

# Chapter 07b - BGP - Border Gateway Protocol

- BGP is a **path vector routing protocol**, use for **Inter-AS Routing (EGP)**.
- Latest version: **BGPv4**, works with both IPv4 and IPv6
- Use **TCP as transport** Protocol - **Port 179**

## AS - Autonomous System

- an AS is a group of routers that share similar routing policies, operate within a single administrative domain.
  - collection of routers running a single IGP; or
  - collection of routers running different protocols but belong to one organization.
- **AS Number**: unique number assigned by IANA to each AS in BGP routing, original 16 bits, but extended to 32 bits.

### Single-homed AS

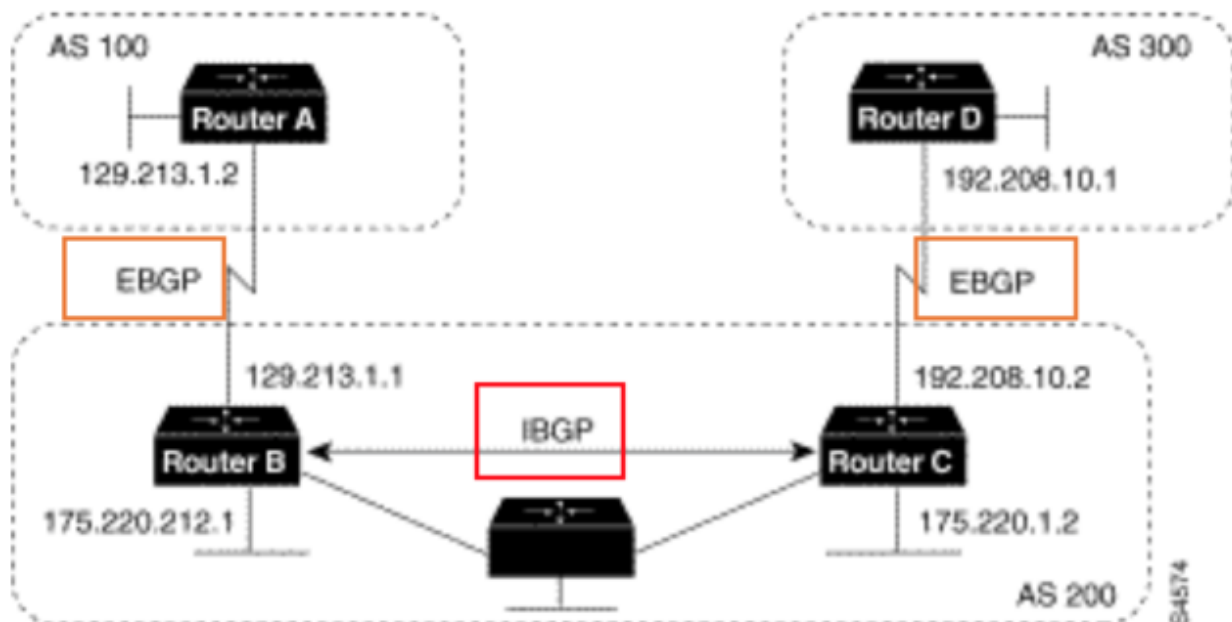
- has only **one exit point** to outside networks, usually the **default route** to handle all traffic destined for non-local networks.
- is usually referred to **stub** networks.
- does **not** need BGP.

### Multi-homed Non-Transit AS

- has **more than one exit points** to outside networks, but **does not allow traffic to pass thru** from one outside connection to another (non-transit)
- incoming route advertisements influence your outgoing traffic, and outgoing advertisements influence your incoming traffic.

### Multi-homed Transit AS

- that has both IBGP (BGP running inside an AS) and EBGP (BGP runs between AS).
  - **IBGP** traffic is routed by **transit router**.
  - **EBGP** traffic is routed by **border router** (or edge router).



In this example:

- Routers A and B are running **EBGP**.
- Routers B and C are running **IBGP**.

## IBGP vs EBGP

### EBGP

- EBGP peers must be **directly connected**.

### IBGP

- IBGP peers **do not require direct connection**, only requires TCP/IP connectivity within same AS.

