BGP Introduction

Introduction to BGP (Border Gateway Protocol)

Border Gateway Protocol (BGP) is the cornerstone of routing on the global internet and plays a critical role in how large networks connect and exchange routing information.

What is BGP?

- **The Internet's EGP:** BGP is the defacto **Exterior Gateway Protocol (EGP)** used to exchange Network Layer Reachability Information (NLRI) – essentially IP prefixes or routes – **between different Autonomous Systems (ASes)**. An AS is a collection of IP networks and routers under the control of one entity (like an ISP or a large enterprise).

- **Path Vector Protocol:** BGP is classified as a **Path Vector Protocol**. This is primarily because of its **AS_PATH attribute**, which lists the sequence of Autonomous Systems a route has traversed to reach its destination. This path information is crucial for loop prevention and policy application.

- **Multiprotocol BGP (MP-BGP):** Modern BGP is technically MP-BGP. This signifies its design flexibility to carry reachability information for multiple network layer protocols, not just IPv4. Common examples include:
    - IPv6 Prefixes (IPv6 Unicast)
    - MPLS VPN routes (VPNv4/VPNv6)
    - Ethernet VPN (EVPN) routes

- **The "Protocol of the Internet":** BGP is what enables the global internet by connecting different ASes. These ASes are not typically connected in a full mesh; rather, a hierarchical and policy-driven structure exists (e.g., Tier 1, Tier 2, Tier 3 ISPs).

- **Scalability:** BGP is designed to be highly scalable, capable of carrying hundreds of thousands of routes and interconnecting tens of thousands of ASes worldwide.
    - For context, the global IPv4 BGP routing table grew from around 814,000 prefixes in January 2020 to well over **900,000 (approaching 1 million)** prefixes in recent years,

and the IPv6 table is also substantial and growing.

- **Policy Implementation Tool:** BGP is more than just a routing protocol; it's a powerful **policy implementation tool**. ISPs and large organizations use BGP's rich set of path attributes (like AS_PATH, LOCAL_PREF, MED, Communities) to influence how traffic enters and exits their networks, based on peering agreements, cost, latency, and other business considerations.

Where and Who Uses BGP?

- **Between Network Carriers/ISPs:** This is the primary use case – connecting large service providers, Content Delivery Networks (CDNs), major cloud providers, and large internet exchanges to form the internet backbone.

- **Enterprises and Service Providers:** Large scale Enterprises use BGP when they are **multi-homed** (connected to two or more ISPs for redundancy and optimized path selection) or when they need to announce their own public IP address space to the internet.

BGP vs. Interior Gateway Protocols (IGPs)

BGP and IGPs (like OSPF, IS-IS, EIGRP) serve different purposes and have distinct characteristics:

Feature	BGP (Border Gateway Protocol)	IGPs (e.g., OSPF, IS-IS, EIGRP)
Primary Use	Routing **between** Autonomous Systems (ASes)	Routing **within** a single Autonomous System (AS)
Scalability	Very high; handles internet-scale routing tables (many prefixes).	Limited; designed for smaller, well-defined network domains.
Convergence	Generally slower than IGPs.	Generally faster; optimized for quick reconvergence.
Path Selection	Complex algorithm based on many path attributes (policy-driven). By default, selects one best path.	Typically based on a single metric (cost, hop count, composite metric). Easily supports Equal Cost Multi-Path (ECMP).
Neighbor Term	**Peers** or BGP Speakers.	Neighbors.
Peering	**Statically configured** between peers.	Usually **dynamically discovered** on enabled interfaces.

Peer Connectivity	**iBGP** peers (within the same AS) don't need to be directly connected. **eBGP** peers (between different ASes) are **assumed to be directly connected by default** (TTL=1), though this behavior can be modified (`ebgp-multihop`).	IGP neighbors are typically directly connected on the same subnet (exceptions like OSPF virtual links exist).
Transport	Uses **TCP port 179** (reliable, unicast communication).	OSPF/EIGRP use their Headers (89/88). IS-IS runs directly over Layer 2. RIP uses UDP 520/521. IGPs often use multicast for Hellos/discovery on broadcast segments.
Next-Hop	Advertises prefixes and a next-hop. BGP next-hop handling has specific rules (more on this later).	Advertise prefixes and a next-hop.