1. Routing Information Protocol (RIP)

RIP is a **dynamic routing protocol** that uses a **distance-vector** algorithm to determine the best path for data. The core principle of a distance-vector protocol is that each router maintains a routing table and shares this entire table with its directly connected neighbors at regular intervals (every 30 seconds for RIP). The metric used to calculate the "best" path is the **hop count**, with the path having the fewest hops being the preferred one. The maximum number of hops allowed in RIP is 15. A hop count of 16 signifies an unreachable destination, which is a mechanism to prevent routing loops from continuing indefinitely.

While simple to configure, RIP has significant limitations. Its reliance on periodic broadcasts of the entire routing table can consume a lot of bandwidth in a large network. More critically, its convergence is slow. If a link goes down, it can take a considerable amount of time for all routers in the network to update their tables, a problem known as the **"count to infinity"** issue.

2. Open Shortest Path First (OSPF)

OSPF is an advanced **dynamic routing protocol** that overcomes RIP's limitations by using a **link-state** algorithm. Unlike RIP, an OSPF router doesn't just know its immediate neighbors. It builds a complete and identical **topological map** of the entire network (or an area) with all other OSPF routers. It does this by flooding the network with **Link-State Advertisements (LSAs)**, which contain information about its directly connected links and their status.

The OSPF process works as follows:

1. **Neighbor Discovery:** Routers on the same network exchange Hello packets to discover each other.
2. **LSA Flooding:** Each router sends LSAs describing its links to all other routers in its area.
3. **Database Creation:** All routers compile the received LSAs into a **Link-State Database (LSDB)**, which is the complete map of the network topology.
4. **SPF Algorithm:** Each router then runs **Dijkstra's Shortest Path First (SPF) algorithm** on its LSDB to independently calculate the most efficient route to every destination. The metric used is **cost**, which is typically an inverse function of a link's bandwidth, making it a more intelligent metric than a simple hop count. OSPF's hierarchical structure, which divides a large network into smaller areas, makes it highly scalable.

3. Static Routing

Static routing is a **manual** method where a network administrator defines all the routes in a router's configuration. The routes are fixed and do not change unless an administrator makes a manual change. This approach is simple to implement and manage for very small networks and provides a high level of security because no routing information is exchanged between routers. It's also often used to configure a "default route" or "gateway of last resort," which directs all traffic for unknown destinations to a specific router. However, static routing is not scalable for large or dynamic networks, as it cannot automatically adapt to network changes or link failures.

4. Border Gateway Protocol (BGP)

BGP is the foundational routing protocol of the public internet. It's an **inter-domain routing protocol**, meaning its primary function is to route traffic between different **Autonomous Systems (AS)**, which are large networks or groups of networks under a single administrative control. BGP is a **path-vector** protocol. This means it doesn't just look for the shortest path based on a simple metric; it considers the entire path of ASes that a packet must traverse to reach its destination. This path information is a key part of BGP routing updates.

This path-vector approach allows BGP to make complex, **policy-based routing** decisions. Network administrators can configure BGP to prefer certain paths based on business agreements, cost, or performance, rather than just technical metrics. BGP is designed for stability and scalability, and its robust message types (OPEN, UPDATE, KEEPALIVE) ensure reliable communication between internet routers.