## BGP Packet

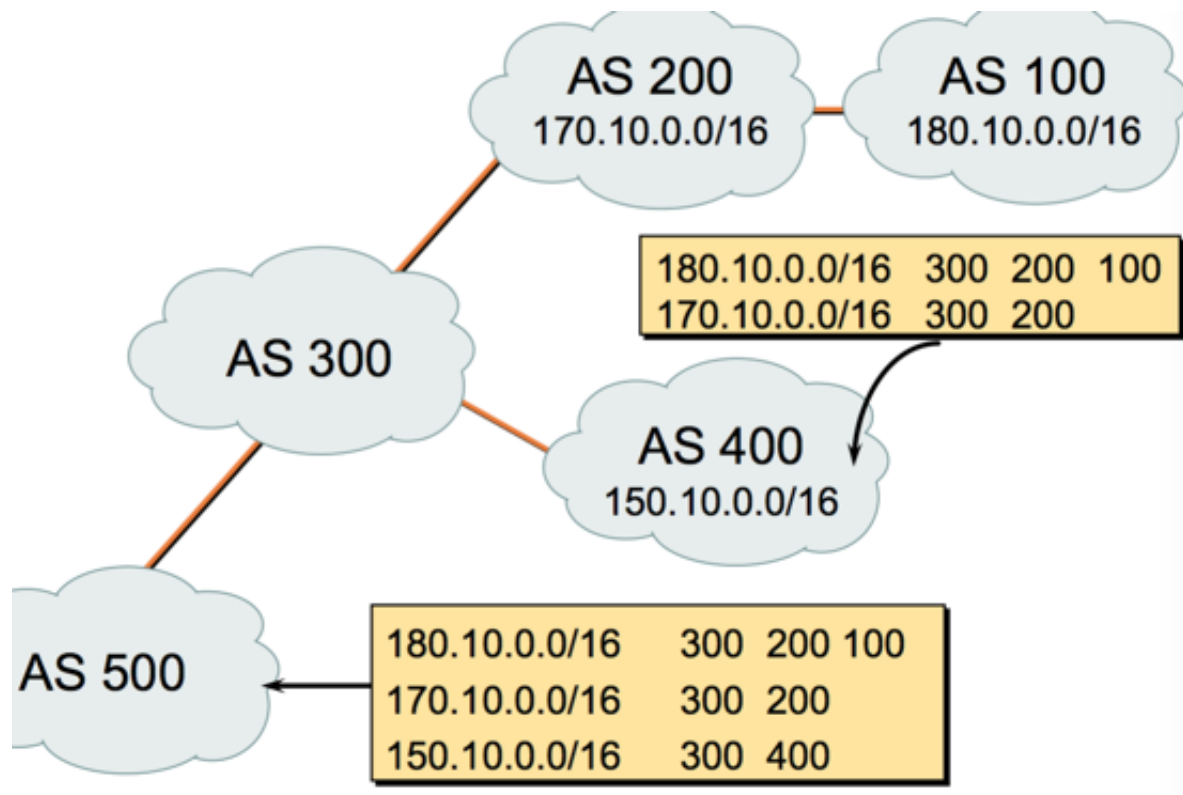
MAC Hdr	IP Hdr	TCP Hdr	BGP Hdr	Data
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- relies on TCP
- TCP port 179

