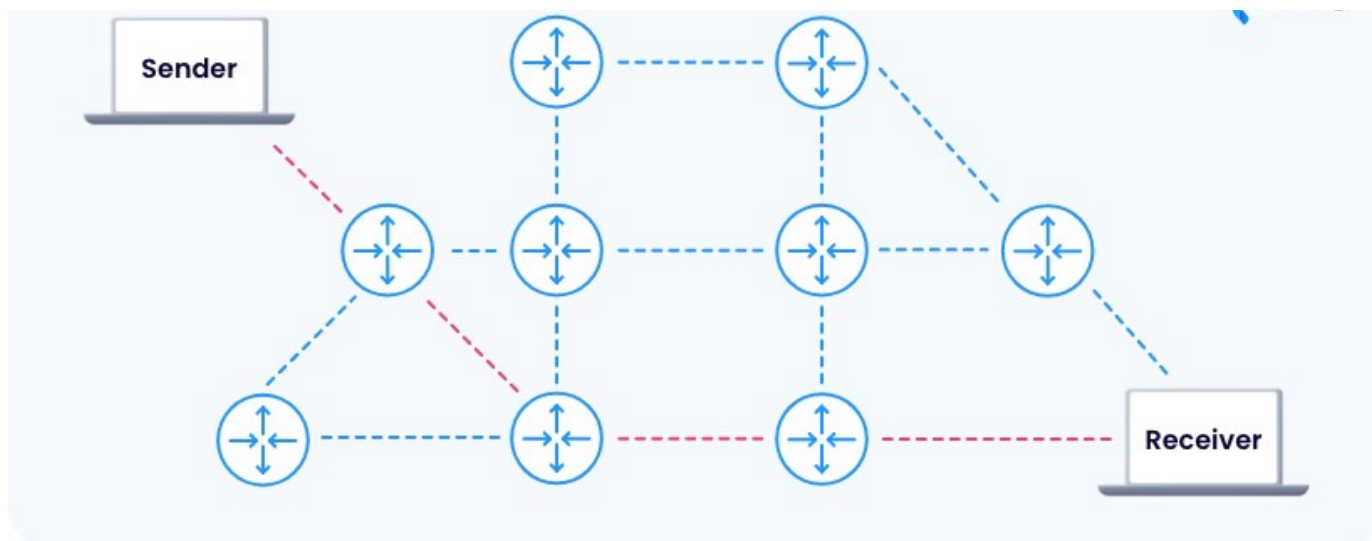
If you've ever used a home or office Wi-Fi network, then you probably are familiar with routers. They're the little flashing boxes you restart when you mysteriously lose your [Internet](#) connection. And if you're familiar with routers, then you're already acquainted with an important piece of hardware in the process of **network routing**.

This article introduces the routing process in computer networks by explaining what routing is and how it works and by analyzing the different routing protocols that make it all possible. Keep reading to learn all about it.

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Routing working example

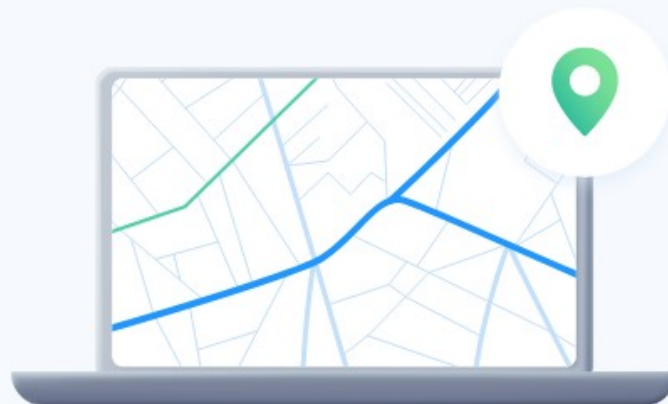
Importance of routing in computer networks

Routing plays a crucial role in ensuring that data packets are forwarded between networks and devices effectively. It helps optimize network traffic, reducing congestion and improving overall network performance. Furthermore, routing is vital for maintaining network security and administration, ensuring that data packets reach their intended destinations without interception or loss.

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Each data packet has an IP address that helps reach its intended destination

Brief history of routing

The evolution of routing reflects the growing complexity and scale of computer networks. Early routing protocols were simple and manually configured, suitable for the limited scope of early networks. As networks expanded, the need for more dynamic and automated routing protocols became apparent. The [development of the](#) routing protocols capable

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from becoming overloaded.

s from one network device
st path for these packets,
ves distributing network
prevent any single path

Computer sends a data packet to a router

When a computer sends a data packet, it attaches an [IP address](#) to the packet. This packet is forwarded to a router, which examines the IP address and determines the best path to take based on its routing table.