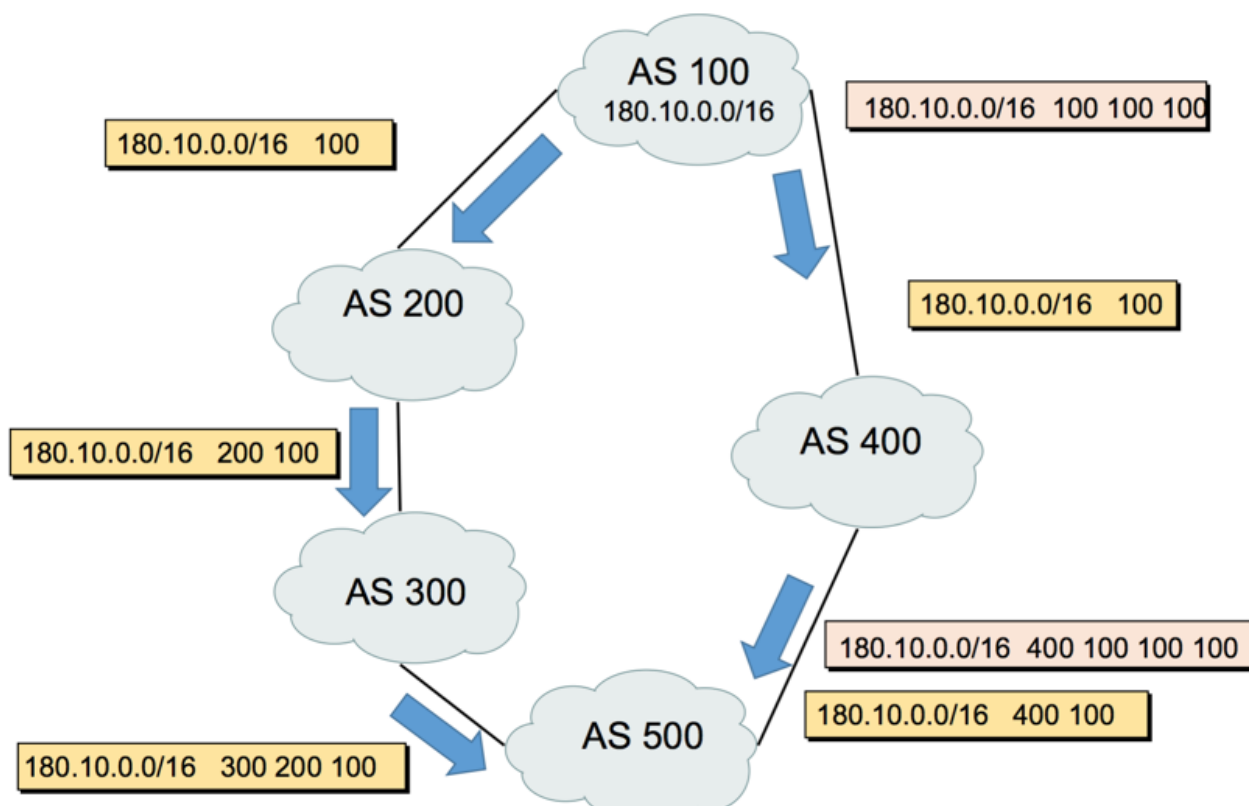
## BGP Attribute Categories

## The AS-Path Attribute

- The sequence of ASs is prepended to the the advertised route between EBGP peers.
  - has loop detection
  - and apply policy (?)



- Repeat the AS number to influence the routing preference.

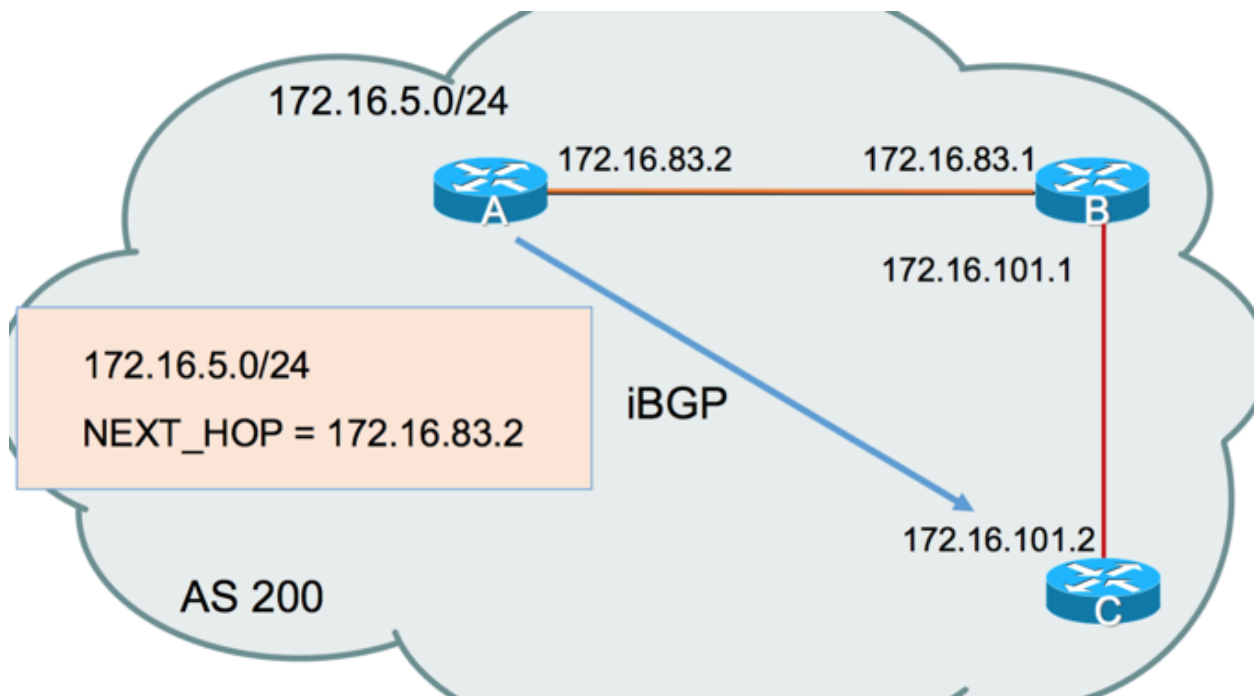


## The Next Hope Attribute

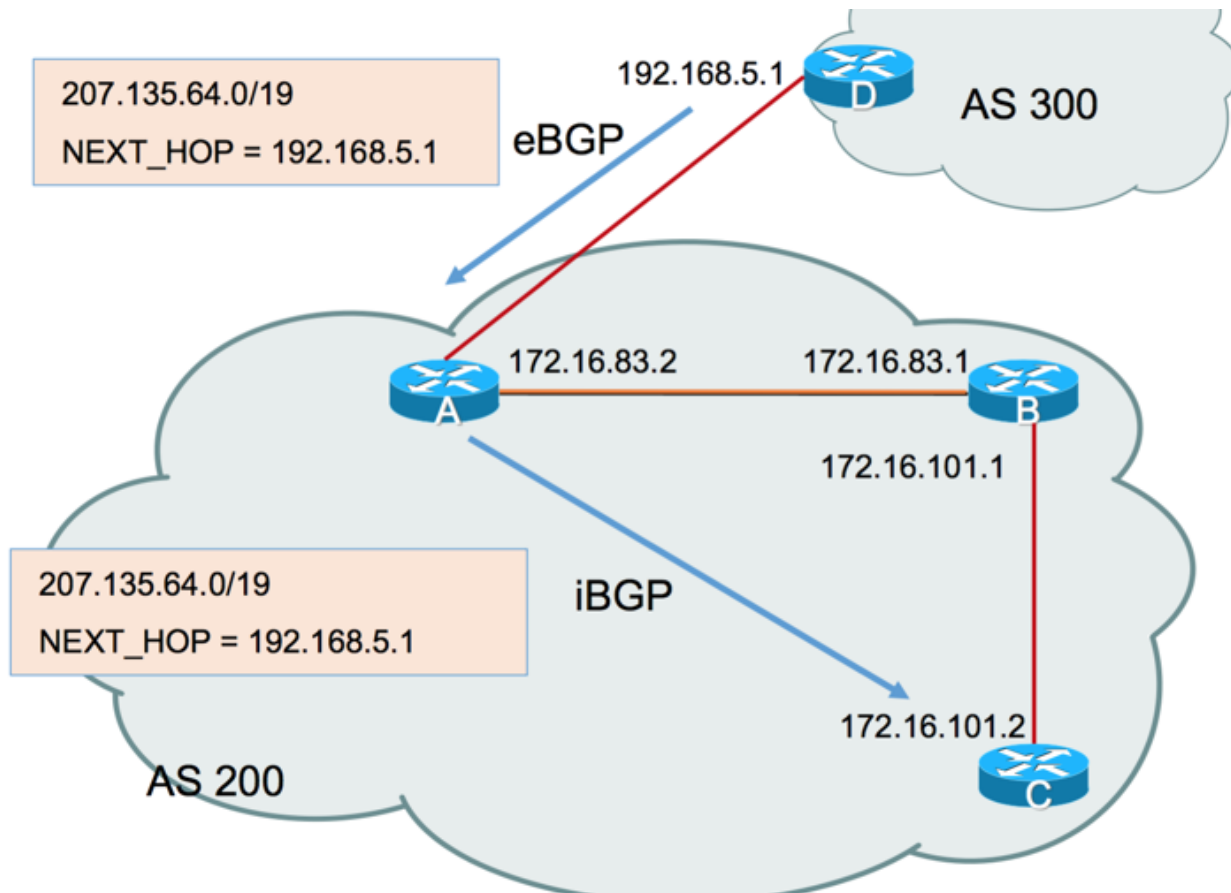
- Case 1: when advertising to a **different AS**, the NEXT\_HOP is the IP address of the **advertising router's interface**.
- Case 2: when **advertising to the same AS** and the **route is in the same AS**, the NEXT\_HOP is the IP address of the **originating router**.
- Case 3: when **advertising to the same AS** and the **route is in different AS**, the NEXT\_HOP is the IP address of the **external peer from which the route was learned**.