Router receives the packet and reads its IP address

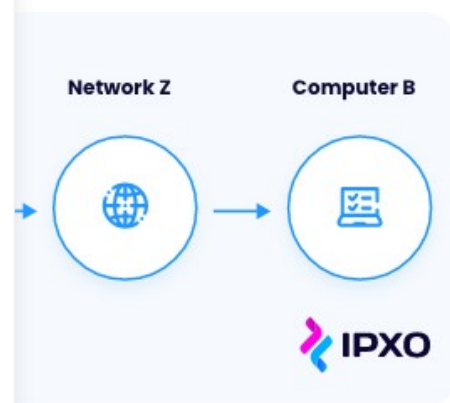
Upon receiving a data packet, the router uses its routing table to determine the optimal path for the data to reach various network devices. The routing table contains information about various network paths and destinations, helping the router make informed decisions. Routers may also use routing protocols to exchange information with other routers, keeping their routing tables updated.

Router forwards the packet

The router forwards the packet to the next hop on the path to the destination network. This process continues, with the packet passing through multiple routers, if necessary, until it reaches its final destination.

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Types of Routing

Static routing

Static routing involves manually configuring routing tables. This method is simple and easy to implement but can be inflexible and prone to errors. Static routing is best suited for small, simple networks where changes are infrequent.

Dynamic routing

Dynamic routing, in contrast, involves automatically updating routing tables using routing protocols. This method is more flexible and adaptable to network changes, making it suitable for larger and more complex networks. However, it can be more challenging to implement due to its complexity.

Routing Tables

What is a routing table?

A routing table is a data structure that stores information about network paths and destinations. It is used by routers to determine the best path for data to reach its destination. The table typically includes destination IP addresses, the next hop, and the cost of reaching each destination.

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at network paths and about the best path for includes destination IP the cost of reaching each

Router 2





Routers refer to routing tables to determine the best path between computers

How routing tables are used in routing protocols

Routing tables are essential components of routing protocols, which use them to exchange information with other routers and update their contents. By maintaining accurate and up-to-date routing tables, routers can ensure efficient data forwarding and optimal network performance.

Routing Protocols

Overview

Routing protocols are used to exchange information and update routing tables. They are responsible for determining the best path for data to travel across a network. There are several types of routing protocols, each with its own characteristics and use cases.

Examples

- **RIP (Routing Information Protocol)** is a distance-vector routing protocol used for small networks. It uses hop count as the metric to determine the best path. RIP is typically used in small, single-protocol networks with a limited number of hops between source and destination.

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- **OSPF (Open Shortest Path First):** A link state protocol used for large networks, [OSPF](#) helps share routing information with [autonomous systems](#).
- **EGP (Exterior Gateway Protocol):** An [older path-vector protocol](#) used for inter-domain routing, now largely replaced by BGP.
- **BGP (Border Gateway Protocol):** A path-vector protocol used for inter-domain routing, [BGP](#) manages the routing between large networks like [ISPs](#).
- **IS-IS (Intermediate System-to-Intermediate System):** A link state protocol used for large networks, similar to OSPF but with different design principles. [IS-IS](#) uses the Network Service Access Point (NSAP) to identify network service access points necessary for packet forwarding. NSAP, along with Network Entity Title (NET), helps differentiate between network routers and ensures proper data routing within and between areas.



PROTOCOLS

- RIP** (Routing Information Protocol)
- OSPF** (Open Shortest Path First)
- EGP** (Exterior Gateway Protocol)
- IS-IS** (Intermediate System-to-Intermediate System)

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protocols

Dynamic routing protocols, a type of routing protocol, automatically update routing tables, making them more adaptable to network changes. These protocols are essential for maintaining efficient data forwarding in complex and changing network environments.

Advantages and disadvantages of dynamic routing protocols

Advantages:

- **Scalability:** Can handle large and growing networks.
- **Fault Tolerance:** Automatically adapts to network failures and changes.
- **Flexibility:** Adjusts routing paths based on current network conditions.

Disadvantages:

- **Complexity:** More challenging to implement and manage.
- **Resource Intensive:** Requires more processing power and memory.

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Link State Routing algorithm

The Link State Routing algorithm uses a graphical map of the network to determine the least-cost path from each node to every other node. Routers share information about their immediate connections, allowing each router to build a complete network map. This algorithm is used in protocols like OSPF and IS-IS.

Path-vector protocol

Path-vector protocols, such as BGP, use a routing metric to select the best path, incorporating information about the entire path to a destination rather than just the next hop. This approach is used in inter-domain routing protocols like BGP, which are crucial for managing large-scale internet routing.

Routing Metrics and Administrative Distance

Metrics used in routing protocols

Metrics are used to determine the best path for routing data packets. Common metrics include hop count, bandwidth, and delay.

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through.

ce to destination.

Distance

s routes from different es. By assigning

administrative distances, routers can select the most *reliable* path when multiple

routes are available.