### Example:

Case 2

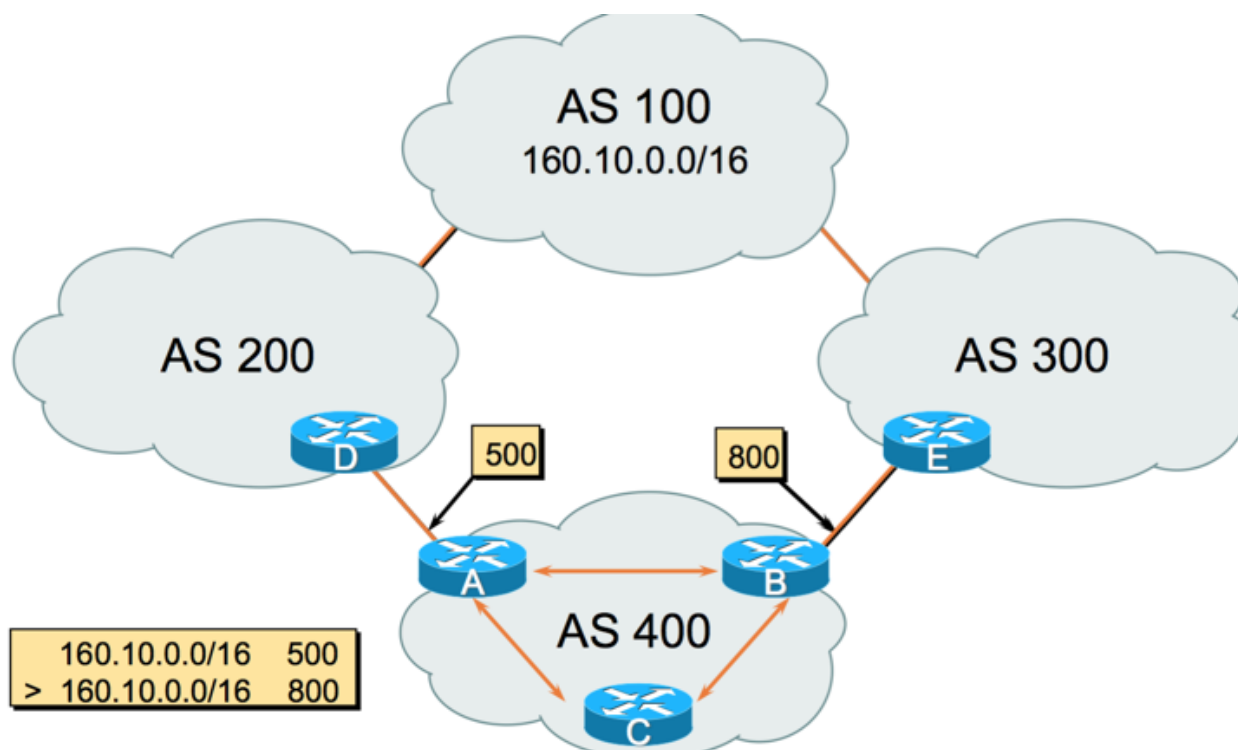


Case 1, 3



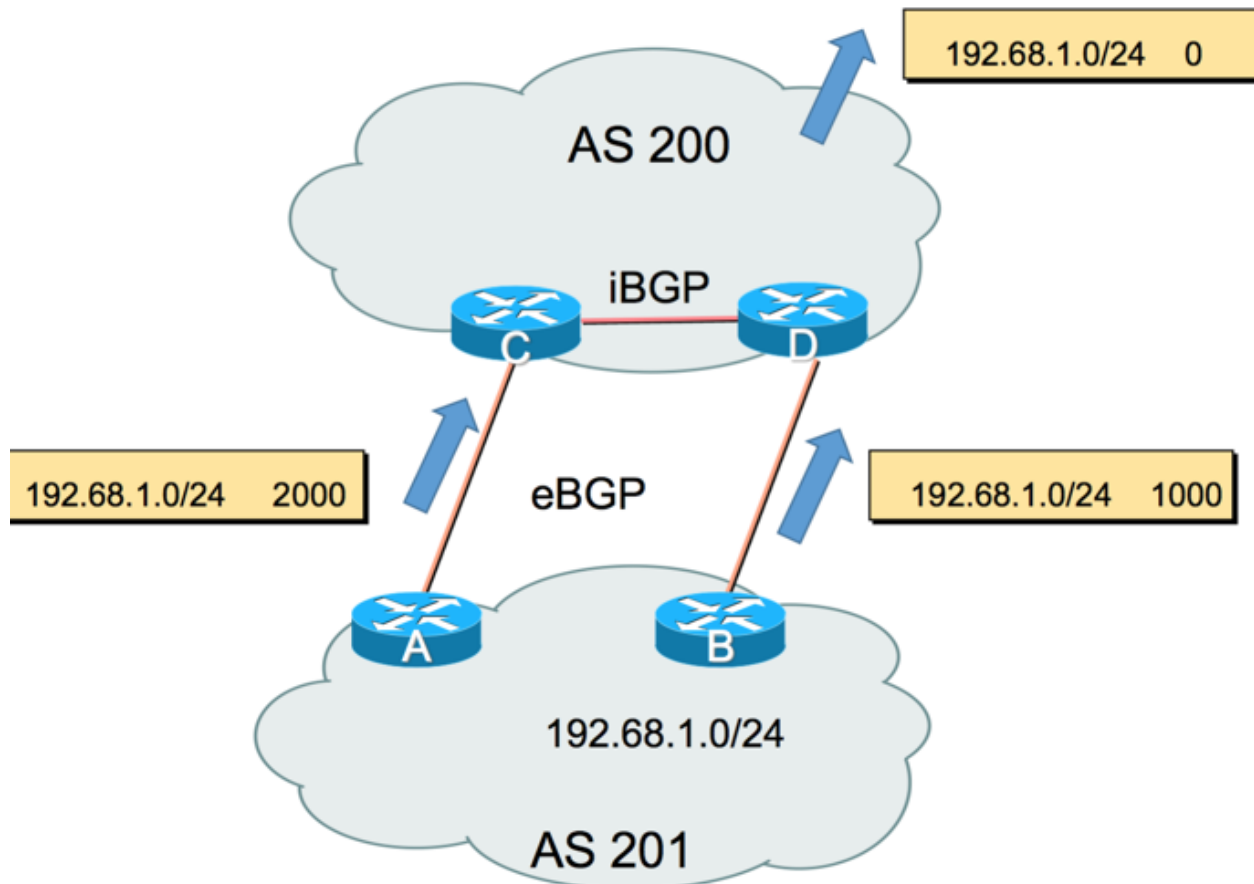
## The Local Preference Attribute

- used to influence BGP path selection, determines **best path for outbound traffic**.
- Path with **highest local preference wins**.



## The Multi-Exit Discriminator (MED) Attribute

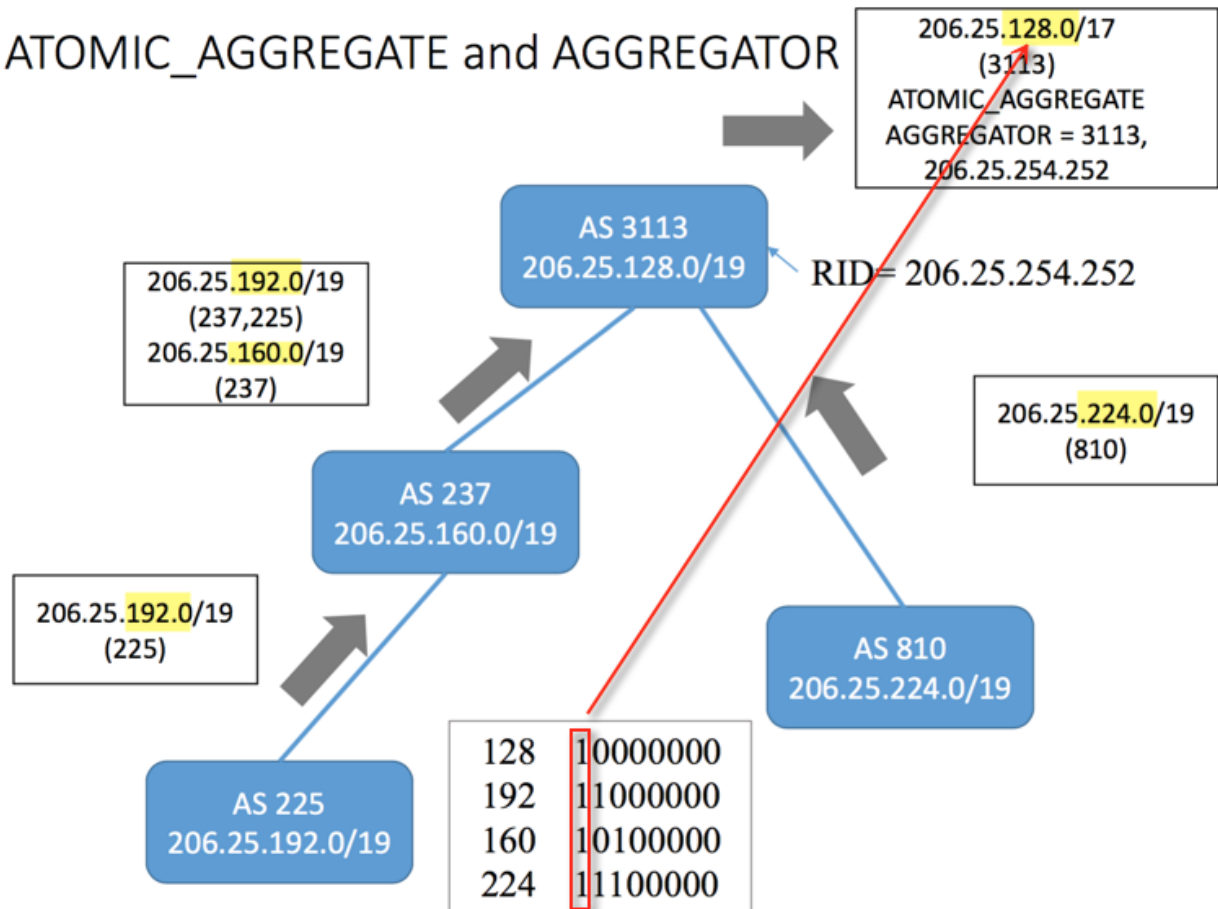
- Used to influence inbound traffic, determined by **Inter-AS Metric (MED)**.
- Lower MED value is preferred.



## The ATOMIC\_AGGREGATE and AGGREGATOR Attribute

- Instead of passing a "busy" list of route, one of the router will be come an AGGREGATOR and summarize the advertised routes into ATOMIC\_AGGREGATE.