Classful and Classless Routing

Classful Routing

Classful routing protocols do not send [subnet mask](#) information during routing updates. These protocols, which are now outdated, were used in the early days of networking when IP addresses were allocated based on fixed classes (A, B, C).

Classless Routing

Classless routing protocols, in contrast, send subnet mask information during routing updates. This allows for more efficient and scalable use of IP addresses, accommodating modern network needs. Examples include [CIDR](#) (Classless Inter-Domain Routing) and protocols like OSPF and [BGP](#).

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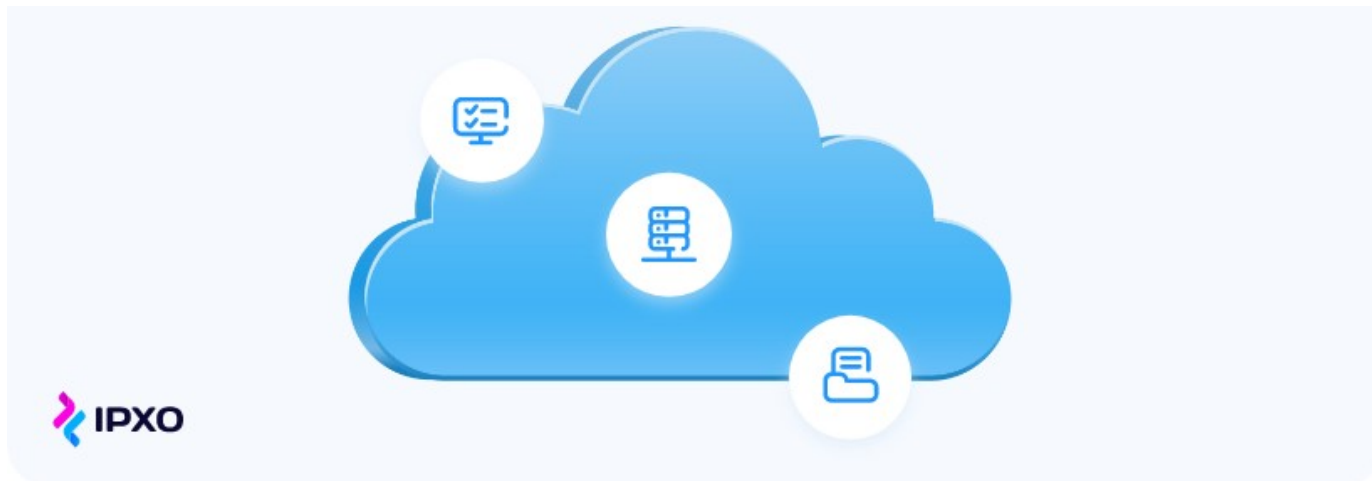
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Cloud networking services between virtual cloud network cloud routing ensures security and services. Routers play a crucial role in directing packets within packet switching their intended destinations through



Cloud routing involves dynamically managing connections between virtual cloud networks.

Evolution of routing in modern networks

Routing has continually evolved to meet the demands of modern networks. From simple, manually configured routes to sophisticated, automated protocols, the advancements in routing technology have been driven by the need for efficiency, scalability, and reliability.

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FAQ

What is routing in computer networks? —

Routing is the process of selecting the best path for data packets to travel across a network from the source to the destination. It ensures efficient and reliable communication by making decisions about which path to take to reach a destination network or device.

Why is routing important in computer networks? +

How do routing tables work? +

What is the difference between static and dynamic routing? +

What are some common routing protocols? +

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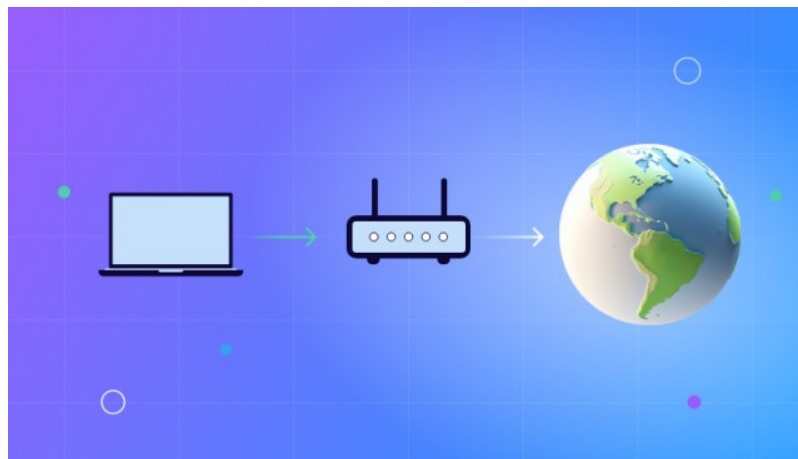
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