## ATOMIC\_AGGREGATE and AGGREGATOR



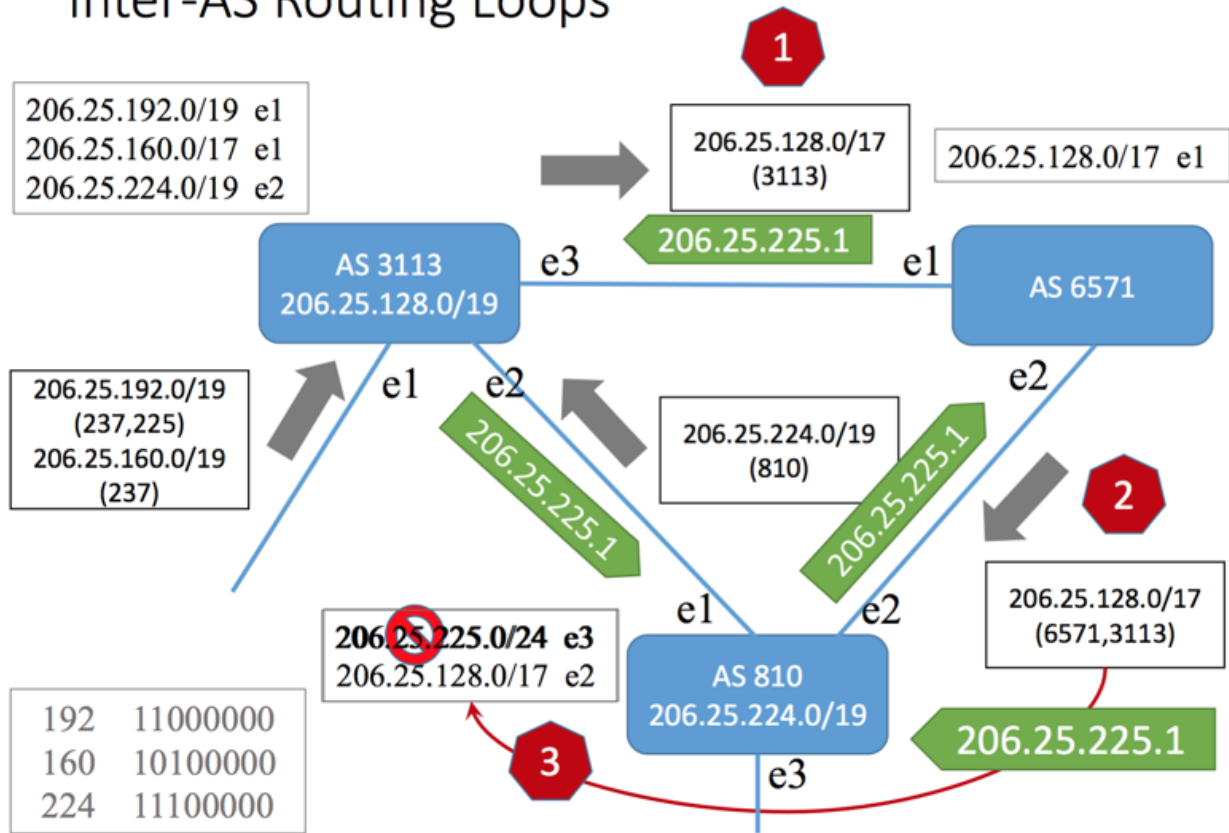
In this example, 160.0/19, 192.0/19, 224.0/19 are summarized as 128.0/17 (ATOMIC\_AGGREGATOR)

## The AS\_SET and AS\_SEQUENCE Attribute

- Are used for preventing Inter-AS Routing Loops
  - AS\_SEQUENCE: **Ordered** set of ASes a prefix in the UPDATE message has traversed.
  - AS\_SET: **Unordered** set of ASes a prefix in the UPDATE message has traversed.

If AS-810 / e3 goes down, the loop happens:

## Inter-AS Routing Loops



Use AS\_SET and AS\_SEQUENCE to prevent that

## AS\_SET and AS\_SEQUENCE

